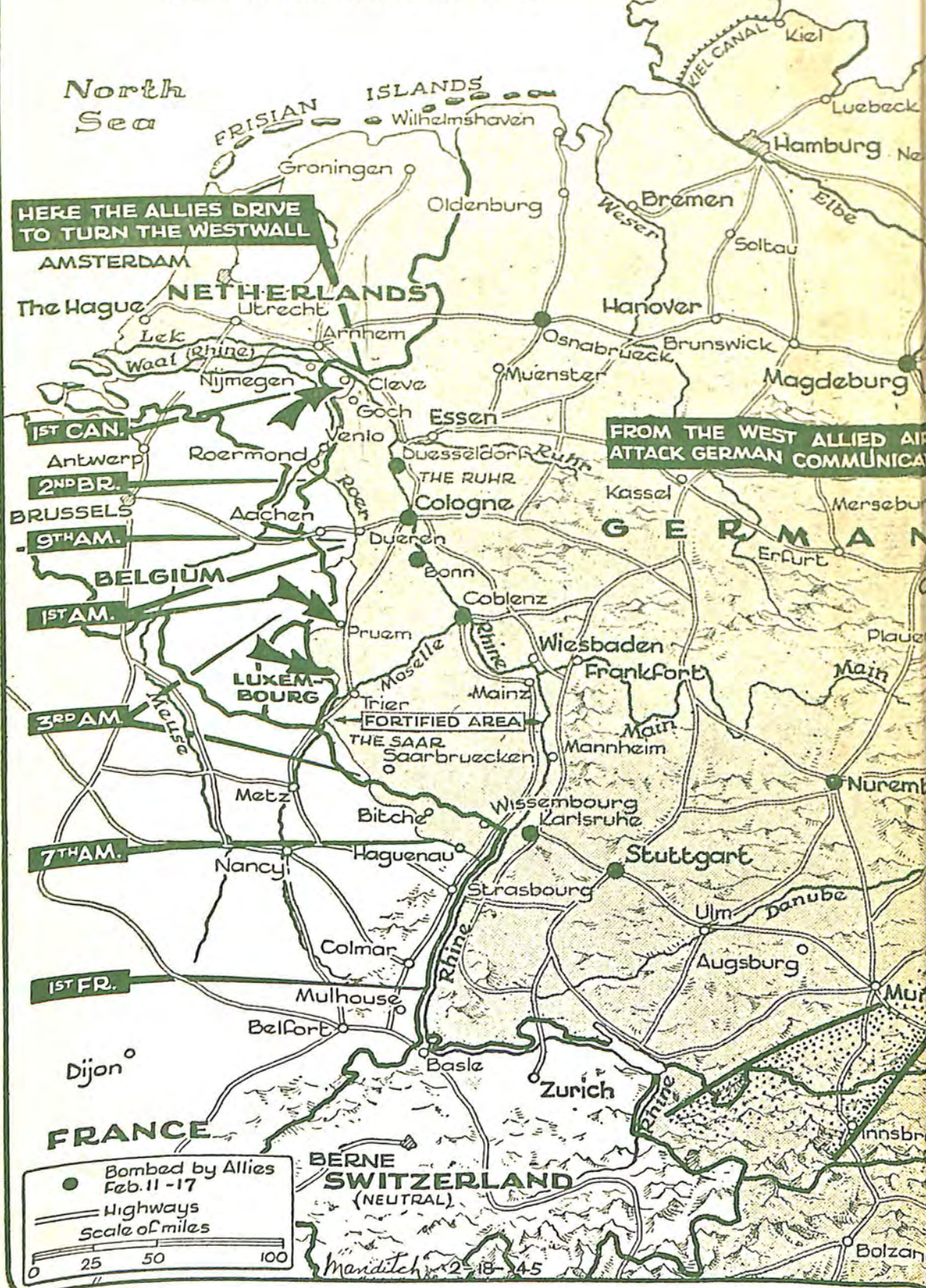


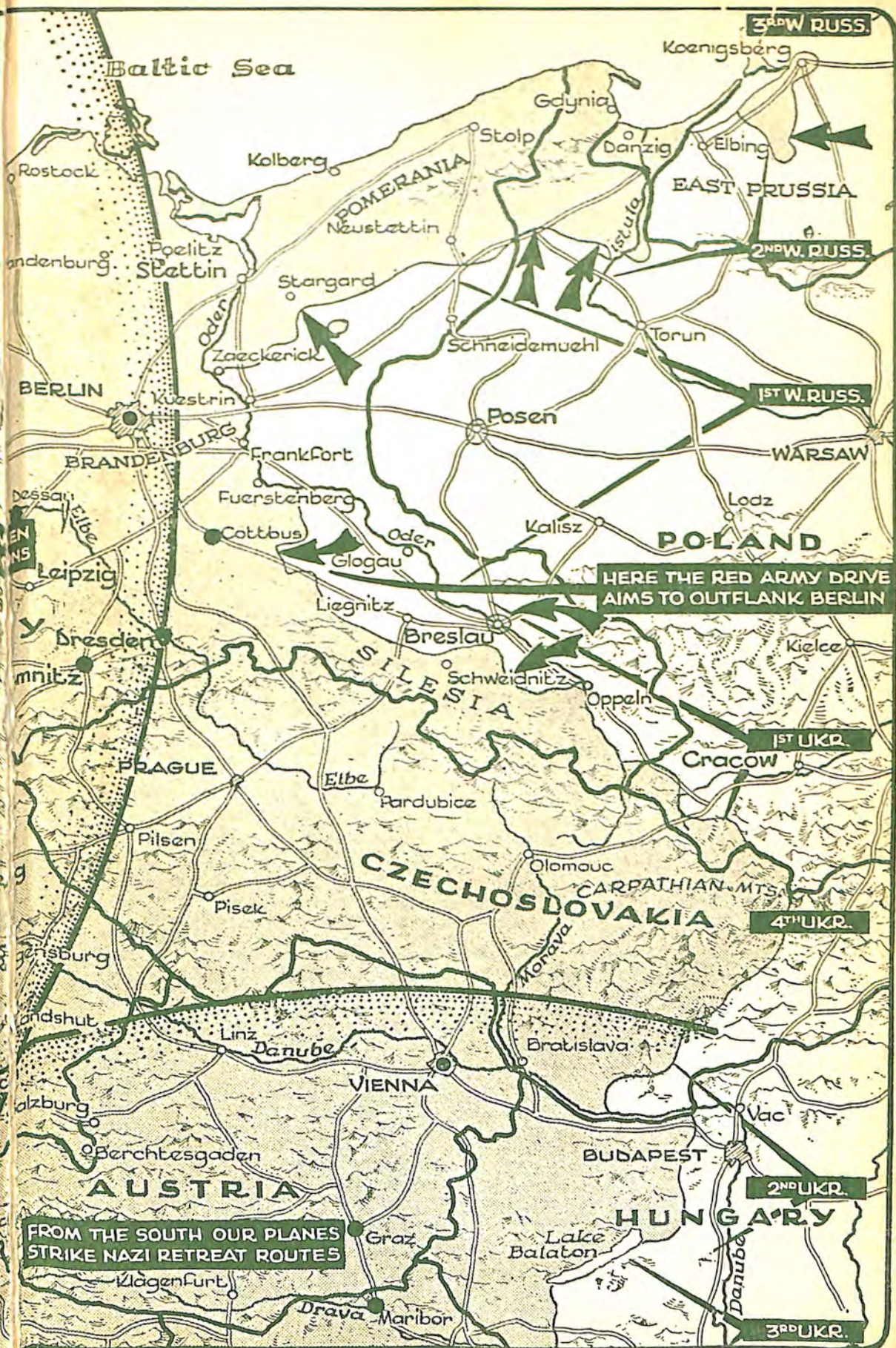
*The*  
AIRCRAFT  
YEAR BOOK

*For 1945*

# GERMANY: A FORTRESS BESIEGED

COURTESY *The NEW YORK TIMES*





3<sup>RD</sup> W. RUSS.

Baltic Sea

Koenigsberg

Gdynia

Kolberg

POMERANIA

Stolp

Danzig

Elbing

EAST PRUSSIA

Rostock

Brandenburg

Poelitz

Stettin

Stargard

Neustettin

2<sup>ND</sup> W. RUSS.

BERLIN

Kuestrin

Zaackerick

Schneidemuehl

1<sup>ST</sup> W. RUSS.

Posen

WARSAW

BRANDENBURG

Frankfort

Fuerstenberg

Kalisz

POLAND

Pless

Leipzig

Glogau

HERE THE RED ARMY DRIVE AIMS TO OUTFLANK BERLIN

Dresden

Liegnitz

Breslau

Kielce

Wroclaw

SILESIA

Schweidnitz

Oppeln

1<sup>ST</sup> UKR.

Cracow

PRAGUE

CZECHOSLOVAKIA

CARPATHIAN MTS.

4<sup>TH</sup> UKR.

Plzen

Elbe

Pardubice

Olomouc

Morava

Landshut

Linz

VIENNA

Bratislava

2<sup>ND</sup> UKR.

BUDAPEST

HUNGARY

FROM THE SOUTH OUR PLANES STRIKE NAZI RETREAT ROUTES

Salzburg

Berchtesgaden

Lake Balaton

Klagenfurt

Drava Maribor

3<sup>RD</sup> UKR.

AIRCRAFT YEAR BOOK FOR 1945



U. S. Army Air forces photo

#### THE LAST GERMAN HIDE-OUT

An aerial view of Berchtesgaden, Hitler's retreat in the mountains of Bavaria. Other German leaders had their hide-outs nearby.

*The*  
**AIRCRAFT  
YEAR BOOK**

*(Registered U. S. Patent Office)*

*For 1945*

TWENTY-SEVENTH ANNUAL EDITION

HOWARD MINGOS

Editor

*Official Publication of*  
Aeronautical Chamber of Commerce  
of America, Inc.



*Published by*

LANCIAR PUBLISHERS, INC.

10 Rockefeller Plaza

New York 20, N. Y.

Copyright 1945 By  
LANCIAR PUBLISHERS, INC.  
NEW YORK, N. Y.

MANUFACTURED COMPLETE BY  
THE COLONIAL PRESS INC., CLINTON, MASS.

# TABLE OF CONTENTS

CHAPTER	PAGE
<p>I. THE WAR IN THE AIR . . . . .</p> <p style="padding-left: 2em;">We Come a Long Way Toward the End of the War—Coordination of Land, Sea and Air Forces Brings Decisive Victories in Europe and the Pacific—Our Air Supremacy in All War Theaters Paces Defeat of Our Enemies—Our Tremendous Destruction of Enemy Equipment—Our Air Forces Play Vital Role in Liberation of France—We Knock the Japanese Out of Half of the Total Area They Had Dominated—Our Record Production of Aircraft.</p>	11
<p>II. THE U. S. ARMY AIR FORCES . . . . .</p> <p style="padding-left: 2em;">The World's Most Powerful Air Force—More than a Million Tons of Bombs Hurlled on the Enemy in 1944—The Record of Destruction—Over 19,000 Enemy Planes Destroyed—AAF Operations on Five Air Fronts—The Invasions of Normandy and South France—The Return to the Philippines—The Campaigns in Asia—The Bombing of Japan—Gen. Arnold's Comments.</p>	27
<p>III. U. S. NAVAL AVIATION . . . . .</p> <p style="padding-left: 2em;">How Navy Air Power Helped to Roll Back the Jap—A Major Factor in Our Pacific Victories—Coordinated Surface and Air Arms Destroy Enemy at Every Turn—Extraordinary Achievements of Fast Carrier Task Forces—The Strength of Naval Aviation—Maintenance of Supply Lines—Incredible Heroism of Navy Airmen—The U. S. Coast Guard.</p>	69
<p>IV. THE AIR TRANSPORT RECORD . . . . .</p> <p style="padding-left: 2em;">Our Wartime Air Transportation System Spans the World—Enormous Shipments of Military Cargoes Across the Atlantic and the Pacific—Our Wounded Are Flown Home from All the Battle Fronts—Operations of the Army Air Transport Command, Naval Air Transport Service and the Air Lines of the United States.</p>	93
<p>V. TRAINING FOR AIR SUPREMACY . . . . .</p> <p style="padding-left: 2em;">Millions of Americans Receive Various Kinds of Training in Aviation—How Our Army and Navy Air Forces Became the Most Powerful in the World—Results of Civil Pilot Training by CAA—Training Activities of the Civil Air Patrol—Work of the Schools.</p>	129
<p>VI. ACTIVITIES OF THE FEDERAL AGENCIES . . . . .</p> <p style="padding-left: 2em;">The National Advisory Committee for Aeronautics—Aircraft Production Board, WPB—The Civil Aeronautics Administration—U. S. Forest Service—U. S. Weather Bureau—U. S. Public Health Service—Federal Communications Commission—Aviation Division, Department of State.</p>	153



	PAGE		PAGE
Fairchild		Assembly . . . . .	281
C-82 Packet . . . . .	258	Fire Power of the P-51 Mustang . . . . .	280
Loading C-82 Packet . . . . .	128	Mitchells . . . . . 51, 52,	195
Federal Transmitter Unit . . . . .	341	P-51D Mustang . . . . .	32
Firestone Rocket Launchers . . . . .	343	Production . . . . .	277
Flying Mail for the European Fronts . . . . .	118	Northrop	
Grumman		P-61 Black Widow . . . . . 30,	199
Avenger . . . . .	81, 91	Top Turret of the Black Widow . . . . .	284
Hellcat Aboard Navy Carrier . . . . .	71	Numberall Holder . . . . .	365
JRF Grey Goose Over Alaska . . . . .	92	Onsrud Bevel Miller A-92 . . . . .	310
Wildcat . . . . .	187	Pacific Engineering Aerostands . . . . .	363
Harvey-Whipple Preheater . . . . .	350	Parachute Forest Fire Fighters . . . . .	161
Invasions		Pennsylvania Central Airlines . . . . .	125
Leyte . . . . .	23, 180	Pioneer Gyro Flux Gate Compass . . . . .	337
Luzon . . . . .	24, 89	Pioneer Parachute Tester . . . . .	364
North France . . . . . 15, 39, 41,	43	Piper	
South France . . . . .	45	Ambulance . . . . .	105
Jacobs		Cub . . . . . 54,	201
Engine Production . . . . .	304	Liaison Plane in Burma . . . . .	65
Inspection Turntable . . . . .	303	Pratt & Whitney Assembly Line . . . . .	306
Plant . . . . .	165	Republic P-47 Thunderbolt . . . . .	33
Jacoe Tension Testing Machine . . . . .	352	Ryan	
Jones, Casey, School of Aeronautics . . . . .	149	Automatic Riveting Machines . . . . .	291
Kellogg Switchboard . . . . .	353	Exhaust Manifolds . . . . .	293
Link Trainer . . . . .	135	Making Aluminum Alloy Extrusions . . . . .	292
Lockheed		Sikorsky	
Assembly . . . . .	267	Assembly Line . . . . . 294,	295
C-69 Constellation . . . . .	124	Helicopter . . . . .	168
P-38L Lightning . . . . .	31	Simmonds Weather Instrument . . . . .	368
Production . . . . .	263	Stewart Technical School . . . . .	147
Lodwick School of Aeronautics . . . . .	151	Surface Combustion Heaters . . . . .	374
Martin		Chance Vought	
Assembly . . . . .	269	Corsair . . . . .	72
Inside a Mariner . . . . .	197	Corsair Jet-Assisted Take-Off . . . . .	296
Mars . . . . . 106,	123	F4U Corsairs . . . . .	167
PBM Mariner . . . . .	209	F4U-ID Corsair . . . . .	205
Meat Flies to Alaska . . . . .	177	OS2U-3 Kingfishers . . . . .	173
National Advisory Committee for Aeronautics		Waco	
Altitude Wind Tunnel . . . . .	155	CG-13 Superglider . . . . .	179
Wind Tunnel . . . . .	154	CG-15A Glider . . . . .	300
Navy Carrier Task Force . . . . .	21	Western Electric M-10 Electrical Director . . . . .	381
North American		Wright Assembly Line . . . . .	309
AT-6 Texan . . . . .	150		

## AIRCRAFT 3-VIEW DRAWINGS

	PAGE		PAGE
<b>Beech</b>		<b>Eastern Aircraft</b>	
Model 18 . . . . .	215	Grumman Avenger . . . . .	255
Personnel Transport . . . . .	216	Grumman Wildcat . . . . .	256
<b>Bell</b>		Fairchild C-82 Packet . . . . .	257
P-39 Airacobra . . . . .	221	<b>Grumman</b>	
P-63 Kingcobra . . . . .	222	F6F-3 Hellcat . . . . .	259
<b>Boeing</b>		Grey Goose . . . . .	261
B-17G Flying Fortress . . . . .	227	Widgeon . . . . .	260
B-29 Superfortress . . . . .	232	<b>Lockheed</b>	
C-97 . . . . .	231	Constellation . . . . .	264
<b>Consolidated Vultee Coronado</b>	238	P-38L Lightning . . . . .	266
<b>Curtiss-Wright</b>		<b>Martin</b>	
Commando . . . . .	242	B-26 Marauder . . . . .	273
Helldiver . . . . .	244	Mars . . . . .	270
Warhawk . . . . .	241	PBM-3 Mariner . . . . .	272
<b>Douglas</b>		<b>North American</b>	
A-26 Invader . . . . .	250	B-25H Mitchell . . . . .	279
C-47 Skytrain . . . . .	251	P-51D Mustang . . . . .	282
C-54 Skymaster . . . . .	248	Northrop P-61 Black Widow . . . . .	285
DB-7B-Boston . . . . .	252	Republic P-47 Thunderbolt . . . . .	289
SBD-3 and A-24 . . . . .	253	Chance Vought Corsair . . . . .	297
		Waco CG-13 Army Cargo Glider . . . . .	299



U. S. Army Air Forces photo

#### TOKYO'S ROYAL PALACE

The emperor's palace in Tokyo, with moat and all the other forms of feudal protection. This photo was taken from an Army Air Forces Boeing B-29 Superfortress.

## CHAPTER I

### THE WAR IN THE AIR

We Come a Long Way Toward the End of the War—Coordination of Land, Sea and Air Forces Brings Decisive Victories in Europe and the Pacific—Our Air Supremacy in All War Theaters Paces Defeat of Our Enemies—Our Tremendous Destruction of Enemy Equipment—Our Air Forces Play Vital Role in Liberation of France—We Knock the Japanese Out of Half of the Total Area They Had Dominated—Our Record Production of Aircraft.

**A**S this is written early in March, 1945, 39 months have passed since Germany, Japan and their satellites declared war on the United States and we joined Britain, Russia and the others in a fight to a finish for unconditional surrender against enemies who long had been preparing to destroy our civilization. They almost succeeded, too, during the early campaigns, because they waged war with savage malignity such as our world had never known, not even in the darkest of the dark ages. We enter that indictment here in order to explain what we and our Allies had to do to combat that menace and exterminate it. We had to match frightfulness with frightfulness and blast the evil out of every place it infested and root it out at home where it spawned.

Since the beginning of 1944, we have come a long way toward the end of the war, which has been moving swiftly from one victorious climax to another. The Germans, who overran nearly all Europe like a plague from the Pyrenees to the gates of Moscow, have been driven back inside their own borders in the East and West, their cities and industries pounded into rubble and their transportation wrecked, with abject defeat inevitable. The Japanese, who swept along the coast of Asia seizing all the mainland States to the borders of India, taking also the Philippines, East Indies and other islands of the far Pacific until they dominated an area four times the size of the United States, have lost half of it in the last year. We are back in the Philippines, and the Japs at home are beginning to receive the same kind of punishment meted out to Germany—annihilation through the perfectly coordinated power of the Allies on land and sea and in the air.

Our part of the war in the air has been, indeed, a frightful task. It has meant creating a holocaust vastly more horrible than anything the enemy has succeeded in doing, and it has required an incredible mass



U. S. Army Air Forces photo

#### RIGHT IN DER FUEHRER'S FACE

Flying Fortresses of our Eighth Air Force during one of many daylight raids on Berlin wreck Tempelhof airport, at lower left, and the nearby railroad yards.

of explosives. In 1944, the air forces of our Army and Navy hurled upon our enemies, both German and Jap, more than 1,130,000 tons of bombs.

While the details of just what our air forces did and how they did it are set forth at length in the following chapters and the statistics in *Flying Facts and Figures* in the Appendix, here the overall picture of the air war will serve to show the trend it is taking and its decisive influence on ultimate victory in Europe and across the Pacific.

Our air power has been in full stride for the last 14 months. We dropped in 1944, our third year of war, more than five times the bomb tonnage of the first two years combined. Destruction of flying equipment tells the same story. Our Army and Navy airmen destroyed about 25,600 enemy planes in aerial combat and on the ground in 1944, as against about 15,600 during the first two years; and they lost ap-

proximately 6,400 in 1944, as compared to 4,000 during the first two years combined. The figures, incidentally, embrace only the enemy planes known to have been destroyed. They do not include the more than 3,500 listed as probably destroyed in 1944 and the more than 3,300 during the first two years.

The record of combat sorties also shows that 1944 was the year in which we began to bring our tremendous air power against the enemy. A sortie is one flight by one plane. Our Army and Navy air forces made a total of about 1,417,000 combat sorties against the Germans and Japs in 1944. They made about 407,972 against the Japs alone. But the Army Air Forces made 1,008,697 sorties against the Germans in 1944, as compared to 242,241 against the European Axis during the first two years. Here the statistics begin to fall into a mosaic which may be the pattern for victory and the end of the war.



U. S. Army Air Forces photo

#### WHAT AIR WAR DOES TO A TOWN

The Italian town of Cassino after our air forces had bombed it in efforts to break the German line that held up the Allied advance on Rome.



U. S. Army Air Forces photo

#### OUR 15th AIR FORCE HITS PLOESTI

Waves of Fifteenth Air Force Liberators blast the Concordia Vega oil refinery in Ploesti, Rumania, May 31, 1944.

Not only did our Army Air Forces fighting the Germans in 1944 make five times the sorties of the first two years; they dropped six times the bomb tonnage. Combined with the magnificent work of the British Royal Air Force and the Russian Red Air Fleet, along with smaller contingents representing others among the United Nations, the brilliant operations of our Army Air Forces, which were the largest in Europe, paced the defeat of Germany.

The battle of Germany did not begin after the enemy had been pushed back behind its own borders. It started with the first bombing of German industries and transportation systems, and was carried on by the RAF before we entered the war. After the surrender of Italy on September 3, 1943, however, it began in earnest, Allied air forces, either on strategic missions against the German military machine or working tactically in closest possible cooperation with the armies, developed one disaster after another for the enemy until he was sent reeling home.

From bases in Italy the Allied air forces went out to demolish the enemy's aircraft, steel and oil plants almost daily. They fought over the front lines, giving tactical support to our armies. They cut the railroads and highways on which the Germans depended for supplies; and they kept them cut, so that the enemy could not get away. In a period of three months in 1944, they cut German supplies more than 90 per cent, and we were able to take Rome.

Our air power, being preponderantly the strongest in Europe, made possible the invasion of Normandy and the liberation of France. It was the largest and most decisive air operation in history. It knocked out German aircraft, oil and steel plants and disrupted railway and highway communications throughout Western Europe, and this went on for months before the invasion, gaining momentum week by week. It waged a most destructive campaign against the launching sites for German robot bomb planes and rocket bombs. While many of these vicious missiles fell in England and did a great deal of damage in London, our air campaign was so effective in destroying the installations that the official records credit it with probably having saved London from near destruction. This air power kept on knocking out all kinds of installations which the Germans had set up to protect



U. S. Army Air Forces photo

#### ALLIED INVASION OF NORTH FRANCE

As thousands of boats ferried to and from our beachheads on the Cherbourg Peninsula, June 6, 1944, the German air forces remained conspicuous by their absence.





U. S. Army Air Forces photo

#### OUR EIGHTH AIR FORCE BLASTS KIEL

While our Liberators drop incendiaries on Germany's important shipyards, our Flying Fortresses drop high explosive bombs from a higher altitude.

themselves from invasion. Their big gun emplacements were destroyed repeatedly, and likewise most of their forts along the Channel coast. Their supply bases were blown up, their ammunition dumps exploded and their entire defensive system thrown into confusion. Their important radar stations were wrecked, so that they could not tell when or where the Allies were going to strike. We had gained absolute air supremacy over the entire area before the day of the invasion, and we still hold it. In his report of invasion operations between D-Day on June 6 and August 25, 1944, Gen. Dwight D. Eisenhower, Supreme Commander, Allied Expeditionary Forces, made this comment: "The brilliant preparatory work of the Air Forces, a belief

in the effectiveness of which was the very cornerstone of the original invasion conception, began months ago and reached its highest intensity at the very moment of landing. It is my conviction that except for this aerial preparation, including as a specific mission a prolonged campaign against the transportation systems of Northwest Europe.



U. S. Army Air Forces photo

#### DESTROYING A GERMAN OIL PLANT

Reconnaissance of the Hemmingstedt oil refinery, attacked by B-24 Liberators of the 44th Group, Second Air Division, January 14th, 1945, showed the primary vital part, the main distillation unit, to be severely damaged in addition to extensive destruction and damage to other buildings and installations. The attack was one of many against oil targets made by the Eighth Air Force.

the venture logically could not have been undertaken. The air support of ground forces has been most effective throughout the campaign. The supply and maintenance services have performed miracles."

Our air power did precisely the same thing in the Allied invasion of South France, and it kept smashing the retreating enemy until he had left a trail of wrecked and charred transport vehicles and mechanized combat equipment for hundreds of miles up through the Rhone Valley and back to the Rhine.

It fought the campaigns with each of our armies across Europe. It protected Gen. Patton's Third Army on the right flank and helped him blaze a fiery trail on his wild dash through France, one of the most remarkable in the annals of war. It located the German tank concentrations which warned us of the enemy's break through our lines on the Belgian frontier in December, 1944, and this, "the battle of the bulge," ended in favor of the Allies with the extremely effective help of our air forces.

Air power, our Army Air Forces bombing by day and the RAF at night, practically covered strategic German centers, ranging as far as the cities which the Russian armies were besieging, hurling thousands of tons of bombs on a people who had set out to impose their brutal new order on Europe and now found frightful retribution closing in on them from all sides and from above. An example of the magnitude of these operations lies in the record of our Eighth Air Force which from its English bases in 1944 dropped 36,726 tons of bombs on enemy aircraft plants, 52,622 tons on oil installations, 39,630 tons on other industries, 42,603 tons on German city industrial areas, 57,810 tons on airfields and airports, 129,149 tons on railway marshaling yards and other communications, and 71,526 tons on military installations. During these early months of 1945, all our bombing operations have increased in intensity and weight, and this is a mighty contribution to the overall effort which is bringing sure defeat to Germany.

Japan will be defeated in the same way after the full force of our air power has been concentrated against her from all sides, in the Pacific and on the Asiatic mainland. We already have made a splendid beginning, and it is one in which the air forces of our Army and Navy share the honors. Both Services have performed miracles in the Pacific war theaters. Their operations have been a striking example of effective coordination of land, sea and air.

All told, they made about 407,972 combat sorties against the Jap in 1944, and they dropped on him about 194,045 tons of bombs. This was a threefold increase over the 64,151 tons dropped by both Services during our first two years of war. But the figures do not present the whole picture. The Services accomplished much more in the Pacific campaigns, vastly more.

Up to the beginning of 1944, our progress against the Jap had been relatively slow from a mileage viewpoint; and here in the Pacific the

miles counted. True, we had stopped the Jap. We were on Guadalcanal and the north shore of New Guinea, and we had a foothold in the Gilbert Islands. But we still were thousands of miles from Tokyo. The distances were so great between our island objectives that they kept down the number of flights and the tonnage of bombs that we were able to drop during any period. Flights ranged up to a thousand miles each way. This gave the Japs a chance to make repairs, and it required repeated bombings and surface bombardment to keep them knocked out. It interfered with our island hopping program, both in the Pacific areas where operations were under Adm. Chester W. Nimitz and in the Southwest Pacific where Gen. Douglas MacArthur gazed longingly toward the Philippines from his bases nearly 2,000 miles to the Southeast. The development of the Navy's fast carrier task forces, which reached full strength in 1944, changed our strategy in the Pacific.



U. S. Navy photo

## A LANDING ON NEW GUINEA

A Navy Douglas Dauntless dive bomber soars high over Tanahmerah Bay on New Guinea, as our landing craft streak for the beach on April 22, 1944.



#### THE BOEING B-29 SUPERFORTRESS

The long-range heavy bomber which made history in 1944 by its raids on Japan. It is powered by four 2,200 h.p. Wright Cyclone engines.

As we acquired enough ships, planes and men, these Navy task forces embraced all types from battleships and both large and small carriers to destroyers and supply ships. They could prowl over the Pacific at will, striking the enemy at any time. In February, 1945, one of these task forces went close to Tokyo and unleashed hundreds of planes in sustained attacks on vital objectives all the way from Tokyo to Yokohama, flying at levels under 5,000 feet and blasting away special targets, including certain industries and communications facilities, which had been picked in advance.

The Navy's carrier task force is one of the two most important developments in our war against the Jap. The other is the Army Air Forces Boeing B-29 Superfortress which for eight months has been bombing Japan's war plants from high altitudes, as well as other objectives on the mainland.

The Navy task forces permitted us to change our program from hopping from island to island in the Pacific to leap frog tactics whereby we by-passed the great enemy bases such as Rabaul and Truk after pounding them into a state where they could not interfere and keeping



U. S. Navy photo

#### A MILLION TONS OF U. S. WARSHIPS

This is part of the first U. S. Navy war fleet to drop anchor in waters that were Japanese before Pearl Harbor. Showing only a part of the task force, the picture reveals nine aircraft carriers, a dozen battleships and scores of cruisers, destroyers and supply ships.

them that way by cutting off their supplies and reinforcements from home. This enabled our Far East Air Forces with Gen. MacArthur to pace his advance all the way from New Guinea to within striking distance of the Philippines. They also were able to cut down Jap fuel supplies by long range strikes at the enemy's oil plants in Borneo.

The Navy carrier task forces meanwhile took the Marshall Islands, then Saipan, Tinian and Guam in the Marianas, and whipped the Japs in several strikes at the Palau Islands and the Western Carolines. At the same time the task forces supported Gen. MacArthur's advance from base to base out of New Guinea and toward the Philippines.

The first Battle of the Philippines in June, 1944, was a bitter fight between carrier forces. The Japs lost. By driving the enemy away with what was left of his fleet and his planes we were able to operate from Saipan. The same procedure took the Navy and Marines into Tinian and Guam and other islands. After two and a half years, the Navy took the war back to the Philippines in September with a smashing two-day attack by our carrier aircraft, near Luzon, in which the Japs lost 40 ships and hundreds of planes.



U. S. Navy photo

#### THE NAVY RAIDS SAIPAN

Scene on one of our carriers as a Jap plane is sent down blazing during the Saipan and Tinian raids February 2, 1944.

After that our carrier task force operations were continuous. They struck the Ryukyu Archipelago in October and sank 46 enemy ships. They hit Formosa for several days, and the Japs lost 416 planes and 32 ships against our loss of 66 planes. Those were examples of the rising tempo of the air war in the Pacific.

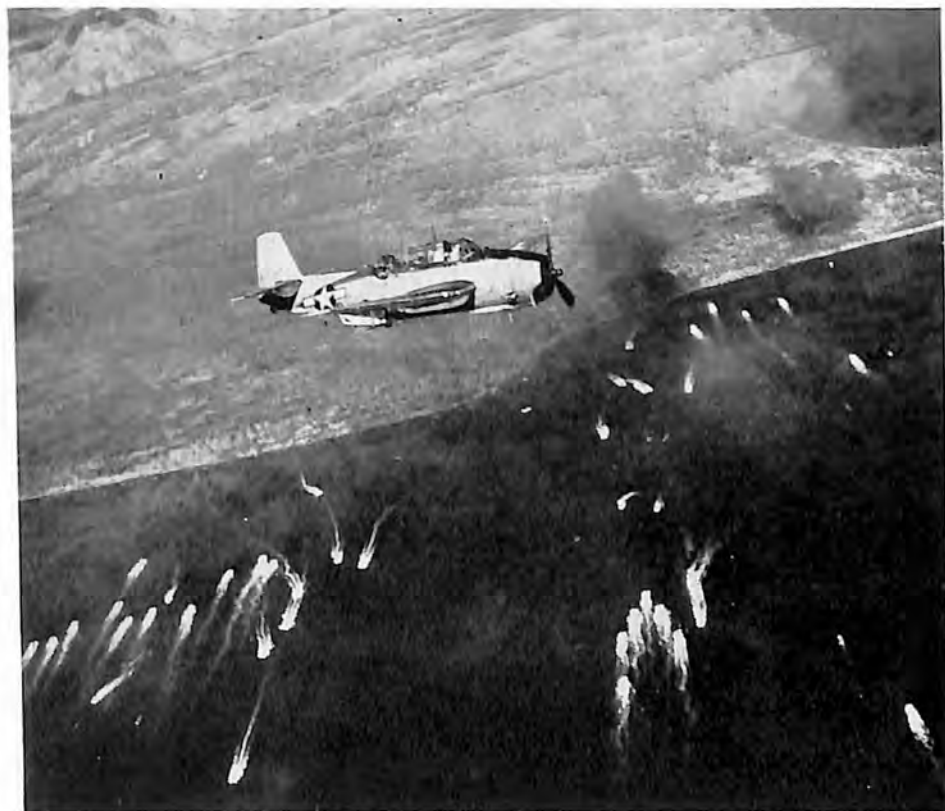
When Gen. MacArthur took his troops back to the Philippines on October 19, 1944, he was supported by the largest concentration of Allied forces to be assembled in the Pacific, and this goaded the Japanese Navy into action. It sent out three powerful task forces. The ensuing Battle of Leyte Gulf for five days beginning October 22, involved many air and surface encounters, and it ended in a decisive defeat for the enemy. After that our Navy carrier task forces went anywhere they chose in Japanese waters, raiding the mainland and, in February, 1945, launching the plane attacks on Japan, then covering the landings by our Marines on Iwo island only about 700 miles from Tokyo.

With Leyte secured, Gen. MacArthur carried his campaign through to Luzon early in 1945. Our combined land, sea and air forces took part in the landings on the beaches of Lingayen Gulf and

our air forces covered the operations that took MacArthur into Manila, Bataan and Corregidor.

Air power also took part in every campaign waged on the mainland. In China and in Burma our Army Air Forces paced the surface attacks, fought off Jap air forces and chased them back out of range. Our bombers went far out over Jap territory, destroying ships, docks, bridges, supply dumps and everything designed to make the Jap more comfortable in Asia.

Our Army Air Forces on the Asiatic mainland dropped 34,304 tons of bombs in 1944. Army Air Forces squadrons with Gen. MacArthur, the Far East Air Forces, dropped 90,087 tons of bombs, while our Army Air Forces with Adm. Nimitz dropped 20,729 tons of bombs. Their accomplishments in blasting out enemy resistance and hopes for survival, however, were immeasurably heavier. They showed what can be done to Japan when the full force of our air power is unleashed



U. S. Navy photo

#### OUR INVASION OF LEYTE

When General MacArthur took Leyte as his first stop on returning to the Philippines, Navy planes patrolled the skies. The white flashes are wakes made by American landing craft, some returning to the ships for second loads.





U. S. Navy photo

#### OUR INVASION FLEET OFF LUZON

Thousands of black and gray puffs denoting explosion of anti-aircraft missiles form a protective canopy over Lingayen Gulf during Gen. MacArthur's landing on the principal island of the Philippines, January 9, 1945.

against her. Japan will be smashed from the air just as extensively as Germany is being smashed. The Jap in China and Manchuria should go the way of the German thrown out of France, his war industries wrecked, his communications destroyed and his supplies reduced to a level where he no longer can wage war. Then it will be a matter of going into his homeland and digging him out of the rubble.

To back our full-out air attack on Japan we have the world's most powerful Navy and air forces, and we are able to put armies of any size deemed necessary anywhere in Asia, even in the Japanese homeland. We are ahead of the Jap in the performance and endurance qualities of our equipment on land and sea and in the air.

Our fighter planes have been improved steadily in the last year. Some are nearly 100 miles an hour faster, and are now flying at speeds of about 500 miles an hour; and so are some of England's and Germany's, too. We have doubled the effective range of our fighters, and their armament has been tripled in firepower. Still faster machines are being developed.

The Boeing B-29 Superfortress is in a class of its own among all the world's bombers; but now we are developing even larger and more powerful machines.

The aircraft industry of the United States produced the record number of 96,369 planes in 1944, including more than 35,000 bombers, over 39,000 fighters and naval reconnaissance, nearly 10,000 transports, about 7,500 trainers and about 4,500 for communications and other special purposes. The 1945 schedules calling for about 7,000 planes a month assure our air forces plenty of equipment in the coming campaigns.



U. S. Army Air Forces photo

#### OUR ARMY AIR FORCES RETURN TO TOKYO

On June 15, 1944, a Twentieth Air Force group flying the new Boeing B-29 Superfortresses made the first attack on Tokyo since the Doolittle raid in 1942. This photo showing Mt. Fuji was snapped by Capt. Raymond Creekmore.



U. S. Army Air Forces photo

## WRECKING JAP OIL SOURCES

In another of a series of smashing strikes at Japanese oil refineries in the Netherlands East Indies, three Thirteenth Air Force B-24 Liberators on December 9, 1944, slipped in at dawn over Sangga-Sangga, 45 miles north of Balikpapan, ignited eight oil reserves, three of which are shown in this picture burning through the early morning mist, blew up Dondang bridge, strafed the refinery area and set fire to a ship in the harbor. The low-level attack caught the enemy's defenses unprepared and as a result the "Fightin' 13th" planes did all their extra work "just for good measure." Primary mission was to knock out the bridge.

## CHAPTER II

### THE U. S. ARMY AIR FORCES

The World's Most Powerful Air Force—More than a Million Tons of Bombs Hurlled on the Enemy in 1944—The Record of Destruction—Over 19,000 Enemy Planes Destroyed—AAF Operations on Five Air Fronts—The Invasions of Normandy and South France—The Return to the Philippines—The Campaigns in Asia—The Bombing of Japan—Gen. Arnold's Comments.

**T**HE United States Army Air Forces, with the most destructive mass of air power ever to fall on this earth, smashed our enemies in Europe, the far Pacific and in Asia. Its commander, Gen. Henry H. Arnold—whose lot had been to take it into this global war pitifully small for the tragic task ahead of it—early in 1945 was hurling against the German and the Jap the world's most powerful air force, one which already had a record for annihilation on such a scale that it defied imagination.

The Army Air Forces had grown into a huge organization, its size commensurate with its world-wide operations. On January 1, 1945, it numbered 2,359,500 officers and enlisted personnel. Its greatest feat during our first three years of war was its effective destruction of German installations and communications before and during the invasion of North France. Beyond question that was a vital factor contributing to the Allied victory. The ensuing campaign against Germany and her resources in neighboring captive countries was another achievement of first magnitude; and there also our AAF undoubtedly made a great contribution to the enemy's ultimate defeat. It was important, too, because it pointed the way to an equally desirable holocaust for the Japanese, an undertaking which our Army Air Forces and Navy carrier task forces already had well under way across the Pacific. Here are the highlights of that record culled from War Department summaries based on the official reports. More detailed statistics will be found in Flying Facts and Figures in the Appendix.

The Army Air Forces threw more than a million tons of bombs on the enemy in all theaters during 1944, more than five times the lethal tonnage of 194,755 in 1943. Our squadrons in the fight against Germany dropped 937,698 tons in 1944 as compared to 149,684 the previous year. In the war against the Jap our AAF in 1944 dropped 145,120 tons where it hurt him most, including Tokyo, as against only 45,071 tons in 1943.

The unparalleled development of the AAF effort is shown by the comparative numbers of its sorties. A combat sortie is one flight by one plane. In 1944, the AAF made 1,271,784 sorties in all theaters, as compared to 364,910 in 1943 and 26,688 in 1942. Against Germany our planes made 1,008,697 sorties, as against 232,492 in 1943. Our AAF squadrons against the Jap made 263,087 sorties in 1944 as compared to 132,418 in 1943.

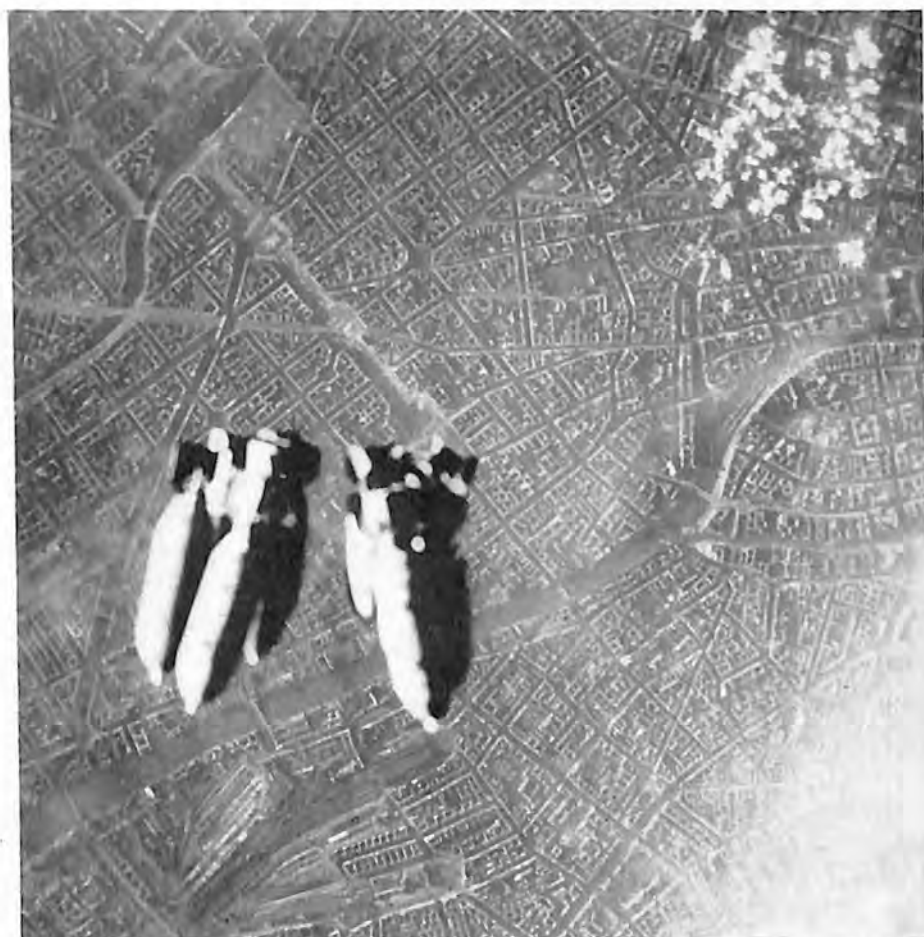
Even more gratifying were the results in destroying the enemy's air strength. During 1944 in all theaters, our AAF destroyed 13,846 enemy planes in aerial combat and 5,360 on the ground. At the same time there were reported as probably destroyed 3,197 in the air and 468 on the ground; and 5,082 damaged in aerial combat and 2,836 damaged on the ground. Our AAF losses in 1944 were 5,142 planes destroyed in aerial combat and 176 on the ground.

In order to throw the full weight of destruction against the German war machine, the Allied air forces were reorganized early in 1944 to conform to the overall organization plan of the Allied Expeditionary Forces under Gen. Dwight D. Eisenhower. Besides the Allied Expeditionary Air Forces there were the U. S. Strategic Air Forces commanded by Lt. Gen. Carl Spaatz. In this were the two strategic bombing commands, the Eighth Air Force, based in England under Lt. Gen. James H. Doolittle, and the Fifteenth Air Force based in Italy under Major Gen. Nathan F. Twining. For administrative purposes the Fifteenth also was included in the Mediterranean Allied Air Forces commanded by Lt. Gen. Ira C. Eaker, along with our Twelfth Air Force (Tactical) under Major Gen. John K. Cannon and the RAF Mediterranean and Middle East Command. The Allied Expeditionary Air Forces embraced our Ninth Air Force (Tactical) under Major Gen. Hoyt S. Vandenburg and the RAF 2nd Tactical Air Force, both based in England. These two tactical air forces, however, were to support the armies, and they accompanied them into Europe. The RAF 2nd supported Field Marshal Bernard Montgomery's British armies, while the Ninth had three permanent commands, the Ninth Tactical Air Command under Brig. Gen. E. R. Quesada supporting our First Army under Lt. Gen. Courtney H. Hodges, the 19th under Brig. Gen. O. P. Weyland supporting Lt. Gen. George S. Patton's Third Army, and the 29th Tactical Air Command under Brig. Gen. R. E. Nugent supporting Lt. Gen. William H. Simpson's Ninth Army. That was the AAF organization which was to help the Allied armies free France and drive the Germans back behind the Rhine.

Early in 1944, the U. S. Strategic Air Forces had been built up to a heavy bomber strength that promised increased destruction to German aircraft plants and oil refineries, at that time the two main objectives. The Eighth Air Force had about 30 Bomb Groups in three Air Divisions with nearly 2,000 B-17 Fortresses and Liberators avail-

able for duty. The Fifteenth Air Force had 17 Bomb Groups with about 900 heavy bombers, mostly Liberators. Both those sections of the Strategic Air Force had been provided with more adequate long-range fighter escort—Lightnings, Mustangs and Thunderbolts equipped with extra fuel tanks.

Germany, realizing the threat of increasing Allied air power, had reorganized her entire aircraft industry, developing component and assembly "complexes" in order to centralize production and achieve maximum output of sorely needed single and twin-engine fighters. They were among the 175 industrial and military targets on the American program for daylight precision bombing. The RAF, mean-



U. S. Army Air Forces photo

#### OUR EIGHTH AIR FORCE OVER BERLIN

First bombs of a thousand plane attack by our Eighth Air Force Flying Fortresses strike Berlin. The RAF hit the German capital at night and we struck by day, until it became the most heavily bombed city in Europe.



#### THE NORTHROP P-61 BLACK WIDOW

One of the deadly American combat planes that helped to wreck German air power in 1944 was the Black Widow, a night fighter carrying a crew of two or three, and several 20 mm. cannons in the wings. It was used for intruder tactics, observation and certain kinds of attack support. It was loaded with radio detection devices that let it locate an enemy plane on the darkest night. Its sensitive equipment stretched its wave lengths into the darkness and sought out hidden targets that recorded themselves on a small screen.

while, was carrying on night bombing of target areas, taking a full share of destruction to the Germans.

During six days of good weather beginning on February 20, 1944, the U. S. Strategic Air Force dropped nearly 10,000 tons of bombs on 15 important fighter aircraft plants, besides engine and ball-bearing factories. Our Eighth and Fifteenth Air Forces lost 261 bombers, 33 fighters and 2,643 airmen, a majority of whom were made prisoner. The Germans lost 558 planes. The main result was that German fighter production fell below 600 a month; and this gave the Allies air superiority, which they were able to retain.

During April, 1944, over 9,800 tons of bombs were dropped on those German aircraft plants known to be operating. Still enemy production increased to some extent, and our commanders agreed

that the Germans had succeeded in developing underground plane factories which would be difficult to knock out. But their engine factories and fuel plants were vulnerable. Two years or more were required to get a synthetic oil plant into production, and now it was too late for the Germans to take them underground. The enemy's trouble with his oil and gasoline production became progressively more serious.

Our Fifteenth Air Force based in Italy made 24 raids on the Ploesti fields in Rumania from April to the end of August, 1944 (when the Russians moved in) a total of 5,266 sorties, during which it dropped 12,737 tons of bombs, reduced the Ploesti oil production capacity 90 per cent and downed 334 enemy fighters, with 239 others probably destroyed or damaged. The Fifteenth also carried on extensive bombing operations over South Germany, Austria, Hungary, Bulgaria and Albania. Our Eighth Air Force, meanwhile, had struck a number of the important oil plants deep in Germany; and the RAF had accounted for others in the Ruhr. This, with destruction of vital communications facilities leading toward North France, paved the way for invasion.

The vital role played by the Army Air Forces in the Allied invasion of German-occupied France on June 6, 1944, was the greatest single operation in the history of air power. Our AAF alone had



#### THE LOCKHEED P-38L LIGHTNING FIGHTER

This latest model of the twin-engine Air Forces fighter is powered by two Allison 1,500 h.p. engines.





#### THE P-51D MUSTANG FIGHTER

North American Aviation's late model of the Army Air Forces fast high-altitude fighter, with teardrop canopy giving the pilot 360-degree vision. It is powered by a Rolls Royce Merlin engine and a Hamilton Standard four-blade propeller.

assembled in England more than 500,000 different items of equipment and spare parts. It had a record concentration of planes in all categories, from heavy bombers to transports and gliders. The British RAF was similarly equipped. The Allies had more than 31,000 airborne troops which had practised for many months the jobs they were to do in the invasion. Bomber and fighter squadrons had been briefed as to just what they were to do and where they must do it in order to help smash through Germany's boasted Atlantic Wall on the French coast. Most important of all had been the Allied bombing and strafing for months before D-Day which had so crippled the German war machine—including industries, communications, military installations and air force operations in general—that enemy capacity to resist the invasion was reduced drastically. For example, the Allies discovered later that some 200 German coastal radar stations had been wrecked by the air forces. This had contributed to German failure to locate the Allied surface concentrations, and thus the enemy did not know that invasion was upon him. He apparently failed to pick up the invasion fleet of about 4,000 surface craft, and his aerial patrol was negligible. Some of our strongest opposition near Isigny in Normandy came from German troops surprised while they were holding beach maneuvers. Air power had paved the way for one of the most successful military feats in the annals of warfare.

During May—the month before the invasion—Allied air forces broke all records for operations against an enemy. While the RAF took on its share of the work in every field, and Allied air forces in Italy kept hitting German objectives with increasing fury, our Eighth

(strategic) and Ninth (tactical) Air Forces carried devastation to the enemy all the way from the French coast to Berlin, daily and with pinpoint precision.

Our Eighth Air Force, going into action 27 days in May, completed more than 30,600 sorties—over 16,400 for the bombers and 14,200 for the fighters. Our Ninth Air Force made more than 30,000 sorties into enemy territory to attack 100 different targets on the Continent. More than 36,000 short tons of bombs were dropped by the Eighth on aircraft factories, oil production plants, airfields and railway yards in enemy-dominated Europe. Of this total, more than 20,400 tons were directed at targets in Germany. The Ninth, operating against purely tactical or semi-strategic objectives, primarily rail, road and canal traffic in Northern France and Belgium, dropped over 20,000 tons, an increase of 60 per cent over the April figures.

The German air forces met these assaults with a furious defense at some points and little or none at others. The gunners of our Flying Fortresses and Liberators shot down 428 German planes, while Eighth



U. S. Army Air Forces photo

#### LOADING ROCKETS ON FIGHTER PLANE

Rockets added to the deadly fire power of American combat planes. Here is a Republic P-47 Thunderbolt, with eight .50-cal. machine guns, being loaded with rockets—three carried under each wing.



#### THE DOUGLAS A-20 HAVOC

Showing the attack bomber with four .50 cal. machine guns in the nose. It is powered by two Wright Cyclones.

Air Force fighter pilots destroyed 475 in the air, and many others on the ground. Their losses for the month were 310 bombers, less than two per cent of the number dispatched, and 171 fighters, less than one per cent of those sent out.

Our Marauders and Havocs, engaging in 38 missions in their 24 days of action with heavy escort of Ninth Air Force fighters, met less fighter opposition than the heavies, but heavy flak defenses. The Ninth fighters destroyed 90 enemy aircraft in combat and 140 on the ground. Losses were 32 Marauders and 12 Havocs, all due to anti-aircraft fire, and 63 fighters.

During May, the Eighth Air Force made 48 attacks on 32 railway marshaling yards in France, Belgium, Luxembourg and Germany. Eighteen yards were severely damaged, and the 14 others torn up in varying degrees, with extensive losses in locomotives, cars, tracks and shops.

Bombing of enemy airfields and air parks in Germany and occupied Europe included 36 attacks on 35 targets where hangars, workshops and dispersal areas were objectives. Severe damage was inflicted on 10 fields, 10 more were considerably damaged, 12 received moderate damage, and two more were slightly damaged.

Attacks on enemy aircraft factories in France, Germany and Poland resulted in very heavy damage to three, the JU-88 components

plant in Halberstadt, the Oschersleben FW-190 fighter assembly factory and the Leipzig-Heiterblick ME-109 components plant; severe damage to the huge Dessau Junkers factory for fighters, bombers and aircraft engines, Cottbus and Sorau FW-190 assembly plants, the Leipzig-Mockau JU and ME factories and the Kreisling (Poland) FW-190 components factory; considerable damage to the Brunswick-Wilhelmitor ME-110 plant, the Villacoublay assembly and repair factory, and the Bourges factory; while moderate damage was inflicted on the Brandenburg Arado works and the Woippy (France) engine repair works.

Important blows were struck at Germany's synthetic oil production with 11 attacks on eight targets, one in Czechoslovakia. Of these, the plants at Brux, Czechoslovakia, and Bohlen, Zeitz and Politz, in Germany, were damaged severely. Considerable damage was inflicted on the plants at Merseburg, Ruhland, Lutzkendorf and Magdeburg, all in Germany.

Twelve industrial works, including three shipyards, were damaged in Berlin and five other German cities. Very severe damage was inflicted on the Wilkewerke constructional engineering works in Brunswick and on the Kloeckner steel works in Osnabruck; while in Berlin,



#### THE B-24 LIBERATOR BOMBER

Consolidated Vultee's Army B-24 Liberator, powered by four Pratt & Whitney 1,200 h.p. turbo-supercharged engines, has four power operated turrets each equipped with two .50 cal. machine guns.

the A.E.G. Apparate Fabrik, makers of aircraft radio equipment, suffered major damage. Minor damage to important buildings of a torpedo components firm, an airbrake and compressor factory, and to an engineering firm in Berlin also resulted. One of the most important single targets attacked was the German army's tank and armored vehicle depot at Konigsborn, which suffered almost total destruction.

An outstanding fighter sweep across Northern France, through the Lowlands to a point east of Berlin, netted more than 200 destroyed or damaged locomotives, in addition to destruction and damage to parked enemy planes, airfield buildings, trucks, river barges, trains, factories and ground defenses.

During May, the Ninth Air Force sent out Marauders and Havocs in the largest single force in its history, 400 bombers in all, and one day flew three major operations. More than ever during May, Ninth Air Force fighters flew as fighter-bombers in addition to their long and short-range escort assignments and strafing missions. Our Thunderbolts, Mustangs and Lightnings in May flew more than 22,000 attacks, and dropped a record of 5,522 tons. On clear days, Ninth Air Force fighter-bombers and fighters put more than a thousand aircraft into action from sunrise to sunset. The Thunderbolts, which bore the brunt of the fighter-bombing, often carried out more than 10 large-scale operations in 12 hours, ranging all the way from the Brest Peninsula in the West to Coblenz in the East. During the month, the main task assigned to the Ninth was to disorganize the intricate network of rail, road and waterway routes in France and Belgium—especially between Paris and the industrial cities of the North and Belgium.

Although Ninth Air Force operations were directed against traffic over every navigable river in Northern France and Belgium, they were concentrated on the Seine and the Meuse. In the last 10 days of the month, Marauders and Havocs dropped more than 4,000 tons of bombs—greater than the total tonnage for an entire month in 1943—on 10 bridges crossing the Seine alone. Both highway and rail, the bridges were located all the way from Paris to the Channel and were vital connecting links between southwestern France and the channel ports. Twelve of 13 bridges attacked in May by the Marauders were knocked out. By D-Day, out of 24 railway bridges and 14 highway bridges crossing the Seine between the Coast and Paris, all except one railway and five highway bridges had been knocked out. A day later, these also had gone.

As the medium and light bombers increased the frequency and weight of their attacks, they found their targets more bitterly defended by anti-aircraft fire. Ninth Air Force Thunderbolts, Lightnings and Mustangs, in their third month of fighter-bombing, ransacked the northern shores of the Continent for every conceivable type of target. Attacking in formations varying from huge waves to a few aircraft, the

Thunderbolts, Lightnings and Mustangs hammered everything from important airfields and railway yards to solitary gunposts at the edges of German army camps and German staff cars moving across Belgian highways. Ninety per cent of their effort was aimed at movements of troops and supplies in northern France and Belgium. They attacked railway lines, bridges, locomotives and rolling stock, railway sidings and embankments, tunnels and canal locks. Striking either at pre-determined targets or sweeping wide swaths of enemy territory for any military objectives they could find, the fighter-bombers measured their results in hundreds of locomotives destroyed, many miles of track torn up, hundreds of gun posts and large and small fuel and ammunition dumps blown up.

Not only radar, but all other German installations for defense of the Coast were spotted, photographed and mapped for Gen. Eisenhower and his staff at headquarters. Then they were bombed and machine-gunned from the air. Again, the air forces ranged far along the Coast and in the rear of the German defenses many miles away from the prearranged invasion points. This kept the Germans guessing while their Channel defenses were being wrecked.

D-Day—the day for which the United Nations had been preparing for years—climaxed more than six months of preparation by Allied air forces. Knowing that he had absolute air supremacy, Gen. Eisenhower told his assault troops: “You need not worry about the air. If you see a plane, it will be ours.”

The night before D-Day, the RAF dropped 5,000 tons of bombs on 10 crucial enemy batteries between LeHavre and Cherbourg. At dawn, 1,500 heavy American bombers were to give them, as well as other installations, another pounding.

The weather, which had been so bad that Gen. Eisenhower had postponed the invasion for 24 hours, remained bad enough to worry both air and surface forces. The Channel was choppy, and the air was turbulent, with cloud banks tumbling down to a 500-foot ceiling. Nevertheless, shortly before midnight a line of 1,000 Douglas C-47 transports and long trains of gliders—forming a column nine planes wide and more than 200 miles long—swept across the Channel from the English bases, staying only 300 feet above the water but rising higher as they crossed the Normandy coast. They carried more than 31,000 airborne troops, our 82nd and 101st and the RAF 6th divisions. They were the first to engage the enemy. Led by the 9th Troop Carrier Command's Pathfinder group, which blinked drop signals 10 minutes after crossing the coastline and spotting the prearranged landing places, our paratroopers tumbled out into the flak-streaked night. As fast as they hit the ground, they seized fields and cleared them of obstacles so that the gliders could come in—our Waco CG-4A's and the RAF Hamilcars and Horsas, all loaded with fighting troops or ammunition, land mines, field artillery, jeeps, radio equip-

ment, food, medical and other supplies. Some of the giant Hamilcars carried tanks. This airborne part of the invasion army kept on landing at various points back of the coast until, as they admitted later, the Germans did not know which way to turn. We lost only 26 of our 1,000 Skytrains, and a relatively small number of gliders.

Our bomber crews, crossing the Channel by moonlight just before dawn, saw through occasional breaks in the clouds sections of the great armada taking our assault troops to the Normandy beaches, while concussions from naval broadsides against the German positions seemed to rock our Fortresses and Liberators. Our Marauder crews prowled lower than usual, covering landing operations, while our fighters roamed high and low looking for German planes. But only a few appeared, probably not more than 50 all day.

The endless procession of Allied air power continued throughout D-Day—with more than 4,300 sorties by the Eighth Air Force, more than 4,800 by the Ninth and about 2,000 by the RAF 2nd Tactical Air Force. More than 13,000 battle flights were flown during the first 24 hours. The Germans came over next day in some strength, and each side lost 23 planes. At the end of the third day of the invasion, the Allies had made about 27,000 sorties and had lost 289 aircraft, mostly from ground fire. The Germans had so few planes in the air that their losses were necessarily low, only 176 planes—but they also had lost North France.

On June 9, the weather became so thick that practically all flying was halted, which gave the enemy an opportunity to bring up reinforcements and supplies. This looked bad at first, but when the skies cleared next day our fighters and bombers literally blasted Germans and their supply trains off the roads.

Allied pilots commenced making emergency landings in Normandy fields; and two days later, fighter squadrons were using airstrips, and our transports were evacuating the wounded by air. Back in Germany, the propagandists whined: "Our troops are helpless against the overwhelming superiority of the American air force which is continually over the battle area in great strength."

The scope of tactical air operations was shown by the record of our Ninth Air Force for June, 1944. It made a total of 37,577 sorties with medium and light bombers and fighters carrying bombs, dropping a total of 22,482 tons of bombs, besides carrying on all its other tactical operations in support of our armies.

Cooperation between ground and air forces, which had proven so successful in the North African and Pacific campaigns, was applied even more extensively and successfully in Europe. When Gen. Eisenhower organized his armies on the Continent he attached to them certain tactical air forces. (This organization is listed fully in the Appendix.) The Ninth Air Force, commanded by Major Gen. Hoyt S. Vandenburg, supported our First Army Group under Lt. Gen.

Omar Bradley. Their two headquarters never were more than a few minutes walk apart, and they worked together in a combined operations-intelligence tent—as a single organization. As the size of our forces increased during the Summer of 1944, and new field armies came into the picture, a tactical air command, headed by an air general, was assigned to each army for close, day-to-day, air-ground cooperation. After the invasion of southern France in mid-August there were four of these air-ground teams: 1—9th Tactical Air Command-First Army; 2—19th TAC-Third Army; 3—20th TAC-Ninth Army; and 4—the First Tactical Air Force (Provisional), including American and French tactical units, cooperating with Lt. Gen. Jacob Devers' Sixth Army Group, which embraced the American Seventh Army and the First French Army.

Our tactical air power enabled Lt. Gen. George S. Patton, Jr., to drive his Third Army headlong across France in one of the most brilliant operations in history. The 19th Tactical Air Command under



U. S. Navy photo

#### OUR INVASION OF NORMANDY

This panorama of our landings on Cherbourg Peninsula on June 6, 1944, was made by a U. S. Coast Guard combat photographer on a hillside wrested from the Germans.



Brig. Gen. O. P. Weyland was assigned to support the Third Army. Patton told Weyland: "I am going to depend on you to protect my right flank with your airplanes." But that was only part of it. Patton set out on August 1, and kept on going. He not only went ahead; he sent his columns in all directions, and as they went this way and that, the air command had to go this way and that, too.

Besides its usual tactical duties of column support and reconnaissance, the 19th took on all the jobs of the old time cavalry. Weyland's men had to cover all exposed areas and handle anything that developed. Normally, armies moved so far, stopped, regrouped and moved on again. Patton did not stop. He depended on his air forces, and kept on smashing through the German lines.

Groups of the 19th hung over Third Army armored columns and kept enemy planes away, at the same time obliterating any obstacle that threatened to hold them back. They could not destroy any bridges, because Patton did not want to waste time repairing them. When they were not supporting the army columns, Weyland's men were ranging as far as 30 miles ahead blasting everything in sight. The 19th also protected the bottleneck at Avranches, through which the Third Army's men and supplies were pouring. There were enemy ships to be blasted in the harbor of St. Malo. Our pilots were out on three and often five missions a day.

As Patton's wild dash gained momentum, the work of the 19th increased. New groups were added almost daily. This was what air-men had been dreaming about for a generation. In the first five days of the Third Army's drive, the 19th flew 1,088 sorties and lost only three planes. They knocked out 250 motor vehicles, 12 tanks, four locomotives, two naval vessels, and many railway cars and horsedrawn vehicles. They cut five railroad lines, destroyed two marshaling yards, 17 gun positions, seven fuel and supply dumps, a gas tank, a headquarters; and they shot up and bombed 21 troop concentrations—all that besides ceaseless reconnaissance and patrol.

After he had broken out of Normandy, Gen. Patton hit Brittany. The Germans tried to cut our line through Avranches, and Patton swung east against the enemy facing our First Army and the British Second. Meanwhile, he continued his campaign in Brittany, and set out to secure the Loire river for his right flank. The 19th had the job of protecting that flank, while doing the other jobs. Patton's headquarters later sent word to the 19th: "Movement east, south and west by ground troops was greatly facilitated."

The German air forces went up on August 7, after the first week of the campaign, and they lost 33 planes. Patton went so fast that his headquarters advanced nearly every day. This kept the 19th's bases so far behind that Weyland had to fly up front to see the Third Army commander almost daily. In this way the 19th knew what Patton needed, and they blasted out the way for him, sometimes smashing

enemy areas that they only felt that he might want to move into in the near future. During the action that closed the Argentan gap on the Germans, the 19th's Thunderbolts hit a concentration of about 1,000 enemy vehicles and destroyed half of them. Germans by the hundreds began waving white flags at our squadrons, and our ground troops would be summoned to take them back of our lines. The 19th wrecked food supplies so completely that whole German columns had nothing to eat for days. Meanwhile, the 19th had taken care of the Germans on the 400 mile stretch along the Loire, so that Patton could put his armored patrols in that area on days when bad weather prevented



U. S. Army Air Forces photo

A MARTIN MARAUDER ON D-DAY

A Martin B-26 Marauder bomber wipes out a German fuel dump in North France on the day of the Allied invasion, June 6, 1944.

flying. When the German planes went up to fight, the result was an average of four of theirs destroyed for one of ours.

When the Germans tried to retreat across the Seine before the fall of Paris, the 19th blew up the ferry slips. Bridges had gone weeks before. After the fall of Paris, Patton was still dashing toward Germany, and the 19th kept on supporting him, at the same time bombing enemy targets that he had by-passed, all the way back to Brest. The 19th's Thunderbolts bombed and strafed a concentration of about 20,000 Germans in the path of one of Patton's columns near the French border. The job was so complete that these enemy troops wanted no more. When one of our infantry officers told them more Thunderbolts were coming if they did not give up, the 20,000 surrendered to a few of our infantry platoons.

Allied air forces so dominated the battered German air forces during the invasion of Southern France that we were able to muster a total strength of 5,000 planes against a bare 200 craft which the enemy could put into the sky. In contrast to our powerful air support given the Allied assault upon the French beaches near Toulon on D-Day, August 15, 1944, the German Air Force opposed Allied landings with only 60 sorties. On August 16, the mauled Luftwaffe made only 70 sorties against our assault troops, indicating that even after a day's time for reinforcements it was capable of delivering no more than a puny air blow against the invasion forces. On the other hand, the Allies, with our Army Air Forces bearing the brunt of the attack, made D-Day in Southern France the greatest display of air strength ever witnessed in the Mediterranean. More than 4,200 sorties were flown on the day of the landings. By the end of the week our air forces had launched 9,646 sorties against the enemy and dropped more than 3,800 tons of bombs. With the battlefield isolated by air and the German coastal guns and garrisons drenched by bombs, the assault troops reached their primary objectives in short order and with a minimum of casualties. Heavy losses might reasonably be expected in such an assault operation against seven German divisions, but so overwhelming was Allied power that casualties at the end of invasion week numbered only 1,529 killed and missing. German prisoners during the same period totalled 16,500.

A few days after the initial landings Lt. Gen. Alexander M. Patch, commander of our Seventh Army, expressed to Lt. Gen. Ira C. Eaker, Commanding General, Mediterranean Allied Air Forces, air commander during the invasion, his "profound appreciation for the great efficiency of the air effort. Its aiming and accuracy were superb. Its effectiveness has been of utmost assistance." The French coast defended by the Germans was a rugged one with rocky promontories. Before the collapse in 1940, France had erected well-situated coastal batteries. To these the Germans had added some 450 heavy and 1,200 light anti-aircraft guns. In addition to the estimated seven divisions

in the area, the enemy had on call various battalions and similar units.

The assignment of the air forces prior to and during D-Day was to neutralize enemy air forces; to provide air protection to assault convoys and subsequent operations; to retard effectively movement of enemy forces into the assault area; to assist assault and subsequent operations by air action; to transport and drop airborne troops, and to support operations by French Maquis by air action and supply. In carrying out that complicated task, not one airborne troop carrier plane nor a single glider was lost to enemy action. In addition, three assault divisions hit the beaches between Frejus and St. Tropez and met virtually no resistance.

The success of the operations, particularly in view of their tremendous scope, indicate how thoroughly the Allied air forces had supremacy over the Luftwaffe. During the invasion, troop carriers flew nearly 1,000 sorties and hundreds of gliders were towed. In all, 9,000 personnel, more than 200 jeeps, more than 200 artillery pieces, and one and three quarters million pounds of equipment were airborne—all without one loss due to enemy action.

The complete story of Allied air supremacy for the Southern France invasion goes back to December, 1943. The invasion was con-



U. S. Army Air Forces photo

#### A PIPER CUB IN NORMANDY INVASION

All dressed up in its D-Day paint, it lands in a pasture lot in Normandy.

ceived at that time by the Combined Chiefs of Staff, and even before the last German troops had been driven from the island of Corsica, air reconnaissance began with a view toward using it as the springboard for the attack. Corsica, a rocky, barren island, offered scant harbor facilities and no operational airfields. But against terrific odds 14 operational airfields were built between then and D-Day. Among the mountains of supplies which had to be conveyed to the island in small vessels were more than 50,000 tons of bombs.

Air preparation for the invasion actually had begun, however, in April when heavy bombers made a highly successful attack on Toulon. Between then and the first week of August, when the first specific phase of air operations in connection with the invasion began, the MAAF flew more than 6,000 sorties, dropping 12,500 tons of bombs on Southern France. These were aimed at installations, submarines, supply and communications lines and the Luftwaffe, all as a prelude to the full-scale attack scheduled to precede the actual landings.

As Allied armies pushed up the Rhone Valley, our air forces concentrated on German road movements, with the result that more than 2,000 enemy vehicles, among other equipment, were found charred wrecks on 120 miles of highway.

Some of the most decisive operations of the European campaign were carried on by the Twelfth Air Force under Gen. Cannon. Its main task was to support Gen. Mark Clark's army on the Allied advance through central Italy. But the Germans held a barrier across the country below Rome. Not even our destructive bombardment of Cassino on March 15, 1944, pried loose the enemy from that line. It was evident that he was able to get enough supplies and reinforcements in from the North. The Twelfth Air Force set out to demolish supply lines in the German rear. The other air forces helped at times. By March 24, all the enemy supply lines leading to Rome had been cut. The Twelfth averaged 30 railway cuts a day and sometimes 100 cuts were made. The highways were blasted so that the automotive equipment could not move at night. When it struggled on in daylight, it was an easy mark for our low-flying fighter-bombers. In May 2,700 enemy vehicles were shot up. That and the cuts in the railways reduced the German supply capacity from 100,000 tons a day to 4,000 on this front alone.

The enemy's lines broke under the ground offensive, and he was unable to withdraw in order because his transport system was under constant air attack. When Gen. Clark's army entered Rome on June 4, he stated that the Twelfth's "splendid air effort had enabled us to show the enemy how irresistible the air-ground combination can become." During the summer, the Twelfth destroyed 25 primary road and rail bridges over the River Po within 72 hours. All told, from May to October, the Twelfth destroyed or damaged more than 1,000 bridges, including those rebuilt and redestroyed.

After success in the invasions of France had been assured, both our Eighth and Fifteenth Air Forces intensified their campaign against strategic German targets. During one week in July, the Eighth made 8,000 bomber and 5,000 fighter sorties against 50 strategic objectives.

A total of 292,402 American airmen—in fighters and bombers—participated in the Allied strategic offensive against Germany between June 6 and July 30, 1944. They made a total of 27,330 bomber sorties and 19,102 support sorties in that period of less than two months; and they dropped 61,872 tons of bombs on strategic targets in Germany, Austria, Poland, Czechoslovakia, Hungary, Bulgaria and Rumania. We lost 601 bombers and 196 fighters, and destroyed 1,391 enemy aircraft. None of those figures includes our tactical air force operations.

Results of all this Allied bombing were apparent by October, 1944. Germany had lost about three-fourths of her oil production capacity and was dipping heavily into her reserves. The Russian sweep into Eastern Germany during the winter, the Balkan campaigns as well as the Russian victory in Hungary, combined with Allied successes on the Western Front, further depleted both production and reserves.



U. S. Army Air Forces photo

#### DURING OUR INVASION OF SOUTH FRANCE

Our paratroopers fill the sky when dropped by the Troop Carrier Command's Douglas C-47's of our Twelfth Air Force between Nice and Marseilles. This picture shows only a small part of the airborne invasion forces.

This assured final defeat of the Germans. Still the strategic bombing was kept up all over Germany, and her major cities fell into rubble—all of which helped the armies in their conquest.

Besides its two main campaigns—against German aircraft plants and oil resources—the U. S. Strategic Air Forces carried out attacks against important ball-bearing, chemical, radio and radar, ordnance and tank and truck plants, and also against transportation centers and rocket and rocket sites.

On February 7, 1945, the War Department reported that "an unprecedented total of 15,116 tons of bombs has been dropped on Berlin by the U. S. Army Air Forces since the first assault by the AAF on March 4, 1944, helping to pave the way for Allied forces now marching on the German capital and making it the most heavily bombed target in Europe. This cascade of destruction, aimed at strategic military targets of every category in coordination with the Royal Air Force, was dropped by B-17 Flying Fortresses of Lt. Gen. James H. Doolittle's British-based Eighth Air Force.

"The most recent attack, that of February 3, 1945, which had as its objectives the aggravation of German discontent, disruption of the enemy's administrative machinery and communications, and the blocking of his troops pouring eastward to man the Oder River line, was the most devastating in the 11 months campaign. Preliminary reports show that at least 2,266 tons were unleashed on the city. More than 6,400 heavies have been sent into combat over Berlin to hammer at marshaling yards, war industries and other installations which are the source of supplies for the Wehrmacht. Most of the 15,116 tons dropped in the 11 months period were aimed at marshaling yards and the industrial nerve center of Germany. The Berlin Spandau aero-engine works and ordnance depots received 691 tons of bombs; Berlin Tegel tank plants a total of 641 tons; Berlin Marienfelde aero-engine plants 271 tons; Berlin Niederschonweide tank plants 223 tons; Berlin Nowares marshaling yards 42 tons; Berlin Zehlendorf marshaling yards 42 tons; Berlin Tempelhof marshaling yards 36 tons, and Berlin Templin marshaling yards, another 88 tons." The War Department added that 14 other important German cities had received a total of 127,736 tons of bombs from our air forces.

More extensive use of rocket projectiles fired from planes followed a two months test by the Ninth Air Force using Thunderbolts equipped with rocket-firing tubes under the wings. In the two months period a Thunderbolt squadron using rockets destroyed 35 locomotives, 85 tanks, 15 armored cars, 164 motor transports, 19 gun positions, nine hangars, six warehouses, 36 cars and two ships, and damaged 105 other pieces of equipment.

The most serious setback sustained by the Allied armies pressing Germany on her western frontier occurred on December 16, 1944, when the German commander, Field Marshal von Rundstedt, broke

through in Belgium, driving a wedge between our First and Third armies, and threatening to recapture the vital port of Antwerp. The reason for this temporary success was bad weather—the worst of the year, with blizzards and zero ceilings for 10 days prior to the breakthrough. Our armies had not been caught off guard, however. Prior to the storms, our aerial reconnaissance had shown the German 6th panzer army to be grouped east of the Rhine. But it might have moved in one of several directions. For the next 10 days the weather was so bad that although our planes were able to take off from the vicinity of Liege, by the time they reached the front line the ceiling was zero. For two hours on December 17th, the second day of what was known as "the battle of the bulge," one of our Army Air Forces pilots flying only 30 feet above the ground, picked up a large column of enemy armor near Stavelot, and radioed its position to the ground control, with the result that our fighter-bombers soon attacked and put that enemy tank column out of commission as a striking force. On December 23, good weather arrived in the form of a front moving east to west, known as a "Russian High." Four days of fine flying weather gave our Allied air forces a chance for perfect support to American and British troops. Our heavy bombers, mediums, fighter-bombers and fighters went to work on the enemy. In one day our Eighth and Ninth air forces flew 10,000 sorties over the bulge. There were at least a thousand planes visible from any spot in the bulge area at any time during daylight hours. About 50 per cent of the German tanks, trucks and motorized vehicles were destroyed from the air. It helped our surface forces in their brilliant counter-assaults, and the enemy made no more advances. Instead, he was turned, in



THE DOUGLAS A-26 INVADER

Showing the top and belly turrets and 20 mm. nose cannon.





U. S. Army Air Forces photo

#### STRIKING AT GERMAN SUPPLIES

Our Eighth Air Force Fortresses dropping bombs on a target in Germany.

some cases his forces were decimated, and his retreat continued back past his former lines.

An example of how bad weather could bring partial failure to a well planned operation was recorded between September 17 and 23, 1944, when over 7,000 transport sorties dropped our U. S. 82nd and 101st Airborne Divisions and the British 1st Parachute Division in Holland. Our airborne troops seized Nijmegen and Eindhoven while the British dropped into Arnhem, north of the other points. After 10 days of the most heroic fighting, the bad weather prevented reinforcements from being flown to the British, and they had to be withdrawn through enemy lines. However, the overall success of our strategic and tactical air forces in the European theater of the war promised equally favorable results when the full force of Allied land, sea and air power should be brought against the Jap.

During our third year of war and in the early months of 1945, the

Army Air Forces hit the Jap from five main air fronts, helped to push him back about 2,000 miles across the Pacific, regain the Philippines and take part of Burma. At the same time the AAF began blasting the Nipponese at home, and Tokyo became an augury of the future like Berlin. While this was only a sample of what Germany was receiving, there was every assurance that our bombing of Japan soon would assume the same catastrophic proportions. Land, sea and air power combined to doom the Japanese.

In the Pacific ocean areas—under command of Adm. Chester W. Nimitz, with his deputy commander-in-chief one of the Navy's pioneer aviators, Vice Adm. John H. Towers—the Army Air Forces had large contingents working in close cooperation with Navy and Marine Corps aviation under the overall direction of Adm. Nimitz. They included the U. S. Strategic Air Forces, POA, commanded by Lt. Gen. Millard F. Harmon, with Maj. Gen. Willis Hale as deputy commander for operations. The USSAF embraced the 21st Bomber Command



U. S. Army Air Forces photo

#### FIFTEENTH AIR FORCE HITS KLAGENFURT

Our Fifteenth Air Force knocks out the vast rail yards in Klagenfurt, Germany, on February 22, 1945.

under Major Gen. Curtis Le May, the Seventh Air Force under Major Gen. Robert L. Douglass, Jr., and the 4th Marine Aircraft Wing, USMC, under Major Gen. Louis E. Woods of the Marine Corps. The 21st Bomber Command was that part of the global Twentieth Air Force set up in 1944 to use the Boeing B-29 Superfortresses anywhere on earth that the commanding general, Gen. Henry H. Arnold, should decide. He was in direct command of the Twentieth, with Gen. Harmon as deputy commander and Brig. Gen. Lauris R. Norstad chief of staff. The 21st bombed Tokyo and other Japan targets from Saipan, and moved its headquarters to accompany Adm. Nimitz. In February, 1945, they were on Guam.

In 1944, the AAF in that area commanded by Adm. Nimitz made 27,992 sorties, as compared to 6,119 in 1943. They dropped a total of 20,729 tons of bombs as against 4,136 in 1943; and they accounted for a great deal of the destruction to Jap planes, shipping and installations made only after long flights over water in order to reach island objectives. It will be noted that the vast distances in the Pacific campaign required much more flying than the number of sorties would indicate, especially when compared to the vastly greater number in Europe.

The Seventh Air Force, from new bases in the Gilbert Islands, worked with Navy and Marine Corps forces in softening the Marshall Islands, which received a pounding every day for three months, until they were secured in February, 1944. Wotje, Maloelap, Mille and Jaluit were blasted to such an extent that our surface forces could by-pass them safely and take Kwajalein on February 6.

In a three months period, the Seventh's Liberators alone flew 1,135 sorties. On Kwajalein they demolished the radar installations so effectively that when the time came for our amphibious forces to strike, the Fleet was able to make its approach undetected. Navy planes brought these attacks to a climax with a series of overwhelming strikes. The occupation of Kwajalein and establishment of a strong air base there moved the bomber line 500 miles nearer Tokyo. Eniwetok, 370 miles to the west, was subdued by March 2, 1944, and this base became a most important staging area for bomber and air transport operations.

In order to protect our flank for the important campaign in the Marianas, involving the capture of Saipan, Tinian and Guam, the next three months (March to early June) found Army, Navy and Marine aircraft consistently striking the by-passed Marshalls bases and also the principal points in the Japanese defense network in the Carolines. These included Kusaie, Ponape, Truk, Yap and Palau. AAF Liberators and 75-mm. cannon-bearing Mitchells made up a perfect bombing team, the Liberators pinpointing from high and medium altitudes, and the Mitchells going in at medium or treetop heights to drop their lethal cargoes and blast enemy installations. This was the first time

the big aerial cannon had been used during an entire campaign, and it proved remarkably effective in neutralizing Jap anti-aircraft and fire from his automatic weapons. The land-based bombers averaged 2,431 miles a round trip in their early strikes against the Marshalls. One of the longest missions flown by the Seventh was 2,769 miles, while the average mission was more than three times the distance from London to Berlin. In April, the Seventh's Liberators, from bases in the Marshalls attacked Guam in the Marianas, flew south to bases in the Admiralties, refueled, loaded up with more bombs and dropped them on enemy bases in the Carolines on the way back to their Marshalls bases.

Our assault upon the 600-mile Marianas chain began on June 15, with a carrier strike on the 11th. Seven days later, hard-hitting P-47s, with eight .50-cal. guns and rocket launchers, landed on the Aslito airfield. After 25 days of fierce fighting over rugged terrain, Saipan was secured by the V Amphibious Corps (Marines and Infantry), and American forces were now in a position to strike at the heart of Japan from both air and sea. On July 24, landings were made on Guam, and within 20 days that important island was completely secured, except for spasmodic fighting in the hills. Tinian was secured by the end of July. Japan's inner defenses thus were penetrated, and she was forced to pull in practically all her air and naval strength from the Central Pacific. Only Palau was left, and the assault on this powerful base was begun on September 15 in a highly integrated operation involving



U. S. Army Air Forces photo

#### ARMY AIR FORCES STRIKE JAP AIR STRIP

Fifth Air Force B-25 Mitchells dump fire bombs on a bit of Nippon's air power near Wewak, New Guinea.



THE B-25H MITCHELL BOMBER

North American Aviation's cannon-firing bomber. It carries a 75 mm. cannon and 14 .50-cal. machine guns, and is powered by two Wright Cyclones with Hamilton Standard three-blade propellers.

Army-Navy-Marines, naval air, AAF Seventh Air Force and Far East Air Force (Thirteenth). Meanwhile, the Seventh Air Force had made another jump in July by moving 1,500 miles from Kwajalein to Saipan.

In his report, Gen. Arnold commented on these Central Pacific operations as follows: "Truk, once the most heavily defended island in the Carolines and the keystone of the entire Japanese defense system in the Central Pacific, is now to a large extent neutralized. Other enemy bases in the Carolines—Kusaie, Ponape, Woleai and Yap—have been bombed into impotence. In the Bonins and the Volcano group, Chichi Jima, Haha Jima and Iwo Jima for some time have been under the same systematic bombardment. The mission of the Seventh Air Force fighters in the Marianas was the defense of the islands, special raids against airfields, gun positions and communications on Saipan, Tinian, Guam, Rota and Pagan. Our P-47 Thunderbolts flew daylight shifts, and P-61 Black Widows, new in the Central Pacific, operated at night. From July 1 to 31, 1944, when Tinian was secured, our Seventh Air Force fighters flew 3,430 sorties, some of the men averaging two or three a day. Naturally, it is possible within the scope of this report to touch only on the highlights of our Central Pacific progress. To state, for instance, that the distance between the Seventh Air Force's forward bases and Tokyo was shortened from 3,467 to 1,267 nautical miles during 1944, gives a very small measure of this achievement. But in a sense, these figures speak for themselves."

One of our air fronts against Japan lay over the North Pacific.

The Eleventh Air Force, commanded by Major Gen. Davenport Johnson, covered the North Pacific from the Aleutians to the Kurile Islands, the latter forming Japan's first line of defense on her home islands from Alaska. Once the Japanese had been eliminated from the Aleutians, the Eleventh was in a position to improve its supply lines, build new bases and strengthen old ones, and consolidate its gains. Liberator and Navy Ventura bombers, loaded with GP and photoflash bombs lifted the curtain of secrecy from one after another of the Jap air, ground and naval bases on the islands of Paramushiru and Shimushu, and later from Matsuwa, Onnekotan and other islands of the central Kuriles. In addition to these photographic and bombing missions, Eleventh Air Force Mitchells conducted offensive sweeps against Japanese shipping with excellent results. All through 1944, despite the worst kind of weather, the operations were continued in the same general pattern—striking the enemy with bombs and machine-gun fire wherever he was to be found within the range of our aircraft, afloat, ashore or in the air. The Jap kept intensively at work strengthening and expanding his old positions and constructing new installations of various types. The primary mission of the Eleventh, therefore, was to keep the Jap and his Kurile activities under constant surveillance, and destroy him when possible.

From the viewpoint of our Army Air Forces, their most important air front against the Jap was over the Philippines from which they had been driven at the start of the war. The AAF had its own slogan, supplementing that of Gen. Douglas MacArthur's "I will return." The AAF said: "We will make the Jap pay a hundredfold." The formula for victory, which had been tested constantly since July, 1942, included 1—Gaining air control by destroying enemy aircraft on the ground and in the air, and rendering untenable all airfields within range; 2—establishing and maintaining an air blockade to prevent replacement or reinforcement, and cutting off the flow of supplies to the area under attack; 3—destroying enemy supplies, knocking out his anti-aircraft, artillery and ground defense system; 4—supporting by heavy bombing and strafing attacks the amphibious forces which seize the ground and construct airfields from which our aircraft repeat the program for another move forward.

Under Gen. MacArthur were the Far East Air Forces commanded by Lt. Gen. George C. Kenney with Brig. Gen. Thomas D. White deputy commander. The command embraced the Fifth Air Force under Major Gen. Ennis C. Whitehead, the Thirteenth Air Force under Major Gen. W. St. Clair Streett and the First Marine Aircraft Wing, USMC, under Major Gen. Ralph D. Mitchell.

In 1944, the Far East Air Forces made 155,107 sorties as compared to 103,148 in 1943, and dropped 90,087 tons of bombs as compared to 30,054 in 1943. They fought all the way from New Guinea



#### BRINGING IN A CUB FOR LIAISON

Landed on a Pacific island, it will be at work in a few hours seeking out Jap infiltration attempts.

to Luzon, with side raids as long as a thousand miles to wreck Jap oil supplies and communications as far east as Borneo. They put the Jap air force out of existence in the Philippines, and by February, 1945, were renovating their old AAF headquarters at Clark Field and Nichols Field near Manila.

The Fifth Air Force had been in the Southwest Pacific campaign from the beginning. It had helped materially in the campaigns which drove the Jap out of Australian waters, and had a full share in the drive to neutralize and by-pass Rabaul and other enemy bases. The Fifth would strike them one day, Navy aviators the next, and the Jap never knew from what direction the next blow was coming.

In February, 1944, the Japs tried to relieve Rabaul and Kavieng. The Fifth sank 24 vessels in four days. A few weeks later, the enemy tried to relieve Wewak in New Guinea, and the Fifth sank seven of their nine ships. After that the Japs at these bases were left to their fate. In March, Gen. MacArthur's forces occupied Manus and Los Negros islands in the Admiralties, seizing strategic Momote airfield just ahead of Japanese reinforcements. It was the most important operation in that theater, and put our forces into a favorable position for the leap-frog operations which were to put the Americans back in Manila within a year.

On March 29 and 30, Fifth Air Force Liberators escorted by new long-range Lightnings, assaulted Hollandia and wrecked most of the Jap installations. Next day low-flying Mitchells and Douglas A-20's wrecked the remaining planes and airfield facilities, burned Hollandia itself and destroyed all the fuel and supply dumps. Here the Jap lost more than 400 planes, and it was the end of his air power in the Southwest Pacific. MacArthur's forces occupied Hollandia and Aitape on April 22, while our air forces kept most of the Japs back in the woods. This advanced our bomber line 500 miles, giving us airfields from which to strike Palau, Davao, Balikpapan and Soerbaja. We had cut off and by-passed the former powerful Jap bases in Wewak and the



U. S. Army Air Forces photo

#### LOW-LEVEL BOMBING HITS JAPS

Our Fifth Air Force flying low drops parachute bombs with pinpoint precision on a long line of Jap planes on Old Namlea airfield, Boeroe Island.



Hansa Bay area. Hollandia, in Dutch New Guinea, became the first Dutch territory retaken from the Japs.

After MacArthur's troops had seized Wakde island, 100 miles west of Hollandia on May 17, our AAF occupied its excellent airfield, and the forward march continued, into Biak island 10 days later, and Noemfoor on July 2. The Thirteenth Air Force in June was able to move its Guadalcanal headquarters 1,000 miles to Manus island in the Admiralties. Sansapor on the far western tip of New Guinea was occupied on July 31, and a few days later, the Thirteenth made another 1,000-mile jump, taking its headquarters to Wakde. The Halmaheras and Palau islands were softened for our surface troops, and a tight air blockade was established over the Celebes and Moluccas. Jap air power became non-existent throughout the area. Peleliu and Morotai were occupied on September 15, in coordinated land, sea and air operations. MacArthur was nearing the Philippines.

The landings on Leyte beginning October 19, 1944, were marked by the practically perfect coordination of land, sea and air forces of both the Army and the Navy, with the forces of Adm. Nimitz and Gen. MacArthur working as one magnificent team. Both Army and Navy air forces had been softening the Japs in the Philippines for weeks, the Navy planes operating from carriers. Navy planes helped to cover MacArthur's landing on Leyte. This land, sea and air cooperation continued throughout the Philippines campaign. One of the first AAF jobs on Leyte was to prepare an airstrip for squadrons of the Far East Air Forces, and they had to do this under heavy bombing from the Japs. Hours before the strip was in any shape for use they received radio messages from a contingent of Navy planes that they were coming in for emergency landings. The AAF engineers worked frantically, and were still working when the Navy planes glided across the shore line and into what was anything but an airfield. The last Navy plane had just landed when in came a squadron of Lightnings from the Far East Air Forces. Thus the two Services occupied the first air base to be reestablished in the Philippines. The Mitchells and Liberators of the Thirteenth Air Force were based at Moratoi while the Fifth moved its headquarters to Leyte. Both took part in neutralizing the enemy bases throughout the Philippines, at the same time making long-range strikes against the Jap oil fields in Netherlands East Indies.

Gen. Arnold in his report stated: "In November, units of the Fifth Air Force were on Leyte, operating from airfields constructed with remarkable speed under great difficulties. A Tokyo broadcast reported by the Federal Communications Commission on December 10, had this to say about the fighting on Leyte: '. . . because of the air power advanced by the enemy on Tacloban, Dulag, San Pablo and Burauen airfields, which he speedily established, our ground fighting and maintenance of the sea supply line became extremely difficult . . . The city of Ormoc has been reduced to ashes by the bombardment of

enemy planes and long-distance guns. Should an enemy plane find even one person on a street, it swoops down so low as to brush the tips of coconut trees and showers machine-gun fire . . . Not even the headlights of our motor vehicles or cigarettes can be used during the night . . . There were many cases where our field and anti-aircraft artillery could not be used during the day for fear the enemy planes might locate our position. In contrast to this, the enemy continuously attacked us during the day . . . Particularly the machine-gun fire of enemy Lockheed P-38's, which usually come in a formation of six planes during the daytime, is so violent as to shoot 500 shells a second. They shoot out as if a bomb had dropped.'

"After we were well established on Leyte," continued Gen. Arnold, "we built and quickly made operational a series of airfields on Mindoro. From these advanced air positions, as well as from our larger bases in the South, we struck at Luzon in force. Air power, which had been used so effectively against us in the Philippines three years be-



U. S. Army Air Forces photo

#### WRECKING JAP AIRFIELD AT BORAM

Planes from our Fifth Air Force dropped parachute bombs and destroyed more than 50 enemy planes, blasted other installations and the Japs in their anti-aircraft gun positions.

fore, was now spearheading and covering our own major offensive there. In keeping up such relentless, round-the-clock pressure, the Far East Air Force had flown, through December 31, 1944, a total of 155,107 combat sorties. During that period, they dropped 90,087 tons of bombs. Through November, 1944, 326,490 tons of enemy shipping were sunk, 197,982 probably sunk and 540,500 tons damaged. Also through November they consumed 143,257,000 gallons of gasoline. From January 1, 1944, through December 31, 1944, they destroyed 2,414 enemy aircraft, probably destroyed 563, and damaged 692; while losing in combat 818 of our own."

Gen. MacArthur required only about five weeks so to defeat the Japs on Luzon that he could occupy Manila and Bataan, and drop the 503rd Airborne Division on Corregidor in Manila Harbor. The 503rd had been one of our greatest outfits from the start of the campaign to regain the Philippines when it helped capture vital points in New Guinea. For that matter, there were hundreds of other AAF units whose brilliant operations in that campaign would fill volumes. They ranged from the airport engineers and service troops to the air transport and supply units. All in their own way helped to make the Philippines secure.

Our fourth air front against the Jap was on the Asiatic mainland in China, Burma and India. Major Gen. Claire Chennault commanded our Fourteenth Air Force in China. In the southern sector the Allied air forces were our AAF Eastern Air Command under Major Gen. George E. Stratemeyer, and it embraced, with other Allied units, the Tenth Air Force under Major Gen. Howard C. Davidson. Also on this front was part of Gen. Arnold's Twentieth Air Force operating Superfortresses. It was the 20th Bomber Command under Major Gen. Roger Ramey with forward bases in China.

In 1944, the Army Air Forces based on the Asiatic mainland made 79,988 combat sorties, as compared to 23,151 in 1943. They dropped 34,304 tons of bombs as against 10,881 the year before.

Operations on the Asiatic mainland always were colorful and dramatic. The AAF air transport system across the Hump of the Himalayas between India and China was one of the really great achievements of our war in the air, and it is described in detail in the chapter on air transport. Reconquest of North Burma and the development of Allied air superiority throughout those theaters had eliminated the danger of Jap attacks on our transport planes by the end of 1944. It also permitted a route change which let the transports fly at about 12,000 feet instead of the former 18,000 which had been necessary to clear the Hump.

However, a land route between India and China was also of the highest importance. The construction of the Ledo Road, aptly renamed the Stilwell Road by Chiang Kai-shek, was one of the most remarkable feats in engineering history. Early in 1944, the first truck

went through from Ledo, India, to the head of the Hukwang Valley, and during the first two months of the year Gen. Stilwell's American-trained Chinese troops pushed the Japs down the valley, with General Pick's engineers close on their heels. In March, Major Gen. Frank Merrill's Marauders seized Walawbum, and on the same day the first contingent of the late Major Gen. Orde Wingate's British Chindits were landed by glider and parachute deep behind enemy lines by Colonel Philip Cochran's Air Commandos. A few days later saw the clean-up of the Hukwang Valley, and the fight for the Mogaung Valley, with the great prize of Myitkyina, Jap stronghold on the upper Irrawady River, as the chief objective. By a brilliant surprise maneuver the Marauders, with Chinese units attached, made a wide sweep through the jungles and seized the Myitkyina airfield on May 17. Airplanes with sufficient reinforcements to hold the airfield were landed almost immediately, but not enough to take the town. The Japs



U. S. Army Air Forces photo

#### OUR AIR FORCES HIT JAP OIL SUPPLIES

The Liberators of our Thirteenth Air Force hurl the fourth of their heavy raids against the enemy's principal oil refineries in Balikpapan, Borneo.

dug in, contested every yard, and were not thrown out finally until early August. The next objective was Bhamo, 150 miles to the south, and after its capture on December 15, the way was open for a short cut from the new Stilwell Road (which had reached Myitkyina and beyond) to the old Burma Road without going all the way down to Lashio, the old terminus. When the Chinese finished their end of the campaign along the Salween (January, 1945), the two forces met, and early in February, the first big truck convoy for China started on its way.

The Allied air forces in the Burma-India theater were charged specifically with all phases of strategical and tactical air offense and defense, and cooperation with ground forces. Allied fighters quickly established superiority, destroying the enemy on and over his own fields and forcing 100 per cent replacements repeatedly. These fighters included RAF Hurricanes, Spitfires and Beaufighters, and AAF Mustangs, fighter-bombers A-36 and P-40 Warhawks, and later, P-47D Thunderbolts. Mitchell medium bombers were especially effective in disrupting the Jap main lines of communications, and the famous 7th Bombardment Group, flying B-24 heavy bombers, attacked shipping and harbor facilities in Rangoon with such good effect that it was practically immobilized as a useful port, while long-range missions against Bangkok greatly diminished the utility of that important supply center.

In addition to active and close cooperation in all phases of the advance along the Stilwell Road, air power, especially air supply, was a key factor in repulsing the Japanese thrusts in the Arakan area, in Southwest Burma, and against Imphal and Kohima, in Northeast India. In both these actions completely isolated Allied forces were supplied by air, heavily reinforced and maintained as fighting units with such effect that the Japanese were defeated decisively. The light Piper Cub planes which flew in with medical supplies and then flew out with the wounded performed great service.

The Cochran-Alison-Wingate airborne invasion of North Burma, in which 9,000 troops were transported, supplied and partly defended, was one of the outstanding feats of the war. Landing deep behind the Jap lines in the triangle, formed by Myitkyina, Bhamo and Wuntho, complete surprise was achieved, and the airstrips "Broadway," "Picadilly" and "Chowringhee" (named after a main street in Calcutta) were scenes of feverish activity. The aviation engineers (airborne), brought in by glider with the first troops, did an outstanding job in preparing the strips for the C-47s.

Among the new techniques and tactics developed by Major Gen. Davidson's Tenth Air Force were the low-level, shallow dive attacks on bridges by B-25s of the 490th Medium Bombardment Squadron (Burma Bridge Busters), which ran their score to 100 by November, 1944, including many blasted over again, when the Japs had repaired

them to the point of renewed serviceability. P-51s and B-25s, equipped with three-tube rocket launchers under each wing, used the 4.5 inch rocket with devastating effect in the Burma theater. During one short period four Mustangs equipped to carry six rockets each, turned in the following score: Firing a total of 290 rounds, they destroyed six large warehouses, 12 medium warehouses, one foundry, four locomotives, 10 Japanese aircraft, two river boats, four native shacks, four trucks and one medium-sized building, besides damage to several items in each of the above categories. Fire bombs improvised by a mixture of thickened oil and gasoline in drop tanks were skip-bombed by fast, low flying Mustangs with great effect on many occasions, this being one of the factors in the final clean-up of Myitkyina town.

Gen. Arnold, in his report early in 1945, gave this dramatic account of the India-Burma operations: "The mission of Admiral Mountbatten, Supreme Allied Commander, South East Asia Com-



U. S. Army Air Forces photo

#### CUTTING A JAP SUPPLY LINE

When our Fourteenth Air Force in China bombed out the middle span of this bridge at Ha Trung, French Indo-China, it cut the vital Jap railway running north from Saigon into China.

mand, was to protect, develop and expand air and land communications between India and China, and to make whatever progress was possible with the limited resources at his disposal toward clearing the Japanese out of Burma. To carry out this mission, air supremacy over Burma was essential, and to this end all RAF and AAF combat units on the Burma front were formed into the Eastern Air Command under Gen. Stratemyer. The Eastern Air Command's counter-air force measures were successful. By early Spring, the Japanese were avoiding air combat. Their offensive raids against our ground forces and transports flying the Hump route practically ceased. Today the character of the Japanese air effort in Burma continues to be sporadic, reluctant and ineffectual.

"In ground operations, however, the Japanese by no means relinquished the initiative they had possessed since early in 1942. Allied plans for advances into Central and Northern Burma were opposed by Japanese plans for an invasion of India. The result was a series of fiercely fought campaigns.

"In February, 1944, a Japanese offensive enveloped the Indian Seventh Division in the Arakan. A year earlier, a similar maneuver had turned an Allied offensive into a retreat to reestablish ground communications. This time the decision was made to stand and fight. Our Tenth Air Force Troop Carrier squadrons, led by Brig. Gen. William D. Old, and strengthened by planes of the Air Transport Command, established an air line of supply for the Seventh Division of Lt. Gen. Slim's Army. Wounded were brought out by air. The Seventh fought its way clear, and the campaign which had threatened India itself ended with the lines stabilized.

"The accomplishments of the First Air Commando Group, under Col. Philip G. Cochran, represent one of the spectacular operations of the war. To disrupt the Japanese lines threatening Gen. Stilwell's North Burma operations, commando transports towed gliders, loaded with airborne engineers and equipment, and infantry, more than 150 miles behind the Japanese lines. On the night of March 5, 1944, the gliders landed at "Broadway", a clearing in the jungle, carrying 539 personnel, three mules and 29,000 pounds of stores. In 24 hours the engineers had built a strip on which transports were able to land with cargoes of troops, supplies and pack animals. Other trips behind the Japanese lines soon were made regularly for a period of two months. At the same time, long-range penetration groups, also supplied by air, slashed at the Japanese communication lines. The Japanese airfields in the Mandalay area were kept under continuous attack.

"The second Japanese offensive of 1944 came in the Spring when they crossed the Chindwin in force, took Tiddim and surrounded elements of the Fourteenth Army at Imphal and Kohima. As in the Arakan, traditional staff tactics again called for a retreat, but again it was decided to fight it out. The Eastern Air Command kept approxi-

mately 200,000 troops supplied with food, ammunition and equipment. In 758 sorties, transports flew an entire division, complete with pack animals, from the Arakan into Imphal. During the 80 days that Imphal was cut off, 28,120 tons of supplies and 61,000 men were flown in. The Japanese offensive was turned by the ground-air combination into a retreat, with three of their divisions virtually annihilated.

"In the highly important capture of the Myitkyina air field, Major (then Brigadier) Gen. Merrill's Marauders were supplied by air. A few hours after the Myitkyina strip had been captured, troop carrier planes were towing in gliders filled with Aviation Engineers and their specialized equipment. Within five hours, using miniature bulldozers and graders, the engineers had the field in shape for use by heavy transports. During this operation and for weeks later, the field was under constant fire from Japanese snipers, machine guns and light artillery. Nevertheless, the Myitkyina strip became one of the busiest in the world. From May through October the air lift into North Burma by Major Gen. Davidson's Tenth Air Force totaled 98,823 tons. More than 75,000 men were flown in and over 10,000 casualties evacuated. While engaged in these operations, the Tenth Air Force also supplied air cooperation to Gen. Stilwell's forces, the British 36th Division and various Chinese units. Converted B-24's of the Seventh Bombardment Group also flew more than 1,500,000 gallons of aviation fuel from India to the gas-hungry Fourteenth Air Force."

During 1944 the Fourteenth Air Force, under the dynamic leadership of Major Gen. Claire Chennault maintained the defense of the India-China transport routes and their China terminals, and cooperated with the Chinese ground armies within the established areas of the Fourteenth's operations. That included destruction of hostile aircraft, river shipping and installations. A third mission, and one of its most effective types of operation, was crippling of the Japanese military effort by continuous attacks against shipping in the South China Sea. Because of the terrific supply problem, the Fourteenth still was a comparatively small air force, and its operations were conducted in the face of obstacles that strained to the utmost the courage and endurance of the officers and men of the Flying Tigers, a name re-adopted in memory of an epic of air resistance in China and Burma during the early months when the Allied cause was at a low ebb on all fronts. These obstacles included Chinese weather with its long rainy seasons; the uneven terrain, over which the few air bases were widely scattered; sole dependence upon air-flown supply; lack of U. S. ground forces; and the constant threat of an enemy almost ceaselessly on the offensive, pressing in from all sides. Despite these handicaps the Fourteenth Air Force steadily carried on blasting of Jap shipping and lines of communication. Its cooperation with the harassed Chinese armies, armies almost wholly without artillery and tanks, and extremely deficient in mortars and automatic weapons of all categories,



was a powerful factor in bolstering the morale of the Chinese people. As far as possible the deficiencies were supplied with firepower from airplanes. The relatively low firepower of the Chinese troops was supplemented with what amounted to flying machine gun companies and air artillery, through use of fighters, fighter-bombers and medium bombers, armed with machine guns, aircraft cannon, rockets and bombs. Aircraft used in this way included the P-40, now well into its fourth year in this theater, the P-51, P-47, and the twin-engine P-38, used as a fighter-bomber and long-range reconnaissance plane; also the B-25 Mitchell, veteran in the CBI theater since the summer of 1942, in the early days of Chennault's China Air Task Force.

Operations of the Fourteenth were on three main fronts. The first of these was in the northern Honan Province, along the Yellow River, and although the heavy fighting of the Spring of 1944 quieted down after the Japs had more or less consolidated their positions along the Peking-Hankow railway line, Gen. Chennault's flyers continued to hammer important targets in that area. For example, during one week in December, 1944, a squadron of Mustangs carrying 500-pound bombs attacked airfields in Tsinan, Shantung Province, North China; smashing up more than 65 Jap fighters and bombers. A day or two later another fighter group destroyed 60 enemy planes at Hankow, largest enemy base in Central China.

Then there was the Hunan front, with its recently abandoned string of bases on the Hankow-Canton railway, Changsha, Hengyang, and Lingling, followed by Kweilin, Tanchuk and Liuchow. During the enemy advance through the great rice bowl of Hunan Province, "which started from the Tung Ting Lake region in May, the Fourteenth played a vital role in hampering the Jap armies. Enemy soldiers and their pack animals were hit in and near the battle lines, while supply centers, airfields, motor convoys and river transport were bombed and strafed. In a representative period on this front the figures on air action in support of the hard-pressed Chinese armies were impressive. From July 1 to August 15, the Fourteenth Air Force made more than 10,000 sorties, dropped nearly 4,000,000 pounds of bombs and sprayed nearly two and one-half million rounds of .50-cal. ammunition into Japanese positions, close-packed columns of infantry, cavalry, troop-laden river transports and supply craft. In a single day in September sorties from one wing of the Fourteenth reported killing more than 1,000 Japanese troops, 600 horses, and the destruction of numerous trucks and river craft.

The third main front was West China, from Kunming to the Burma Road. This front was the scene of important victories by the Chinese armies, which were on the offensive for most of 1944 against continually reinforced Japanese positions along the Salween River. These victories included the capture of Tengchung and strongly fortified Lungling on the old Burma Road. With the final seizure of Wan-

ting, the link with Gen. Stilwell's Chinese forces was completed, and within a few weeks the trucks started rolling along the entire course of the Stilwell-Burma Roads to Yunnan Province. This western Wing of the Fourteenth played a most vital part in these victories which reopened a land route to long-blockaded China.

However, cooperation with the Chinese ground troops was not the only task of the Fourteenth Air Force. Within the limitation of available gasoline and bombs, strategic bombing missions were carried on throughout China, and over the China seas. Devastating attacks were made on important Japanese bases in Formosa, Hainan and Indo-China. However, the heaviest and most telling blows of all resulted from unceasing attacks on enemy shipping, the most vulnerable part of the Japanese military organization. Altogether the Fourteenth Air Force had sunk, probably sunk or heavily damaged more than a million tons of Japanese shipping, of which over one-half were confirmed sinkings. In actual number of ships sunk, the Fourteenth probably piled up a greater score than any other organization. Squeezed between Formosa and the China coast, Jap shipping routes were attacked repeatedly from the West by Gen. Chennault's Liberators and



#### IN THE BURMA CAMPAIGN

A busy crew services a Piper liaison plane in a jungle repair shop.

Mitchells, driving coastal shipping into the area of deep sea submarine operations. The work of a special B-24 outfit, using electronic devices for low altitude bombing through the overcast, was noteworthy.

After the Fourteenth Air Force bases were pushed further inland and those in Southeastern China cut off, the operations against shipping became more difficult. However Navy carrier-based planes and AAF planes based on Luzon joined our submarines in attacking from the East and South, so the squeeze play went on. The South China Sea became an American lake, and the Japanese empire to the south was practically cut off. The Fourteenth Air Force was now in a position to leave the anti-shipping campaign very largely to other forces and devote itself almost entirely to the vital job of harassing the Jap armies on the mainland.

The bombing of Japan by Boeing B-29 Superfortresses on June 15, 1944, marked a major development in aerial warfare which was destined to play a leading role in defeating the Jap. The Twentieth Air Force had been created to have jurisdiction over all combat operations of the B-29. It was operated directly under control of the Joint Chiefs of Staff, and was commanded personally by Gen. Arnold. Brig. Gen. Haywood S. Hansell, Jr. was its first Chief of Staff. Brig. Gen. Lauris Norstad succeeded him. Gen. George C. Marshall, U. S. Army Chief of Staff, declared the long-range bomber introduced a "new type of offensive against our enemy" and created a "new problem in the application of military force." He stated: "Because of the enormous range and heavy bomb loads of these Superfortresses they can strike from many and remote bases at a single objective. The power of these new bombers is so great that the Joint Chiefs of Staff felt that it would be uneconomical to confine the Superfortress organization to a single theater. These bombers, therefore, will remain under the centralized control of the Joint Chiefs of Staff, with a single commander, Gen. Arnold, acting as their agent in directing their bombing operations throughout the world. The planes will be treated as major task forces in the same manner as naval task forces are directed against specific objectives."

Gen. Arnold paid tribute to our planners and engineers, coupled with the capacity of American industry, as "an unbeatable combination" and said that the advent of the B-29 made possible a softening-up attack on Japan very much earlier than would be possible with aircraft hitherto known to combat. "The Superfortress", he said, "is not going to win the war by itself nor has anyone thought that it will do so. It will, however, like its predecessors, the B-17 and B-24, strike at the sources of enemy strength and prepare the way for ultimate decision by our well established team of land, sea and air forces."

The effectiveness of the first eight months of B-29 operations against Japan was described by Gen. Norstad on February 12, 1945. He said that the Japanese were partly dismantling some of their larg-

est aircraft factories in an effort to scatter production facilities for greater protection against attacks by Superfortresses which were approaching the scale of the mass assaults that wrought such heavy damage on Germany's war industries. He pointed out that in 26 attacks on the Japanese homeland since the Twentieth Air Force made its first raid on June 15, 1944, the Superfortresses had reduced production substantially at three factories that produced an estimated 75 to 80 per cent of all Japanese aircraft engines. Factories heavily hit had been the big Omura plant on the island of Kyushu; the Musashino Nakajima plant outside Tokyo; the Nakajima plant northwest of Tokyo at Ota; the Kawasaki plant at Kobe (very heavily damaged), and the sprawling Mitsubishi plant at Nagoya, largest aircraft factory in the world. Gen. Norstad said that the Japanese had begun their efforts at dismantling and dispersing their large aircraft and engine factories at a later stage of the game than the Germans.

More than 200 Superfortresses flew over Japan in a single mission, from bases on Saipan, Tinian and Guam. These bases, how-



U. S. Army Air Forces photo

#### WE CATCH THE JAPS AT HONG KONG

The Japanese thought our East China air bases had been destroyed, and they moved their shipping to Hong Kong to escape our Navy task forces. Here our Fourteenth Air Force bombed their ships and docks.

ever, were more than 1,500 miles from the target. About halfway between lay the Volcano and Bonin island groups. On one of the islands, Iwo Jima, the Japs had two airfields from which their fighters could rise to intercept our Superfortress operations. When the U. S. Marines went ashore on Iwo in February, 1945, it was to destroy that Jap interception and give us, either there or nearby, staging areas for the Superfortresses and a base from which our fighter planes could escort our bombers over Japan.

To decentralize the command functions over the four continental air forces and the First Troop Carrier Command, a new Headquarters, Continental Air Forces, was activated late in 1944. It was to be responsible for the air defense of the United States, for joint air-ground training, and for the organization, reorganization and training of service and combat units and crews, and their preparation for deployment overseas. Its base was to be at Andrews Field, Camp Springs, Md. Andrews Field was named for Lt. Gen. Frank M. Andrews, first commander of the GHQ Air Force.



U. S. Army Air Forces photo

#### OUR SUPERFORTRESSES HIT JAPAN

Yawata, the "Pittsburgh of Japan" burns under the third attack by our Twentieth Air Force on the largest steel works in Japan.

## CHAPTER III

### U. S. NAVAL AVIATION

How Navy Air Power Helped to Roll Back the Jap—A Major Factor in Our Pacific Victories—Coordinated Surface and Air Arms Destroy Enemy at Every Turn—Extraordinary Achievements of Fast Carrier Task Forces—The Strength of Naval Aviation—Maintenance of Supply Lines—Incredible Heroism of Navy Airmen—The U. S. Coast Guard.

**T**HE aviation forces of the United States Navy in 1944 played a dominating part in rolling back Japan's once-arrogant legions of conquest nearly 1,900 miles westward across the Pacific, from Tarawa and Makin to the Marianas, and 1,600 miles northward and westward from the jungles of New Britain to the Philippines. At the beginning of 1944, the United Nations had a scant foothold in the Pacific—control of the Solomons and the small Gilbert Island of Betio on the Tarawa atoll. Early 1945 presented a heartening picture of the enemy forced back inside a defensive arc from the Kuriles to Manila, 2,800 miles in length. Back of the Allies' forward bases lay supply lines 6,000 miles long. No military operation ever embraced so much of the earth. The task still to be accomplished, despite the gigantic strides already made, was tremendous. Every item of supply, from the match for the pilot's cigarette to the huge bomb he would drop on Tokyo had to be transported over those 6,000 miles, a logistical problem defying the imagination, yet one which was being met and solved daily. Even in this supply task Naval aviation played a memorable part, with its hundreds of huge transport planes hauling thousands of tons of vital freight and passengers to the fighting fronts.

The Navy received 30,000 planes in 1944, and at the beginning of 1945, its plane strength was 37,000, while 29,000 planes were scheduled for delivery during the next 12 months. A total of 105 Navy carriers had been identified as having been in action.

Our Navy and Marine Corps airmen made about 144,800 combat sorties against the Japs in 1944. They dropped about 50,000 tons of bombs, as compared to 12,000 tons in 1943. They shot from the air or destroyed on the ground a total of 6,473 Jap planes in 1944, while losing 1,147 of their own, a ratio of 5.7 to one in the Navy's favor. During our three years of war our Navy and Marine Corps airmen shot down or destroyed on the ground a total of 9,819 Jap planes against our losses of 1,882—a ratio of 5.2 to one in our favor. Mean-



U. S. Navy Photo

#### CURTISS HELLDIVERS OVER BONIN ISLANDS

Rising over the smoking ruins of four ships they have just bombed at Haha Jima in the Bonin Islands, 600 miles from Tokyo, six deadly Curtiss Helldivers of a Pacific Fleet Task Force re-form to return to their carrier.

while, Naval aviation increased its effectiveness month by month, sinking countless Jap ships, knocking out vital installations, pounding the Nipponese all the way across the Pacific to the Asiatic mainland. It softened them for our landing operations on one island after another during our implacable progress toward Japan, all the way to Iwo Jima in February, 1945. At the same time devastating low level bombing attacks were made on Tokyo by planes from one of our fast carrier task forces commanded by Vice Adm. Marc A. Mitscher. These operations were of the greatest importance to our overall campaign in the Pacific, and they were of dire portent to the Japs because they helped to speed the descent of their setting sun.

In their first raid on Tokyo, February 16 and 17, the Navy squadrons destroyed 509 enemy planes and damaged 150; and sank 14 ships and damaged 22 more. That, besides the destruction to war plants and military installations, was accomplished at a cost of 49 American planes. In the second strike on February 25, our Navy airmen destroyed 158 Jap planes and damaged 75 at a loss of nine American machines. Between December 1, 1944, and February 26, 1945, carrier-based planes of our Third and Fifth Fleets destroyed 1,610 enemy planes and sank 187 Japanese vessels of all types, besides damaging 1,078 planes and 402 ships. Our losses were 178 planes and no naval vessels.

The decisive victories and other notable successes of Naval aviation may be attributed to the remarkable degree of coordination established between the land, sea and air forces under the leadership of

Adm. Ernest J. King, Chief of Naval Operations, and Adm. Chester W. Nimitz, Commander in Chief of the Pacific Ocean Areas. They used their ships and planes and their land-based forces as a single team; and in the many campaigns in which the Navy cooperated with the Army, all forces under the American flag worked as a team. It was this teamwork that won the victories.

Naval aviation participated in all the pivotal actions on the Pacific during 1944. The first and second battles in Philippines waters, the latter known officially as the Battle of Leyte Gulf, might not have been so disastrous for the Japs had not our aviators played their great part in driving Nippon's air forces from the skies, pinned down the enemy's submarines, smashed his supply lines and neutralized all his air bases within effective range of the Marianas and Philippines which we occupied. The Japs were aware of the strategic importance of these battles, and for that reason they did their best on the sea and



U. S. Navy photo

#### A HELLCAT POISED FOR ATTACK

A Grumman Hellcat is ready for take-off from a Navy carrier in the far Pacific. The rapid change of air pressure and consequent drop in temperature create the moisture halos in the path of the propeller tips.





U. S. Navy photo

#### OUR NEW AIRSTRIP IN THE MARSHALLS

On a battlefield blasted into jagged craters from our air and sea bombardment when we took the Marshalls, Navy Seabees and Army Engineers created this field for our aircraft.

in the air, to drive us off. These were the only occasions during 1944 when they risked their dwindling naval strength; and on both, our Naval aviation inflicted blows from which the Jap probably never could recover completely. In the Battle of the Philippines Sea, Navy airmen shot down over 400 Jap planes in one day as the enemy tried to dislodge Allied forces from Saipan. This is believed to be the largest number of enemy aircraft shot down on any single day in any theater of the war. The following day, the Navy's Fast Carrier Task Force caught the Jap fleet from which these planes had been launched and punished it severely, sinking two aircraft carriers and possibly another. Thereafter Allied forces had aerial supremacy in the Marianas. Within five months, Army B-29 Superfortress bombers were striking the Japanese homeland from bases constructed on Saipan.

In the Battle of Leyte Gulf, fought on October 24, 25 and 26, the enemy made even more desperate attempts to stop the Allied onslaught. The end of that battle saw Japan reduced to a fifth-rate naval power; and it permitted the invasion of Luzon as the new year began. The enemy lost two battleships, four aircraft carriers, six

heavy cruisers, three light cruisers, three small cruisers or large destroyers and six destroyers—all definitely sunk. American losses were comparatively light, including a medium and two light carriers. This furious action brought into play all the long-practised coordination between the surface and air forces of the Navy. The four Jap carriers were destroyed largely by air attack. Navy pilots played a part in sinking most of the other Jap vessels.

During 1944 our surface ships and Navy and Marine Corps aircraft sank, in all, two battleships, five carriers, seven heavy cruisers, over 300 cargo ships and transports and about 200 other vessels. They destroyed 6,650 enemy aircraft in the Pacific Ocean areas, bringing to nearly 10,000 the number of Jap planes knocked out of the war since Pearl Harbor. About 1,700 Navy planes were lost because of enemy action up to the beginning of 1945.

One of the most influential, but unpublicized, factors in the course of the war in 1944 were the Navy's land-based air forces. As the Allies moved across the Pacific, they drew after them and flung out before them a fine mesh of air blockade and search. By this block-



U. S. Navy photo

#### VOUGHT CORSAIRS IN THE PACIFIC

Bomb-carrying Navy Corsairs warming up at a mid-Pacific airstrip for a strike against the Japs.

ade, a quarter of a million enemy troops on by-passed holdings were rendered militarily helpless, or dead. By the search, reaching out 1,000 miles ahead of the fleet, the Fast Carrier Task Force could probe deeper into Jap territory without fear of surprise. Such names as Truk and Rabaul, Jap bastions discussed in awed whispers by airmen in 1943, were only names on New Year's Day, 1945. They were still dangerous, but only if one drew near enough to them to fall within range of anti-aircraft. No Jap airplane arose to defend Rabaul after February 19, 1944.

The Fast Carrier Task Force, carefully conceived and brought to a highly-effective state of organization over a two-year period by the Navy's high command, reached a peak of devastating power in 1944, as the Navy acquired sufficient strength in ships, planes and men to render this force entirely mobile, without other responsibility than to destroy the enemy wherever it might find him. The carrier task force became the irresistible tackle of the gridiron, smashing wagon-width holes in the enemy's line for the backfield to surge through. Operating first within the Fifth Fleet, under Admirals R. R. A. Spruance and Marc Mitscher, and then within the Third Fleet, under Admirals William F. Halsey and John S. McCain, this force became the enemy's greatest nemesis of 1944. In early 1945, under Vice Adm. McCain, who had left his desk as first Deputy Chief of Naval Operations (Air), the carrier task force had in three months destroyed more than 1,500 Jap aircraft, in addition to sinking scores of enemy ships.

Outstanding tactical achievement of the carrier task force was its demonstrated ability to sustain its attacks over long periods of time. In contrast to the early days of the war, when the carriers struck a target for a day or two and then retired to port to re-arm, refuel and provision, our carrier forces in 1944 remained in active contact with the enemy for periods of from one to three months. At Saipan, after clearing out enemy air, providing pre-invasion bombardment and close support for the landing forces, the carrier task force remained in the area for more than a month to provide air cover for the island. In the Philippines campaign, the carriers were active from early October, before the invasion, and remained in the area until well into 1945, refueling, re-arming and provisioning at sea. In effect, this provided scores of air bases for the landing forces until land strips could be constructed, or as long as they were needed.

The operations at Palau, Hollandia, Nansei Shoto and Formosa were conducted more than 1,500 miles from any possible source of supply. Without these carrier forces the advance of the United Nations would have reached no further in 1944 than the Central Pacific. The carrier task force was the latest development of surface and air power combined. Time after time, as at Truk in February, 1944, and in the Philippines in October, warships finished off enemy units damaged and slowed by bombing, and vice versa.

The work of the carrier forces had a vital part in our Pacific victories throughout 1944. In February, 1944, the Marshalls were taken. Beginning with an attack on Palau on March 30 and 31, and on Ulithi and Yap on April 1, there followed a series of operations by fast carrier task forces in support of Gen. Douglas MacArthur's campaign. In the Palau operations, 110 enemy planes were shot down, 160 were destroyed on the ground, and 27 ships were sunk. Specially-trained pilots dropped mines denying the use of the Palau harbors to the Japanese during the critical period of operations off the New Guinea coast.

From April 21 to 24, a fast carrier task force supported the landings at Hollandia and in the Tanamerah Bay area of New Guinea. Ground installations were blasted and Gen. MacArthur's troops were effectively supported. As a diversion, a combined British-American task force, including carriers of both navies, struck at Sabang in Su-



U. S. Navy Photo

#### THE NAVY BOMBS WAKE ISLAND

Navy Curtiss Helldiver dive bombers shattered Jap installations on Wake Island in support of the Hollandia invasion by our Army forces on April 22, 1944.

matra on April 19, 1944. The same force also raided Surabaya in Java on May 18, at the time that Southwest Pacific forces were landing at Wadke, New Guinea. The carrier forces that supported the Hollandia landing took opportunity on the return to base to strike at Truk, Ponape and Satawan. On April 29 and 30, 65 enemy planes were shot down and 84 blasted on the ground. Nine ships were sunk. Hangars, radio station, oil tanks, supply dumps and other installations were levelled.

Then the fast carrier forces began preparation for the Marianas invasion. Carriers with air groups which lacked combat experience conducted raids on Marcus Island on May 19-20 and on Wake May 24. Early in June units of the greatest striking force so far assembled sortied from Central Pacific bases for the attack on the Marianas. Operations began with a fighter sweep on June 11. From that date until August 11, carrier planes operated continuously over an area ranging from the Bonins to Palau, from the gateway to Tokyo to the front door of the Philippines. On June 19-20 occurred the Battle of the Philippines Sea, already described. Because the second day's attack was made late in the day at extreme range, the return was made over long distances in the dark. Many planes were forced to land in the water beside or near the fleet.

The complexity of landing hundreds of planes, nearly out of gas, aboard carriers at night brought about some of the most dramatic incidents of the war. The climax came when the command ordered the fleet to illuminate, so that the aviators might be saved, whatever the consequences. The surrounding waters were infested with Jap submarines, but the value of American lives which otherwise certainly would be lost, justified the risk of illuminating. The brilliant rays of searchlights went up from scores of warships, and flares and star shells were fired, so that the airmen could get back aboard or make successful water landings. While 106 planes were lost, personnel losses were held below 40, due to heroic rescue efforts by submarines, destroyers and rescue aircraft.

For 13 days, the carrier force operated at full strength 1,000 miles from the nearest American-held territory. When the Jap fleet withdrew, and captured Saipan airfields became operable, it was possible to return the carriers to their bases for rest and replenishment. In July, the full carrier force was reassembled for the attacks on Guam and Tinian. During this phase of the Marianas campaign, the fast carrier task forces engaged in extensive neutralization and diversionary attacks ranging from Palau, Ulithi and Yap in the Western Carolines (July 26, 27) to the Bonin and Volcano Islands (August 4). Successful conclusion of the South Pacific campaign permitted rearrangement of fleet units, including the carrier task forces. The famous Third Fleet, under Adm. Halsey, was transferred to the Central Pacific, and the Seventh Fleet, was augmented and assigned to support of

Gen. MacArthur under Vice Adm. T. C. Kinkaid. By the end of August, this reorganization was complete, permitting a series of operations which culminated in our invasion of the Philippines.

That campaign opened with raids on the Bonins between August 31 and September 2. From September 6 on, planes from a fast carrier task force operating with the Third Fleet struck both at Palau and the Philippines, indicating that, just as the South and Southwest Pacific offensives had merged in 1943, so now the Central and Southwest Pacific operations were converging on a single objective. These raids led up to landings on September 15 on Morotai Island off Halmahera and on Peleliu and Anguar Islands of the Palau group. Between September 6 and 24, 75 enemy planes were shot down and 88 destroyed on the ground. At roughly the same time, carrier planes sank 201 enemy ships in the Philippines, in addition to 52 probably sunk. While most of this shipping was small, the noose was being drawn in-



U. S. Navy photo

#### ARMY, NAVY AND MARINES BOMBARD ROI

No less than 10 fires are raging here on Roi Island in the Kwajalein group. They were set by our surface and aerial bombardment prior to our invasion early in 1944.

exorably tighter around the Jap supply lines when he already was hard-pressed to supply his far-flung forces.

The Halmahera and Palau operations were preliminaries to landings on Leyte, in the central Philippines on October 20. The usual savage attacks by Naval airmen preceded the landings. On October 20, the Ryukyu Islands, only 300 miles from the Jap home island of Kyushu, were hit. During the next five days, the enemy lost 357 planes in the air and 366 on the ground, in addition to 46 ships. But as the Navy flyers probed ever deeper into Jap territory, the opposition became more intense, as expected. Seventy-one planes were lost in combat. The objective was gained, however. The enemy was swept from the air, his shipping supply lines were throttled, and his ground installations were so battered as to interfere seriously with his ability to stage warplanes into the Philippines during the critical stages of the Leyte landings.

Although close air cover over Allied amphibious forces was provided by escort carriers attached to the Seventh Fleet, the airmen from the larger carriers kept Northern Luzon neutralized and aided in the greatest air-sea engagement in history from October 24 through 26, 1944. Of the total losses suffered by the enemy in this now historic Battle of the Leyte Gulf, planes from the Essex and Independence class flattops accounted for four Jap carriers, a seaplane carrier, two light cruisers and many destroyers. Some of these units were finally polished off by ship's gunfire after being rendered helpless by our airmen. During the period October 15 to 27, planes from the fast carrier task force shot down 494 enemy planes and demolished 154 on the ground.

From our air power viewpoint, the Marianas and Philippines campaigns were highly significant. While they did not entirely destroy enemy ship-based aviation, they did inflict losses in planes, ships and highly-trained personnel that would require a long time to replace, even if our attacks had not continued, as they did, ceaselessly.

Securing of Leyte and, subsequently, many other smaller Philippine islands on the road to Manila, did not lessen the activity of our carrier forces. As 1945 opened, strikes were made on Manila's strategic Clark and Nichols airfields, from which a handful of heroic American flyers had opposed Japanese conquest of the Philippine capital in early 1942. The harbor of Manila was turned into a graveyard for Jap shipping. Air supremacy over Luzon was established, which the Jap air force was kept from reinforcing by repeated neutralizing raids on Formosa and other staging points toward the homeland. On January 9, 1945, our amphibious forces struck again, this time going ashore in Lingayen Gulf, where the Jap aggressor had landed three years previously. Navy and Marine aviators afforded close support to the landing parties. Allied forces began the march on Manila under Gen. MacArthur.

From carrier decks roared into enemy skies the Navy's "first team"—the Grumman Hellcat fighter, Curtiss Helldiver dive bomber and Grumman Avenger torpedo bomber. Early in 1945, the Vought Corsair fighter, which had a fine record of land-based operations, was added to the carrier complements. The Helldiver came into its own during the year, replacing the valiant Douglas Dauntless dive bomber



U. S. Navy photo

#### THE NAVY BLASTS PALAU

Columns of smoke rise from Jap vessels, docks and military installations as one of our Navy task forces give Palau an aerial blasting on March 29, 1944.



which had wrought such havoc on Jap fleet forces during the first two years of war, and which still was carrying on from land bases.

The organization of the fast carrier task force would have been impossible without the great development of the escort carrier. Although big carriers participated in all the major landings, they had not been, because of the escort carrier, tied down to the amphibious force; nor had they been forced to divert their striking power to protect the transports, landing craft, bombardment ships and other vessels that accompanied our invasion forces. The escort carriers, constructed from oiler or merchant hulls, supplied planes for these routine functions. They also supplied a reserve of aircraft which could be added to those of the fast carrier force in combatting major enemy thrusts, as in the Marianas on June 19 and in Leyte Gulf from October 24 to 26.

During the latter engagement, a small group of escort carriers with a few destroyers and destroyer escorts were attacked and thunderously shelled by one of the three major Jap fleet forces which sought to attack the landing forces off Leyte. Although two escorts were sunk by air and surface attack, and several others heavily damaged, aircraft from these little vessels helped mightily in assuring that not one of the attacking battleships, cruisers and other warships would fight again for many months, if ever. While the carrier and destroyer gun crews heroically and defiantly traded punches with the Jap's overpowering 12, 14 and 16-inch rifles, their own five-inchers looking like peashooters in comparison, the Avengers and Hellcats tore into the enemy, bombing, torpedoing, strafing. Long after their ammunition was expended, these gallant, couldn't-be-beaten airmen were still making "dry" runs on the enemy ships, forcing them to take evasive, maneuvering action, which delayed them, and thus aided our little escorts in their fight against the most terrific odds ever stacked in a sea battle.

In the Philippines campaign between October 12 and 29, 1944, aircraft from our escort carriers destroyed 170 enemy planes in the air, and 117 on the ground. In addition, they sank one light and two heavy cruisers, probably sank another heavy cruiser, and damaged five battleships, three heavy cruisers, one light cruiser, one destroyer and 63 other vessels. During this brief period, over 2,000 sorties were flown and 135 tons of bombs, in addition to rockets and torpedoes, expended. Losses, while substantial, could not be considered excessive in view of the fact that these carriers had engaged in an action for which they were not designed. In addition to our Saint Lo and Gambier Bay sunk, 162 planes and 39 pilots and aircrewmen were lost. The escort carriers made it possible to turn the fast carrier task forces loose to prowl after Japan's holdings and forces. Without them, our big carriers would have had to stay close to the landing forces and would have lost much of their versatility and range of action.

Earlier, the escort carriers proved their complete capability at their intended tasks—convoying and ferrying. Just as they took Curtiss Warhawks to Africa in 1942, so did they carry Republic Thunderbolts to the Marianas and Philippines in 1944 for the Army. Meanwhile, thousands of Navy planes were speeded across the Pacific to replace losses and obsolescence on the big carriers. Their ferrying function became so important that a separate command, named the Carrier Transport Squadron, Pacific, was created. It kept the Navy's air forces fully equipped with personnel and aircraft in the far corners of the world. Many other escort carriers continued to protect United Nations shipping throughout the world. Not an important convoy moved without their air cover. Their achievements were not only the submarines sunk, which was a substantial number, but in the number of attacks they prevented. One escort, the Block Island, was lost in this work in May, 1944.

Our land based Navy airmen cooperated closely with the escort carriers in keeping the submarine menace controlled. Off United



U. S. Navy photo

#### THE GRUMMAN AVENGER

A Navy Grumman torpedo bomber warms up for a take-off from its carrier in the North Atlantic.

States coasts, in the Caribbean, off South America, in the waters of the Atlantic from Nova Scotia and Newfoundland to Iceland and England, in the Mediterranean, off the North African coast, from the islands of the Pacific and Australia, Navy planes and blimps patrolled constantly. This was tedious but important work. A squadron in two years of patrols made only two attacks, one of which resulted in damage to an enemy submarine, the other in destruction of a whale.

The new Consolidated Vultee Privateer, a four-engine search land plane, with a 1,500 miles cruising radius took the place of the 1,000-mile Liberator. The Liberator (PB4Y) in 1944 carried out many thousands of search and reconnaissance missions, ever seeking out and finding enemy forces, constantly guarding advancing task forces against detection by enemy search planes. One amphibious operation, the landings at Biak in New Guinea, undertaken by strategic necessity without benefit of strong fleet protection, was completely successful because the search planes kept any enemy scout from coming within visual distance of the transports and landing craft. The successes attained by these land plane squadrons, introduced for the first time on a large scale in 1944, won for many of them the prized Presidential Unit Citation. While search and reconnaissance were their primary missions, targets of opportunity were bombed with telling effect. A single land based Central Pacific squadron destroyed 43 and damaged 91 Jap vessels over a period of nine months. It was a PB4Y which flew the first reconnaissance mission over Truk, bringing back the information that the harbor there was full of enemy shipping, the signal which activated the first task force raid on that boasted bastion of Japan.

Far to the northward, flying from our Aleutian bases, another naval aircraft had a great year. The Lockheed PV Ventura, flown by naval air crews through one of the world's worst weather areas, periodically bombed and kept under reconnaissance the Jap holdings in the Kurile Islands, which reach down the Russian coast almost to the Japanese homeland. Many Ventura squadrons gained fame by remarkable flying in bad weather.

Two- and four-engine flying boats continued to carry out their patrol and rescue functions with unusual distinction throughout the year—the twin-engine Mariner and Catalina and the four-engine Coronado. The old workhorse Catalina, on duty when the war started, remained active. Painted a black, she flew silently over enemy installations and shipping at night—silent until she let loose with guns and bombs to bring eternal sleep to countless Japs. The Catalina had a long record of amazing rescues of downed airmen and others. One of the two naval aviators awarded the nation's highest decoration, the Congressional Medal of Honor, in 1944 was Lt. Nate Gordon, a Catalina pilot who landed his flying boat in Kavieng Harbor under the direct fire of Japanese shore batteries to rescue the crew of an Army

bomber which had been shot down. During the landings on Mindoro, two Catalinas picked up more than 110 survivors of a sunken warship on one trip.

Marine Corps aviators continued to make an amazing war record. Some Marine squadrons were returned to carrier operations in 1944. Trained for this work in prewar years, the diversified talents of the handful of Marine pilots available at the start of war, were devoted exclusively to defense of American land bases, and then to the bitter defense of Guadalcanal in late 1942 and early 1943. By late 1944, a sufficient number of new Marine aviators—all Marine flyers went through the same schools and courses as naval aviators—had been trained to permit staffing a number of escort carriers. By the end of the year, there were more than 10,000 Marine pilots, more than there were in the entire Navy at Pearl Harbor time. The new Marine carriers operated directly with Marine divisions in offering close support to Marine Corps amphibious operations. This was done twice by Marine pilots in 1944, although not from carriers—on April 14 at Ujelang in the Marshalls where three flyers made one of the longest sustained flights of single-engine fighter planes on record, nine hours and 40 minutes; and on September 28 when a Marine Corps fighter squadron, operating from Peleliu, taken 13 days previously, covered landings on nearby islands in the Palau group.

The chief effort of our Marine Corps pilots in 1944 was neutralizing many by-passed enemy bases—Bougainville, Rabaul, Kavieng and others in the Marshalls, Marianas and Western Carolines. With the capture of Green Island in February, enemy garrisons at Bougain-



THE PB<sub>2</sub>Y-3R CORONADO

A Consolidated Vultee Navy transport version of the PB<sub>2</sub>Y-3 four-engine patrol bomber.

ville were sealed off and Kavieng brought within range of Allied fighters. The Green Island base, together with those in the Admiralties and Emirau, seized early in April, drew a ring about remaining Japanese forces in the Bismarck Archipelago. From these bases, our Marines, aided by Army, Navy and New Zealand flyers, kept up a constant pounding that rendered enemy bases useless. At night Marine pilots in North American Mitchell medium bombers gave the Japs at Kavieng little rest.

The task of establishing and supplying bases for this work of neutralizing by-passed islands while enemy occupants starved was tremendous. For instance, one Marine Corps squadron used 200,000 pounds of bombs in seven weeks in the Marshalls. Nevertheless, the saving in time and lives which would have been spent in taking these points—weary months, possibly, hundreds of lives, certainly—compensated for the logistical difficulties encountered. To have proceeded otherwise would have been to play into Jap hands. The enemy believed their countless island airstrips constituted unsinkable aircraft carriers that would have to be captured one by one, a process they believed would have taken so long the Allies might have given up in sheer weariness. They overlooked the fact that an airfield, like a flight deck, becomes inoperable when it is full of holes. Navy and Marine flyers simply kept all the fields full of holes. When the Jap had filled nearly all the holes, our flyers went over and made new holes. In this contest, it was the enemy who wearied first, not only because his flying fields were hit again and again, but also because his repair shops, fuel installations, anti-aircraft positions and living quarters were destroyed or badly damaged. This was the latest form of an old naval tactic, the blockade.

Naval aviation in 1944 participated to some extent in every major landing in the European operations. During the Normandy landings, in June, 1944, naval aviators spotted the fire of Allied warships and flew continuous anti-submarine patrol over the western approaches to the English Channel. The fire-spotting was done by a group of battleship and cruiser pilots flying fast land based fighters, including English Spitfires. In August, when United States and French troops assaulted Southern France, planes of an Allied carrier force helped provide air cover, in addition to flying anti-submarine patrol. Sparsity of enemy air opposition resulted in Hellcat fighters with bombs and rockets ranging far up the Rhone Valley searing airfields, communications and enemy columns. To take part in the anti-submarine activity, a squadron of Goodyear blimps flew the Atlantic, a unique feat in itself.

Use of the blimp in convoy work was continued during 1944, but an increasing emphasis was placed on its utility for specialized rescue work. A spectacular achievement, which could have been performed by no other type of aircraft, took place in the South American jungles,

where in a single month, our blimps lifted 15 Army and Canadian flyers from spots otherwise inaccessible.

Allied successes in the Pacific, added to the reluctance of the Jap to commit his air force except in major engagements, combined in 1944 to bring about changes in tactics. A major development was the Navy's decision, not to decrease its use of fighters, as might have been expected, but to adapt the fighter as a major offensive weapon. Realizing the inherent advantage possessed by fighters over other types by reason of its high speed, the naval air command fitted it with bomb racks and rocket launchers, so that the striking power of bombers and torpedo planes might be enhanced. Droppable fuel tanks, easily jettisoned, were added to increase range. This step, plus the shortening distances as Allied forces closed in on Tokyo, gave the Navy a plane capable of delivering a 2,000-pound bomb load on Jap bases. The higher speed of the fighters made it possible to deliver these loads oftener in a given period than could the slower bombers. Further, because the fighters were smaller, the bomb potential was increased by adding to the carrier fighter complement while reducing the number of dive and torpedo bombers. In this way, bomb and ammunition potentials of carrier air groups were increased by more than 10 per cent early in 1945. A further advantage of this plan was the availability of the additional fighters as interceptors by the simple



#### CONSOLIDATED VULTEE PRIVATEER

The PB4Y-2, land-based patrol bomber built for the U. S. Navy. The single tail and side gun turrets distinguish it from the PB4Y-1. It was powered by four Pratt & Whitney 1,350 h.p. Wasp engines.

expedient of leaving off bombs and rockets. This fighter-bomber development, and VLB (fighter-bomber) squadrons which were organizing and training as such, resulted in a 30 per cent increase in Navy fighter requirements.

Still another reason for the success of naval aviation was the Integrated Aeronautic Plan, formulated early in 1944. It assured every aviator in the combat areas the use of new fighting planes sent out from the United States in first class condition, while planes requiring major overhaul were sent back to the States for that work and kept there for training. This was a great improvement over past procedure, and it removed one of the most vexatious problems from the Pacific forward areas where machinery and parts were difficult to obtain because of vast distances from the continent and also because at times food and other supplies had highest transportation priority.

In his report to the House Naval Affairs Committee on November 22, 1944, Rear Admiral Dewitt C. Ramsey, Chief of the Bureau of Aeronautics, described the remarkable growth of naval aviation as follows: "To keep pace with the material expansion of naval aviation, greatly increased numbers of pilots, ground crews, administrative officers, and civilian personnel were necessary to man the aeronautical establishment. At the end of August of this year there were available 47,276 pilots in the Navy and Marine Corps, or more than seven times the number in service at the time of Pearl Harbor. As of October 1, 1944, 24,336 ground officers were on duty in the aeronautical organization and 228,356 enlisted men held ratings as petty officers in the aviation branch. In addition, many thousands of enlisted personnel other than aviation rates were on duty at naval air stations and bases and on aircraft carriers and tenders. On October 1, 1944, the aeronautical organization included 2,293 officers and 16,846 enlisted personnel of the Women's Reserve, who have released large numbers of male officers and men for active sea and combat duty. At the same time the number of civilian personnel in the aeronautical organization, which stood at 5,587 in 1940, grew to 109,153 as of October 1, 1944."

The incredible deeds of heroism and others amazing achievements of Navy airmen were countless and limited only by the vast expanse of the Pacific under war conditions in all kinds of weather both day and night. An idea of the variety of performances required in naval aviation may be gained by a few examples from the thousands of records in Navy archives. Navy Patrol Squadron 11, during 20 months of duty around New Guinea, Morotai and Leyte, sank 75,000 tons of Jap shipping. They flew through all kinds of weather, through the black of night, to bomb, torpedo and strafe from their Catalina flying boats. They rescued 15 aviators from the open sea. One of their achievements was evacuation of 219 Australian officers and men and 25,000 pounds of machine guns and other gear from the Sepic River area, near Wewak. The Japs were only a few miles away when

the first Catalina landed in the winding Sepic River, only four wing spans wide, with a heavy current running and a fog down to 50 feet. Seventeen trips were made to complete the evacuation. This squadron received the highly-prized Presidential Unit Citation.

Navy Patrol Bombing Squadron 4 bombed from cargo planes. Its big, four-engine Coronado flying boats had been retired to cargo service, as a type, shortly after the start of war. But when strategic necessity for bombing Wake and Ponape arose, and there was no other equipment available at the time, Lt. Comdr. F. L. Curtis insisted that his planes were bombers. The squadron covered over 3,000,000 miles in more than 24,000 flight hours, performing every manner of task possible for flying boats, and some believed impossible. Once they took off and flew a reconnaissance mission in a 65-mile-an-hour wind. Another was a 2,400-mile night flight to bomb and neutralize enemy installations on Wake. Each Coronado carried 2,400 pounds of bombs, and every plane made the round trip successfully, one of the longest bombing missions in Navy history.

Air Group 18 flew from the deck of one of the big Essex class carriers. Its record was as outstanding as that of any Essex air group, and all had outstanding records. One was much like another, with the names of the men being different. Group 18 went through 80 action-packed days in the far Western Pacific, destroyed or damaged 557 Japanese planes and sank 69 ships. Between September 6 and November 25, 1944, Group 18 fought in the Battle of Leyte Gulf, and made strikes on Palau, Mindanao, Davao, the Visayas and Luzon, Nansei Shoto and Formosa. Led by Comdr. William E. Ellis, and Comdr. Wilson M. Coleman, the pilots of this group helped to sink a carrier, damaged three battleships and a carrier, among scores of other ships. One hundred and seventy thousand tons of Jap ships were sunk or damaged, in all. Group 18 was in the thick of the Battle of Leyte Gulf for three straight days, during which one of its fighter pilots became the Navy's second leading ace. On October 24, 1944, Lt. Cecil E. Harris was one of three pilots who spotted the huge Jap force moving through the Sibuyan Sea toward the San Bernardino Straits and the American beachhead just established on Leyte. There was the only air group in the area. Nothing daunted, the pilots attacked the Japs three times. The enemy, damaged, turned around as if to retire, whereupon 18's carrier steamed north to meet the big Jap carrier force reported steaming down from Formosa. The following night, October 25, after four Jap carriers had been sunk, the American force rushed south to intercept the Jap force hit on the 24th. This force had about-faced and slipped through the Straits and, now, further battered was seeking to flee. Group 18's pilots hit the Japs again on October 26. Harris carried a 1,000-pound bomb under his Hellcat's wing that day. He left the bomb in the vitals of one of Japan's two newest, biggest battleships, the 45,000-ton Yamato class. Both



of these monster warships, loaded with anti-aircraft protection, were in that day's battle. The *Musashi*, sister of the *Yamato*, was sunk by our Naval aircraft. Five torpedoes and many bombs settled the question of whether planes alone could sink an up-to-date, big battleship. Harris' thousand-pounder helped. But he became better known for shooting down 24 Jap planes, seven in one day over Manila.

Navy Photographic Squadron 4 was dubbed the "Shutter Bugs." Flying Liberators, they flew a total 6,400 hours on 239 sorties over heavily-fortified enemy bases without losing a single plane. Photo reconnaissance was one of the most dangerous jobs of the war. The pilots worked singly or in pairs, calmly holding their big planes steady through clouds of flak so the cameras could do their best work and the command could have clear, undistorted pictures of enemy installations on which to base attack plans. Lt. Comdr. Charles H. Clark led the "Shutter Bugs." Some of their flights over Japan covered 2,500 miles. In addition to taking pre-assault photographs of the Marianas, the squadron covered Truk, the Bonins, the Volcanos, Yap, Woleai, Ocean and Nauru, turning out as many as 93,000 pictures a month. "Fight, then photo!" often was VD4's lot. Over Iwo Jima on November 7, 1944, six of them were jumped by 10 Jap fighter planes. The crewmen calmly beat off the enemy interceptors and the important pictures were taken. One of the Liberators had 22 holes in it.

Independence-class carriers could range with the big fellows, 30 knots, sometimes faster, but they could not support nearly as many planes in their air group because of their small cruiser size. They carried no dive bombers, only fighters and torpedo bombers. Air Group 21 operated from one of these greyhounds. After four months of sizzling action, Group 21's record showed three enemy carriers and two cruisers sunk, with the help of other air groups, one battleship and two cruisers damaged. Four fighter pilots from Group 21 dived into a formation of 32 Jap planes approaching the carrier task force on October 13 off Formosa. Ten enemy planes were shot down in flames. The enemy attack was repelled. Just 48 hours later, 10 of Group 21's Hellcat pilots beat off 50 enemy planes trying to get at the Group's bomber formation which the Hellcats were escorting. Not one Jap got through; and 14 never returned home. Starting with support of the amphibious operation at Guam in August, Air Group 21 participated in strikes on Palau, the Philippines, Nansei Shoto and Formosa, and climaxed its combat duty in the Battle of Leyte Gulf. Lt. Comdr. Robert A. Kennard, skipper of Torpedo 21, led two attacks against the Jap carrier force in this battle. On one he carried a torpedo, and the second time he dropped bombs directly on a carrier. Fighting 21, led by Comdr. Vincent F. Casey, shot down 36½ enemy planes in all. Air Group 37 flew from an escort carrier. From Tarawa through Apamama, Kwajalein, Eniwetok, Aitape, Hollandia, Saipan, Guam, Morotai and Leyte, Air Group 37 fought 13 months in the

Pacific. Its most notable attack, perhaps, was on a Jap battleship force which turned its full and fearsome armament on our little carrier, its heaviest deck armament a single five-inch gun. In the air, however, its fighters and torpedo bombers put up the ship's best defense in the form of a daring offense. The fighters actually strafed battleship decks, wading through flak, until ammunition ran out. Then they flew "dry runs" to force the Jap ships to maintain evasive action while our carrier cruised out of range. Meanwhile, Group 37's torpedo squadron, under Lt. Comdr. Stanley E. Hindman, Air Group Commander, made its own record. Traveling more than 100,000 miles in its extended cruise, the group made more than 5,300 carrier landings. Its veteran torpedo pilots averaged more than 500 hours of combat flying, the fighter pilots over 400. In 10 separate amphibious operations, the Group helped to clear the enemy from 6,000,000 square miles of ocean, dropping 650,000 pounds of bombs and firing 600,000 rounds of .50 caliber ammunition.

Air Group 19, flying from an Essex-class carrier, compiled a record for teamwork. In five months of action, the group's pilots and aircrewmembers won 75 Navy Crosses, 18 Silver Stars, 147 Distinguished Flying Crosses and 100 Air Medals. As a team, 19 shot down 167 Jap planes and sank 12 warships, including two carriers and a heavy cruiser.

The carrier Essex's air groups broke nearly all records. The Essex had aboard Comdr. David McCampbell, the Navy's leading ace in 1944 and recipient of the Congressional Medal of Honor. He was commander of Air Group 15 on the Essex. Group 15 shot down 312 Jap planes and destroyed 348 on the ground, destroyed nearly 175,000 tons of enemy merchant shipping and 77,000 tons of warships includ-



U. S. Navy photo

#### GOING ASHORE ON LUZON

Landing craft sweep toward the shore of Lingayen Gulf during Gen. MacArthur's invasion of the Philippines island that led straight back to Bataan and Manila.

ing a carrier, a destroyer and a destroyer escort. These were sent to the bottom unaided by other groups. With outside help, two carriers and a heavy cruiser were sunk and a battleship and light cruiser probably sunk. Three battleships, a carrier, five heavy cruisers, three light cruisers and 19 destroyers were damaged.

In a single action, on June 18, Fighting 15's pilots shot down 67½ Jap planes, believed to be the record for a single day's operation by a carrier squadron. The record, however, of which Fighting 15 was proudest was that not a single dive bomber or torpedo plane was lost to enemy attack under its escorting cover. Torpedo 15 had its greatest day on October 24, 1944, when its Avengers put three torpedoes into one battleship, two into another, and two more into each of two heavy cruisers. The following day, the squadron scored nine torpedo hits and four bomb hits on four enemy carriers, a battleship and a heavy cruiser. All four carriers were ultimately listed as sunk. Torpedo 15's record for two days, then, was 17 confirmed hits on enemy capital ships out of 29 torpedoes dropped. Bombing 15's record was just as enviable. In their Helldivers, they got 40 hits out of 60 bombs dropped in the October 24-25-26 actions. Ten of the hits were on a Yamata class battleship, eight on a huge Shokaku class carrier, and eight on a converted battleship with a flight deck. Such was air war in the Navy.

Following Pearl Harbor, December 7, 1941, when the United States was thrust into total war, the U. S. Coast Guard went into Navy operations, but it did not lose sight of its primarily peacetime mission of saving life and property at sea. These duties were expanded, and new wartime tasks were assigned to Coast Guard Aviation, which necessitated a tremendous increase in equipment and personnel. At the beginning of 1945 it had been tripled in size. During 1944, the Coast Guard accomplished considerable research and development which would have a far-reaching effect on future aviation.

With the United States entry into the war the Coast Guard's special knowledge and experience, gained from years of service along our coastline, was welcomed into the fight against the submarine menace. The Navy assigned it the mission of assisting in fighting this peril. From December 7, 1941, until the end of 1944, the Coast Guard contributed more than 90,000 hours of anti-submarine patrol duty covering 90 million square miles of sea. At the same time hazardous rescues at sea, often under the most trying conditions, were increasing. Many armed service and merchant seamen owed their lives to the courage of Coast Guard crews who flew many miles to sea, to land on rough waters, pick up a patient, and fly him to the nearest hospital for medical attention. When the submarine activity began to lessen, particularly in 1944, the Coast Guard was able to give more thought to developing more efficient methods for saving life at sea. Two great successes resulted, that not only proved profitable for wartime rescues,

but were to have a far-reaching effect upon the tremendous growth expected in postwar aviation. These were the helicopter and the Air-Sea Rescue Agency.

The possibilities of the helicopter were recognized quickly by Coast Guard officials, and in February, 1943, it was charged with test and evaluation of this revolutionary type of aircraft. The experimental program was elaborated upon in 1944, and combined with a training program, gave the Coast Guard a large group of highly-trained helicopter pilots and mechanics. The program still was in operation in 1945, and all the various possibilities of the helicopter were being explored, both for life-saving, transportation and commercial uses. The Bureau of Medicine and Surgery and the Department of Agriculture joined in determining its use for malaria control by disseminating insecticides.



U. S. Navy photo

#### U. S. NAVY ATTACKS ASIATIC MAINLAND

Avengers from the Third Fleet wing over the coast of French Indo-China as they head back to their carrier after striking Saigon during our Navy operations in the South China Sea in January, 1945.

The Air-Sea Rescue Agency was established by the Secretary of the Navy at the request of the Joint Chiefs of Staff. It was headed by the Commandant of the Coast Guard, assisted by a board of representatives from the other armed services. The Agency studied development and design of air-sea rescue equipment and methods of air-sea rescue activities. Practical application of these studies proved effective throughout the war theaters.

The Coast Guard maintained few operating aircraft outside the continental limits of the United States. One of the largest groups was a patrol squadron based in Greenland. It flew on anti-submarine patrol and convoy escort duty, and did a great deal of rescue work. A small number of planes was based in Alaska. Coast Guard planes were instrumental in ridding Greenland of German invaders.



U. S. Coast Guard photo

#### COAST GUARD PATROL IN ALASKA

A Grumman JRF Grey Goose over a desolate area in the Far North.

## CHAPTER IV

### THE AIR TRANSPORT RECORD

Our Wartime Air Transportation System Spans the World—Enormous Shipments of Military Cargoes Across the Atlantic and the Pacific—Our Wounded Are Flown Home From All the Battle Fronts—Operations of the Army Air Transport Command, Naval Air Transport Service and the Air Lines of the United States.

**A**IR transportation broke all existing records in every branch of its far-flung activities during the climactic war year of 1944. This included not only the amazing operations of our forces in war transport, but also the flights of the commercial air lines in the United States. These domestic air carriers, while still continuing their special contract jobs for the Government, set up new all-time high marks for their commercial operations, though to be sure, the latter included carrying many passengers and much cargo and mail on war business. The 16 strictly domestic air lines of the United States flew a total of 2,264,282,443 passenger miles during 1944, an increase of 37.8 per cent, or 621,685,803 passenger miles over 1943. Route mileage in the United States reached 62,937 miles, a gain of 8,435 over 1943. The number of revenue miles flown by the domestic lines showed an increase of 37.2 per cent over 1943. The 1944 total was 142,234,837 miles, which was 38,633,394 higher than in 1943. The amount of pound miles of air mail reached a new high of 101,650,403,775, as compared with 71,650,403,775 in 1943, a gain of 41.4 per cent. The pound mileage of air express carried likewise hit a new peak. The increase over 1943 was 13 per cent. The 1944 total was 34,188,058,000, representing a gain of 3,952,208,000 over 1943. The annual gross revenue of the air lines, including passengers, mail, express, and miscellaneous items, reached a total of \$156,235,733, as compared with \$120,945,440 in 1943, an increase of 29.2 per cent.

At the same time that the carriers were building up their regular business to levels exceeding the prewar scale, they continued war transport flying directly for the Government. Nine of the lines continued operating overseas routes to all theaters of war under contracts with the Army Air Forces Air Transport Command and the Naval Air Transport Service, carrying troops, ammunition, equipment, and critical supplies, ranging in size from delicate radio parts to entire aircraft engines. These nine lines were American, Braniff, Eastern,

Northeast, Northwest, Pan American, United, Transcontinental & Western Air, and Western. A tenth, American Export, was added during 1944.

Most noteworthy developments of 1944 were mass air transportation of wounded veterans on a scale never before reached; and the shipment of whole blood (which often saves lives when plasma cannot) to distant theaters of battle.

Fourteen of the lines operated special domestic cargo routes for the Army and Navy, though these services were being taken over gradually by the military flyers. The air lines also continued to conduct many of the schools in which they taught military pilots the tricks of the trade of transport flying in big four-motor ships and over long routes. The instruction included training of other crew members, ground crews and specialists in transport operations. Another big part of the war job performed by a number of the lines directly for the Government was the operation of huge modification centers where their engineers and mechanics changed stock models of military aircraft after they came off the production line to fit them for special purposes or for use under unusual climatic conditions.

Scheduled civil routes continued primarily to serve the war effort. Passengers having priorities accounted for about 54 per cent of the traffic, including both military personnel (some members of the armed forces on leave) and civilians traveling on urgent war business. This was a relaxation from the 61 per cent priority passenger list in 1943, but did not offset the growing urge toward air travel by the general public, in spite of the policy conscientiously followed by the air carriers of discouraging rather than stimulating all except essential air travel until war demands should diminish.

The great expansion of civilian air transport during 1944 was made possible by several factors, the most direct of which was release to the lines of more planes by the Government from strictly military operations, so that by 1945, the commercial fleet of 347 transports was practically back to its prewar size. Another factor was the increasingly efficient use of equipment, with longer daily use of individual planes, speed-ups in servicing and repairs, shortcuts in airport operations, smoother handling of passengers while embarking and disembarking, and better coordination of flight schedules. For example, planes in service during 1944 were flown on an average of from 11 to 12 hours daily as compared to seven to nine hours before Pearl Harbor. In some cases they flew as many as 14 hours daily, without detriment to safe maintenance. Greater loads were made possible through saving in many cases as much as 10 per cent of the gasoline required under prewar standards of operation. This was accomplished by development of a more efficient method of operating large aircraft over long distances. For example, an airplane which would have required 2,500 gallons of gasoline for a certain flight under former conditions,

could now make the journey on 2,250 gallons. Three-quarters of a ton of load could be added because of the 10 per cent saving in gasoline.

Still another reason why the air lines were able to set up the record they did in 1944 was the high point reached by the passenger load factor. This means the actual extent to which the available seats were filled for each flight. The revenue passenger load factor for 1944 was 89.45. Even that high level was kept down by special instances, because most of the time it ran well over 90, and in the case of one major line was 96 per cent for the year. In 1935, the figure stood at less than 50 per cent.

The total number of passengers carried in 1944 was 4,668,330. This compared with 3,454,040 in 1943. The passenger revenue in 1944 was \$113,037,592. This compared with \$85,586,144 in 1943, \$73,188,025 in 1942, and \$24,335,549 in 1938. Air mail revenue in 1944 was \$32,405,766 as compared with \$23,832,100 in 1943, \$23,197,991 in 1942 and \$15,751,408 in 1938.

Five fatal accidents occurred in the domestic operations of scheduled air transports during 1944, three of them involving passenger operations. The death total was 58, including 48 passengers, eight pilots and co-pilots, and two other crew members. The passenger death rate per 100,000,000 passenger-miles was 2.1. The rate had been lower in only two years—1.4 in 1943 and 1.2 in 1939. The rate in 1942 was 3.71. The 1944 record means that 47,000,000 passenger-miles were flown per passenger fatality, and that there were only .03 fatal accidents per 1,000,000 miles flown. Of interest both to air line travelers and operators was the decision of one of the largest insurance companies to make pilots and crew members eligible for ordinary insurance and to reduce special premiums required.

The network of air routes available for transportation of passengers, air mail and cargo in the United States also was increased by a record-breaking mileage to meet home front war needs in 1944, according to a survey made by the Air Transport Association of America. The new routes authorized by the Civil Aeronautics Board during the year totaled 8,435 miles. The total for the domestic air lines at year-end reached the all-time high of 62,937 miles, to which 600 more miles were added in January, 1945. Many schedules already had been put into operation on the newly authorized routes, while others were to be on the timetables just as rapidly as transport planes being returned by the Government to the lines could be reconverted for commercial use.

The 1944 extensions involved 13 carriers and 24 routes, some relating to relatively minor terminal changes; but a majority introduced important new features in the domestic airway network. The longest item was 1,035 miles for Northwest Airlines from Minneapolis to New York. Among others were: National Airlines, 870 miles, New York-Savannah; Western Air Lines, 843, Los Angeles-Denver;



American Airlines, 675, El Paso-Tulsa; 626, Nashville-Oklahoma City; Chicago & Southern Air Lines, 692, Paducah-Detroit; United Air Lines, 570, Cleveland-Boston; Northeast Airlines, 404, Boston (and various stops)-New York; Transcontinental and Western Air, 511, Pittsburgh-Boston; Pennsylvania-Central Airlines, 247, Detroit-Chicago; 320, New York-Pittsburgh; Braniff Airways, 476, Oklahoma City-Memphis; Eastern Air Lines, 184, into Boston; 198, into Miami. Also included were short additions for All-American Aviation and Continental Airlines. The January, 1945, addition was for Mid-Continent Airlines, 584, New Orleans-Tulsa, and a six-mile terminal change for Continental Air Lines.

More than 700 more applications for new service were pending before the Civil Aeronautics Board, including Colonial Airlines, Delta Air Lines, and Inland Air Lines.

Most of the lines continued direct war service for the Army and Navy on a contract basis, flying transports, remodeling planes, and training pilots and crews. At the same time, the bulk of trips on their regular commercial routes involved carrying passengers, mail, and express for war purposes. Col. Edgar S. Gorrell, president of Air Transport Association, pointed out that the route mileage increase in 1944 was the greatest in the history of air transport in the United States except for 1929, when the total extent of the airways was considerably less than half of the present mileage, and when most routes involved one or two trips over them a day, as contrasted with the frequent departure times in 1944. The 1944 figure was an increase of about 15½ per cent over the route mileage at the end of 1943.

During 1944 many legislative proposals vitally affecting commercial air lines came to the foreground at both national and State levels. Divergent interests developed strong controversial cases and wide discussion produced much crystallization of opinion. But the year passed with few important decisions finally reached. Most of the issues went over into the new Congress and Legislatures as unfinished business, with likelihood that 1945 would see many far-reaching questions resolved into settlement.

Of major interest in Washington was the Lea Civil Aviation bill, the two main objects of which were: 1—to reorganize the Civil Aeronautics Administration as an independent agency and set up a separate Office of the Director of Safety; and 2—to place in Federal hands virtually all regulation of air carriers. The measure died in Rules Committee, to be re-introduced forthwith with various reductions in the scope of proposed Federal control. The second part of that measure was the focal point for a deep-seated split of opinion among the varied groups concerned.

The Army Air Forces air transport operations extended around the earth. The number of planes employed by the Air Transport Command under Major Gen. Harold L. George increased from 787 in

January to 1,900 in December, 1944. In that year a total of 1,256,870 passengers were carried, and 439,208 tons of cargo were flown, involving 858,380,000 ton miles. Part of these operations was over the Hump of the Himalayas between India and China—the worst flying route in the world.

In his report made public early in 1945, Gen. H. H. Arnold, commanding the Army Air Forces, described the work of the Air Transport Command as follows: "Our Air Transport Command has pioneered in intercontinental transportation, and the aid of the commercial air lines in this work, particularly in its earlier phases, has been acknowledged with appreciation many times. There is no substitute for the day-to-day experience and operational 'know-how' which is gained by large-scale operations.

"It can be stated now that the Air Transport Command has delivered a total of 40,000 planes overseas up to January 1, 1945. In 1942, it was flying 4,800,000 miles a month in ferrying operations. By 1943, the rate was 12,500,000 a month. In 1944, through November, it was 21,872,000 miles a month [in ferrying operations]. ATC flew 28,000,000 miles a month in transport operations in 1944, or 340,000,000 miles for the entire year. In total ferrying and transport operations, the ATC flies about 51,000,000 miles a month, or approximately 70 times around the world at the equator every 24 hours.

"In 1944 some 560,000 tons of high priority passengers, cargo, and mail were carried by ATC, and most of the 1,200,000 passengers flew



#### AMERICAN FIGHTERS FOR RUSSIA

A group of P-63 Kingcobras at the Bell Aircraft plant near Niagara Falls, N. Y., prior to being ferried to Russia by way of the Northern route over Alaska and Siberia. They bear the red star of the Soviet air force.

over foreign routes. Some 80,000,000 pounds of mail, or more than 3,500,000,000 letters, were included in that total. The ATC network of routes now totals 161,000 miles of which 118,900 are beyond the continental United States. A plane is crossing the Atlantic every 19 minutes, carrying whole blood for the wounded, along with vital personnel and cargo, and bringing back casualties. In 1944, the ATC carried an estimated 130,000 patients, from the Ground, Service, Air Forces, Navy and Allies.

"Some 70,000,000 pounds of military cargo were flown by ATC over the Hump from India to China in one month, and during one 24-hour period about 2,500,000 pounds of freight, or one flight every 2½ minutes. From foreign countries the planes have brought back vital war materials for domestic production such as tungsten for armor, shells and filaments, mercury for detonators, tin, industrial diamonds, mica, and many other cargoes. Those are regular cargoes. Here are some emergency ones: In January, 1944, the Navy required additional engine parts on short notice for landing craft in the Pacific. Within 24 hours the ATC flew five tons of the parts to Hawaii. In May, 1944, the ATC diverted 11 planes to carry an emergency cargo of 55,000 pounds of mine-cutting equipment to the United Kingdom for use on D-Day. In June, 1944, the WPB said there was only enough of a certain critical material on hand to keep radio-radar production going for two weeks. The ATC diverted three C-46's from the Central African Division to lift 23,000 pounds of the material in India, and the first lots reached Miami four days later. As fast as they could be manufactured at Edgewood Arsenal, Air Transport Command rushed mortar propellant charges to Paris to help check the German breakthrough in December-January. Seventy thousand pounds of this vital cargo were delivered in the European theater two days after it left the factory."

The India-China division of ATC was the aerial lifeline to China, the only means of getting personnel and supplies into China from the time the Japs took Burma and cut off the Burma Road until in 1944, they were driven back and a road was opened by way of Ledo, named the Stilwell Road. Lt. Gen. Joseph W. Stilwell was our Army commander who trained the Chinese armies and supervised construction of the road in a remarkable campaign against both Japs and natural obstacles.

Until then, however, the Air Transport Command flew everything over the Hump. Here the pilots encountered the worst possible weather. Terrific air currents battered the transport planes. Jagged peaks seemed to line the ever-present clouds with solid rock. Jap fighters tried constantly to intercept the unarmed transports. But, the Air Transport Command persisted. During one month in 1944, it flew more than 23,000 tons over the Hump, which was much more than the Burma Road ever had carried. In a single 24-hour day, the

ATC planes made 569 sorties over the route, an average of one Hump crossing every two and a half minutes. In that period more than 1,300 tons of gasoline, ammunition, trucks, jeeps and other war materials, were flown over the Himalayas into China. The planes flew heavy cargoes, on occasion road scrapers each weighing 25,000 pounds.

The ATC supported Gen. Stilwell's campaign in Burma in April, 1944, by flying more than 18,000 Chinese troops over the Hump to India. Late in 1944, the Allies drove back the Japs from North Burma and the border of India, and they also established such air supremacy that the Jap no longer was a menace. The transports of the ATC were able to change their route and fly at somewhat lower altitudes. In January, 1945, the ATC set a new record, flying 44,000 tons of supplies into China. This record for one month showed the progress that had been made. In 1944 the tonnage was 231,000 tons for the year, and this was very good considering that only 48,500 tons had been flown in 1943.

One of the most important activities of the Air Transport Command was its part in evacuating sick and wounded by air. On July 18, 1944, Major Gen. David N. W. Grant, Air Surgeon of the Army Air Forces, stated that 7,432 casualties had been transported from Normandy, following the invasion, from June 10 to July 1, 1944.

"All over the world, our airplanes now are carrying in the neighborhood of 1,000 patients a day," said Gen. Grant, who told of the work of the flight surgeons and the flying sergeants of the First Air Commando Force in evacuating sick and wounded air commandos and British Chindit troops in liaison-type airplanes from behind the lines in Burma early in 1944. He continued: "The Allies' employment of this 'flying jeep' type of airplane for the movement of casualties added



THE CURTISS C-46 COMMANDO

These Army Air Forces transports were doing effective work in the Asiatic war theater. The Commando is powered by two Pratt & Whitney 2,000 h.p. Wasp engines and four-blade Curtiss electric propellers.



#### DOUGLAS C-47 SKYTRAIN TRANSPORT

The military version of the DC-3.

a new chapter in the story of air evacuation. The AAF began this story early in the war with the mass movement of the sick and wounded aboard two and four-engine transport airplanes. These big troops and cargo carriers have removable litter supports enabling them to transport up to 24 patients. Care in flight is provided by flight nurses working in medical air evacuation squadrons under the supervision of flight surgeons.

"We had these squadrons ready on D-Day to go into the Normandy beachhead and remove the wounded. Actual medical air evacuation operations began on D-plus-four, as soon as the engineers had built a runway on which the C-47s could land. Several hundred flight surgeons, flight nurses, and enlisted technicians were assigned to this duty of bringing the wounded out of France under the protection of our fighter planes."

During 1944, our wounded were flown back to the United States from Europe and the far Pacific war theaters in increasing numbers every month. Having arrived in this country, they were then flown or taken by train to Service hospitals nearest their homes for further treatment.

The Naval Air Transport Service [NATS] maintained close liaison with the Army Air Transport Command, and both Services cooperated in handling personnel and shipments of cargo and mail by whichever means would accomplish the movement most expeditiously. In 1944, the part played by NATS became even more important than it had been because of the spread of action throughout the Pacific.

During the year 1944, NATS routes increased to 80,000 miles.

The Naval Air Transport Service increased the number of transports used in its operations from 201 in January to 351 in December, 1944. During the year the NATS flew a total of 549,393 passengers, as compared to 118,593 during the last six months of 1943. NATS flew a total of 77,428,341 miles in 1944, as compared to 19,197,557 miles in the last six months of 1943. It carried 76,664 tons of cargo, including mail, as compared to 21,217 tons in the last six months of 1943. Its ton miles flown in 1944 totaled 209,473,181 against 45,799,816 during the last half of 1943.

Rear Adm. Dewitt C. Ramsey, Chief of the Bureau of Aeronautics, presented a fine description of this service in his report to Congress in November, 1944.

NATS was organized on December 12, 1941, said Adm. Ramsey, "to meet the requirements of the fleet and naval shore establishment for rapid transportation on schedule and under sole and complete control of the Navy Department, of urgently needed cargo, personnel and mail. The great distances from the United States sources of supply to the theaters of active battle in both hemispheres, and the



United Air Lines photo

#### HOMEWARD BOUND FROM SOUTH PACIFIC

Made comfortable in litters and attended by Army Air Forces flight nurses, these wounded soldiers start from an Australian base in a United Air Lines Douglas C-54 transport operated for the Air Transport Command.



U. S. Navy photo

#### NAVY WOUNDED HOSPITAL-BOUND

Casualties from a South Pacific battle aboard a Navy Douglas Skytrain on their way to a base hospital. This aerial ambulance service was operated by the South Pacific Casualty Air Transport, U. S. Navy.

ever-increasing complexity of machines employed in battle, made it essential that means be provided for rapid redeployment of key personnel, for rapid delivery of repair and replacement parts for equipment, and for expeditious movement of mail between the United States and the forces in the field. In December, 1943, the transportation functions of NATS were expanded to include ferrying of new and used combat aircraft within the continental United States, between factories and modification centers and operating units of the fleet. These movements previously had been accomplished by units functioning in coordination with naval establishments charged with the acceptance of new aircraft deliveries from the factories. Consolidation of these activities under one command was effected in the interests of more economical utilization of pilot and maintenance personnel, and more efficient delivery of the aircraft. In the early months of 1942, time had not yet permitted development of an adequate organization for trans-ocean operation, and long-range transport aircraft suitable for such operations to remote naval establishments were practically non-ex-

istent. The few in operation were held by certain commercial operators. In order to utilize to best advantage the existing organizations experienced in overseas air transport operations, and to acquire the use of some of these aircraft, contracts were negotiated with Pan American Airways System and American Export Airlines, which resulted in acquisition by the Navy of eight B-314 (Boeing Clipper) aircraft, two S-44 (Sikorsky) aircraft, and seven two-engine landplanes.

"Operations supplementing the operations of NATS squadrons were conducted by these contractors to naval establishments in the Atlantic, the Pacific, Alaska and the Aleutians. As the military situation permits, and as NATS squadrons can be expanded to meet the Navy's requirements for air transportation to an area served also by the contractors, it is planned to release the contractors from their obligations and permit them to revert to their former commercial status, in order that they may plan and develop their organizations fully, and establish their postwar commercial positions without restriction. In accordance with this policy, the Navy's contract with Pan American Airways, Pacific-Alaska Division, Alaska Sector, was terminated as of July 31, 1944, due first to the decline of military demands for air transportation in the Alaskan and Aleutians areas, and second,



U. S. Army Air Forces photo

#### TRANSPORTING WOUNDED IN SOUTHWEST PACIFIC

A giant Douglas C-54 Skymaster hospital plane is shown here at Funafute, loaded with wounded from Makin Island. Airplane ambulances brought wounded home from battle areas around the world.





#### A SOUTH PACIFIC SPECIAL

The Air Transport Command operations moved on with our victories. Here a United Air Lines Douglas Skymaster is taking off from Guadalcanal.

to the fact that the operating capacity of the Naval Air Transport Service squadron serving the area was adequate to meet present and projected requirements. Similarly, the reduction in the needs of the Navy for air transportation to Europe and Africa led to the decision to terminate the contracts with PAA, Atlantic Division, and American Export Airlines, on December 31, 1944.

"During the period under review, NATS operations expanded from the original two flights weekly between Norfolk and Boston, and Norfolk and Corpus Christi, in March, 1942, approximately 2,200 route miles, to operations over 80,000 route miles in September, 1944, on regular schedules, which on some routes called for 75 flights per week. The original six R4D airplanes assigned to NATS in March, 1942, since have been augmented by over 300 others; on October 1, 1944, NATS total transport fleet comprised 327 aircraft—60 four-engine landplanes, 70 four-engine seaplanes, 145 two-engine landplanes and 52 two-engine seaplanes. In addition, 49 small miscellaneous airplanes are used for training purposes. The estimated 200 officers and men comprising NATS when VR-1 was commissioned, have since increased to a total of 18,183 as of October 1, 1944, and in addition 7,876 people were employed by the contract operators.

"Routes and schedules have been established solely with reference to the Navy's requirements, and serve to connect fleet bases and shore establishments requiring air transportation with supply depots within and outside the continental United States. NATS has been organized to provide maximum flexibility, so that routes and schedules may be altered or extended as conditions warrant, in order to render optimum service to the Navy as a whole. Should requirements in any one area

increase suddenly, or should special shipments of high priority cargo necessitate additional flights over and above the regular schedule, this flexibility is such that equipment and crews can be shifted as required, temporarily or permanently, from those operations and routes best able to spare them to meet the more urgent special demands.

"In September, 1944, NATS loaded 56,166 passengers for a total of 73,106,608 passenger miles and loaded 7,529.8 tons of cargo and mail for a total of 22,120,699 ton miles. Total plane miles flown have increased from 3,258,347 in October, 1943, to 7,443,278 in September of this year. Ferrying operations, which began under NATS in December, 1943, have continued at a uniformly high level throughout 1944. The volume of traffic handled by NATS transports has increased more than proportionately to the numbers of aircraft operated and personnel assigned, illustrating clearly the advantages of larger aircraft capable of hauling greater loads over longer ranges. Future acquisitions of transport aircraft, it is hoped, will be almost exclusively four-engine aircraft designed for transport operation, such as R5D's and JRM's, in order to reduce as far as possible the logistics requirements of NATS in the forward areas, and to economize in the use of personnel, and in communications, flight control and meteorological services.



U. S. Navy photo

#### BIG PLANE DELIVERS A SMALL ONE

A Piper Navy ambulance emerges from a huge transport near a Pacific battle ground.



#### THE MARTIN MARS

Prototype of the Navy long-range transports under construction at the plant of The Glenn L. Martin Company. The Mars is powered by four 2,000 h.p. Wright Cyclone engines.

"All maintenance of NATS aircraft is performed by NATS personnel except the overhaul of engines, which is performed either by naval activities established and equipped for this purpose, or by commercial organizations performing such overhaul under contract to the Navy. The maintenance policy of NATS is that of "preventive maintenance", as practised by commercial air lines; which means briefly, that all component parts of an airplane, including engines, instruments, control surfaces and landing gear, are removed from the airplane before failure and replaced with new or overhauled parts. These changes are made on the basis of an estimated safe period of operation in terms of flying hours for each such component, which periods have been established through operating experience of both the Navy and commercial air lines. The policy of preventive maintenance guarantees that the airplane will at all times be thoroughly airworthy and can be operated safely and efficiently, and that schedules can be maintained without interruption or cancellation resulting from mechanical failures.

"Since the demands for air transportation far exceed the capacity available, it was found necessary to institute a system for the certification of priorities for passengers, cargo and mail to be carried by NATS. The priorities, which range from Class-1 through Class-4, are

certified for any particular shipment on the basis of its urgency as determined in the case of high priorities by the Naval Air Priorities Offices, the Bureau of Supplies and Accounts for cargo, or the Bureau of Naval Personnel for naval personnel, and in the case of lower priorities, by the shipper of the material or the naval unit ordering the movement of the personnel involved."

The largest division of the Navy's air transport system was NATS-Pacific, operating between San Francisco and Sydney 7,800 miles, San Francisco to Saipan 6,468 miles, San Francisco to Manus 6,516 miles, Sydney to Saipan 3,655 miles. The so-called "short" shuttle routes included Honolulu to Midway 1,313 miles, Noumea to Auckland 1,123 miles, and Tutuila to Tarawa 1,601 miles. The longest non-stop flight was from San Francisco to Honolulu 2,407 miles, and on that route NATS was making 15 round trips a day.

Of the thousands of high priority items carried by NATS-Pacific medicines of course ranked first, and blood was the most consistently important item of all. During our return battles for the Philippines, blood, whole blood, was flown within 48 hours from San Francisco to the Leyte beachhead, about 6,500 miles distant. The first shipment was 160 pints. In 10 days 800 quarts were sent into the far Pacific battle areas, and NATS was preparing to deliver a ton of blood daily, if needed. The containers were lightweight portable refrigerators with a capacity of 16 pints and capable of keeping the blood at the required temperature for 60 hours. Unlike whole blood, plasma was not perishable, and it was routine air cargo to the extent of several thousand pounds a week. The Navy Mars flew 14,000 pounds of plasma to Honolulu on one trip.

In 1944, a total of 1,761,438 airborne shipments, principally war materials, machine parts, printed matter and drugs, was handled by the Air Express Division of Railway Express Agency on domestic air lines, an increase of 14.1 per cent over 1943. Gross revenues for 1944 touched an all-time high with about \$11,500,000 as compared with about \$10,900,000 in 1943. Weight totals of air express were 34,000,000 pounds of cargo in 1944 as against about 30,700,000 pounds in 1943. In its 17th year of regularly scheduled service, air express operated over nearly 50,000 miles of routes and handled shipments at 728 air express offices, including 375 airport cities.

National synchronization of air-rail-truck facilities kept vital materials moving between 23,000 express offices. Shipments handled in combined air-rail service topped 1943 by 11.3 per cent with upwards of 457,000 shipments handled by air-rail in 1944, compared with 404,400 in 1943. Shippers paid approximately \$4,462,966 on air express traffic that moved part-way by rail, as against \$4,063,776 in 1943. Emergency shipments to many non-airport cities and off-air route towns were assured express speed delivery by the coordination of wheel, rail and wing, and reliability in completion of traffic sched-

ules was considerably stabilized. A fleet of 15,000 motor vehicles was kept rolling by REA in its effort to furnish door-to-door pickup and delivery service wherever feasible. In December, 1944, air-rail shipments leaped to a peak volume of 48,705 as against 40,500 in the same month of 1943. Charges on this monthly total amounted to \$444,448, compared with \$371,102 for December the year before. Nearly 70 per cent of air express cargo in the country moved all-air between airport cities, while about 30 per cent went air-rail.

Air express history was made at La Guardia Field, New York, in 1944, with 699,357 shipments handled, a 25.9 per cent increase over 1943. Another spectacular record established at La Guardia was the estimated 10,135,000 pounds of cargo forwarded and received, which compared with 8,111,000 pounds in 1943.

In the peak month of December, 1944, 90,023 shipments were handled, an increase of 25,000 over December, 1943, while gross revenue of more than \$435,000 was reported, marking a rise of 51.5 per cent over 1943. An average of about 3,000 daily air shipments were handled in December, compared with 2,100 daily shipments the rest of the year. Consignments at the field were handled on both a priority and non-priority basis.

A substantial number of transport planes returned to the air lines by the Services in the latter half of 1944 and re-establishment of service at a number of points throughout the country were contributing factors in the upward trend of air business. On the other hand, based on the first 10 months of 1944, the average shipment dipped below that of 1943, 19.4 pounds against 19.8 pounds. The trend toward reduction of rates was evidenced by the fact that in 1944, the average charge per shipment was \$6.49, compared with \$7.10 in 1943. The average shipment traveled about 1,000 miles by air express and 500 miles by railway express. Air shipments averaged 19.4 pounds, rail shipments 60 pounds.

International air express also hit a new high in 1944, with 248,519 shipments, a 43.4 increase over 1943 when 173,200 shipments were handled. Express charges amounting to over \$900,000 were paid on this traffic, indicating a rise of about 47 per cent over 1943.

Both incoming and outgoing shipments were included in the totals which also showed a monthly average of more than 20,700 international shipments, well over the 14,190 mark set in 1943. A better than two to one balance of outgoing over incoming traffic was maintained all through 1944.

One of the features of incoming traffic was a shipment of toads, imported to fend off a parasitic invasion of Florida's cane sugar industry. Machinery, medical and dental equipment were among major items of air export. A daily average of 14 all-cargo flights was maintained by the domestic air lines, with the traffic divided between mail and express.

The third year of American participation in the war brought continued gains in all phases of operations by Pan American World Airways, both for the military and on its international commercial air routes. The year 1944 was noteworthy in another sense in that, as hearings were resumed by the Civil Aeronautics Board on applications for international air routes of the future, Pan American disclosed detailed plans for the operation of comprehensive, American Flag air transport service after the war over round-the-world airways which it had been projecting long before Pearl Harbor. As the strategy of global war reflected growing United Nations successes, contract operations carried on by Pan American for the Naval Air Transport Service were terminated in the Alaska theater and on transatlantic routes. Pan American's Africa-Orient Division, set up to carry out contract operations for the Army Air Forces Air Transport Command, remained the largest contract operator for the military in any theater, however.

The Clippers of Pan American's Atlantic Division, based at LaGuardia Field, New York, returned to full time commercial operation on January 1, 1945, immediately following termination of the Navy contract. During the year the Division's 42-ton flying boats spanned the Atlantic 305 times on regularly scheduled flights, logging more than 1,571,000 miles over the routes that bound the United States to the British Isles, Europe, Africa and South America. Over the northern, middle and southern air tracks the Clippers carried safely to their destinations 13,723 passengers and 379,600 pounds of express. They flew a record-breaking load of 1,120,654 pounds of American and foreign mail—a total load estimated as the equivalent of almost 45,000,000 letters, a new high in commercial transocean air cargo. It was on the Clippers that the first experiment in air delivery of whole blood was undertaken, transfer of the vitally needed blood having had its origin in regular American Red Cross shipments to a hospital located on an off-shore island. A new monthly record for commercially flown cargo was established by the Atlantic Division cargo unit in August, 1944, when 726,172 pounds of mail and express were flown across the Atlantic. Meanwhile, the Division's Boeing flying boats set two new records in the South Atlantic. In July, Capt. Frederick K. Schader commanded a Clipper that carried 51 passengers—six more than were ever carried before—across the ocean from near Monrovia, Liberia, to Natal in Brazil. Five months later another record was established when Capt. Wallace D. Culbertson commanded a Clipper which carried 52 passengers over the same 1,870-mile run.

During 1944, peak performance on Pan American's contract for Atlantic operations with the Naval Air Transport Service was achieved. Flying Consolidated Vultee Coronado flying boats, patrol bombers converted to use as transports, contract crews kept open the aerial lanes to vital ports in the Atlantic theater. A Pan American-operated Coronado of the NATS, commanded by Capt. Olaf Abra-

hamsen, established a transatlantic speed record of 17 hours 45 minutes flying time from an undisclosed port in the British Isles to LaGuardia Field on July 22, 1944. The flight mechanics school conducted at the LaGuardia Field base for the Naval Air Technical Training Command completed its first year of operation in May, 1944. During its first 20 months, graduates of Navy aviation machinists mates schools throughout the country were trained to qualify as flight mechanics for multi-engine aircraft attached to the fleet or transport squadrons. Graduates of the LaGuardia Field School were qualified to serve on Coronados and Martin Mariners. Officers who were to be assigned to flying boats of the Mars class matriculated for the 15-week course of study. In 1944, diplomas were presented to nearly 600 enlisted men qualified as flight mechanics, an increase of 65 per cent over the graduation list of the previous year. Pan American staffed the school with a faculty of experienced flight engineers, well trained in the long-range operations technique developed by the company, together with specialists in technical subjects. The latest in training aids, as well as the extensive facilities in Pan American's base, were made available for the trainees as another contribution to the over-all war effort.

Early in 1944, Pan American's operations in the Pacific and the Alaska sectors were consolidated into one operating unit known as the Pacific Alaska Division. In the Pacific war theater Pan American flew more than 15,698,000 plane miles for the NATS. Between September 1, 1942, and October 31, 1944, Pan American carried 57,000 passengers, flew 133,453,000 passenger miles and accounted for 23,536,000 ton miles of cargo. The total plane miles were equivalent to more than 600 flights around the world or 33 round trips to the moon. Passenger miles flown were the equivalent of the transport of a division and a half of infantry from San Francisco to Tokyo or four divisions from San Francisco to Honolulu. The 17,000,000 gallons of gasoline consumed in these operations were the equivalent of seven 60,000 barrel tankers or a train of railroad tank cars 15 miles long. One of the Pan American pilots, Capt. F. C. Richard, had more than 2,500 hours of wartime flying to his credit.

All Pan American's facilities in the Pacific, where it pioneered the world's first transocean airway in 1935, went on a full war footing shortly after the first Japanese bomb dropped on Pearl Harbor. Initial Jap successes cut the line's 15,000 miles of transpacific routes to less than one-seventh of its prewar system, leaving only the 2,500-mile airway between the U. S. mainland and Hawaii. In addition to concentrated service over this sector under Navy priority control, Pan American undertook extensive contract operations for the Navy beyond Hawaii. In the development of its Pacific routes the NATS made full use of the experience and personnel of Pan American. The NATS South Pacific system followed at first the routes flown by Pan

American in the area, using the bases of Canton Island, Suva, Noumea in New Caledonia and Auckland, N. Z. Later, routes were added in accordance with the changing fortunes of war, and planes operated by Pan American for the Navy made regular stops at such Pacific outposts as Funafuti, Espiritu Santo, Efate, Wallis, Samarai, Kansohe, Tongatabu, Upolu, Penrhyn, Nasilxai River, Nandi and Milna Bay. During this period, with ports of call established as military necessity dictated, the route stretched over 11,959 statute miles from San Francisco to Australia.

Eighty-five crews flew a fleet of 29 flying boats over the South Pacific supply line. Planes used in the operations were converted military patrol bombers—the Consolidated Vultee Coronado PB2Y-3 and the Martin Mariner PBM-3—as well as Pan American's Boeing-built Clippers on commercial schedule from San Francisco to Honolulu under Navy priority.

To meet its war job the division's personnel was increased 363 per cent. Equipment and ton miles flown showed increases of 833 and 806 per cent respectively. Intensive training courses were set up for flight and ground personnel. In the field, the staff increased from 65



Pan American Airways photo

#### AIR CARGO FOR OUR ARMIES

Here are 30,400 lbs. of military cargo arriving at La Guardia Field, N. Y., marine terminal to be flown overseas by Pan American Airways. In a single month of 1944, Pan American flew 726,172 lbs. of high priority mail and express across the Atlantic.



to more than 500. Hangar facilities at San Francisco were doubled.

Forming the nucleus for expanded operations, veteran Pan American pilots piled up thousands of additional hours of wartime flying. Capt. Kenneth V. Beer now in charge of flight training, added some 1,340 hours of wartime flying to a 13,000-odd peacetime log which included the first passenger flight to New Zealand. Incidentally, he was one of three Coronado pilots who rushed Marine torpedo bomber ground crews to Midway during the crucial hours of that decisive battle in 1942. Pan American's Capt. W. W. Moss was another flyer who made aviation history when he brought a Navy Mariner down on storm-tossed seas to rescue 48 survivors of a torpedoed U. S. transport.

As another phase of its war service Pan American's engineering department made many improvements which contributed to the efficiency of the Coronados and Mariners when operated as cargo planes. Engineers designed firewalls for the Coronado, redesigned its cowling to speed maintenance and shorten service time, worked out improvements for electrical propeller installation and designed an engine run-in stand to expedite trouble shooting. Short exhaust stacks were developed for the Mariner and the hulls of both military types were stripped to save weight, cut maintenance manhours and eliminate the danger of corrosion under a painted bottom. Maintenance manual publications and cruising control data were prepared for use by the Navy. Recooopering methods were devised to reduce weight of cargo shipments. Vital cargo carried over the far-flung supply lines ranged in size from a delicate replacement part for radar equipment, weighing only a few ounces, to such sizable pieces as a 2,200-pound shaft for the deck of a carrier.

With the defeat of the Japs in the South Pacific, Pan American was assigned highly concentrated schedules between our mainland and Honolulu late in 1944, omitting its South Pacific flying to rush priority passengers and materiel to the supply base for our mighty offensive which moved into Japan's home waters. All Pan American's facilities in its Alaska sector were transferred to the Navy for contract operations as of September 1, 1942. The company was to operate these facilities, together with additional facilities supplied by the Navy, primarily as a special service for military requirements to Anchorage and points beyond in the Aleutians, where at that time the Japs had secured footholds on Attu, Agattu and Kiska.

With the enemy driven out of Alaska and the crisis in military transportation to the territory from the States a thing of the past, the Navy on August 1, 1944, permitted Pan American to return to its normal job of providing commercial air transport between the United States and Alaska and within Alaska itself, where the line had been pioneering since 1932. During that critical 23-month period the company's Alaska sector carried more than 3,170,000 pounds of cargo and

77,150 passengers to the Territory and to Aleutians bases. High priority cargo items ranged from a 2,360-pound engine for a Navy torpedo boat to a five-ton shipment of plate glass, aircraft engines, crane parts, life rafts, diving equipment, fishing gear, machine guns, radios, V-mail, penicillin and blood plasma. Personnel increased from 508 to 1,136 by June, 1943. Intensive training programs were set up to turn out qualified flight and ground crews in sufficient numbers to meet expanded operations. Scheduled air transport service between the States and the Alaska theater were only one phase of Pan American's wartime operations, however. Many emergency, survey and special flights were made, including those to Point Barrow on Alaska's Arctic coast, where the Navy had undertaken a survey of undeveloped oil reserves.

Meantime company engineers made important contributions to the modification of aircraft for efficient operation in subzero temperatures. The widespread communications and meteorological facilities of Pan American filled a vital role until Government networks for Alaska were established. As a matter of fact, Pan American's "pilots-in-flight code", a speedy and secret method for the exchange of weather information, was adopted by the military air transport services operating between Seattle and Alaska, and it remained in use until early 1944, when it was believed to have become insecure. To expand ground facilities in the States, in the Northwest Territories and in Alaska, moreover, Pan American completed more than half a million dollars worth of construction work. Early contract operations for the Navy were between Seattle and Kodiak by way of Anchorage over two routes, the inland route established by Pan American for commercial operations with two-engine aircraft and the coastal airway. The former extended from Seattle to Prince George in British Columbia, then north between the Coast Range and the Rocky Mountains to Whitehorse in the Yukon, and finally westward behind the St. Elias and Chugach Mountains to Anchorage and Kodiak. The mountains along virtually the entire route protected flights from the strong winds and turbulence of the Alaskan Gulf. Though more direct, the coastal route meant flying through an area of notoriously bad weather, where icing conditions often were severe and security regulations restricting the use of "in the clear" radio communications handicapped rapid transmission of vital weather information. The aircraft used were R4Ds, Navy versions of the Douglas two-engine DC-3 commercial transports. By March, 1943, Pan American was using six aircraft in military service, and the following month its operations were extended west of Kodiak to Dutch Harbor and Adak to serve those and other key Aleutians bases in preparation for the Army and Navy operations which were to blast the Japs from that area. This meant operations over one of the most difficult flying areas in the world. Nine times out of ten the entire flight was



DOUGLAS C-47 SKYTRAIN IN SOUTH PACIFIC

made above a heavy overcast. Flight crews saw little or nothing of the treeless, rocky islands below them, only the peaks of the volcanic mountains which protruded through the thick cloud blanket characteristic of the Aleutians. Landing at Dutch Harbor, on an airport set in the midst of jagged peaks, was no picnic even in good weather. Between Unalaska and Adak in the Andreanofs lay the "Aleutian low." This low pressure area, where the weather for the territory and the coast originates, was known as the "weather factory."

By the end of 1943, Pan American was operating a fleet of 11 aircraft exclusively in military service on that division. Although emergency flights were made in shorter time, the normal round trip between Seattle and Adak at the outset took about 84 hours, with overnight stops at Anchorage and Adak. Round-the-clock Cannonball service was started on April 21, 1944, cutting time to 36 hours. As soon as one crew would complete the 1,544-mile leg from Seattle to Anchorage, a fresh crew would board the plane and fly the 1,400 miles to Adak. Here another crew would take over to fly the plane back to Anchorage, and a fourth crew would wheel on in to Seattle, thus completing the 6,000-mile round trip in 36 hours. In addition to the Cannonball service, a so-called "milkrun" was set up, cutting round trip time to 60 hours by use of two crews and overnight stops on the northbound flight.

Calling on more than a decade of experience in air transport operations under Arctic and sub-Arctic conditions, Pan American engineers worked out modifications to increase the efficiency of aircraft where temperatures of 40 below zero are commonplace. In conjunction with

the Air Research Manufacturing Company, General Controls Company and the Douglas Aircraft Company, they designed and installed a satisfactory hot-air heating system for Douglas planes which not only provided increased comfort and safety for crew and passengers but increased the use of aircraft.

In China, Pan American's national affiliate, China National Aviation Corporation, made new records in its wartime flying over the hump of the Himalayas and by the end of 1944 had completed about 25,000 flights over the world's worst airway.

Pan American's Latin American Division set a high mark in air trade and travel between the Americas. All-cargo service across the Caribbean, new night lighting facilities and increased utilization of aircraft enabled the division and its Latin American affiliates to cover more miles with more passengers and cargo despite wartime restrictions on the acquisition of new flight equipment. To meet the growing manpower shortage, stewardesses were employed on some Latin American runs, replacing stewards in Pan American flight crews for the first time in the company's history.

In its applications before the Civil Aeronautics Board for expansion of its Latin American operations, Pan American first disclosed its postwar plans for mass air transport at rates within reach of the average man.

"We propose to move boldly ahead in the postwar period and to provide mass transportation for the business man and tourist at low rates unique in air transportation," said Juan Trippe, president of Pan American, in announcing the program. "We are confident that both trade and travel volume will come if we provide comprehensive service within the reach of every business, both large and small, and within the means of the average man and woman."

The program for Latin America and for operations across the Atlantic and the Pacific was predicated on the use of huge Clippers capable of carrying more than 100 passengers through the stratosphere at speeds of about 300 miles an hour. Tariffs would be as low as 3½ cents a passenger mile and 10 cents a ton mile for classified cargo on long hauls. Under such a program Rio de Janeiro would be less than 20 hours away from New York by Clipper, and the fare would be only \$175 one way. A business man could board a Clipper at Chicago and be in London in 17 hours and 55 minutes, for a fare of \$161. One would need little more than eight hours to fly from Los Angeles or San Francisco to Honolulu and he would pay \$96.

The projected Clippers, land plane types, were described as twice as large as Pan American's 42-ton transocean flying boats. Their great size would permit the offering of a variety of accommodations for passenger comfort and convenience, ranging from staterooms and berths to reclining seats. The routes extensions sought were designed to serve interior centers in Europe and beyond, which heretofore

could not be reached because of technological or diplomatic considerations, or the war, and to complete an integrated, American flag network around the world.

Over the transatlantic airways which Pan American pioneered in 1939, services would be extended beyond the prewar terminals of London, Lisbon and Marseilles to Paris, Berlin, Moscow, Geneva, Rome, Athens, Cairo, Basra, Karachi and Calcutta. A new and more northerly crossing would link New York and Moscow via Iceland, Oslo, Stockholm and Leningrad. Key ports of Chicago, Detroit, Montreal, Baltimore and Boston, as well as New York, would be served.

In the Pacific area, where Pan American built the world's first transocean airway in 1935 and subsequently established service not only to the Orient at Hong Kong and Macau but to Singapore and to Australasia at Auckland, New Zealand, via island stepping stone routes, operations would be extended to Sydney, Australia; to Batavia, Java, and beyond the Hong Kong-Canton-Macau area of China to Bangkok in Thailand and Calcutta, India, to join with transatlantic extensions and complete the round-the-world network. To the South Pacific and mid-Pacific airways, moreover, Pan American would add the short, long-sought Northwest Passage to the Orient from Seattle through Anchorage, Alaska, the Kurile Islands, Tokyo, Shanghai, Canton, Bangkok and Calcutta.

From the Kuriles, moreover, a branch would be extended to Mukden in Manchuria, Peiping and Shanghai in China. Connections between the northern and the mid-Pacific route would be established through branches between Wake Island and Tokyo, between Tokyo and Manila and between Shanghai and Manila with a stop at Taihoku in Formosa.

To provide equal access to Latin America from all parts of the United States and Canada, Pan American proposed integrated operations from key gateways at New York, Charleston, Miami, Tampa, New Orleans, Houston, Brownsville and Los Angeles, and cut-offs over the heart of the South American continent. And to serve the great continent of Africa, Pan American proposed to link New York and Johannesburg, Union of South Africa, via the Azores, Monrovia in Liberia, Leopoldville in the Belgian Congo and Livingstone in Northern Rhodesia.

The Board of Directors of Pan American approved a program for new financing, the largest in the history of air transportation, which would be accomplished through an offering to stockholders, and which was intended to raise a minimum of \$25,000,000 of new capital funds in 1945, to be available for the purchases of new equipment and other requirements. The new financing was to be the first step in providing for the System's postwar equipment program which might exceed 100 million dollars.

On October 7, 1944, K.L.M., Royal Dutch Airlines, observed the

25th anniversary of its founding at the Hague, Holland. The company had started its operations early in 1920 and with a couple of converted military observation planes equipped with seats for two passengers, started its first service, from Amsterdam to London, every other day. Gradually extending its international and domestic network, before the outbreak of the war in Europe in 1939, K.L.M. flew frequent schedules between practically all European capitals and important traffic centers. In 1924, the first trial flight on the 9,000 mile Amsterdam-Batavia route was made, followed in 1929 by the opening of a regular service, which in 1939 was flown three times a week. In 1934, one of K.L.M.'s three-engine Fokker planes flew from Amsterdam to Curacao, Netherlands West Indies. This 6,600 mile flight included the first midatlantic crossing ever made. After that, regular air lines were established in the West Indies, beginning with an 80-mile service between Curacao and Aruba. This Caribbean network gradually extended to cover 5,180 route miles. The main line in that area extended from Miami, Fla., via Cuba, Jamaica and Haiti to Curacao, and provided through connections to various parts on the South American mainland, Trinidad and Paramaribo in Dutch Guiana.

During the German invasion of the Netherlands in May, 1940, 20 of K.L.M.'s fleet of 35 Douglas planes were destroyed or severely damaged. A few planes were in England, and some others managed to fly away from Amsterdam before they were captured by the Germans. Not long afterwards, K.L.M. started to operate a regular service between London and Lisbon, under charter to the British Overseas Airways. This created an important link with the transatlantic services to the latter port. Until the fall of the Netherlands East Indies, a twice weekly service between Lydda in Palestine and Batavia was maintained.

K.L.M.'s main operations early in 1945 were in the West Indies, where as a result of the serious curtailment of shipping services, air transportation became increasingly vital to the war effort. In 1944 in that section it flew one and one quarter million miles, carried 35,000 passengers, equaling 11,500,000 revenue passenger miles, and in addition 750,000 pounds of air express and 75,000 pounds of airmail. On order of the Netherlands Government, K.L.M. was making relief flights from England to the starving people of the liberated part of Holland.

American Export Airlines' four-engine flying boats (Flying Aces) were making regularly scheduled commercial flights for more than two years across the North Atlantic on the New York-Ireland-Africa route, with direct connections for England at Foynes, Ireland. In addition to this service, the company conducted a military air transport service to points in the United Kingdom and Africa, across both the North and South Atlantic as well as to a number of off-shore islands,



American Export Airlines photo

#### FLYING MAIL FOR THE EUROPEAN FRONTS

An American Export Airlines plane takes on nearly 10,000 lbs. of mail for delivery across the Atlantic.

and to points on the east coast of South America. The line, early in 1945, had a contract to operate a fleet of four-engine C-54 land planes for the Air Transport Command of the Army Air Forces, and had begun operations. This took the place of the company's contract with the Naval Air Transport Service which, due to developments in the war, was terminated at the end of 1944.

American Airlines increased global operations under contract to the Army Air Transport Command and maintained service on its routes inside the United States. An American Airlines flight crew landed in Paris, France, on Christmas afternoon, 1944, to mark the company's 5,000th transatlantic crossing since contract operations for the ATC began in the Spring of 1942. In contrast, U. S. pilots had made, prior to 1939, only an estimated 33 flights across the Atlantic. American Airlines had flown one-third of the total of 15,000 Atlantic crossings made by all Allied aircraft since the start of war. In its ATC operations during the thirty-three months of war, large quantities of ammunition and supplies were flown by American Airlines 33 million miles—the equivalent of 1,650 round-the-world trips—to 27 countries. In 1944 alone, more than 62 billion pound-miles of cargo, including mail, munitions and other sorely needed supplies, were flown

over 16 million miles by American flight personnel to points as far distant as Marrakech in North Africa, Calcutta, India, China, the British Isles and points on the continent of Europe. American received from the Government about half of the transports which were taken out of its Flagship fleet at the time its ATC operations began.

American Airlines flew 929,902 passengers in 1944, (a daily average of 2,548) as against 788,990 in the preceding year. Plane miles rose to 34,582,820, an increase of more than eight million over 1943. Revenue passenger miles were 572,094,112 as compared to 435,913,741 of 1943. A total of 11,166,384 ton-miles of mail and 5,378,285 ton-miles of express and air freight were flown in 1944 as against 8,145,462 and 4,882,115 respectively in 1943.

An innovation in freight transportation was the introduction by American in the fall of 1944 of air freight. Taking off from La Guardia Field on October 15, the first American Airlines Air Freighter carried war priority cargo to Burbank, Calif., in 16 hours. Thus began a daily air freight service between New York and 42 other cities on American's system. In the last two-and-a-half months of 1944, more than 8,492,373 miles were flown in air freight service. The number of domestic cities served on American's system was increased to 69 during 1944 with the addition of Joplin, Mo., and San Antonio, Tex. Approval of applications pending with the Civil Aeronautics Board in Washington for an additional 5,349 miles would bring American's domestic mileage well in excess of 13,000. The international routes of American Airlines extended south of the United States to Monterrey and Mexico City and north to Toronto and Windsor in Canada. With Civil Aeronautics Board approval of its applications to originate transoceanic flights from Boston, Chicago and New York to London and Paris, the foreign routes of American would cover more than 5,000 miles.

Contrasted with about 2,000 employees in 1934, American early in 1945 had more than 8,000 on the payroll, more than 250 of whom were stationed at American's foreign stops. In addition, 2,000 employees were on military leave, many of them serving with the Air Transport Command at stations throughout the world. American, late in 1944, ordered 55 four-engine transports—25 Douglas DC-4 planes seating 44 passengers, and 30 Douglas DC-6 50-passenger planes, for delivery as soon as production for commercial use became possible.

All American Aviation, operating an air pick-up service, was in its sixth year and was operating between 118 cities in six States. In July, 1944, its average mail load was 103.1 pounds. This average mail load was higher than that of six of the other domestic carriers, and the 11,339,000 pound miles of mail carried was higher than that of five of the six carriers.

United Air Lines achieved record gains in essential wartime air





#### THE BOEING C-97 TRANSPORT

This new transport counterpart of the B-29 Superfortress has a length of 110 ft., 4 in. and wing spread of 141 ft., 3 in., its two decks capable of carrying more than 100 fully equipped troops.

mail-passenger-cargo operations, increased its scheduled domestic service to 100,000 miles daily and carried out far-flung military contract operations overseas and at home. The company's revenue passenger miles for the year totaled an estimated 456,636,000 for a gain of 28 per cent over the 357,196,592 recorded in 1943; revenue airplane miles, 29,574,000 for a 35 per cent increase; mail ton miles, 18,825,000 for a 70 per cent gain; and express ton miles 4,222,000, up about six per cent over 1943.

In addition to transporting essential civilian and military passengers and cargo over its 6,300 mile coast-to-coast and Pacific Coast system, United completed its 2,000th transpacific flight for the Army Air Transport Command, and chalked up more than 5,200,000 miles of flying between the United States and Alaska since 1942 in maintaining military supply lines, also for the ATC. Other military activities included modification of the 5,000th four-engine bomber at United's Cheyenne modification center, and training of military ground and flight personnel.

In the latter part of 1944, United terminated its Alaskan and domestic military operations for the Air Transport Command. Flight and ground crews from these operations were reassigned to the transpacific route flown by the company for the ATC—a route which assumed new importance with Gen. Douglas MacArthur's drive into

the Philippines. United crews averaged two round trips daily between San Francisco, Hawaii and New Guinea, rushing men and materials to the Southwest Pacific and returning with sick and wounded. The vital supply route covered 7,300 miles, extending northward as the campaign against the Japanese progressed.

While they left no visible trails in Alaskan skies, United's ground and flight personnel could look back with justifiable pride on their record of achievement in keeping supply lines open to that northern territory. Briefly, United's record included more than 5,200,000 miles flown; approximately 10,000,000 ton-miles flown; transportation of 33,500 military passengers, almost 6,000,000 pounds of military cargo and more than 2,500,000 pounds of mail. Not a major mishap or injury marred the entire job.

Improvement of high prewar standards of maintenance contributed materially to new highs in airplane utilization. United's fleet, gradually increased during the year by the addition of planes returned from Army service, averaged 13 hours, 20 minutes, or 2,000 miles per plane per day. It compared with eight hours, 15 minutes, or 1,200



TAIL OF THE BOEING C-97

Designed as a troop carrier or heavy cargo ship this transport sister plane of the B-29 was loaded from the rear. The huge doors closed to make a pressure tight cabin for high altitude service.

miles per plane per day before the company, in the spring of 1942, turned over approximately half its fleet to the Government for military use. Twenty-two Douglas DC-3's were returned to United by the end of 1944, bringing its fleet to a total of 55 planes and providing much-needed accommodations for heavy passenger-mail-express traffic.

Seven of the returned planes were reconverted as Cargoliners and pressed into service on scheduled all-cargo flights to accommodate expanded air mail and express traffic. These all-cargo trips, totaling 18,458 miles a day, carried between 40 and 50 per cent of the mail and 25 per cent of the air express handled by United over its entire system. For the first nine months of 1944, United's Cargoliners flew 11 to 16 per cent of all the nation's air mail and roughly seven per cent of total air express pound miles flown by domestic lines.

United ordered 50 giant four-engine planes for postwar service—15 four-mile-a-minute Douglas DC-4's accommodating 44 passengers and cargo, and 35 five-mile-a-minute DC-6's of 50-passenger and cargo capacity, capable of reducing coast-to-coast schedules to approximately 8½ hours. Both were to be commercial developments of the Douglas C-54 Skymaster, flight-tested over millions of miles of transoceanic military operations.

As part of its postwar expansion program, United applied to the CAB to extend its domestic services to Alaska and Hawaii, points thoroughly familiar to veteran United pilots engaged in ATC operations. The company also pressed applications to add 20 west coast cities plus numerous mid-west and eastern points to its system, and continued its fight to have the Denver-Los Angeles route made a part of its coast-to-coast transcontinental route. CAB approved United's application to serve Boston, Hartford and the New England area, adding 586 miles to the company's system.

Transcontinental and Western Air filed with the Civil Aeronautics Board an application for the first round-the-world route proposed by an air line, and at the beginning of 1945 it was the only domestic air carrier ready to start over-ocean commercial service with equipment on hand. The TWA's Intercontinental Division, flying world routes for the Army Air Transport Command, was in its third year of operation. On December 30, 1944, it completed 6,000 ocean flights. Of these, a record 3,500 were made in 1944, with 14,000,000 plane-miles flown and 8,000,000 ton-miles of payload, mail and cargo, flown to the fighting fronts. Sixty thousand passengers were carried, many of them wounded soldiers returning home. Organized shortly after Pearl Harbor, the TWA Intercontinental Division operated four-engine transports for the Army on a schedule closely approaching the regularity of air line service at home.

In its coast-to-coast commercial service, TWA's revenue was estimated at \$24,750,549, an increase of 32.1 per cent over 1943. An

estimated 348,258,005 revenue passenger miles were flown, a gain of 43.9 per cent over 1943. Mail pound miles were up approximately 29 per cent and express pound miles 18 per cent. In 1943, each transport had averaged 11.3 hours of daily use, while in 1944, the planes averaged 13 hours daily.

Daily all-cargo flights were started in 1944, both coast-to-coast and between New York and Chicago. Early in 1945 TWA service was started on a new route from Pittsburgh to Boston by way of Williamsport and Albany.

Years of development work were climaxed in April, 1944, when the giant Lockheed Constellation, conceived by TWA, was delivered to the air line. In turning it over to the Army Air Forces for immediate war duty, Howard Hughes, principal TWA stockholder, and President Jack Frye flew the 57-passenger plane from Burbank to Washington in six hours, 57 minutes and 51 seconds, a new trans-continental transport record. Constellations were to go into TWA commercial service after their war mission had ended.

The readiness of TWA to fly over-ocean routes was made possible



#### ABOARD THE MARTIN MARS

Showing the flight deck of the huge Navy transport flying boat produced by The Glenn L. Martin Company.



#### LOCKHEED CONSTELLATION IN FLIGHT

This C-69 Constellation transport is powered by four Wright Cyclone 18 engines.

by the return of its fleet of five Boeing Stratoliners after two and a half years of military service. These four-engine planes were put through an unique modernization process whereby new Flying Fortress wings, landing gear, horizontal tail assembly, and more powerful Wright engines were added. The reconversion increased the Stratoliners to 38-passenger transports capable of cruising at more than 200 miles an hour. They were to enter commercial service early in 1945.

The round-the-world route sought by TWA included a North Atlantic crossing, thence by two different routes through Europe to Egypt, then to Calcutta, across to China and Japan, then over the North Pacific to Alaska and down to Seattle, a distance of 22,000 miles. At the North Atlantic routes hearing before the CAB, TWA filed fares and schedules for both Stratoliner and Constellation operation from the United States to London, Egypt, and Calcutta. It offered Stratoliner fare of \$263.80 from New York to London, and promised that when Constellations were available the rates would be reduced.

TWA also took a leading part in the CAB's Honolulu-Mainland hearings as a result of its purchase during the year of a stock interest in Hawaiian Airlines, pioneer air carrier in the islands. Hawaiian was among the applicants for routes from San Francisco and Los Angeles to the islands, and this application represented TWA's interest in the route.

While making vast preparations for peacetime operation on world routes, TWA also was getting its domestic operations ready for postwar expansion. The first step was a major reorganization whereby the Operations Department and the field functions of the Traffic Department were combined in a Transportation Department with John A. Collings as vice president of transportation. The new organization made for greater efficiency and better service to passengers and shippers.

Early in 1945 Northwest Airlines was preparing to start operations on its new service between New York and Milwaukee, via Detroit, thereby making it a transcontinental line with its western terminal at Seattle. Northwest also had applications pending for routes to Alaska, the Aleutian Islands, Tokyo, Shanghai and Manila.

The military operations of Pennsylvania-Central Airlines included a domestic scheduled military cargo service that grew to a



#### OVER THE NATION'S CAPITAL

A Pennsylvania Central Airlines transport comes across the Potomac for a landing at Washington National Airport.

system transporting about one-third of all the domestic military cargo carried by the air lines under war contracts. There also were special urgent missions, flown over the North American continent under secrecy. The records showed that 58 different types of military aircraft were serviced at PCA's main base of operations at National Airport, Washington, D. C., at the request of 41 different military agencies. PCA in 1944 broke all of its previous passenger-carrying records. In August, PCA carried 53,550 air-travelers—a new all-time monthly high mark—and proceeded to carry over 50,000 passengers a month for the next few months to create new records. The line had applications pending for a world-girdling network; and had CAB approval to operate from Washington, D. C., to New York, as well as the right to fly non-stop between Detroit and Chicago. PCA applications before the CAB included a route over the North Atlantic to the capitals of England, France, Scandinavian countries, and to Moscow. Another proposed PCA air route would extend from England through the Middle East to India. Another would cross the South Atlantic to Africa, and from there to Portugal and Spain; and a route by way of Alaska to Japan, China and on to India.

Having concluded various military contracts in 1944, Delta Air Lines turned all its energies to providing, and preparing for better air line service in its home territory, the South. With DC-3's returned from the Army, eight new flights were added over existing routes, while four major new route applications went before the Civil Aeronautics Board. Delta's military work had included modification of Army and Navy aircraft to fit the requirements of particular battle-fronts. Nearly 1,000 planes of 14 widely different types were handled by Delta's modification department in Atlanta, Ga., including last-minute changes on B-29's; building "piggy-back" seats into P-38's and winterizing these planes for operation in extreme cold weather; designing and installing new navigation and communication equipment for attack bombers to be used by Russia and converting battle-scarred aircraft to training ships.

Overhauling and reconditioning engines and instruments removed from Army planes were carried on in Delta's regular overhaul shop, where many women were trained as mechanics. Delta trained Army privates in air line maintenance, and operated air cargo routes for the Army Air Transport Command, flying freight between Army bases in ships flown and maintained by Delta personnel. These domestic routes covered the entire United States, with the ships being in constant operation, heavily loaded, flying in weather which would have grounded a passenger transport. Nearly five billion cargo pound miles were credited to this organization. In 1944 passenger traffic increased over 1943 figure by 51 per cent. Revenue passenger miles for 1944 were 65,838,063, with the actual number of travelers being 174,750, compared with 110,437 in 1943. Mail pound miles in 1944

mounted to 2,058,543,291, an increase of 49 per cent over the previous year. Air express increased 45 per cent, totaling 343,755,582 pound miles in 1944.

Braniff Airways on December 1, 1944, began a new international air express service to Mexico from four United States gateways, Dallas, Fort Worth, San Antonio and Laredo.

Late in 1944 Eastern Air Lines contracted to purchase a fleet of giant Lockheed Constellations and Curtiss (CW-20E) Commandos to complement its Great Silver Fleet in the postwar period. The four-engine Constellations, cruising at more than 300 miles an hour, would enable Eastern to maintain much faster schedules on long-distance runs; for example, four and one-half hours between New York and Miami or New York and New Orleans, Eastern's fastest 1944 schedules between these points being slightly over eight hours. The pilots in the company's Military Transport Division, operating for the Air Transport Command, gained considerable experience in flying the twin-engine Curtiss Commando across the South Atlantic ocean between Brazil and the Gold Coast of Africa. Eastern Air Lines broke all operations records in commercial air transport history when its fleet of Douglas DC-3 planes completed 70 consecutive days of operations at 100 per cent efficiency. The record was established between May 28 and August 5, 1944, and included runs on all routes of the EAL system. During this period all scheduled flights were completed. EAL was to include St. Louis Mo., and Boston, Mass., in its 1945 operations.

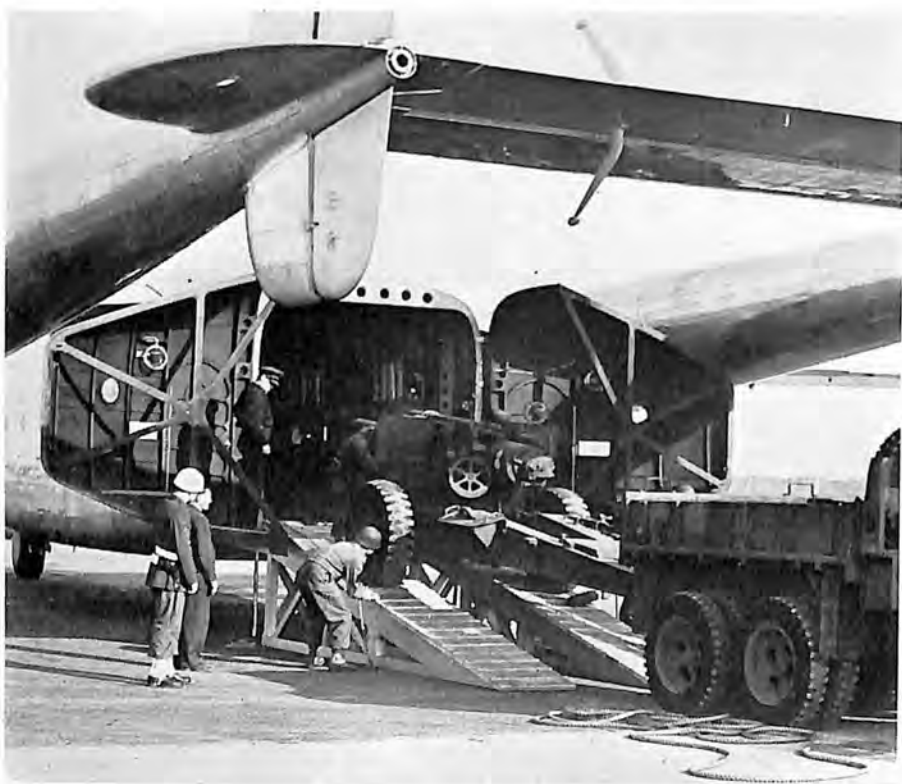


#### THE LIBERATOR EXPRESS

Consolidated Vultee C-87 Liberator cargo and personnel transport used extensively in the war theaters.



During the last several months of 1944, Mid-Continent Airlines had 12 flight crews engaged exclusively in operating approximately 114,000 miles a month for the Army Air Transport Command. During the Summer, a peak of operating efficiency was reached by completing 99 per cent of schedule flights. During the last six months of service for the Army, Mid-Continent flew 1,357,762 ton miles. During the period from May 19, 1942, when Mid-Continent started operations over cargo routes, to September 25, 1944, contract termination date, a total of approximately 16,700,000 pounds of vital war goods was transported over these routes. During this period, the line flew approximately eight and one-half billion pound miles for the Army, and carried approximately 8,500 military passengers.



#### LOADING FAIRCHILD C-82 PACKET

Designed to carry heavy war equipment, the Fairchild Army cargo plane is shown here taking on a 155 howitzer.

## CHAPTER V

### TRAINING FOR AIR SUPREMACY

Millions of Americans Receive Various Kinds of Training in Aviation  
—How Our Army and Navy Air Forces Became the Most  
Powerful in the World—Results of Civil Pilot Training by  
CAA—Training Activities of the Civil Air Patrol—  
Work of the Schools

**T**HE vast training programs of our Army Air Forces and Navy aviation developed the largest and most effective air forces in the world. At the same time other agencies were at work on training or educational programs either contributing directly to this part of the war effort or in other ways preparing Americans for positions in postwar aviation. Early in 1945, millions of young men and women already were skilled in the various aviation professions and trades, and thousands of others were in training.

In 1944, the Army Air Forces Training Command struck its peak in the output of pilots, navigators, bombardiers and gunners; tapered off in the production of technicians and began devoting a large portion of its energies to improvement and refinement of its training methods, and to the development of new skills required by specialized developments in aerial warfare. The year 1943 had been one of most rapid expansion and unprecedented manpower totals, as well as a year in which technical training hit the highest level, but 1944 output broke all records except in the number of technical courses completed.

In 1944 the AAF Training Command graduated 82,487 pilots, 22,180 navigators, and 19,214 bombardiers. The number of pilot courses completed reached 137,319. The margin of 54,832 courses was accounted for by the fact that many of the 82,487 men who won their wings went on to pilot transition courses in combat types of aircraft; and in addition there was a small number of glider, liaison observers and women pilots. The number of aerial gunnery courses successfully completed also reached a new high in 1944, with a total of 146,724.

The number of technical courses dropped sharply to 293,913 in 1944. In this total the number of basic courses completed was 151,172. Graduates of advanced courses numbered 56,118, factory courses 55,823 and officer courses 30,800. Some individuals were engaged in more than one course. The 293,913 total was classified by specialties

as follows—radio 96,883, aircraft maintenance 129,827, armament 40,463 and all other 26,740.

The 1944 grand total for all courses completed, including duplications involving individuals who took more than one course, or who took a technical course and a gunnery course, reached 619,350. The grand total was under that of 1943, due to the reduction in technical courses.

In the latter part of 1944, the trend in all categories was toward a reduction in volume; but meanwhile, marked progress was being made in improvement of all types of training, through the lengthening of training periods, through standardization of teaching methods, by providing new training manuals and training aids, and through expanded curricula. Among the new courses adopted was "Fighter Transition, Single Engine, and Fixed Gunnery." Major changes were made in the flexible gunnery program, through the use of four-engine training aircraft and addition of high altitude missions. Meanwhile, the Training Command initiated new types of training in such fields as radar and very heavy bombardment. Training on helicopters and an Emergency Rescue School were established in 1944.

As compared with November 30, 1943, when it had 490 schools and various other activities in operation—397 in flying training and 93 in technical training—the physical size of the AAF Training Command dropped sharply. The total number of activities on Dec. 31, 1944, was 150, of which 114 were in flying training and 36 in technical training. Among the activities eliminated were 151 college training detachments.

The Army Air Forces had a splendid system of aircrew selection and classification, which was adopted by the RAF. The Free French adopted the AAF psychological testing procedures. These procedures were described by Gen. Arnold in his report early in 1945.

Gen. Arnold stated: "The battery of 20 psychological tests used for classifying all candidates for pilot, navigator, bombardier, and aerial gunnery training have proved valid in predicting not only an aviation cadet's chance for winning his wings but also the flyer's chance for combat success. In a follow-up study of both bomber and fighter pilots in the European theatre, it was determined that pilots who had scored highest in the psychological tests administered before they learned to fly tended to be rated by the squadron commanders as most successful in combat. Likewise, those who had the minimum acceptable scores appeared to be most frequently 'missing in action.'

"The aviation psychology program in the past year has been extended to a point where it contributes to the number of bombs which hit within the target areas. It has been observed that bombing accuracy, as far as the human element is concerned, depends largely upon the ability of the navigator to set a course to the target area and upon the ability of the bombardier to identify the target and direct his bombs

to it. The practice of using Pathfinder airplanes to mark a target and of the units of a formation to drop their bombs on a signal from the lead airplane places a premium on the proficiency of the lead navigator and the lead bombardier.

"To aid the commanding officers of heavy bombardment groups in selecting the men best qualified for these key positions, psychological aptitude and proficiency tests have been adopted and are now routine in the European theater. A detachment of aviation psychologists studied bomb strike photographs in a three-months' series of missions against Germany and found a definite correlation between the accuracy of lead bombardiers and the original aptitude test scores they had received a year or more before, when they were untrained. The Aviation Psychology program has paid off in time, lives, and money saved, and through its selection of the raw material has aided in the establishment of an effective combat air force. This has been done at a total cost of less than five dollars per candidate tested.



#### TRAINING ON A BEECHCRAFT

Army Air Forces student bombardiers and gunners with a Beechcraft AT-11 advanced trainer.

"The personnel mainly responsible for training flyers in the efficient use of oxygen masks, electrically heated suits and other personal equipment are the aviation physiologists of the AAF Altitude Training Program and the personal equipment officers who are assigned to each tactical unit to preach the gospel of survival. During the past year air crew trainees were indoctrinated in the physiology of flight in 65 altitude, or low-pressure, chambers at the rate of 58,000 a month. Each airman is required to make three chamber 'flights,' the highest to a 'pressure altitude' of 38,000 feet, to learn the need of rigid oxygen discipline to prevent anoxia, or oxygen want, at high altitude.

"The contribution made by the aviation physiologist and the personal equipment officer, supported by aero-medical research, may be judged by the thousands of missions flown over Europe at altitudes of 20,000 to 30,000 feet without anoxia incident, and by the anoxia accident statistics of the Eighth Air Force. The anoxia accident rate among heavy bomber crew members was reduced in a one-year period from 116 per 100,000 man missions to 23. Meanwhile the fatality rate for anoxia dropped from 22 per 100,000 man missions to seven.

"Flying day after day against the enemy, dodging flak bursts, and shooting it out with enemy fighters has produced a type of war-weariness new to the American airman. On long missions the pilot, bombardier, tail gunner and other members of the team must be on the alert for eight or ten hours, watching, thinking, planning, shooting, administering first aid, and sweating out the long trek home. Combat wears men down. This war has now been going on twice as long as the last one. Replacement combat crews are shipped to the war theaters each month to relieve weary crews who return to the United States for rest and rehabilitation. To date over 100,000 AAF officers and men have been returned on rotation from overseas. Where men are so valuable that they cannot be spared for rotation, they are sometimes given thirty-day leaves in the United States.

"Overseas, combat crews become tight teams, each man trusting and supporting the other members. When a man has gone through combat with a group, he develops a dependency upon them as a team. Therefore, when a man is returned from combat under the rotation program, he comes back to America to face all the supposed uncertainties alone. This often produces a sense of detachment and loneliness.

"The AAF was the first to establish in 1943, a separate organization to receive and process overseas returnees, the AAF Redistribution Center, reconstituted in 1944 as the Personnel Distribution Command. The Command assumed jurisdiction over the three original redistribution stations at Atlantic City, Miami Beach, and Santa Monica, and has since established two others at Santa Ana, Calif., and Richmond, Va., Army Air Bases. Returnees, after 21 days leave at home, flow into these stations. In comparative leisure and comfort

three tasks are performed. First, the returnee is given a thorough medical examination. Second, he discusses his military experience with men who understand his problems because they also have faced them. Third, he is given an orientation on developments at home since he has been away and his future responsibilities, and he soon realizes that his continuing contribution will be of great value to the AAF. He is then assigned to an AAF station and recommended for the duty for which he is best suited.

"Making a clean break from the theory that once a patient's wounds have healed, only time and rest will bring him back to normal, the Air Surgeon declared early in the war that a minimum of time need be used in returning men to duty in health, if the patient's attention could be turned from his ailments toward a constructive program of educational and physical activity. The recovery program is based on the patient helping himself. On arrival, he is given a handbook in which he is asked to keep a record of his own recovery. However, for a welcome change in his military life, he does not have to fill out any forms—the medical people do that for him. He selects his own convalescent activities. He is treated as an individual. He is assigned to one doctor, who becomes his personal physician, with the physical therapist, the psychiatrist, and other medical specialists as consultants.

"Flyer's fatigue is an ailment peculiar to air combat. To cure it AAF convalescent hospitals have developed a specialized treatment, the results of which are returning our men weeks and months ahead of schedule, rested in mind and body, to assume positions in the AAF



PIPER CUBS AT EMBRY-RIDDLE SCHOOL

At Chapman Field, Fla., Navy pilots received training. Following completion of that program, civilian students were enrolled.

or in civilian life. To help our patients help themselves, the AAF has amassed at its convalescent hospitals equipment for all forms of vocational and physical treatment. Workshops with machinery used in teaching patients to make things and thereby to strengthen arms, legs and fingers, are basic equipment. So, too, are facilities for education. To his regular corrective exercises, a patient adds as much exercise as he wishes. He is encouraged to play golf, ride, fish, swim and hike. Hospital authorities are continually looking for new therapy outlets. Farms are operated in conjunction with many of the convalescent hospitals, the patients managing them and doing the work."

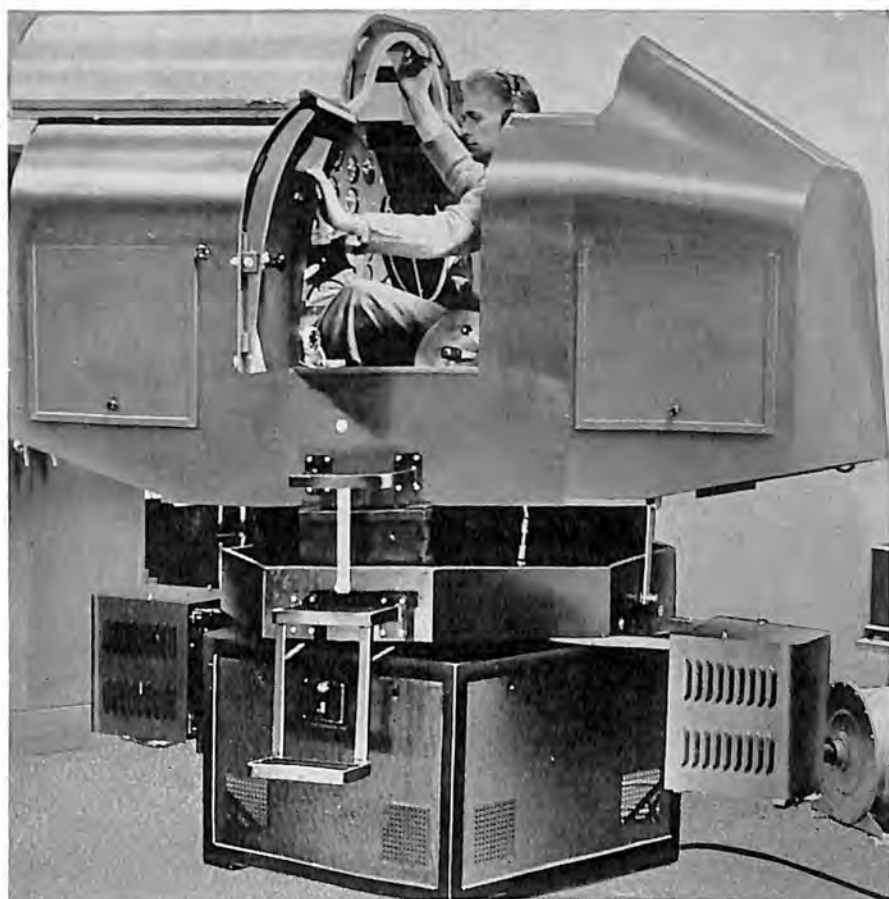
The United States Navy had 47,276 Navy and Marine Corps pilots in service at the end of 1944, as compared to 6,300 at the time of Pearl Harbor. Meanwhile, Navy aviation service schools turned out 27,515 graduates in 1942, 70,648 in 1943, and 72,945 graduates in 1944.

Rear Adm. DeWitt C. Ramsey, Chief of the Bureau of Aeronautics of the Navy, in his report of November, 1944, gave a most comprehensive description of the Navy's great part in training an air force for victory. He stated: "Confronted with the enormous problem of supplying pilots for the ever growing number of fighting planes of naval aviation, the training program was expanded rapidly. That it succeeded in achieving its goal without reduction in quality is attested by the combat record of Navy and Marine flyers, who consistently have maintained a record of shooting down five Japanese planes to every single loss of our own. In addition, at least 65 per cent of our airmen shot down have been rescued.

"Before the wartime expansion, pilot training consisted of a modest elimination training course designed to weed out the obviously unfit, followed by six months flight training at Pensacola and such amounts of further training with the fleet as circumstances allowed. This program was expanded until in February, 1942, just over two months after Pearl Harbor, the full wartime course, taking over 20 months for completion was instituted. Aviation cadets, all volunteers and all carefully screened and selected to secure none but the best mental, moral and physical specimens, first were given preliminary academic work at flight preparatory schools, established at 20 colleges. This was followed by preliminary ground training and very elementary flight training at 92 war training service schools conducted under Civil Aeronautics Administration supervision at schools and aviation fields throughout the country. Next the cadets were given a strenuous course in physical training, including boxing, wrestling, swimming, football, hand-to-hand combat, labor engineering, and military track, the latter on obstacle courses which have become well known features of many American campuses. This instruction was given at the five pre-flight schools, where instruction also was given in survival techniques. These pre-flight courses were designed to bring the future fliers to the peak of physical condition and to give them the alertness

and quick reflexes so necessary for combat fighting together with the ruggedness and endurance essential for survival if forced down on land or sea beyond their own lines.

"Following pre-flight school, the cadets were sent to primary flight training at one of the former Naval Reserve air bases where for 11 to 14 weeks they studied aerology, navigation, communications, recognition, and gunnery, and were given their first real flight training. In intermediate training at Pensacola or Corpus Christi, they had 14 to 18 weeks of similar studies, at the end of which they were awarded their Navy wings and were qualified as naval aviators. From intermediate, most aviators went on to operational flight training, where in a rigorous course, including qualification for carrier landings, they prepared for fleet service. From operational training they went on to the fleet, usually after some additional shore practice while forming their squadrons at various Naval Air Stations on either coast. Naval



NEW LINK INSTRUMENT TRAINER

This is model 45 of a long line of Link trainers.



Air Transport Service Pilots, Inshore Patrol pilots, Utility squadron pilots, and flight instructors were sent on to their specialties after the end of intermediate training. Marine Corps pilots, in view of their special future missions, at the end of intermediate went to Cherry Point, N. C., or to the West Coast for advanced training in their own squadrons. Lighter-than-air pilots went direct from pre-flight school to the lighter-than-air training centers at Lakehurst or Moffet Field for a four months course to qualify as Naval Aviators (Airship).

"As the program began to catch up with the wartime demands for pilots and facilities expanded, even more training could be given men already considered the best-trained aviators in the world. In 1944 Flight-Preparatory work and War Training Service were dropped from the program. These formerly consumed between 23 and 27 weeks. With the elimination of these phases, Pre-Flight work was expanded from 11 weeks to 26, Primary Training from 12 to 16 weeks, Intermediate Training from 14-18 weeks to 16-20 weeks, Operational Training from eight to 8-10 weeks. The total course is scheduled for a standard 70 weeks, and the pilots obviously benefit from the greater number of hours now spent in physical conditioning and actual flight instruction. In addition advanced training, beginning with a six weeks course, in special types of planes such as the PB4Y has been instituted. Moreover, under the present program, every cadet entering naval aviation from civilian life received academic work under the V-12 program which has been increased from one to two to three semesters of college work as the war has progressed. Cadets entering the training program from the fleet now get academic refresher courses of 16 weeks to put them on an academic par with their ex-civilian colleagues of V-12.

"Aircrewmen and groundcrewmen also had to be trained to service and maintain the planes of the huge wartime armada. That this training was also highly successful is proven by the low operational losses our squadrons have sustained both here and overseas. In 74 schools of the Technical Training Command, enlisted men were trained in engines and their parts, propellers, hydraulics, heaters, cameras, turrets, radio and radar, rubber equipment repair, guns and fire control, ordnance, special devices, parachute rigging and other specialties, the complexities of most of which have been increased vastly by the scientific and technical advances made during the war. Present capacity of the Technical Training Schools (including Class A, Class B, officer and refresher courses), is 43,206. Successful efforts have been made to introduce group training to aircrewmen for the multi-engine types.

"To release flyers for actual flight service, approximately 18,000 men without aviation background, but of proven ability, were commissioned from civilian life to take over administrative billets in the aviation program. Officers have received instructions in ordnance,

navigation radio aids, photo interpretation, control tower operations, air combat information, aerological and aviation engineering and other specialties from schools of the Technical Training Command. In addition to basic instruction, many refresher courses are offered to keep proficiencies in the various specialties at a peak and abreast of the latest developments. To carry out the training program, nearly 3,800 other men were commissioned and trained as instructors for the schools of the various training commands. Instruction in Flight Preparatory Schools and War Training Service Schools was entirely in civilian hands. Many officer and enlisted WAVES in aviation have received specialized training in the schools of the Technical Training Command in aerology, control tower operations, photography and photo-interpretation, gunnery, communications, parachute rigging, and other techniques.

"Supplementing the formal training facilities a number of important and effective innovations have been introduced. A large number of synthetic training devices have been developed for the training



THE BOEING ARMY-NAVY TRAINER

Named the Kaydet, Army model PT-13D, Navy model N2S-5, was built by the Wichita Division of the Boeing Airplane Company.

program (see below about special devices). Use of training films was inaugurated in 1940, and by October 1, 1944, over 368,000 prints of training films and slides had been distributed to aeronautics activities. Selections from combat films have been liberally used as they became available. Sixty-seven training manuals, textbooks and instructors' guides have been prepared and published either with the cooperation of private publishers or by the Navy itself. Eighteen "Sense Manuals" have been distributed to the training facilities and the fleet. Over two hundred specialized aerological and climatic local and regional studies have been prepared with the cooperation of the Army and the Weather Bureau and distributed.

"The scientific and engineering activity of the nation has produced, during the period since July 1, 1940, the most complex machines, equipment and weapons of war the world has ever seen. These expensive machines must be operated by young men, sent into combat in the air where the price of a first mistake is usually destruction. The problem of training pilots and aircrews and readying them for combat without delay necessitated radical innovations in methods of instruction, and it has been solved largely through what has become known as synthetic training. The synthetic training methods developed by the naval aeronautical organization have made possible the teaching of necessary skills rapidly, safely, and relatively cheaply through special devices which faithfully simulated operational equipment, thus stimulating instinctive reaction in the operation of combat equipment and giving the student the opportunity of making his mistakes before he meets the enemy. Operating synthetic training devices, students have experienced all the varying conditions of flight, and under controlled conditions have faced all the problems posed by complicated machines and human error, all with incredible realism and complete safety, and without interruption by bad weather, the bane of all training. By these methods operational planes and equipment have been saved for use in combat and training has been speeded up.

"Since April, 1941, nearly 850 projects have been processed and corresponding studies, development, and prototype work initiated. Of this total, about 500 different types of devices have been produced successfully and distributed to naval air training commands, the Army, and to our Allies. These include 55 devices to aid in navigation training, 25 in aircraft simulation, 60 in landfall techniques and recognition, 110 in gunnery, 30 in bombing and torpedo training, 90 in radar, and 80 for use in technical training such as engine operation and maintenance, anti-aircraft and anti-submarine warfare, and others. In February, 1942, the Bureau was working on 80 projects. Today there are 550 active projects under way. A total of 346 contractors have been employed on these projects. The variety of the functional requirements of special devices has necessarily not only involved invention, but exhaustive research, engineering, manufacture and distribu-

tion in such widely divergent fields as optics, mechanics, hydraulics, electronics, photography, and at times even medicine and psychology, as well as basic research in aviation, ballistics, navigation and the other training program subjects.

"Thousands of Army and Navy fighter pilots have improved their marksmanship by training on the hundreds of Gunairstructors developed and made available to teach pilots fixed gunnery. Well over a thousand 3-A-2 free gunnery trainers now in constant operation are providing basic and refresher training for free gunners in the Navy, the Army and for Allied flyers. During the past year 110 million feet of 16 mm. film and 50 million feet of 35 mm. film were specially processed and made available for use in recognition and gunnery training devices, a service which not only increased the efficiency of our gunners but directly reduced the amount of equipment and ammunition which otherwise would have been required and consumed for training purposes.

"Many effective devices have been developed to aid in better recognition of airplanes, thus drastically reducing the hazard of our planes being shot down by our own gunners, and improving our facility to spot and shoot down enemy aircraft. One of the most important of these devices is the Flash Projector, which gives airmen practice in recognizing planes of both friend and foe in a split second. Many thousands of school students, now young men enrolled in the military services, received their initial training in aircraft characteristics and plane recognition through the National Model Building



U. S. Army Air Forces photo  
BEECHCRAFT ARMY ADVANCED TRAINERS

Model AT-11 Kansan, used by the Army Air Forces for specialized training of bombardiers and gunners. These trainers were equipped with flexible guns and bomb racks.

Program initiated by the Bureau of Aeronautics with the cooperation of the U. S. Office of Education. Nearly a million approved recognition plane models were built by 500,000 high school students from Navy plans. These plans, translated into Spanish and Portuguese, have stimulated similar model building programs in many Latin-American countries.

"Advanced synthetic training equipment has been completed in the form of the Operational Flight Trainer, a full-scale replica of the fuselage of a plane in which an entire crew can simulate a bombing mission and perform their tasks as crew members on the ground without attendant danger of such practice in actual flight. Other devices of the same nature developed and used to provide aircraft simulation include pilot cockpit replicas with all the instruments and controls; aircraft arming replicas, which give aircrewmembers practice in loading their planes with bombs and guns with bullets; and cockpit trainers using genuine equipment from crashed planes and providing for correction of pilot mistakes by instructors. The 7-A-3, an advanced bomber trainer, is used to teach problems in dead-reckoning navigation, observation, reconnaissance, and high altitude bombing. Scores of devices have been developed for navigation training, chief of which are the Celestial Navigation Trainer and the Celestial Navigation Class Trainer which facilitate group training in celestial navigation and give navigators, pilots, and radiomen actual mission responsibilities without risking loss of life and equipment. Operable in any kind of weather, these trainers also may be used in groups to simulate squadron procedure.

"To meet urgent anti-aircraft training needs aboard ship, about 275 anti-aircraft gunnery trainers or modifications of existing aerial gunnery trainers have been produced and made available for installation on all types of carriers, battleships, light and heavy cruisers. Installations of anti-aircraft equipment also have been made at armed guard schools and other training centers. Special AA film depicting dive bombing and torpedo attacks were supplied with these devices. As the result of research in anti-submarine warfare, and the development of new training techniques and equipment, a complete submarine attack trainer was built. In the field of radar many devices still held secret for military purposes have been engineered, produced and made available to training activities and to the fleet for operational use.

"An aero-medical unit organized in the Bureau has developed refrigerated altitude chambers, oxygen equipment, and night vision and fatigue testing devices, use of which has brought changes in operational equipment and training techniques. Work is now progressing on cockpit standardization for purposes of more skillful operation and safety of aircraft. Device familiarization and maintenance courses have been set up for officer and enlisted personnel in both the Navy

and Army on major devices requiring detailed information relative to installation, operation and maintenance of equipment, with resulting increase in operating personnel efficiency and full utilization of equipment. Time and motion studies have improved the efficiency of pilots in landing and launching planes, handling crews, servicing and arming aircraft, loading and unloading bombs, and checking torpedoes on airplanes. Similar studies have been applied in modernizing a part of the training at the Naval War College."

Having given flight training to more than 400,000 students during the five years of its existence, the pilot training program of the Civil Aeronautics Administration came to a temporary halt in mid-1944. Its war job done, activity was terminated, but Congress passed a bill extending to July 1, 1946, the Civilian Pilot Training Act, under which the program had been authorized in 1939 for five years. It was expected that when the war situation permitted, and appropriations were made, the renewed authority would be used to establish in the colleges a revised version of the original CPT. This, it was hoped, would serve as a stimulant to the development of postwar personal flying. At its close, the program was engaged in giving initial flight training to men assigned by the Army and Navy. Since its change-over in July, 1942, to a full-time job of training instructors and pilots for the armed forces, the program had supplied the Services with



CONSOLIDATED VULTEE VALIANT

More than 11,000 of this type were produced for basic training.

326,816 fully or partially trained pilots. During its first three years, CPT trained more than 100,000 young men and women civilians, a reserve on which the armed forces drew heavily for pilot material. Many leading aces including Major Richard Bong, of the Army Air Forces, and Major Joseph Foss, of the Marine Corps, started with CPT. In addition, CPT was one of the greatest contributions to development of private flying. When the program began, there were less than 25,000 certificated civilian pilots in the country. Early in 1945, there were approximately 125,000. Not all the increase represented pilots trained in CPT, of course, but many persons became interested in flying, through the impetus given by CAA contract schools to aviation activity in their communities. The CAA training program was conducted under a system of contracts with colleges and commercial flight services, about 600 centers being in operation at one time. Many became thriving centers of private flight training. Another long-range effect of the program was the creation of a corps of skilled instructors numbering more than 13,000.

The only flight training carried on by CAA at the beginning of 1945 was its Inter-American program. A group of 30 young men from the other American republics were taking courses with Purdue Aeronautics Corporation leading to a commercial pilot certificate with instructor rating. Other phases of the program were training of 66 aviation mechanics at Spartan School of Aeronautics, and 39 air traffic controllers and communicators at CAA regional headquarters, Kansas City, Mo. In addition, 46 mechanics were taking post-graduate work in industry. They were the latest classes in a program which began in January, 1942, and had supplied several hundred trained hemisphere personnel for air line and other aviation activities previously dominated by Axis influences.

Early in 1942, the CAA undertook a nation-wide program of stimulating and assisting public schools in placing aviation in the curriculum. Early in 1945, thousands of students in the nation's high schools were studying aviation. The CAA's educational consultants, who, during 1942 and 1943 stumped the country explaining the importance of educating the young in aviation, were serving as consultants in advising on actual methods of putting aviation courses into school systems. Communities and, in many cases, whole States began this kind of training. In seven States during 1944 education officials met and adopted programs which they proposed for State-wide adoption. Although the subject matter differed, each of those states, Wisconsin, Colorado, Texas, California, Illinois, Connecticut and Pennsylvania, recommended to local school officials inclusion of four hours of dual flight instruction for each student of aeronautics. Similar instruction had been given in the past in some school systems in other States. A Source Book for Aviation Education Materials, prepared at Leland University in a CAA project, was completed. It

listed the methods and materials for aviation education in kindergarten and the first nine grades of school, and was available to all educators. The CAA continued a project of assembling practical laboratory teaching materials for aviation subjects, which was on display in Washington, D. C.

The Civil Air Patrol made one of the greatest contributions to the war effort by supplying tens of thousands of pre-trained men and women to the armed forces and to war industries. Earlier in the war, the detailed roster of CAP members was drawn upon often to secure airmen, trainees, and instructors for ferrying, glider training and pilot schools. After CAP became an auxiliary of the AAF in 1943, its first big job was to support the recruiting of young men of 17 to 26 for aviation cadet training. CAP was especially effective in securing large numbers of 17-year-old youths who took the physical and



#### AT CAL-AERO TECHNICAL INSTITUTE

Personalized instruction is the policy at Cal-Aero. Student, left, is shown working on airplane under guidance of instructor, right.



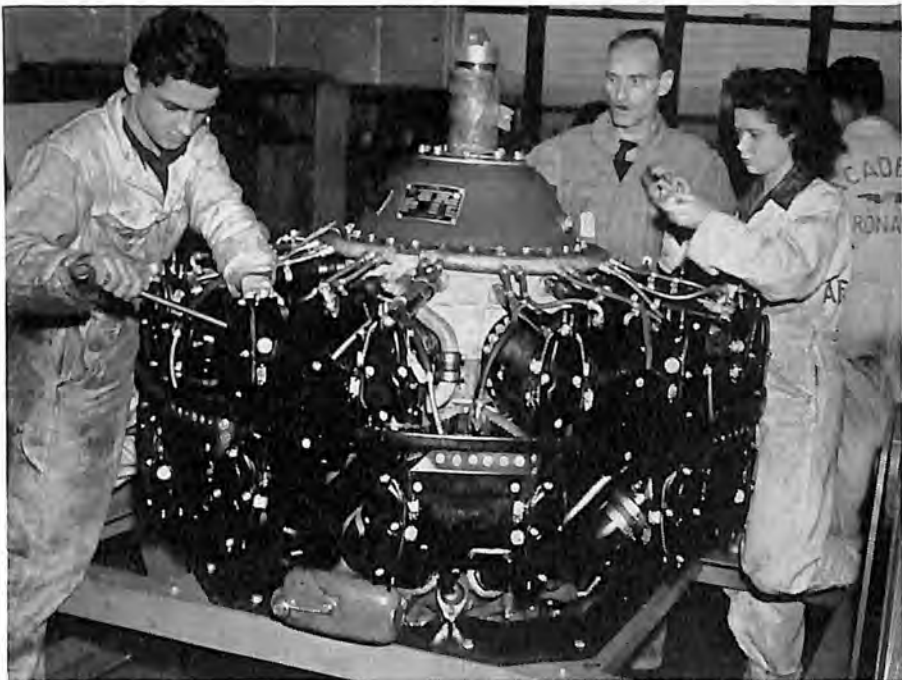
mental tests for the Air Corps Enlisted Reserve, and at 18 were called to active duty for training as pilots, bombardiers, navigators or gunners. By intensive local drives, utilizing all manner of promotional media through the Summer and gaining the cooperation of the schools in the Fall, CAP units in all areas gave substantial aid to the AAF examining boards and to the recruiting officers of the nine Army Service Commands. CAP not only interviewed applicants, but gave the mental screening test to tens of thousands.

Achieving success in that work, CAP expanded its cadet program, started on an experimental scale in 1942, in order to give as much aviation and military training as possible to young people about to enter the Service. It was found that young men with even a little military drill had a great advantage over raw recruits. Those who had studied such subjects as Morse code, meteorology, and navigation had such a head start that their chances of passing the rigorous Army courses were much improved. Training a combat pilot cost about \$25,000; so any reduction in failures saved the taxpayer's money. Through most of 1944, CAP continued its recruiting and mental screening for the Enlisted Reserve on an expanding scale. CAP Cadets of 15 and 16 were prepared to take the mental and physical tests at 17, and continued to train in CAPC until called to active duty. CAP also assisted the WAC recruiting effort, and many of its women members enlisted in the Women's Army Corps. By the latter part of 1944, the AAF had been built up to fighting strength and ACER recruiting was suspended. That left the CAP cadet program as the only preflight reserve in the country for young persons of predraft ages. CAP's recruiting machinery was functioning to expand the CAPC, but it was ready to go into action if called for the resumption of ACER recruiting. Even though there might be periods when a large surplus of AAF personnel would exist, the training of the young was a long-range need, because combat flying was a job mainly for men below 30, and present air forces personnel would become overage in a few years unless young trainees continued to join. The CAP cadet program was recognized in 1944 as a necessary future reserve when Gen. Arnold pointed out that our present Army Air Forces have been built "the hard way" and that a great reservoir of experience among the young people of the United States is insurance against ever having to build the hard way again. With this stress upon the cadet training phases of CAP, AAF Headquarters jurisdiction over CAP matters was transferred from the Assistant Chief of Air Staff, Operations, Commitments and Requirements to the Assistant Chief of Air Staff, Training. Under this jurisdiction, the CAPC was aided by special training aids and materials.

As the program was conducted early in 1945, cadet squadrons and flights were operating side by side with the senior units to which they were attached with their own cadet leaders under the supervision of

senior officers and instructors. Cadets received essentially the same sequence of instruction as for senior members. When they became 18, they could advance to senior membership and be credited for the courses which they had completed as cadets. While cadets did not engage in regular active-duty missions, they frequently served on volunteer assignments in emergency. Many went on ground search parties to find plane wrecks and rescue survivors. Cadets frequently guarded planes which crashed or made emergency landings, and they guarded airports during mobilizations when there were large crowds to handle. Cadets often signaled planes in distress to safe landings.

Although CAP did not give flight training, the policy was to give orientation flights to all cadets, to give them the feel of flying and to enable them to work out simple navigation and observation problems. The AAF supplied nearly 300 light planes of the liaison type to the 48 State Wings of CAP, primarily for that purpose. During 1944, these planes were flown more than 34,000 hours, and more than 62,000 cadets and prospective recruits were taken aloft. Many others had been given rides in planes owned by CAP members. Many, after advancing with their ground courses, took instruction from local operators and soloed. This was promising for postwar aviation. During the Summer of 1944, nearly 9,000 specially selected cadets



#### AT ACADEMY OF AERONAUTICS

War Service mechanics receiving training on radial engine overhaul.

from nearly all the States went to summer camp at 48 AAF installations for one to two weeks, to be quartered in Army barracks, live a G.I. life, and observe all the activities in the air and on the ground. In many areas, CAP cadets made week-end visits to Army bases. With this experience, the CAP and CAPC units tried to become as nearly as possible like AAF units in military precision and teamwork.

All cadet activities were under close supervision of parents and teachers. Parents, under the regulations, came to at least one meeting a month to see their boys and girls in action. Parental consent was required before cadets could enlist in CAPC and before they were allowed to take plane rides. Usually the cadet units met in school buildings after hours. Where the schools gave preflight courses, CAP credit was given, so there was no duplication between the CAP program and that of the schools. There was no pledge of military service. Besides being a war program, the purpose was to prepare young people for civilian aviation in the future days of peace.

Cal-Aero Technical Institute, Glendale, Calif., was the new name for a combination of famous pilot, engineering and mechanic schools operated by Major C. C. Moseley in Southern California. Major changes during 1944 and planning for the future were parts of the record of Major Moseley's Army-contract flight schools, Cal-Aero Academy at Ontario, Calif., Mira Loma Flight Academy at Oxnard, Calif., and Polaris Flight Academy at Lancaster, Calif., and his Curtiss-Wright Technical Institute, engineering and mechanics school, at Grand Central Air Terminal, Glendale. With discontinuance late in June, 1944, of basic Air Forces flight training in civil schools, Polaris became inactive; but because of superior facilities, Mira Loma Flight Academy, primary training contractor, was moved to mile-square War Eagle Field, vacated by Polaris, at Lancaster, where, at the end of the year, it was one of only two schools in California still conducting Army training. The vacated facilities at Oxnard were taken over by the Navy.

Subsequent curtailment of Army training closed Cal-Aero's operations at Ontario in October, 1944. Cal-Aero Academy immediately purchased the organization's headquarters field, Grand Central Air Terminal at Glendale, from Curtiss-Wright, renaming it Grand Central Airport, and combining Cal-Aero and Curtiss-Wright Tech under the name of Cal-Aero Technical Institute. Major Moseley had operated the field as manager for Curtiss-Wright from 1929 to 1934 and as lessee from 1934, until his outright purchase of it, and had headed Curtiss-Wright Tech since 1929. Plans for the possible reopening of the Cal-Aero field at Ontario after the war and for the future of the Mira Loma Field at Lancaster were indefinite, but an extensive program for Cal-Aero Tech at Glendale was put into effect.

While the school had continued its civilian aviation mechanics and aeronautical engineering training during the war, much expansion

to take care of expected civilian, veteran and foreign enrollment was in progress. At the close of 1944, veteran enrollment was increasing daily. Students from friendly nations, especially from Latin-America, were arriving rapidly; and material increase in enrollment of students under draft age, in 4F classification, or otherwise ineligible for military duty was noted. A new division of the school, known as the Special Devices Manufacturing Division, was created to build Mobile Training Units for Army and Navy aircraft. Postwar plans contemplated continuing this factory for building not only aviation training devices of all sorts, but training and demonstration units for any mechanical device.

At the end of 1944, the three Moseley-operated flight schools had trained approximately 25,000 Air Forces pilots who had received more than 1,400 decorations for valor in combat, not including second awards of the same medal. Cal-Aero Tech's military graduates numbered 7,500, with an overall alumni of nearly 14,000. Cal-Aero planned after the war to conduct flight courses for civilians, conversion of military pilots to private and commercial flying and refresher training. There were 64 civilian contract pilot schools which had turned out war pilots; and it was believed that after the war some kind of an Air Forces R.O.T.C. would be set up by the Government to use these schools and assure an adequate reservoir of combat pilots.



AT STEWART TECHNICAL SCHOOL

Students locating hidden defects in materials by magnaflux inspection.

The Embry-Riddle School of Aviation, Miami, Fla., with branch schools elsewhere in Florida, had trained 26,000 persons since its organization in October, 1939. Of that number, 22,000 were Army and Navy cadets, the company reported. The Embry-Riddle Technical School had a contract to train veterans, enrolling under the G.I. law, in aircraft and engine mechanics and radio. The entire interests of the Embry-Riddle schools in 1944 were purchased by John G. McKay, of Miami, and his associates.

Isaac Delgado Central Trades School, New Orleans, La., resumed civilian training after completing a three year contract for training enlisted mechanics for the Army Air Forces. Day school instruction was offered in aircraft and engine mechanics. Large numbers of the students were of pre-induction age and sought to prepare themselves for assignment to the Air Forces. Student turn-over was high owing to the need of aircraft factories for even partially trained mechanics. A wide variety of subjects was offered in night classes, the primary purpose of these classes being the upgrading of mechanics already engaged in the manufacture or maintenance of aircraft.

The Casey Jones School of Aeronautics, Newark, N. J., and the Academy of Aeronautics, LaGuardia Field, New York, during 1944 were devoted largely to training aircraft technicians, both men and women, for Army Air Corps depots. This program, financed by the Federal Department of Education and under the supervision of the Boards of Education of New York and New Jersey, was conducted for both the Air Service Command and the Air Transport Command, with graduates going to a great number of stations throughout continental United States, Panama and Hawaii. During the year the schools reverted to their former long term courses in aircraft engineering, design and construction, and aircraft mechanics, for civilians and for veterans under the G.I. law. These courses were formulated to provide the training necessary for continued employment in the aircraft industry. In order to keep pace with the advances in the industry a considerable amount of basic engineering was added. Provision also was made to credit returned veterans for mechanical experience received while in the military services, and a number of veterans already had started their training under the new program.

The Lodwick School of Aeronautics, Lakeland, Fla., entered its fifth year of training aviation cadets for the United States Army Air Forces. More than 12,000 cadets had been trained up to the end of 1944. The school's facilities included three steel hangars, administration building and class rooms for ground school instruction, a mess hall, three two story barrack buildings and a Link trainer building. Women workers were used exclusively on the flight line gassing the Boeing Kaydet trainers, cranking them and doing their jobs creditably. Inline production methods were installed in the maintenance hangar for the regular inspection periods which speeded up this work

and cut down man hours. Installation of engines which formerly required four hours now was being accomplished in one hour 15 minutes.

Parks Air College, East St. Louis, Ill., and its affiliate organizations, had an expanding program of civilian and postwar activities. With the cancellation of primary flight training contracts, in 1944, at the parent school, in addition to the Alabama Institute of Aeronautics, Cape Institute of Aeronautics, Mississippi Institute of Aeronautics and Missouri Institute of Aeronautics, Oliver L. Parks, president of the five institutes of aviation training, set the future sights for the five organizations. Parks, original primary flight training operator, trained over 24,000 cadets in his five schools.

Parks Air College continued its program of aeronautical training with the recently-enlarged two and a half year courses in aviation operations engineering, aviation maintenance engineering and aeronautical engineering leading to bachelor of science degrees. Enrollments held up well despite wartime conditions. Many of the students entering Parks were discharged servicemen securing their education and training through the benefits provided by the G.I. law. The veterans proved to be excellent students. Further, more than 300 postwar priority enrollment applications for matriculation at the College following the war had been received from men in the services.



AT CASEY JONES SCHOOL OF AERONAUTICS

Aircraft mechanic trainees preparing for jobs with the Army Air Forces.



#### THE TEXAN COMBAT TRAINER

North American Aviation's Army AT-6 and Navy SNJ which provided training for the flyers of 27 Allied nations.

Newest member of the Parks organizations was the resident flight school for young women, operated as a part of the Alabama Institute of Aeronautics at Tuscaloosa, Ala. First school of its kind in the country, the AIA offered 12 weeks of intensified training in ground and flight experience leading to a private pilot's rating. The school offered 42½ hours of flight time in addition to a comprehensive program of ground subjects. Students lived on the campus in Institute dormitories, under supervision of house counselors.

Spartan School of Aeronautics, Tulsa, Okla., offered civilian courses in aeronautical engineering, air line maintenance engineering, air line pilot, commercial flight instructor, commercial pilot, private pilot, flight instructor rating, instrument rating, weather forecasting, air line service (A&E) mechanic, aircraft mechanic, engine mechanic, radio communications, instrument technician, and women's instrument technician. Enrollments were maintained at a satisfactory level. The College of Aeronautical Engineering was set apart as a separate division of Spartan School and was accredited by the Oklahoma State Regents for Higher Education. Spartan was admitted to the Oklahoma State System of Higher Education as a private college member and approved to issue to graduating students the degree of Associate in Arts in Aeronautical Engineering. Complete civilian schedules were maintained. Spartan also operated a primary ground school for the Inter-American Aviation Mechanic Training Program under joint sponsorship of the Department of State and the Civil Aeronautics Administration. Graduates of this course went home to 14 Central and South American countries equipped to take their place in the aviation industry in their homeland. Spartan School also or-

ganized a new vocational rehabilitation department which gave counsel and supervised the training and placement of veterans who wished to enter the aviation industry. The school entered 1945 with approximately 1,077 employees, 1,101 students under instruction, and a total of 43 modern buildings at its two locations.

Rankin Aeronautical Academy, Tulare, Calif., operated by J. G. "Tex" Rankin, trained more than 10,000 cadets for the Army Air Forces in about 550,000 hours of flying instruction, with only five serious accidents. The school had postwar plans for civilian instruction, service station and other flying activities.

Roosevelt Aviation School, Roosevelt Field, Mineola, N. Y., completed a contract for the training of soldiers as aviation mechanics for the Army Air Forces, but continued its commercial school activities with an average attendance of about 150 civilian students. As a wartime measure, the School specialized in a six month's Aircraft Engine Mechanics Course which prepared for the test given by the Civil Aeronautics Administration for the aircraft engine certificate of competency. Special lecture courses presented by instructors of Roosevelt Aviation School were offered to employees of Roosevelt Field which was engaged in an extensive airplane modification program for the Navy.

Stewart Technical School, New York, had in training a number of



#### LODWICK SCHOOL OF AERONAUTICS

The school at Lakeland, Fla., with Army Air Forces cadets receiving primary training in Boeing Kaydets.



the veterans of this war, and at the same time had classes in the CAA approved mechanics course, as well as the Stewart course in aeronautical drafting and design. A specialized training program was completed for the air lines.

Other schools giving aviation training were Dallas Aviation School, Dallas, Tex., Harman Training Center, Ballinger, Tex., Lincoln Aeronautical Institute, Lincoln, Neb., New England Aircraft School, East Boston, Mass., Robertson Aircraft Corp., St. Louis, Mo., and United Air Lines Training Center, Oakland, Calif.



#### NEW GAS FOR OUR BURMA FORCES

Showing the Tri-Sure plugs on the fuel drums which assure that the contents have arrived in good condition.

## CHAPTER VI

### ACTIVITIES OF THE FEDERAL AGENCIES

The National Advisory Committee for Aeronautics—Aircraft Production Board, WPB—The Civil Aeronautics Administration—U. S. Forest Service—U. S. Weather Bureau—U. S. Public Health Service—Federal Communications Commission Aviation Division, Department of State.

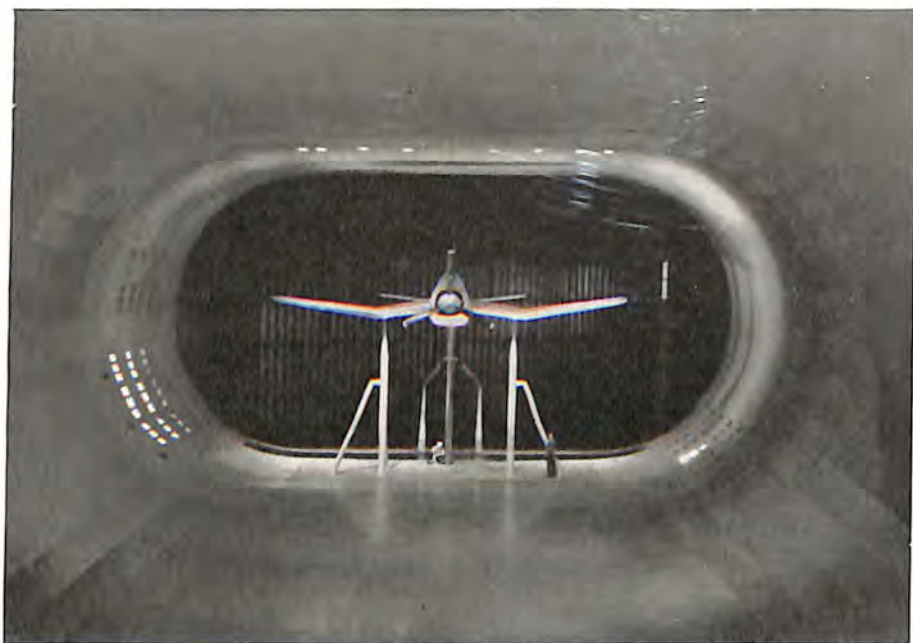
**T**HERE were several non-military agencies of the Federal Government active in the development of aeronautics. In 1944, each of the following agencies made important contributions to the growing strength of American air power.

#### National Advisory Committee for Aeronautics

The National Advisory Committee for Aeronautics was an independent agency of the Federal Government which Congress established in 1915 to "supervise and direct the scientific study of the problems of flight with a view to their practical solution". The NACA had a staff of 7,000 employees. The maximum speed of aircraft was materially increased during 1944 by development of the new NACA high-speed cowlings, which retained minimum drag to a higher range of speed than attainable in the past. Similarly, increases in speed also were facilitated by continuous improvement in NACA high-speed wings. The NACA was extremely active on problems in connection with the development of the gas turbine and jet propulsion power plants, and its research already had pointed the way to substantial improvements in these new fields. An entirely new field of aerodynamic problems involving flight of aircraft and guided missiles at speeds greater than the speed of sound was being explored. To develop these possibilities the NACA was constructing new wind tunnels having airspeeds in the neighborhood of 2,000 miles an hour.

Under the special war mobilization plan approved by the President in 1939, the NACA operated as an aeronautical research and engineering facility of the Army Air Forces and the Navy Bureau of Aeronautics. Under that mobilization plan, the NACA was devoting all its facilities and personnel to the solution of urgent aeronautical problems submitted to it by the Army and Navy. Most of its work was secret.

To overcome one of the most dangerous of weather conditions, that of icing, the NACA devoted about six years to research and develop-



NACA photo

## THE LARGEST WIND TUNNEL IN THE WORLD

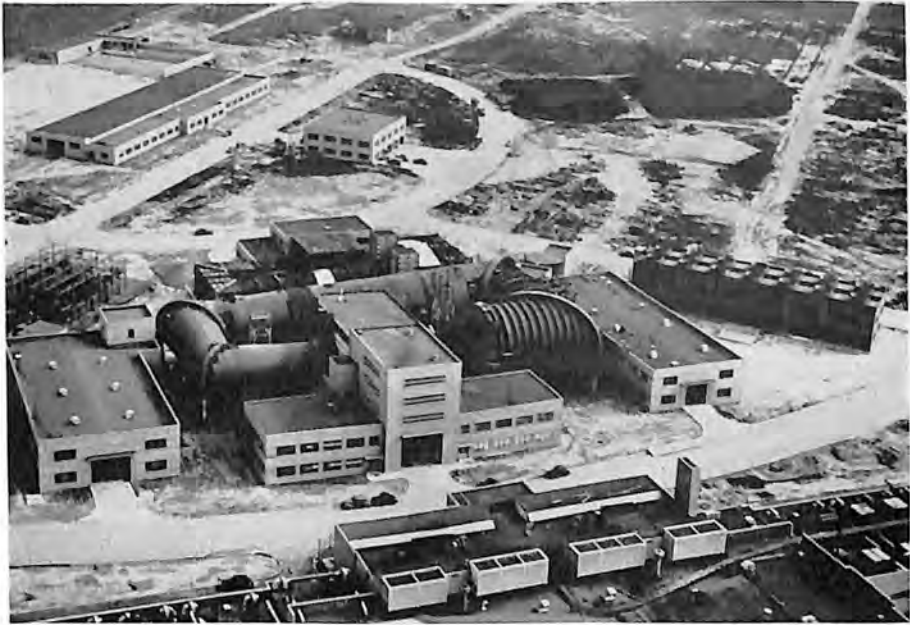
Navy scout bomber mounted in the National Advisory Committee for Aeronautics 40 by 80 feet wind tunnel at the Ames Aeronautical Laboratory, Moffett Field, Calif.

ment of the NACA exhaust heat de-icing system, for the prevention of ice formation on aircraft. In order that it might be improved and demonstrated by flight research, the NACA established a winter ice research station at Minneapolis, Minn. That station and necessary facilities were at first provided by Northwest Airlines under contract with the Army Air Forces, and later the station was operated by the AAF. There the NACA tested and improved its heat de-icing system, the development of which had been started at its Langley Field Laboratories, and continued at its Ames Aeronautical Laboratory at Moffett Field, Calif. That system was put in use on several Army and Navy types of aircraft to permit them to operate under previously impossible flight conditions. By that method, air was heated by the engine exhaust and conveyed to the leading edges of the wings and tail surfaces, preventing the formation of ice.

The top speed of fighter aircraft during the war increased several hundred miles an hour. One of the principal factors in obtaining the last 100 miles of increased speed was the use of wings employing the low-drag airfoils developed by NACA in many variations. The use of those airfoils reduced drag and retarded the compressibility phenomenon, and thus permitted aircraft with conventional power plants to operate at speeds in excess of 400 miles an hour.

Aircraft propelled by conventional power plants, that is, by reciprocating engines, reached their maximum speed at something less than 500 miles an hour in level flight, even when the low-drag wing and all other known aerodynamic refinements were employed. Because superior speed was a great military advantage, the NACA and the designers and builders of aircraft were investigating jet propulsion to obtain greater speeds.

On December 17, 1944, John Stack, Chief of the Compressibility Research Division at the NACA Langley Field Laboratories, delivered the annual Wright Brothers Lecture before the Institute of the Aeronautical Sciences on "Compressible Flows in Aeronautics". In commenting on the high speeds recently attained by aircraft, he indicated that it was not beyond possibility that in the next few years aircraft would travel at "clock-stopping" speeds, that is, aircraft may leave New York at noon Eastern Standard Time, travel with the sun at high noon all the way across the continent, and arrive at San Francisco at noon Pacific Standard Time the same day. That would be maintaining the same speed as the earth in turning on its axis.



NACA photo

#### NACA ALTITUDE WIND TUNNEL

Aerial view of the altitude wind tunnel of the National Advisory Committee for Aeronautics at its Aircraft Engine Research Laboratory, Cleveland, O. With an air speed of 500 m.p.h. it is the only wind tunnel in the world in which research can be conducted under conditions of temperature ( $67^{\circ}$  F. below zero) and density existing in the stratosphere.

**Aircraft Production Board**  
**Aircraft Resources Control Office**

The Aircraft Production Board was authorized by the Chairman of the War Production Board in December, 1942. The successful progress of the aircraft production program during 1943 and 1944 reflected the satisfactory operation of this Board. The Board was formed on December 9, 1942, under the Chairmanship of C. E. Wilson, Executive Vice Chairman of the War Production Board. The other original members of the Board were Lt. Gen. Wm. S. Knudsen, Major Gen. O. P. Echols, Rear Adm. E. M. Pace and T. P. Wright. Weekly meetings of the Board were held until the end of August, 1944, when Mr. Wilson left the War Production Board and Mr. Wright resigned from the Aircraft Resources Control Office to become Administrator of the Civil Aeronautics Administration. A few weeks prior to this, Gen. Knudsen had been made the Director of the Air Technical Service Command, Army Air Forces, and moved his headquarters to Dayton, O. As a result of these personnel losses, there followed a short period when no regular meetings of the Board were held, but during that time, the Aircraft Resources Control Office continued to function with the Joint Aircraft Committee in providing the central direction of the aircraft program.

On October 30, 1944, a reorganized Board met at the call of J. A. Krug, Chairman of the War Production Board. The Board resumed regular meetings bi-monthly, with the following membership: Mr. Krug, Chairman; Lt. Gen. Knudsen, Major Gen. Echols, Rear Adm. L. B. Richardson, Assistant Chief, Bureau of Aeronautics; T. P. Wright and M. A. Tracy, Recorder, Acting Director, Aircraft Resources Control Office. All phases of the aircraft production program were discussed at the regular Board meetings, emphasis being laid on the troubles which, in any way, retarded progress in production. The executive agency of the Aircraft Production Board was the Aircraft Resources Control Office, consisting of a representative of the Army Air Forces and of the Navy Bureau of Aeronautics, under the direction of the Recorder of the Aircraft Production Board. The Aircraft Resources Control Office had prescribed functions as follows:

The publication of aircraft programs. These airplane and engine production schedules, after coordination with the Services and prepared in suitable form, were presented to the Joint Aircraft Committee for consideration and then to the Aircraft Production Board for final approval. The Aircraft Resources Control Office was designated by the War Production Board as the claimant agency for the aircraft program, under the Controlled Materials Plan. This function was discharged by the Resources Division. It also dealt with other requirements of the aircraft program, including those for components, non-controlled materials and tools. Through excellent coordinated

efforts, it managed to keep material and component shortages to a minimum. The conservation and materials officers of this office coordinated between the Services, the War Production Board and industry matters pertaining to conservation and standards of materials and components for the aircraft program. The manpower office carried out the necessary coordination in reconciling the functions of the War Manpower Commission, the Office of the Under Secretary of War and of the Under Secretary of Navy, and the War Production Board, insofar as aircraft requirements were concerned. The Statistical Branch of ARCO prepared and disseminated statistical information pertinent to the aircraft program.

An Aircraft Scheduling Unit was established at Wright Field under the direction of ARCO, to prepare requirements for the air program in terms of materials and components. In addition, this unit handled the allocation and distribution of materials and components to the aircraft industry. The unit also was the point of contact with the industry for ARCO.

Major problems which confronted the Aircraft Resources Control Office during the expansion of the production program were many. In the early days of the program, machine tools were the outstanding critical items. That bottleneck soon developed into troubles on overall facilities, which, in turn, gave way to materials as a principal obstacle to accomplishment of the program. During the early part of 1943, the material situation was bad in a number of fields, but toward the end of 1943, material problems disappeared in favor of the latest bottleneck—manpower. Throughout the entire period of 1943 and 1944, the Aircraft Production Board put forth considerable effort to combat the short term over-optimism on the war in general, which would, from time to time, spring up prematurely as more and more pressure was exerted for reconversion to peacetime manufacture. However, in the third quarter of 1944, with the sweeping Allied successes in Europe, the aircraft production programs were beginning to cut back in anticipation of early victory on that front. Toward the end of 1944, many of these cutbacks had, in some degree, been restored as the European war continued. At the beginning of 1945, material shortages again loomed as a possible limitation on the production of aircraft. Shortages of aluminum sheet began to appear as inventories reached dangerously low levels. Immediate steps were taken to correct this situation through careful screening of requirements and concentrated effort on the manning of aluminum mills.

The coordinated efforts of all the joint agencies of the Government, the aircraft industry and labor resulted in record production. During 1944, the aircraft industry turned out 96,369 planes of all types. In terms of airframe weight, the 1944 output reached the unprecedented total of 1,112,000,000 pounds, an increase of 50 per cent over that for 1943. Increasing emphasis on the larger aircraft marked

the development of aircraft production during 1944. Average weight rose over 2,000 pounds to a weight of approximately 10,500 pounds per airplane. Coincident with the tremendous increase in the weight of aircraft production, the increased efficiency, measured in terms of airframe weight produced per employee per month, increased to such a degree that it was possible to achieve this record production with fewer employees. From a peak of 2,100,000 employees at the first of the year, employment dropped to roughly 1,700,000 in the entire aeronautical industry by December, 1944.

The program set up for 1945 called for even greater output than that for 1944. Early estimates of the 1945 program, in terms of airframe weight, indicated production of about 1,125,000,000 pounds. The monthly schedule for 1945 was stabilized substantially at the 7,000 per month mark, but the ever-increasing average weight of these planes would "require the continued splendid support of the aircraft industry and labor," according to a statement by the Aircraft Resources Control Office.

In November, 1944, the War Production Board set up a new Aircraft Division, and some of the activities relating primarily to civilian aircraft matters were transferred from the Aircraft Production Board to the new division, which was headed by Henry P. Nelson. In February, 1945, Mr. Nelson announced the organization set-up, and outlined its functions as follows: "The functions of the new Aircraft Division based on an over-all survey of the problems affecting the potential production and distribution of commercial aircraft are 1—To keep at peak performance the operation, maintenance and repair of all civilian aircraft, airlines and aircraft facilities (non-military). 2—To set up plans and procedures for programing the production of commercial aircraft and maintenance parts. 3—To establish and maintain working relationships with other Government agencies having a direct or indirect interest in the production, maintenance or distribution of commercial aircraft and aircraft maintenance parts. 4—To establish and maintain working relationships with industry advisory committees as regards the production and distribution of commercial aircraft. 5—To set up and maintain a continuous study of aircraft production facilities and manpower to the end that definite plans can be made that will help the aircraft industry readjust its methods of operation and production into peacetime economy. 6—To secure from other offices or bureaus of WPB, Army, Navy, other Federal agencies, State agencies, civic or business groups or associations such statistics or data as may be pertinent to post V-E and V-J Day (including transition period) problems of reconversion of the aircraft industry from war to peacetime production."

#### Civil Aeronautics Administration

The Civil Aeronautics Administration, in helping to formulate

technical standards for world flying at the International Civil Aviation Conference late in 1944, concluded a year in which the CAA laid the groundwork for a vast expansion of civil flight. CAA experts prepared 300-odd pages of technical documents as the basis for the conference technical discussions; and this contribution was praised highly by the foreign delegations. A ton or more of CAA publications were distributed to the foreign conferees. The CAA planned to play an important part in facilitating the conversion of the aviation industry from a war to a peacetime basis. Recommendation for construction of 3,050 new airports and improvement of 1,625 existing fields was made by the CAA in its National Airport Plan as a requisite to development of postwar flying. It is described fully in the chapter on airports and airways. T. P. Wright was appointed Administrator of the CAA in August, 1944, and Charles I. Stanton became Deputy Administrator. An early action by the new Administrator was to propose CAA cooperation with the industry in development of aircraft for popular use, and selection of an advisory committee from the industry to work with CAA officials in development of personal flying. Revision of the Civil Air Regulations, particularly those affecting private flying, was carried on by CAA with the Civil Aeronautics Board cooperating. The CAA continued its stimulation of air education for the secondary schools, some of which installed actual flight experience in their curricula.

An evidence of a gradual shift toward peacetime flying was the termination of the CAA War Training Service Program, which had furnished the Army and Navy with 326,816 partially trained pilots from July 1, 1942, to August 5, 1944. By-products of the conclusion of this program were the sale of about 5,400 surplus aircraft, disposed of by competitive bidding with an average of eight bidders per plane; a backlog of private business which has kept former CAA flight contractors pressed for help and equipment; and a contract resettlement program that satisfactorily settled 95 out of 96 contracts in as many days.

During 1944, CAA established a center for testing Army and Navy aircraft for civil airworthiness, in order to assist manufacturers in determining the changes which would be necessary to make those planes suitable for commercial use. This CAA Military-Test base was located at Augusta, Ga. In the field of technical research, CAA assisted in the development of inexpensive stall-warning devices which were designed to eliminate that hazard to private flying; successful testing of aerial photography as a means of choosing airport sites; a scientific fabric tester, and perfection of a new type of radio range station which threw out a course signal in all directions. Experiments in pilot training were carried forward under CAA guidance at the University of Tennessee, Stephens College, and other institutions, with the aid of magnetic wire recorders and specially installed moving picture



cameras, which were used to promote uniformity in rating student pilot performance and to improve flight instruction methods.

Instruction of young men from the other American republics continued under CAA auspices, with a group of 31 pilots in training at Purdue; 44 traffic control and communications technicians at CAA Regional Headquarters, Kansas City, Mo.; and 66 mechanics at Spartan School of Aeronautics, Tulsa, Okla.

Foreign operations of CAA were expanded generally. CAA missions aided pilot training in Mexico and Brazil, and in the latter country they also assisted in air traffic control work. Technical advice was given to missions from the Soviet Union, Australia, United Kingdom and many other countries. In Alaska a communications expansion program was carried out which overcame the radio "fade-outs" peculiar to the Territory. They had rendered the system 50 per cent inoperative in the past. A new regional office was established at Honolulu to handle increasing Pacific air traffic. War emergency restrictions on flying were eased considerably outside the vital defense areas, and the boundaries of those zones were narrowed greatly. The CAA program of assisting the development of aviation education in the elementary and high schools won for Dr. Edgar Fuller the Brewer Trophy, awarded annually for outstanding work in this field.

#### U. S. Forest Service

Much of the wartime work of the U. S. Forest Products Laboratory in 1944 was concentrated on research and technical services needed to increase the utility and value of forest products in aircraft. The Forest Products Laboratory was maintained by the U. S. Forest Service at Madison, Wis. Based on studies of the requirements of wood aircraft repair, and the materials, equipment, and methods necessary for making repairs, a manual covering the structural repair of wood airplanes was prepared by Laboratory technicians. The manual was published jointly by the Army Air Forces, Navy Bureau of Aeronautics, and the Air Council of the United Kingdom. A "Handbook on the Design of Wood Aircraft Structures", prepared in 1943 for the Aeronautical Board, was revised to include the latest Laboratory information on design of wood airplanes and gliders. At the invitation of the British Ministry of Aircraft Production, five Forest Products Laboratory staff members went to England to inspect and consult on the use of wood and modified wood products in aircraft under war service conditions, and to effect a more complete and continuous exchange of aircraft research data.

Dry kiln certification studies to assure adequate facilities for drying aircraft lumber were made for the Army Air Forces. A number of rapid and reliable methods were developed for the use of inspectors in determining the suitability of veneer and lumber for aircraft. A

summary of information gathered on the durability of a wide variety of aircraft glues was prepared.

"Staypack", the Forest Products Laboratory's new development in compressed wood, was undergoing tests to determine its suitability for airplane propellers and other war uses. Unlike "compreg" and "impreg", earlier Laboratory developments, staypack required no resin. It was a heat-stabilized, high-density product made by compressing either solid wood or many layers of thin veneers. Compressed under proper heat and moisture conditions, the wood was partially plasticized by the flow of its own lignin. It had practically no tendency to lose its compression under high moisture conditions. Besides being thus practically free from "springback", it had high tensile strength and toughness. As staypack was not in commercial production, its postwar uses in the aeronautical field could be predicted only on the basis of its known properties and on the fact that it was cheaper to manufacture than improved woods containing considerable synthetic resin. Its high impact strength suggested its use in spar plates for strengthening the joints between fuselages and wings in the postwar small airplane and in propellers for aircraft.

One of the important wartime activities of the Forest Products Laboratory was solving shipping container and packaging problems of



U. S. Forest Service photo

#### PARACHUTE FOREST FIRE FIGHTERS

Crew of smoke-jumper trainees preparing for a training flight, supervised by a regular Forest Service jumper, at left.

the armed services. New container designs, improvements in earlier designs, and improved procedures for cleaning, rustproofing and packaging hundreds of items of military equipment and supplies were developed. Much emphasis was placed on the development of containers suitable for repeated use to help conserve the supply of critical lumber. The work of the Laboratory's Container Division resulted not only in preventing much damage to equipment in shipping but in great savings in cargo space. It was estimated that on the average four ships could carry the material for which five ships were formerly required. Part of this container work was carried on for the Army Air Forces. Among the many containers designed were those for radial and inline aircraft engines, self-sealing fuel cells, droppable fuel tanks, turbosuperchargers and gun-sights.

During 1944, the Forest Products Laboratory staff gave special training courses to a total of 6,525 persons, including officers and enlisted men of the armed forces, and manufacturers' representatives. Of these, 5,904 were trained in packaging and shipping container work, and the others in aircraft wood inspection, aircraft repair and maintenance, laminating timbers for ships and boats, and inspection of military vehicle wood. Since the inception of these instructional courses in 1942, a total of 10,240 persons had received training at the Laboratory.

In connection with its timber requirements and supplies work for the War Production Board, the Forest Service prepared grading rules for aircraft lumber and made a study of production costs for those grades.

War requirements for aircraft spruce passed their peak in 1944, and the Forest Service therefore began to wind up its Alaska Spruce Log Project, initiated in 1942 to help meet urgent requirements for aircraft lumber. Falling and bucking of timber at the Edna Bay Camp in Tongass National Forest was suspended in May. Yarding, booming, rafting, and towing the logs to mill, however, took several more months. By the time the project closed, approximately 45 million board feet of high-grade Sitka spruce logs were delivered to Puget Sound mills. About an equal amount of lower grade spruce and hemlock was delivered to Alaska mills for use of the armed forces in the Territory. It was expected that further wartime needs for aircraft spruce could be met by production in Washington and Oregon.

The fire detection system of the Federal and State forest services formed the nucleus of the aircraft warning system set up by the Army after the attack on Pearl Harbor in 1941. Some 730 forest fire look-out stations were incorporated in this service. As the need lessened, most of this activity was discontinued.

The Forest Service's parachute corps in 1944 consisted of 97 men—87 "smoke-jumpers", plus an administrative officer in charge, a chief instructor and equipment development man, two foremen of

parachute squads, and six squad leaders. The group had 28 members qualified as riggers. As in 1943, a majority of the smoke-jumpers were conscientious objectors from Civilian Public Service camps, who had volunteered for this service. Wartime turnover of personnel and expansion of the smoke-jumper activity since the project was started in 1940 with six men necessitated training new men each year. Of 55 men trained from 1940 through 1942, more than 40 joined the Armed Forces, fifteen as officers. Jumper training at the Forest Service parachute training center near Missoula, Mont., was a systematic and intensive course, employing lectures, motion pictures, equipment demonstrations, calisthenics, obstacle course, training tower, and high-line and plane mock-ups. The men had to know not only parachute jumping but woodsmanship and fire-fighting techniques. Representatives of the Army, the U. S. Coast Guard and Canadian Pacific Airways were trained in back-country aerial rescue work at the training center in 1944. Six Army doctors trained in Forest Service methods were credited with saving 79 lives in less than a year.

During the 1944 season, 78 back-country forest fires were confined to small areas and negligible damage by Forest Service smoke-jumpers in the territory served—Montana, Idaho, and parts of Oregon and Washington. Smoke-jumper operations made possible a reduction of 52 ground force positions in the fire protection organization in the national forests covered by the parachute squads. Up to the end of 1944, there were only two lost in accidents on fire jumps during the five years that Forest Service smoke-jumpers had been going down to fires in 'chutes in some of the roughest country of the Western states.

#### U. S. Weather Bureau

The U. S. Weather Bureau's aviation weather-service operations supplied essential weather information and service for the protection of aircraft and to facilitate flying operations, both civil and military. Significant changes included the transfer of the first-order station from Redding to Red Bluff, Calif., and the establishment of new upper wind observation stations at Charlotte, N. C., Goodland, Kans., Lynchburg, Va., Mount Laguna, Calif., Meridian, Miss., and Puerto Cabezas, Nicaragua; and (in cooperation with the United States Coast Guard) at North Truro, Mass., Oak Island, N. C., Point Judith, R. I., and Port Angeles, Wash. Observation procedures were modified to provide additional high-level wind data by the use of larger (100-gram) balloons at 70 pilot balloon stations. All radiosonde stations were authorized, for the same purpose, to run theodolite observations of the 1100 EST radiosonde balloon in flight. New radiosonde observing stations were opened at Grand Junction, Colo., and Jackson, Miss.; and a cooperative station operated in conjunction with the Government of Cuba, was established at Havana. Radiosonde observations were transferred from Detroit to Toledo; and in Mexico the radiosonde

observations at Tapachula were transferred to Merida in the state of Yucatan. There were in operation in Mexico three radiosonde stations making reports available once daily in the United States.

Early in 1944, after operating one and one-half years, the training program for radiosonde observers and technicians conducted at the Washington National Airport was discontinued, having completed instruction of 84 Weather Bureau observers, 245 Army observers, nine Canadian observers, and two Mexican observers. In cooperation with Harvard University specialists in cloud classification, the Weather Bureau inaugurated a program of nationwide instruction to improve the definition and reporting of cloud conditions. Also, a new portable reflection-type nephoscope was developed for reading cloud speeds directly and obtaining their direction of movement in degrees of azimuth.

The program for installing ceilometers (the electronic device for precise measurement of ceilings at all hours of the day and night) was delayed by shortage of funds and difficulty of obtaining labor to accomplish the installations. However, prospects were considerably brighter for advancing this program during 1945.

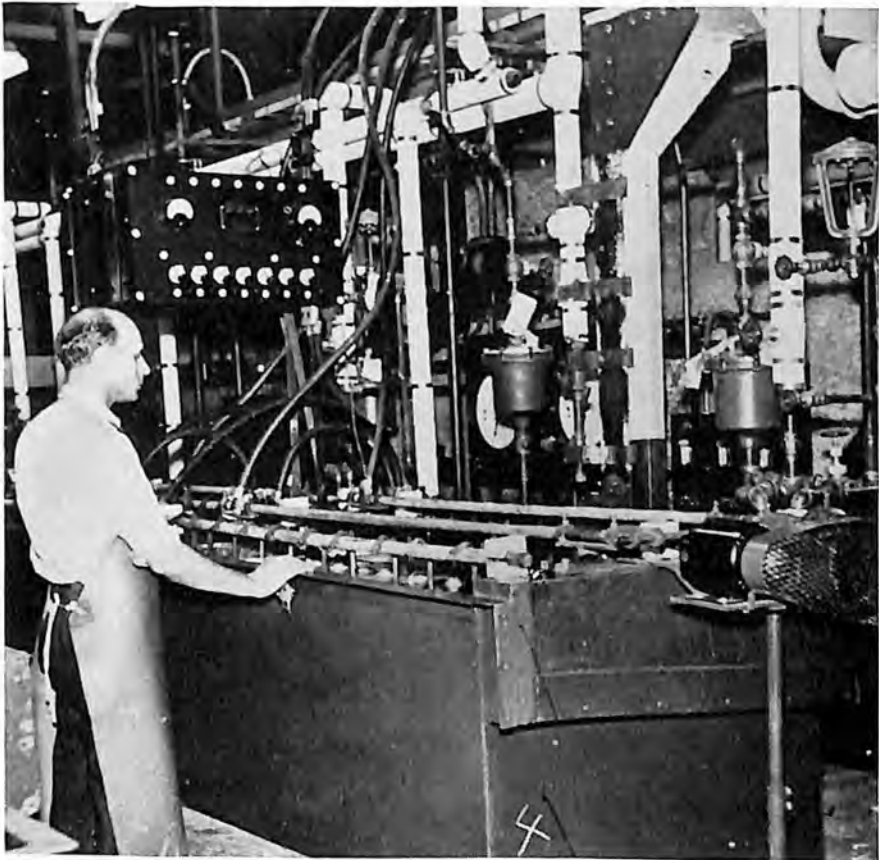
Recruitment and training of competent personnel for the national weather service continued difficult, owing to the manpower shortage. At the close of 1944, approximately 1,000 women were in active service as subprofessional observers, and a few as professional meteorologists. Most of them replaced men who were on military duty, while the remainder filled new positions established to meet the demands of the armed forces for increased meteorological service. For financial reasons it was necessary during November, 1944, to discontinue temporarily the seven regional training classes for observers conducted at New York City, Atlanta, Chicago, Fort Worth, Kansas City, Los Angeles and Seattle. It was thought that they would be resumed in 1945.

Of special interest to aviation was a study being conducted in the Weather Bureau of the structure and sources of energy in hurricanes and thunderstorms. The hurricane that passed over Galveston and Houston, Texas, on July 27, 1943, was investigated to this end. The aerological observations made in the vicinity of this disturbance, combined with certain theoretical deductions, pointed to the likelihood that the circulation about the storm transported dry air into the system above 10,000 feet, while very moist air remained in the underlying stratum. From theory, it was concluded that this distribution of air masses was conducive to the development of strong ascending currents and the formation of heavy rain around the "eye" of the hurricane, accompanied by strong, gusty winds near the surface. Thunderstorms also occupied a high priority in the list of meteorological phenomena requiring further study. An investigation was carried forward to ascertain how the distribution of rain, snow and hail of thunderstorms affects the energy manifested by these local storms. The results indi-

cated that vertical currents may be controlled to a great degree by the falling of ice crystals into a cloud of water droplets. That led to a better comprehension of the factors determining thunderstorm turbulence, often a considerable hazard to aircraft. The practical application of these results to forecasting were logical developments to be anticipated in the future.

#### U. S. Public Health Service

The United States Public Health Service had jurisdiction over aircraft coming in from foreign countries. Some aircraft were disinfected after passengers and crew had disembarked, but others received the treatment before the occupants left the plane. The work in foreign quarantine increased sharply during 1944, with a 61.8 per cent rise in airplane traffic over 1943, and an 81 per cent increase in



#### PREVENTING ENGINE CORROSION

View in Jacobs Aircraft Engine plant showing equipment which electroplates exposed engine parts with cadmium to prevent corrosion.

number of air passengers. The first recorded case of a quarantinable disease (smallpox) crossing an international frontier by air occurred at Miami, where a 24-hour service for quarantine processing of aircraft was established. Entomologists were assigned to a number of airports of entry to supplement the technique of airplane de-insectization, and entomological service was to be extended to other airports as soon as practicable. The Interdepartmental Quarantine Commission appointed in 1943 by joint action of the Federal Security Administrator, the Secretary of War and the Secretary of the Navy, completed its study of quarantine practices throughout the international air routes of the world. A comprehensive plan for guarding against the introduction by air of quarantinable and other diseases of the tropics and elsewhere was submitted, and recommendations which would bring procedure in this country into line with modern scientific knowledge were being put into effect at airports of entry in the United States and its possessions.

#### **Federal Communications Commission**

During 1944 use of radio by aircraft was accelerated in an effort to maintain safety and efficiency of peacetime operations under heavy war traffic and with a limited number of aircraft. During the fiscal year ended June 30, 1944, a total of 3,689 authorizations to use radio transmitting equipment in the aviation services—aircraft, aeronautical, aeronautical fixed, airport control, flying school, flight test and marker beacon radio stations—were issued by the Federal Communications Commission.

The needs of radio frequencies for a greatly expanded commercial and private aviation after the war were examined in overall allocations hearings at the FCC during the fall of 1944. At the hearings, additional space in the radio spectrum was sought for aviation from the very low through the ultra high frequency ranges. In December, 1944, recommended allocations for domestic and international aviation after the war were in preparation at the FCC and were shortly to be forwarded to the State Department for use at forthcoming international conferences on communications.

The Commission, working with the Civil Aeronautics Administration and the Interdepartment Radio Advisory Committee (which allocates frequencies for use by the government), was considering the radio needs of several new interstate air line routes throughout the country for which applications had been made to the Civil Aeronautics Board.

#### **Aviation Division, Department of State**

The Aviation Division of the Department of State, which replaced the Aviation Section of the former Division of International Communications on January 15, 1944, had responsibility for initiating

policy and action in the Department, and coordinating it with other Government agencies, in all matters pertaining to international civil aviation. This included the development and operation of air lines and air transportation, the acquisition of landing rights abroad, and matters relating to airports and airways. It also included negotiation of various international agreements, such as the bilateral arrangements covering air transport and air navigation. The Division assembled basic material and made other preparations for international aviation conferences. In that connection it acted as the coordinating agency in the preparation of background material for the International Civil Aviation Conference held at Chicago during the latter part of 1944. It followed up, with other Governments, the arrangements proceeding from this conference. The Division also represented the Department of State on the International Technical Committee of Aerial Legal Experts (CITEJA), the U. S. National Commission of the Permanent American Aeronautical Commission (CAPA), and other international bodies dealing with aeronautical affairs.

Functions of the Division also included representation on inter-departmental groups having to do with the allocation of aircraft abroad; the implementation of this Government's civil aviation policy in foreign countries; the training, under American auspices, of foreign aviation personnel in the United States and abroad; air mail policy



VOUGHT CORSAIRS IN BRITISH SERVICE

F4U fighters aboard a British carrier in the North Sea prior to a strike against a German convoy off the coast of Norway.



and other subjects involving interdepartmental collaboration. It also obtained military and civil flight permits for United States aircraft proceeding abroad and for foreign aircraft visiting this country.

The Aviation Division was responsible for the assignment of Civil Air Attaches to various foreign countries, and it gave appropriate instructions to these field representatives. The Division also supervised the U. S. Foreign Service (Embassies, Legations and Consulates) in their handling of civil aviation matters and reporting these developments to Washington, and it arranged for the dissemination of such information to other Government agencies and industry.



U. S. Coast Guard photo

#### A COAST GUARD SIKORSKY HELICOPTER

A rescue helicopter is lifted off the deck of a Coast Guard cutter in the North Atlantic.

## CHAPTER VII

### AIRPORTS AND AIRWAYS

How the National Airport Plan Would Establish Landing Fields Throughout the United States—Our World-Wide System of Airports and Airways—An Achievement of Inconceivable Magnitude—Amazing Projects Carried Out by the Army, Navy, Civil Aeronautics Administration and Other Federal Agencies—The Civil Air Patrol's Development of Airports—Landing Facilities Plan of the Aeronautical Chamber of Commerce of America.

**A** GIGANTIC development of airports and airways throughout the United States would be started as quickly as possible, if the aviation people, both in and out of official life, were to have their way. The incredible achievements of air transportation and all our other aeronautical accomplishments during the war, especially technical progress, encouraged belief that postwar flying would grow as rapidly as facilities permitted, just as good roads and service stations popularized motoring. To that end, all the aviation groups and the Federal and State agencies dealing with aeronautics in one way or another were promoting a nation-wide system of airports and, for over-water craft, air harbors to accommodate more scheduled air line operations, more privately-operated flying, both by business and by individuals, and the almost limitless variety of Federal and State, county and municipal activities—ranging from patrol and crop surveys to local air police and visiting nurses, possibly. The countless jobs that flying machines could do well justified some of the optimism, particularly in view of the promise that aircraft after the war could be improved greatly in efficiency, safety and economy of operations.

The National Airport Plan submitted to Congress by the Civil Aeronautics Administration on November 28, 1944, was the most comprehensive, expert and constructive project of the kind in the history of American aviation. The Civil Aeronautics Administration employed all the vast experience accumulated by the Federal bureaus dealing with civil aviation since passage of the Air Commerce Act of 1926. The CAA had access to the facts available from its field forces throughout the country, and too, the intimate details of our wartime aviation. Its recommendations, therefore, were important. These excerpts from the CAA report to Congress describe the main features of the National Airport Plan.

"The Civil Aeronautics Administration estimates that there will be 400,000 civil airplanes in this country within 10 years after the war's end, and that the number will continue to increase in the following years. To serve this expected extensive growth in civil aviation, the CAA proposes that this nation construct 3,050 new airports and improve 1,625 of the 3,000 existing fields. The cost of such a program is estimated at \$1,021,567,945, exclusive of land or airport buildings. Land values will vary considerably with the location, but it is estimated that the cost of the additional land and airport buildings, not including hangars, would be approximately \$230,000,000, making a total cost of approximately \$1,250,000,000. Such a program could be spread over a five to 10 year period for completion, with the Federal Government and non-Federal public agencies sharing the cost on a proportion to be established by the Congress when authorizing legislation is passed. A well-established precedent for the principle of cost sharing between the Federal Government and non-Federal public agencies for national development of transportation facilities is seen in the public roads program, which has operated on a 50-50 basis for many years with great benefit and satisfaction.

"There are 2,942 civil and military airports on record with the Civil Aeronautics Administration. In addition, there are 313 places with landing areas which were in operation before the war, but are not now usable. Existing airports are so distributed that only 1,635 or 53 per cent, of the 3,076 counties in the United States have one or more landing areas. Towns of less than 25,000 population show the greatest lack of airport facilities, although, as will be shown, deficiencies also exist in the larger cities. While the 412 urban places with populations above 25,000 have 602 airports, only 2,340 of the 6,257 towns with 1,000 to 25,000 population have any airports. The 140 metropolitan districts, covering 1.5 per cent of the land area of the United States, average an airport for every 80 square miles, while in the rest of the country there is only one airport for every 1,230 square miles. However, every airport built to serve the 76,000,000 persons living outside metropolitan areas also will provide an additional landing place for the 55,436,568 persons in the metropolitan districts. It is axiomatic that every new airport increases the utility of every existing airport.

"By investing 25 billion dollars in roads during the last 25 years, we have made it possible for the United States to become a nation on wheels, with 32 million motor vehicles in operation during normal times. For a much smaller investment, we can start the United States on its way toward becoming a nation on wings, with all that implies in war and peace. As a by-product of the war, we have the necessary manufacturing facilities, and a huge pool of potential pilots. There will be at the end of the war approximately 350,000 Army and Navy pilots and 150,000 civilian pilots and students. Also interested in fly-

ing will be 2,500,000 men trained by the armed forces in other aviation skills, and an almost equal number who have been employed in our aviation factories. Add to these the 250,000 students who are taking aeronautics courses in the high schools each year, and there is a total of 6,000,000 prospective flyers. There is no way to estimate accurately the number of these who actually will take up flying as a vocation or avocation, but if only one out of four do so in the immediate postwar years, there will be 1,500,000 airport users, plus millions of prospective air line travelers. In addition there are many persons outside these specialized groups who even today are evidencing interest in flying for business and pleasure. To realize the maximum economic and military benefit to our country from this vast potential, however, the utility of the airplane must be increased. This calls for airports near the potential flyer's homes or places of business, and near the recreational areas, national parks and other places to which he might want to fly. The majority of small airports today were located from the standpoints of low development cost rather than convenience to the inhabitants of the communities they serve.

"Without overlooking the importance of air transport, the sale of personal aircraft offers the brightest hope for a mass market which will maintain even a reasonable fraction of our present 20 billion dollar a year aircraft manufacturing industry. Preserving a nucleus of this industry is important both to defense and the national economy, for it can provide a substantial source of employment in peace, and the weapons of war should we ever need them in a hurry. The contribution which airports for personal flying can make toward this goal, and toward training civilian pilots as a reserve of air power, invests them with national interest. That is why this plan, as will be seen, calls for so large a proportion of airports in the categories especially suitable for personal flying. A greater share of the total cost of the program, however, would go for the construction or improvement of airports required to bring or continue the benefits of scheduled air transportation to all sections of the population, although many of these fields also would be available for personal flying. These terminal fields would, in many cases, serve as reserve bases for the armed forces. At the present time, a majority of our large civil airports are used by military or naval aviation.

"To provide facilities adequate to the requirements of places now designated as air carrier stops, it will be necessary to improve 174 airports which are deficient, in terms of transport craft now in use, in number and length of runways, clearness of approaches, taxiways, parking and servicing aprons, or other features. As for the 678 locations named in applications for Certificates of Convenience and Necessity pending before the Civil Aeronautics Board, only 93 have suitable airports. Improvement projects would be required at 385, (257 have no paved runways) and new fields would have to be constructed

at 200. Applications to bring air service to 678 communities not now receiving it are on file with the Civil Aeronautics Board, but the residents of most of these places will not be able to obtain satisfactory scheduled air transportation unless airports are constructed or improved. For private and local commercial flying needs, our present airport system is deficient in the large cities in that it offers too few landing areas, inconveniently located, in relation to the population. There are 438,585 persons per airport in cities of more than 500,000.

"After a lengthy nationwide study, and extensive conferences with State and local aviation officials, the CAA estimates that the United States will require a total of 6,305 airports to serve adequately the transport and private flying which reasonably can be expected in five to 10 years after the war, and to foster its growth. Making up this total are 1,630 existing airports not proposed for improvement; 1,625 existing airports to be improved, including 313 now not open for operations, and 3,050 entirely new airports. The plan calls for one or more airports at 5,269 locations in the United States, as compared with 2,585 places having landing areas today. It would increase the county coverage from 53 to 88 per cent.

"Total cost of the construction proposed in this plan is estimated at \$1,021,567,945. This does not include the cost of land or buildings, which may vary greatly, depending on the exact sites selected. Expenditures may be divided into five general classifications:

1. Preparation of the site—Clearing, grubbing, excavation and grading, drainage, surface conditioning, and fencing. It is estimated that this portion of the work will cost \$525,304,322, or 51.4 per cent of the total.

2. Paving—Runways, taxiways, aprons. Estimated cost of this item is \$395,305,460, or 38.7 per cent of the total. This compares with 46 per cent for paving in the defense airport program, where there was greater emphasis on large airports with paved runways.

3. Lighting—Installation and equipment costs for beacon, boundary, obstruction, range, runway and taxiway flood or contact lights and wind tee or tetrahedron. Estimated cost, \$55,081,978, or 5.4 per cent.

4. Radio—Cost of equipment and installation of necessary facilities. Estimated at \$10,983,000, or 1.1 per cent.

5. Miscellaneous—Includes approach clearing, access roads, marking and landscaping. Estimate, \$34,893,185, or 3.4 per cent.

"Airports intended only for private flying would get 39 per cent of the proposed outlay. Improvement or construction aimed at making possible extension of air line service, and in most cases simultaneously improving facilities for personal flying, accounts for 50.8 per cent of the expenditures, while cost of work at presently designated air carrier stops would amount to 10.2 per cent. The cost for airports which would permit extension of air service to additional communities is about evenly divided between the places named in pending applica-

tions for certificates and those which might subsequently be considered. Expenditures for new airport facilities would be 58 per cent of the total, while 42 per cent would go to improvements of existing airports. Approximately 17 per cent of the funds would be spent in communities of 50,000 or more, and the remaining 83 per cent in communities of less than 50,000 population. It is possible, however, that as metropolitan districts complete comprehensive plans, the ratio will be altered. Class 1 airports would cost 15.2 per cent of the total; Class 2, 45.4 per cent; Class 3, 22.3 per cent; Class 4, 10.7 per cent; and Class 5, 6.4 per cent."

Among the many reasons for official belief that the United States should have the best possible system of airports and airways was the amazing record of our war aviation operations at home and abroad, and universal opinion that the postwar era would bring rapid development in all kinds of flying in all countries. Establishment of a worldwide system of airports and airways for our wartime operations was an achievement of inconceivable magnitude. It was part of our war effort in every theater. The Army and Navy set up facilities wherever they went, which was almost everywhere. The Civil Aeronautics Administration and numerous other Federal agencies helped.

Army engineers built 300 million square yards of runways, taxiways and aprons in the United States. The Navy established seaplane harbors. The services built airports all the way from Alaska to Australia, across Africa, the Near East and in India, Burma, China, on the strategic islands of the Pacific, in the Caribbean and South America, in Greenland, Iceland and the British Isles, and throughout several European countries. While Army Air Forces engineers were setting up airports in jungle and desert or rock and ice, Navy Seabees were carving them out of coral on South Pacific Islands. The CAA, the Army and the Navy communications forces linked them all to-



KINGFISHERS ON EDO FLOATS

Vought OS2U-3 Kingfishers ready for patrol service.

gether with navigational aids. Our prewar experience in building the world's best airways system enabled American agencies to lay out an airway to India, one to Australia, another through Canada to England, one from the United States to Moscow by way of Alaska and Siberia, and many others. All were equipped with adequate facilities.

Our Alaskan airports and airways program was an example of this wartime achievement. Before Pearl Harbor there was disagreement as to the source of possible attack on Alaska. The Army and Navy had few bases there. The Civil Aeronautics Administration had begun construction of an airport at Cold Bay. The Japanese bombing of Dutch Harbor in 1942 was broken up by a pitifully few bombers from a new base northeast of that outpost. This saved Alaska from invasion. At all points in the Aleutians where there were air bases late in 1944, none was in existence in 1941.

Late in 1941, employing an initial allocation of \$3,300,000 for the development of landing areas, the CAA had made available in 60 to 90 working days at least one usable runway on six new airports in Alaska and usable landing strips at five more airports and 13 intermediate fields. All these were located and engineered especially for the defense of the nation's northern approaches and with postwar civil aviation requirements in mind. The classification of these airports had been raised considerably from the status of "bush" landing fields which had long been considered reasonably adequate by Alaska's hardy pilots, but even with the 4,500 foot runways first installed on these fields, they were far from adequate for even the most meager of military uses. The first work was done on the airports at Juneau and Cordova in Southeastern Alaska, Northway near the Canadian border, Big Delta, Galena, Naknek and Nome in Northern and Western Alaska. These pioneering activities by CAA raised the curtain on a huge program in Alaska which culminated in 1944 in the implementation of more than 6,900 miles of airways and the construction of some 22 airports, any of them large enough for the majority of our bombers and the fastest of our fighters. Of this number, 12 were constructed by the CAA, six by Army, two by Navy, and two by CAA and Army. Across these northern airways, more than 10,000 fighting planes were ferried to the Russians, up to the end of 1944.

Contrasts between 1941 and 1945 abounded in Alaska, and almost any single airport was typical. At Nome, farthest west towards Siberia of any of our fields on the mainland, there was a short single landing strip which long had been used by commercial pilots. Construction of a new airport began in July, 1941, and by November of that year two gravel runways approximately 4,500 by 300 feet were in use. The construction season at Nome is very short and in 1942, military use was too great to permit paving operations, but both runways were treated with a dust palliative and a satellite field consisting of one runway 5,600 by 300 feet was constructed. During 1943, both run-

ways of the CAA airport were paved and the satellite field was extended to 6,000 feet with large parking areas at both fields. The 1944 season saw oil penetration treatment of the satellite runway and parking areas, completion and paving additional parking areas, taxiways and roads at the airport, and the near completion of airport runway extensions to 6,000 by 5,550 feet.

At the beginning of 1945, there were airports at intervals of approximately 250 miles along the 6,900 miles of airways throughout Alaska. They were fine fields, the equal of Class 4 and Class 5 airports in the States as far as development of landing areas was concerned. The airports of Alaska had approximately 45 miles of paved and lighted runways averaging better than 250 feet in width, and 10 of the runways were 7,500 feet or more in length. In addition, the CAA constructed 15 intermediate fields and three landing strips with gravel runways totaling approximately 19 miles, most of them 300 feet in width and 12 being 5,000 feet or more in length. All but one of the runways at the intermediate fields were lighted by boundary lights and revolving beacons.

When the CAA went into Alaska in 1939, there was only one radio range in the Territory. By the end of 1944, exclusive of the Aleutians, the CAA had constructed 24 full-powered simultaneous Adcock radio ranges and broadcast stations and one more soon to be commissioned, 12 medium powered loop radio ranges and broadcast stations with four more soon to be commissioned, and two low-powered loop radio localizers. Thirty-four of these ranges were equipped with UHF station location markers. Airways communications in Alaska



C. A. A. photo

#### NEW AIRPORT IN ALASKA

The Civil Aeronautics Administration's field at Gustavus on the southeastern coast.



had been improved phenomenally. High frequency point-to-point radio telegraph airway communications first were installed, but there was frequent interference and outrages due to electrical storms and other atmospheric conditions peculiar to far northern latitudes. To overcome these handicaps very powerful low frequency transmitters with special antenna arrays were developed and installed at all point-to-point stations and these, together with special diversity receivers, made possible solid reception throughout the Territory. High speed circuits for synoptic weather were developed and were in operation between Continental United States and Alaska and between five communication circuit centers within Alaska. Experimental radio teletype circuits also had been in operation for some time, and this was to be the next major communications development.

In 1941, CAA could obtain weather information from 147 off-airway points. Of these, 21 were operated by the Alaska Communications System, 53 by the Office of Indian Affairs, 20 by the Alaska Aeronautics and Communications Commission, and 53 by individuals and communities. These important sources of weather information were augmented by special weather stations established by the CAA in remote but strategic spots like St. Lawrence Island in the Bering Straits, Middleton Island far out in the Gulf of Alaska, and Barrow, farthest north settlement in the Western Hemisphere. CAA was exercising airways traffic control on three of the principal Alaskan airways and operating airport control towers at the Anchorage and Fairbanks municipal fields. That service was expanding.

In 1940 there were 75 CAA employees in Alaska. At the beginning of 1945 there were about 800. Approximately 360 aircraft communicators were required to man the airway stations under prevailing conditions, and in this one category alone, great difficulties were met and overcome. Some communicators were drafted, and CAA was forced to call for volunteers from among its communicators along the 37,000 miles of airways in the Continental United States. This served for a while, but as military use of the airways in Alaska doubled and trebled, more communicators were needed.

The Civil Air Patrol played a most important part in preserving the civil aviation structure through the war period. At the outset the Government feared that light planes might be used for sabotage; that they would be in the way of military traffic and would be difficult to check on the interceptor board; and that they could be of no use in the war effort. It was the discipline and training of CAP that made it possible to utilize rather than ground the resources of private flying.

Not only did formation of CAP make it possible to continue private flying through the war years but the action of local units kept open many airports which otherwise might have been closed. War-time regulations called for the appointment of guards and clearance officers which increased the expense of airport operation. CAP mem-

bers kept local aviation alive by volunteering for these duties. When requisitioning and purchase of thousands of private planes and restrictions against flight training made it hard for local operators to stay in business, CAP units kept many in operation, and in other cases they took over private fields for the duration.

According to a survey of all 48 States late in 1944 of 1,592 fields open for civilian flying fully a third would not have been open during the war had it not been for CAP. At that time the Civil Air Patrol had built 81 airports, largely by the volunteer labor of senior members and cadets; had made major improvements on 108; and was managing or operating 215 fields. Thus the headway of civil aviation was maintained for a more rapid start after the war.

To assist "community planners in providing the landing facilities needed before all Americans can share in the development of this nation's great air future," the Personal Aircraft Council of the Aeronautical Chamber of Commerce of America prepared a 20-page illustrated brochure on airports. It presented a comprehensive landing facilities plan, including:

"1—Metropolitan Airpark. The Airpark may be constructed in the downtown area within a block or two of the main trading center.



C. A. A. photo

#### MEAT FLIES TO ALASKA

This 2,500 lbs. of frozen beef is being flown to an airport construction gang on the Alaskan coast.



U. S. Navy photo

#### ROUGH LANDING IN ALEUTIANS

Our makeshift airfields in the Aleutians were in such bad shape that a crash ambulance rushed up to be ready in case of need as this Navy Catalina came in from a long patrol.

Adjacent to the runway area is a small park for use of pedestrians. The prospective rapid growth of personal aircraft as an everyday utility makes it necessary for metropolitan centers to consider this conception of a midtown parking area for private flyers. Airparks may be constructed in the shapes of X's, T's, V's, or L's. Runways: 2,000 by 300 feet. Surfacing: Turf. Cost: \$25,000 to \$500,000.

"2—Suburban Airpark. The (L-shaped) Airpark should be placed well within the central area of the community. Just as the railroads expanded trade and commerce in small communities, so will the development of air travel and freight result in the growth of a community. The Airpark will give ready access and egress to businessmen, relatives and cross-country travelers. Airparks are basic postwar needs. Runways: 2,000 by 300 feet. Surfacing: Turf. Cost: \$25,000 to \$100,000.

"3—Resort Airpark. A mountain resort with an Airpark will greatly shorten a trip home to this vacation spa. Hours of tedious driving will be eliminated when personal aircraft owners fly to and from such a resort. Hours of vacation time will be added to their stay. Sportsmen, making use of their personal planes, will be able to get away from their work for perhaps a dozen fishing and hunting trips a year,

whereas many are now limited to one or two annual outings due to the lack of direct and fast transportation. Aviation Country Clubs will be made possible through the medium of personal air travel. Fresh conceptions of recreation will appear for the entire family. Runways: 2,000 by 300 feet. Surfacing: Turf. Cost: \$25,000 to \$100,000.

"4—Flightstop. A Flightstop located on a main cross-country highway serves as an intermediate landing facility for private air travelers. These inexpensive public improvements will be required in areas where distances between cities are great to serve the thousands of private airplane owners who will be traveling in their planes in the post-war Age of Flight. States and counties will find these Flightstops to be excellent public developments which will serve as intelligent work projects during the period of readjustment after the war. Planned and constructed only as grass-sodded runways in the shapes of T's and L's, they can be maintained at a low cost to taxpayers. Runways: 1,800 by 300 feet. Surfacing: Turf. Cost: \$6,000 to \$10,000.

"5—Air Harbor. Progressive communities, large and small, situated on a bay, river, lake, sound or canal can be improved and enhanced by the construction of an Air Harbor for the accommodation of various types of amphibious aircraft. A large harbor could dock and service transports. However, many communities will need only small facilities, costing from \$1,000 to \$10,000 to service personal aircraft.

"6—Airport. An Airport is a terminal facility primarily for the use of scheduled air transport on air line routes. These are the Grand Central stations of flying. Runways must be constructed to handle great weight. Traffic is regulated on minute-by-minute schedule. The speed of airliners and the congestion of traffic at most of these terminal points make their use undesirable for personal aircraft in most cases. Cost: \$250,000 upward."



THE WACO CG-13 SUPERGLIDER

It can carry 42 fully equipped troops.

"Good turf," the Aeronautical Chamber found, "is an eminently satisfactory surface for every type of personal aircraft landing, except the Air Harbor, which is a special engineering project. Grading and sodding are comparatively inexpensive operations and well within the financial means of the average community." Leading grass seed companies made special studies of airport requirements, and were supplying new projects with materials designed to produce turf that reduce dust and mud, reduce maintenance expense of flying equipment, absorb rainfall and prevent flying gravel which otherwise could damage planes or injure personnel. The National Aeronautics Association assisted in distribution of the ACCA brochure. Among the individuals who made special studies of airport possibilities and who waged their own individual campaigns were Oliver L. Parks, founder and president of Parks Air College, and William T. Piper, president of Piper Aircraft Corporation. Essential airport maintenance equipment, including important recent developments, is described in the last chapter.



U. S. Navy photo

#### WE RETURN TO THE PHILIPPINES

Part of our invasion armada arriving off Leyte to open the Philippines campaign on October 20, 1944.

## CHAPTER VIII

### THE CIVIL AIR PATROL

An Auxiliary of the Army Air Forces—Nation-wide Activities Important to the War Effort—Emergency Services Over Land and Sea—Search and Rescue Achievements—CAP Courier Service—Flood and Fire Patrol—Aid in Maintaining Communications—A Reserve for Postwar Aviation.

**T**HE Civil Air Patrol was an auxiliary of the Army Air Forces formed to mobilize civil airmen for the war effort and for the advancement of aviation in all of its phases. Founded before Pearl Harbor, CAP was organized into a Wing Command in each State, under the direction of a National Commander appointed by the Army Air Forces. The Wings directed the local units composed of civilian volunteers who rendered part-time service in uniform without pay. The members trained continually in military, preflight, and auxiliary subjects, and flew on practice missions. Thus the CAP units were prepared to function in emergency. While members were ready for CAP duties or for service in the armed forces, they also were to be prepared for civilian aviation after the war. CAP pilots flew on coastal patrol, border patrol, courier service, and many other wartime missions. Early in 1945, they still were engaged in target towing, missing aircraft search and rescue, and many types of civilian work, such as disaster relief and forest patrol. With this flying background, CAP operated as a training corps for adults and cadets, fast growing in membership to build a reserve of aviation skills and equipment. Local units built and improved many flying fields and became established as a fine reserve for the long-range support of aerial preparedness and civil aviation, as described in the chapter on airports.

Outside the national headquarters in New York—which was an AAF base unit—and the Civil Service secretaries at the State Wing headquarters, CAP was composed entirely of civilian volunteers. A Wing commander in each of the 48 States reported directly to the national commander and directed all CAP activities in his State. The Wings were organized in Groups, Squadrons, Flights and Sections. In the smaller States, there were no Group Commands. A typical local unit was a squadron of 50 to 200 senior members or a flight of 10 to 60 members. Each senior unit could form a similar unit of CAP cadets. Their activities are described in the chapter on training. Eligibility for enlistment in CAP was limited to men and women who had been

United States citizens for 10 years or more. All applicants signed blanks containing personal information and oaths of service. Senior members had to be not less than 18 years of age. Cadet applicants of 15 to 18, physically fit and with good scholastic records, could be accepted by local unit commanders. Senior members could resign with the approval of the Wing Commander and cadets with the approval of the local commander, or they could be discharged for non-performance. Enlistments were for the duration of the war plus six months. All members served without compensation in part-time volunteer duties. When assigned to full-time active duty, they were reimbursed for certain expenses, but they drew no salaries. The Army Air Forces supported the CAP only to the extent of maintaining the national headquarters, giving limited assistance to the State Wing offices in such matters as office rent, and furnishing manuals, surplus Army equipment for study purposes, and certain other training aids. The AAF also supplied and maintained a number of liaison-type aircraft used by the State Wings in cadet recruiting and in orientation flights. Otherwise the support of the organization rested largely upon its members. Each local unit found its own meeting place and flying facilities. Members bought their own uniforms and supplied their own equipment without reimbursement. They attended training sessions once a week.

Aviation subjects for CAP training included map reading, theory of flight, meteorology, navigation, aircraft structures, engines, instruments, and Civil Air Regulations—all the subjects required for a private pilot license and many more. Military subjects included infantry drill, safeguarding military information, guard duty, military correspondence, and organization of the Army. Auxiliary subjects included Morse code, communications, first aid, physical training and photography. CAP did not give flight training, but encouraged all members to learn to fly by purchasing flight time from private operators. CAP cadets were given orientation flights. CAP pilots took special flight proficiency courses, and observers went aloft to gain experience for emergency duties. Practice missions, simulating lost plane searches, message dropping and pick-up, and area patrol were flown. Crash procedures, first aid, and radio communications were practised on the ground. Thus the flying and ground personnel of each CAP unit learned their duties and were ready to go into action on call. Non-flyers learned about aviation, and many soon became pilots. Thus a reservoir of skill was built up for this war and for our future air progress and security. The Army Air Forces aided CAP training by the preparation of special training directives and courses, the issuance of Army training manuals, the production of special manuals and the shipment of a great variety of training aids and devices such as are used in training personnel of the AAF itself. Large quantities of surplus equipment such as worn or obsolete motors, instruments, plane

parts, and radio equipment were supplied to CAP units throughout the country for practical study.

From the time of our entry into the war, CAP was called upon to send planes and pilots on military missions. In the words of Gen. H. H. Arnold, Commanding General of the Army Air Forces, "The Civil Air Patrol grew out of the urgency of the situation. The CAP was set up and went into operation almost overnight. It patrolled our shores—performed its anti-submarine work—at a time of almost desperate national crisis. If it had done nothing beyond that, the Civil Air Patrol would have earned an honorable place in the history of American air power."

In 1942, when German submarines were attacking American vessels within sight of our shores and were cutting the vital supply lines to our troops and Allies, the Army and Navy did not have enough planes and ships to guard the coastal waters. CAP volunteers brought their planes and equipment to organize three experimental bases. From their first flights, they made contact with the enemy and called the bombers to the kill. Although they were unarmed, the CAP airmen kept their secrets so well that U-boats about to attack convoys crash-dived on the approach of CAP planes. After this success, a series of bases were manned, developed, and equipped by CAP to cover the entire Atlantic and Gulf coasts from Maine to Mexico.



U. S. Navy photo

#### DOUGLAS DIVE BOMBERS

The Navy SBD Dauntless dive bombers are shown here on the take-off from the deck of a carrier during the South Pacific campaign.





#### THREE TYPES OF BELL AIRCRAFT

At the top is the P-39 Airacobra fighter, in the center is the P-63 Kingcobra, and below is the jet-propelled P-59 Airacomet—all produced by Bell Aircraft.

Bombs and depth charges were slung under civilian sports planes on this duty. Skimming the water, these single-motor planes kept radio contact with their shore bases as they flew on continual watch, often as far as 100 miles at sea in winter weather when the failure of engine meant almost certain death. On this service, 26 men were lost, while hundreds of survivors of ship sinkings and dozens of Army and Navy airmen down at sea were rescued after being spotted by CAP observers. Planes of the CAP Coastal Patrol were flown more than 24,000,000 miles over water. They spotted 173 subs; dropped bombs and depth charges against 57; and were officially credited with sinking or damaging at least two, in addition to those destroyed by planes or ships summoned by CAP. They found 17 floating mines, some in the path of troop convoys. The coastal patrol continued until September 30, 1943, when the Navy took over.

From similar bases inland, CAP pilots and observers flew 30,000 airplane hours along the Rio Grande to prevent illegal crossings in either direction and to report irregularities. They flew so low that they could read the license numbers on autos. For the Second Air Force, CAP planes flew more than 20,000 miles a day throughout the West to carry mail and urgent shipments between widely separated Army posts. At many Army fields in other areas, CAP planes were assigned to carry rush shipments when needed. Inspection of camou-

flage and smoke screens, exercise of the aircraft warning system in the Southeast, radar training flights, and other special missions were flown to relieve Army planes and personnel for combat duty. After the AAF was built to its full war strength, most of those CAP missions were discontinued; but there still was important work for the Patrol to do.

In 1945, CAP still was operating bases in support of anti-aircraft training in the Eastern and Western Defense Commands. These bases were manned mainly by duration volunteers from the Coastal and Liaison Patrols. CAP planes had flown 40,000 hours to tow aerial gunnery targets and to perform tracking missions for guns and searchlights. CAP planes and ground parties were called into action as a regular routine when Army planes were reported missing, especially in mountainous and wooded terrain. CAP pilots and observers, flying low and slowly in their light planes and trained in methods of precision reconnaissance, usually found what they were seeking. Many plane wrecks were spotted, guards posted, and aid given to survivors. Up to the end of 1944, CAP planes flew 15,000 hours on official search missions and much more on their own. Industrial courier service was rendered to war production industries, bringing urgently needed repair parts, materials and blueprints to the factories. Such flights often prevented stoppage of assembly lines. In emergency, CAP units always were prepared to close all civilian airports, block the runways and post guards. Each local unit was prepared to work with military,



THE SB<sub>2</sub>C-4 CURTISS HELLDIVER

Late model of the Navy dive bomber in its sea-blue gloss paint. It is powered by a Wright Cyclone engine and Curtiss electric propeller.

State, municipal and relief authorities to give aid through the planes, radio equipment, cars and personnel of CAP. The Patrol cooperated with many public agencies such as the Civil Aeronautics Administration, the Coast Guard, the Federal Bureau of Investigation, and the American Red Cross to be useful wherever possible, both in the air and on the ground.

In emergencies caused by floods, tornados, hurricanes, blizzards, fires, explosions, or railway wrecks, CAP flew thousands of hours, saved many lives and averted extensive property damage. In floods, CAP pilots flew to drop warning messages, observe the extent of damage and spot persons or livestock in distress. Levees were saved by the toil of CAP members and cadets, and by dropping sacks to be filled with dirt to plug leaks. Guards were posted and medical supplies brought in. Red Cross officials were flown to disaster scenes. Blood plasma was flown to train wrecks. Communications were maintained by CAP planes and radios. Power line and pipe line breaks were located. Large quantities of donated clothing collected by CAP were flown to victims of a gas works explosion.

In cooperation with the U. S. Forest Service, the conservation departments of States, or as volunteers in local emergencies, CAP pilots flew to observe the extent of forest fires and to direct the fire-fighting forces. In several areas, regular forest fire patrol was conducted for several weeks during the fire danger periods in the Spring and Fall of 1944. Extensive timber damage was prevented by spotting fires before they progressed beyond easy control. In many instances, plasma was flown from blood banks to save lives. CAP helped develop special containers and paper parachutes to drop plasma. Air evacuation of patients, or the flying of doctors and medical supplies, such as penicillin, were among the life-saving missions. On the Great Lakes, CAP observed ice conditions in the Spring to help the ore boats get an early start on deliveries. Food was dropped to ships stranded in the ice. Lost fishermen on the ice or in boats were found. Distressed ships were spotted during storms. On the large rivers, ice surveys were made. A levee patrol was maintained on the lower Mississippi in times of flood. In addition to the searches for missing Army, Navy, and Canadian aircraft, CAP personnel often hunted for civilian aircraft. They made landings on the prairies to be first on the scene of air line wrecks and flew over wide areas in search of private or CAP planes. Many Army and Navy airmen owed their lives to the alertness of CAP members who guided them to safe landings when they had been lost and were nearly out of fuel. Many night landings were accomplished through Morse code signals from CAP members on the ground, with flashlights or auto spotlights. Landing strips were lighted by CAP auto headlights and flares. In several States, the CAP Wings served officially as the air arms of the State Guards. In all States, there was close cooperation with the Guards. CAP planes

frequently were used to simulate air attack and support, and CAP personnel joined the Guardsmen in air-ground maneuvers, aided by CAP's communications facilities.

Other missions included aerial hunts for wolves and coyotes for protection of livestock; the herding of wildfowl by planes to prevent crop destruction; and conducting wildlife surveys from the air. Fugitives from justice were tracked by air, and getaway cars spotted. Law-enforcement agents were flown to the scene of crimes in out of the way places. To back the flying missions, each CAP unit maintained the necessary ground personnel and equipment to be ready to go into action unaided for any sort of work likely to be required in its area. Where lost plane missions were frequent, the units concentrated on preparations for search and rescue. Where floods were to be combatted local squadrons were ready for them. All were trained to be on the alert for planes in distress, which might happen anywhere. CAP maintained many special War Emergency Radio Service stations under special FCC license, and trained members in panel reading, blinker signals, message dropping and pick-up, and in the use of carrier pigeons. Thus CAP could operate its own communications system when telephone and telegraph circuits were broken by flood or storm. Air-ground contact could be maintained on search missions or on maneuvers. Many CAP units had their own ambulances and dispensaries. The Red Cross cooperated in first aid and water



GRUMMAN WILDCAT ON EDO FLOATS

safety courses. Many lives were saved, and habits of safety were taught the CAP units. CAP squadrons maintained their own guard units, crash crews and equipment, rolling kitchens, photographers, parachute experts, mechanics, clerical personnel and other services as needed. They made their own maps of auxiliary landing fields. In mountainous regions, CAP organized cavalry and ski units for rescues in rough country where their planes could not land.

The status of the Civil Air Patrol as an active flying organization made it far more effective as a training corps than if it had been founded for training alone. Members who drilled and practised with the understanding that they might be called at any moment to mount guard over a plane wreck or otherwise meet an emergency had a constant incentive to learn the courses and military teamwork that assured success in the CAP war program.

The Civil Air Patrol League was a non-partisan, non-profit membership to give financial and promotional support to CAP. Its board was made up of citizens including representatives of major organizations and civic groups. A third of the board members were CAP Wing Commanders from all nine Service Command areas of the United States. A formula was adopted for the division of funds among the 48 States each month for disbursement by a trusteeship of citizens in each State.



BEECHCRAFT AT-11 TRAINER

For advanced training of bombardiers and gunners.

## CHAPTER IX

### THE AERONAUTICAL ORGANIZATIONS

The Aeronautical Chamber of Commerce of America—The Manufacturers Aircraft Association—Air Transport Association of America—The Aircraft War Production Councils—Institute of the Aeronautical Sciences—National Aeronautic Association—Society of Automotive Engineers—Aircraft Owners and Pilots Association.

**T**HE wartime activities of some of the civilian aeronautical organizations were of the highest importance in helping to maintain American supremacy in the air. In the fields of engineering, new inventions, deliveries of equipment to the Services and the maintenance of adequate production, these organizations worked in closest cooperation with the Army and Navy air forces.

#### Aeronautical Chamber of Commerce of America

The Aeronautical Chamber of Commerce of America, in its 25th year of continuous service as the trade association of the aircraft manufacturing industry in the United States, was cooperating with the Government in every phase of the aircraft war production program. At the same time the ACCA was energetically working to make sure that American superiority in aviation should be maintained and development continued throughout the war and in the days of peace as a vital adjunct to constant preparedness against aggression. Under the management of a Board of Governors comprising 17 executives of important companies, and working through 15 committees, the ACCA staff carried on a program for development of our air power in these five categories: 1—Air Forces of such strength, technological excellence and readiness as to preclude a successful assault on this nation and its possessions. 2—A fully developed system of domestic and international air transport. 3—The broadest and fullest use of personal aircraft. 4—Preservation of a strong aircraft manufacturing industry. 5—Development of public air-mindedness. After that creed had been presented in Congressional hearings, it had the approval of the Army and Navy, other Federal bureaus, and organizations representing both management and labor.

The Technical Service of the ACCA and its numerous committees,

which embraced the best engineering talent of member companies, in 1944 achieved a high degree of industry participation in the development of mandatory Government technical requirements. The airplane and engine technical committees, for example, represented the country's plane and engine companies as their spokesmen before the Government bureaus in matters relating to technical requirements. The industry also was represented on a committee on materials and research coordination set up by the National Advisory Committee for Aeronautics. The technical committees of the Aeronautical Chamber held 29 meetings, and were represented in 44 meetings between the industry and Government. More than 350 separate memoranda were issued, and a total of 204 recommendations were made to the Government in efforts to correlate further the industry's technical activities with those of the Army, Navy, Civil Aeronautics Administration and other Federal agencies.

The Industrial Relations Research Service of the ACCA provided industry representation on the airframes panel of the National War Labor Board. The staff assisted the airframe panel in processing and disposing of 100 dispute and voluntary cases involving 35 companies.

The Traffic Service of the ACCA handled the industry's problems related to freight rates and other shipping details. Substantial savings in cost and time were effected for the manufacturers. In one case alone, the Traffic Service saved them about \$4,000,000 by winning its appeal from a scheduled rate increase which it proved to be excessive. In its work of simplifying traffic procedures, this department also published a "Blue Book of Airplane Parts" which standardized parts descriptions for the first time in the history of the industry.

The ACCA Aircraft Manufacturers Council included the companies making aircraft, and it was decentralized into East and West Coast committees, with regional offices in New York and the regional work coordinated through the ACCA headquarters in Washington, D. C. In the framework of the Aircraft Manufacturers Council were handled the engineering technical problems, including airworthiness requirements; the aircraft parts standardization program, including cooperation with the Army and Navy in standardizing military procurement requirements; industrial relations and traffic matters. The Council also was active in problems dealing with priorities; and further, cooperated with Government agencies in developing a program to assure orderly shrinkage of the industry from its war-expanded production to peacetime levels affording maximum employment.

The ACCA Personal Aircraft Council was made up of 20 companies actively interested in the development of private flying and other civilian uses of aircraft, aside from scheduled transport, when the end of the war should release the manufacturers from the bulk of their military production. The Personal Aircraft Council was working on a three-fold program: 1—Aggressive support to the establishment by

local communities of a nation-wide network of landing facilities for personal aircraft. 2—Liberalization of burdensome Government regulations of pilots and aircraft. 3—Active aid in the development of broader and more comprehensive aviation programs at all school levels. Considerable impetus was given to the landing facility program by the Council's illustrated booklet "Put Your Town on the Air Map," described further in the chapter on airports and airways. The Council also made a presentation to the Government entitled "Freedom of Personal Flight" suggesting revision of civil air regulations to an "enforceable minimum." The Council's aviation education and flight training committee made a report which provided an authoritative basis for planning a national educational formula.

The ACCA Statistical Service provided a central reference for statistical and economic research material, publication of industry statistics, (see ACCA tables in the Appendix, "Flying Facts and Figures") consultation with other fact-finding agencies and studies of special industry problems. The Statistical Service made an important study seeking to appraise the postwar outlook for future aircraft markets and an analysis of the problem of re-employment of veterans. Another important project was a constant effort to coordinate and



U. S. Navy photo

#### DOUGLAS DAUNTLESS DIVE BOMBERS

Circling over their carrier during the attack on Palau, March 29-30, 1944.



unify the statistical reporting system of some dozen Federal agencies requiring reports from the aircraft industry.

The ACCA Public Relations Service provided information to press, radio, periodicals and other media on the industry's activities in general, supplied members with information on industry-wide problems and trends affecting manufacturers, and in cooperation with other ACCA services supplied group industry data and facts about its problems to Federal and State agencies, Congressional committees and State legislatures. Dissemination of material as a basis for aviation education programs was a major activity.

The ACCA Readjustment Service had active charge of all problems affecting war contract termination, disposal of surplus equipment and facilities, accounting (including renegotiation), market development and legislation, including taxes.

#### **Manufacturers Aircraft Association**

The Manufacturers Aircraft Association was organized during the first World War in 1917 to administer the various patent cross-license agreements and license contracts under which the aircraft manufacturing industry operated. Reports of patents were made to the Association, and patent licenses were granted to members of the Association and also to the Government. The Association served as a receiving and disbursing agency for payments to be made under such agreements and contracts, and in addition, developed a specialized procedure which enabled arbitration proceedings to be conducted in connection with claims for compensation on patents reported by members, and in the settlement of the relatively few disputes in regard to such matters which occurred within the aircraft industry. The payments on account of the original patents having expired, the only royalty payments currently required were those resulting from the appraisal of new patents issued to member companies. In 1944, a total of 152 airplane patents were acquired by members of the Association. Including additional patents licensed from the preceding year, a total of 1,648 patents had been brought under the operation of the agreement at the beginning of 1945, thereby continuing the original policy of making licenses on the same terms available to all airplane manufacturers in the United States. A most important objective of the cross-license plan, prevention of wasteful patent litigation within the industry, was attained. No suits for patent infringement were filed under any of the patents coming within the operation of the cross-license agreement. The contract relationship between the Association and the Government, which enabled the War and Navy Departments to obtain licenses on the same terms as members of the Association, placed the Government in the same favorable position as regards all airplane developments originating within the industry. This was vitally

important to the war effort. It permitted the utmost progress in aircraft design and production.

As a necessary incident to administration of the cross-license agreement and to supplement other services rendered to members, the Association maintained a private library devoted to engineering research and technical developments in the field of aeronautics. More than 400 volumes of books and periodicals were acquired during 1944, either by purchase or by gifts from various companies and individuals. In addition there was a complete file of aircraft patents issued in the United States, and as many as were obtainable from Great Britain and other countries, including an extensive classification and indexing system, not only unique from the point of view of research in the patented art, but especially adapted to the needs of members in connection with engineering and research problems.

The Association's Patent Research Division published a comprehensive digest of all aircraft patents and such British patents as became available, including abstracts of the specifications and official drawings, which kept members informed regarding patented developments. It also advised members regarding the trend of technical development, with a view to minimizing infringement claims, and as a basis for the possible acquisition of patents, licenses and design rights. Advancement of the art thus was encouraged by making the important technical progress available to engineering departments of all companies. It was particularly valuable during the war when the equivalent of several years of normal research and development were being



THE CURTISS P-40N WARHAWK

Latest model of more than 15,000 fighters produced by Curtiss-Wright Corporation Airplane Division since the outbreak of war in 1939. It is Allison-powered.

crowded into a period of a few months. Submissions of developments by all inventors in the field of aviation were given careful consideration, and were brought to the attention of the membership, or kept readily available in case of inquiry. Some inventors filed complete data such as blueprints, photographs, and experimental and test records in regard to their patented inventions, so that Association members might know the real nature of constructive improvements offered for purchase or license. A further important service rendered in connection with non-member patent owners has been the substitution of friendly arbitration proceedings for costly court litigation.

#### Aircraft War Production Council

Industrial teamwork through the Aircraft War Production Council led West Coast airframe manufacturers to new levels of efficient warplane output in 1944. The Council, organized in April, 1942, as a non-profit corporation to expedite war production of military aircraft, pioneered the pooling of production know-how in the industry under the slogan "more air power per hour." Members were Boeing Aircraft Company, Consolidated Vultee Aircraft Corporation, Douglas Aircraft Company, Lockheed Aircraft Corporation, North American Aviation, Northrop Aircraft, and Ryan Aeronautical Company. Each member company maintained its own identity while freely exchanging information and manufacturing resources in the interest of speedy, efficient production. This interchange extended beyond the Council to other munitions manufacturers who sought information or assistance.

The Council's regional activities were projected nationally through cooperation with the Aircraft War Production Council, East Coast; The NAWPC; the Automotive Council for War Production; Aeronautical Chamber of Commerce of America, and with the armed Services and Government agencies. At the operational level there was a general manager, staff and working committees. In June, 1944, William F. Peters became manager, succeeding John C. Lee, who had directed the staff since the Council was established. Mr. Lee resigned to become president of Menasco Manufacturing Company, Burbank, Calif.

Through the working committees, made up of representatives of each company, the Council coordinated the cooperative efforts of the companies with the Army, Navy, Government agencies and regional industrial groups to solve mutual problems of engineering, materials, manpower and production efficiency. Operations were carried on through five principal committees, dealing with production expediting, engineering, industrial relations, public relations and accounting. Under these primary groups were sections, concerned with employee services, Government reports, labor utilization, materiel, recruitment and training. There were 18 panels handling problems of conserva-

tion, engineering manpower, field service, Government specifications on technical data, housing, industrial medicine, industrial safety, inspection, librarians, methods improvement, patent officers, selective service, spare parts, testing and research, tooling, transportation, turnover and absenteeism, and women's counselors. In addition, eight project groups worked on specific problems of casting acceptance standards, temperature effects, tooling standards, wage incentives, ANC-5, adhesives, airplane procurement specification forms, and radiographic interpretation standards.

In 1944 the seven Council companies, in all their divisions and branches in 16 States, produced 44,984 planes, which constituted 46.6 per cent of the nation's total output of 96,369. In their home Pacific Coast plants alone, the companies built 25,189 planes, 26.13 per cent of the national total, and the airframe weight of 341,330,900 pounds was 12 per cent greater than the 1943 attainment. Indicative of increased manpower utilization, this was accomplished while plant employment decreased 25 per cent during 1944. The Air Technical Service Command, Western District, reported that one-half of all four-engine bombers, nearly one-fourth of the single and twin-engine fighters, and almost one-fifth of the transports produced in the United States in 1944 came from the Pacific Coast.

At the beginning of 1945, almost all the companies faced sharply increased schedules to meet new tactical requirements of the armed Services. Among the planes most urgently needed were the models already rolling, or about to roll, from Council company assembly lines



B-25J MITCHELL BOMBERS

North American Aviation's Model J Mitchell bombers, each carrying 12 .50-cal. machine guns.

—heavier, far-ranging transports and superbombers, faster, more advanced fighters, special purpose planes such as night fighters and photographic reconnaissance models, and some still in the secret category. It was evident that during 1945 the Services would require from this segment of the aircraft industry an increasingly important share of the warplane output.

Some problems which had been solved temporarily during the latter part of 1944 assumed new significance as the turn of world events caused the nation to strengthen its war effort. Lack of manpower in Pacific Coast aircraft plant areas continued to hamper recruiting activities of companies seeking to build up working forces needed to meet increased production schedules. In an effort to overcome housing shortages which limited the hiring of in-migrants in these areas, the Council's housing panel made a survey of each company's manpower and housing requirements, and submitted it to the National Housing Agency for consideration in the programming of additional public and private housing. Selective Service problems again caused concern when it became known that draft calls in California for the first three months of 1945 were expected to take from the aircraft plants substantially all men in the 26 to 29 age group. A survey made by the Council's selective service panel indicated that approximately 11½ per cent of the entire work force of the California aircraft industry was in that age bracket, and that this group embraced approximately 20 per cent of all male workers.

The aircraft industry's continuous campaign to reduce turnover and absenteeism of employees was carried into 1945 with renewed vigor. All methods of procedure, including hiring and exit interviews, work-to-win incentive plans and a wide variety of other services, were re-examined to discover means of improving manpower utilization by keeping more employees on the job. During 1944 the monthly separation rates for Council companies had decreased from 6.19 per 100 employees in January to 5.53 in December, the lowest level in 24 months. Average rate for the year was 6.91, despite sizeable layoffs in June and September occasioned by reductions in production schedules. The absenteeism rate of 7.4 in January, 1944, was cut to 6.9 in December, and the year's average was 6.57.

#### Aircraft War Production Council, East Coast

Members of the Aircraft War Production Council, East Coast, were The Aviation Corporation; Bell Aircraft Corporation; Chance Vought Aircraft (admitted to membership in 1944); Curtiss-Wright Corporation; Eastern Aircraft Division of the General Motors Corporation; Fairchild Engine and Airplane Corporation; The Glenn L. Martin Company and Republic Aviation Corporation. Subsidiary companies of these parent member organizations included American Propeller Corporation; Lycoming Engine Division of Aviation Cor-

poration; Northern Aircraft Products and Republic Aircraft Products (also divisions of the Aviation Corporation); Curtiss-Wright Corporation—Propeller Division and Ranger Engines Division of the Fairchild Engine and Airplane Corporation. During 1944, the East Coast Council member companies and affiliated branches continued to produce planes of all types—fighters, patrol, dive and torpedo bombers, cargo planes, medium and some heavy bombers, as well as engines, propellers and parts for these planes and those already in service.

Production pace was maintained in the face of constant changes in design necessary to meet ever-changing tactical requirements and to maintain performance superiority. The gains of the industry as a whole were reflected in East Coast production figures, despite the fact that certain types of airplanes (notably trainers) were removed from production schedules, the year 1944 having been marked by an increasing emphasis on production of larger and more powerful combat aircraft. The record was marked with greater efficiency in all lines. Indicative of this was the increase in the amount of airframe weight produced per employee, rising from 70 pounds in November, 1943, to 96 pounds in August, 1944. In January, 1941, only 21 pounds



U. S. Navy photo

#### INSIDE A MARTIN MARINER

Interior view of radio and pilot compartments in a Navy PBM twin-engine patrol bomber.

of airframe weight were produced per employee. Further, the 1944 record was achieved with fewer employees, indicative of increased manpower utilization and improved production methods. Increased production efficiency was reflected also in cost savings to the public.

In the two and a half years of its existence, the Council sponsored more than 1,000 separate meetings on problems that ran the gamut of production. Committees, panels and project groups were comprised of more than 700 member company representatives. At many of the meetings, officials of the Army, Navy, WPB, ASU, WMC, OPA, ARCO, OWI and other Government agencies were in attendance. Under the sponsorship of the test and research panel of the advisory committee on engineering, over 2,100 reports on engineering projects were distributed by means of an engineering index. Fifty-two of these card libraries were prepared and distributed in accordance with the requirements of the East Coast Council members, the West Coast Council, National Aircraft War Production Council, the Army, Navy and the Institute of the Aeronautical Sciences. (A similar, equally valuable index was supplied by the West Coast Council.) By exchanging results of test and research, duplication of effort was avoided, and thousands of manhours as well as tens of thousands of dollars in research expenditure were saved.

Many new subcommittees, specialists panels and project groups were appointed to concentrate on specific projects arising out of the flux of war strategy and the use of new materials in aircraft fabrication. While the industry sought constantly to overcome difficulties arising out of shortages, material surpluses accumulated in the individual plants, for several reasons. Members of the Council's advisory committee on production, in conjunction with the advisory committee on materials, undertook to remedy this condition by the interchange of surplus lists. Several methods of effecting redistribution of idle but usable material had been suggested in different parts of the country. A plan developed by the East Coast Council advisory committee on materials, presented through the Eastern Procurement District, was adopted nationally. ASU-45 ("Surplus Materials Source Request") was issued and purchasing agencies of all companies were urged to use these surplus stocks as a first source of supply. The Committee took an active part in formulating a surplus warehousing plan, an expansion of warehouse facilities for the storage and redistribution of surpluses. This plan was approved by the War Property Administrator, Reconstruction Finance Corporation, the Army and the Navy.

A group, designated materials review board, appointed by the advisory committee on quality, attended meetings at Wright Field to establish a uniform course of action, properly to control material which might deviate from drawings and specifications, but which was not affected as to quality, performance, safety, durability, strength, assembly or interchangeability. During 1944, the advisory committees

on service and spare parts had as their main purpose the implementing of plans which would insure that American warplanes would be serviced to whatever degree was necessary to keep them turning in top performance.

In addition to its advisory committee on industrial relations, the Council maintained subcommittees and specialists panels dealing with manpower problems. They dealt with the matters of absenteeism and related subjects—housing, transportation, rationing, child care, feeding services, service stores, medical services and employee counsel. A specialists panel on selective service concentrated on the problem of supervising replacement and manning table operations. The advisory committee on public relations continued to function primarily as a liaison group, promoting cooperation on the part of the other Council committees. This group met regularly with Army and Navy public relations officers and worked closely with the Industrial Services Division of the War Department and the Industrial Incentive Division of the Navy Department. All member companies of the Council were in complete agreement as to policy in the matter of veterans' employment and every effort was made to secure suitable placement for the handicapped.

Plant protection methods adopted by the industry were responsible for its remarkable record of uninterrupted production and employee safety. An advisory committee on plant defense was working in cooperation with the Internal Security Section of the Air Forces and with the Army and Navy Intelligence and Security personnel.

#### Air Transport Association of America

The Air Transport Association of America, its members the 19 principal air lines operating in and from the United States, together with six associate members operating in Alaska, Canada and the Caribbean, served as a liaison agent between the air lines and the



THE NORTHROP P-61 BLACK WIDOW

Front view of the 3-place black night fighter showing the narrow crew nacelle, only 49 inches wide.



military, naval and marine transport services. The air lines through their central organization were able to mobilize their personnel and equipment without delay. The magnificent job which they performed in transporting cargo and personnel to all corners of the earth, both under special contracts with the Government and through their own commercial operations, was one of the most important contributions to the war effort. The Association also had its postwar plans for a vastly expanded service, because the war advanced flying operations beyond the wildest dreams in regard to range, speed, safety, economy and comfort. Millions of people were potential travelers and shippers by air. The ATA was organized to help the lines develop that traffic. The ATA made available information on legislative proposals connected with air transport, and represented its members in projects dealing with airports, engineering problems, Government regulations and general improvement of service. Committees were active in traffic and sales development. ATA was making a survey of commodities that could be transported economically by air. Other projects included development of a universal air travel plan, advertising promotion, interline ticketing, consolidated tariffs, credit cards, time payment ticket sales, trip insurance and traveler's aid. During the war, a full-time staff was working with the armed forces in directing military priorities.

The ATA committee on air line finance and accounting dealt with analysis of costs and financing, taxation, accounting and record keeping, making findings available to all members. An engineering and maintenance section was working on aircraft requirements, fuels and lubricants and elimination of fire and other hazards. Another unit was working on improvement of operations, including communications, meteorology and airport construction. Another committee dealt with development of passenger and cargo handling equipment. Other committees were dealing with such new elements as radar, jet propulsion, reversible propeller, and other scientific developments in airplane design and operation having a direct bearing on take-off and landing requirements. The Association also had its labor relations and personnel unit; which correlated experience and assisted the air transport industry in solving personnel and labor problems. An information section was active in popularizing air traffic.

#### **Institute of the Aeronautical Sciences**

The Institute of the Aeronautical Sciences completed its 12th year with more than 6,500 members. New sections were organized in Cleveland, Phoenix, Washington, D. C., and Wichita, bringing the number of active sections to 12, which held 33 meetings during 1944. Despite the many students continuing to leave college to enter the armed services, student branches were maintained in 33 colleges and

schools. A total of 45 technical papers were being considered for publication in the Journal of the Aeronautical Sciences and the Aeronautical Engineering Review. The Wright Brothers Lecture was presented by John Stack, Chief of The Compressibility Research Division, Langley Memorial Aeronautical Laboratory, National Advisory Committee for Aeronautics, on the subject, "Compressibility Flows in Aeronautics". At this meeting the National Aeronautics Association presented the Robert J. Collier Trophy for 1943 to Capt. Luis De Florez, U.S.N.R., a Fellow of the Institute.

The following Institute awards were made for 1944: The Sylvanus Albert Reed Award to Fred E. Weick, Chief Engineer, Engineering and Research Corporation, "for his contributions to the development of tricycle landing gear and the two-control non-spinning airplane"; the Lawrence Sperry Award to William H. Phillips, Chief of the Stability and Control Flight Section, Langley Memorial Aeronautical Laboratory, NACA, "for outstanding contributions in the field of stability and control of aircraft"; the Octave Chanute Award to Col. Benjamin S. Kelsey, Army Air Forces, "for his outstanding contributions to the development of high-speed military aircraft and to the knowledge of the effects of compressibility through flight testing"; the John Jeffries Award to Air Marshal Sir Harold E. Whittingham, Director-General of the Medical Services of the Royal Air Force, "for outstanding contributions to the advancement of aeronautics through medical research"; the Robert M. Losey Award to John Cary Bellamy,



U. S. Navy photo

#### A NAVY PIPER CUB AMBULANCE

A flight surgeon supervises the removal of a casualty.

Special Consultant to the Army Air Forces Weather Service, in recognition of outstanding contributions to the science of meteorology as applied to aeronautics; the Thurman H. Bane Award to Col. Donald J. Keirn, Air Technical Service Command, "for his contribution to the development and utilization of the jet propulsion engine".

#### National Aeronautic Association

The National Aeronautic Association had an airport program to enlist popular support among aviation consumers for a national landing facility plan to provide the thousands of landing areas necessary for full development of civil flying. The NAA program took shape, first, in the delineation of a broad private flying policy which included landing facility development, air service for every community in the country, simplification of private flying regulations, aviation education in public schools and by private groups, recognition of aeromodeling as the scientific and technical preparation for youth in aviation, the promotion of hemispheric postwar flying through the Inter-American Escadrille, of which NAA was the United States Wing, and a broad educational program, interpreting and providing information on every phase of aviation.

In July, 1944 NAA held the joint airport users conference, inviting representatives of 87 business, industrial, education and Government organizations. Fifty-one sent official delegates. This first general conference of all parties interested in airport promotion and construction laid down the types and size of facilities needed for different services after the war. A permanent joint airport users conference, voted by delegates of the national groups was created to promote like thinking and action by member organizations. Member groups were left free to act in their own names, without being bound by conference decisions. After that meeting, special committees studied Federal landing facility legislation in relation to existing law, in an attempt to find the most satisfactory means of implementing the sound, economic expansion of the nation's landing facilities. Uniform State airport enabling and zoning acts were circulated to member organizations. Efforts were made to develop factual material to encourage the enactment of constructive and helpful State legislation. NAA's role in the program encouraged local interest in landing facilities by a general educational campaign and by organization of aviation consumer groups within communities to act in concert with other local organizations in actual development work. In addition, NAA provided information and consultant service.

Assisting NAA's national landing facility program on the local chapter level were seven series of chapter service bulletins, a digest of airport literature, the services of a joint NAA-Aeronautical Chamber of Commerce of America Speakers' Bureau, kits for NAA speakers on the landing facility and air power programs, airport consultation,

a manual published by ACCA, entitled "Put Your Town on the Air Map," and a newsletter, FYI, carrying a report of each week's most significant developments in civil aviation.

Private flying was encouraged not only by the concerted drive for landing facilities, but also by efforts to remove or lessen limitations and restrictions on private flyers. To simplify the purchase of 73 and 80 octane gasoline, and avert impending curtailment of supplies to private flyers, NAA took the lead in advocating the transfer of the rationing power from the Office of Price Administration to the Civil Aeronautics Administration. As security conditions permitted, NAA made representations to civil and military authorities seeking to lift restrictions in the Eastern and Western Vital Defense Zones. First relaxation was the creation of flight corridors along the East Coast. Security and military operations restricted private flying on the West Coast, but NAA expected that some civilian training would be permitted in 1945. Simplification of private flying regulations was advocated by NAA, as well as other organizations. Speakers discussed the need for simplification before many groups. NAA had a project to determine how medical examinations for pilot's licenses could be relaxed with a maximum of safety, so that more people might fly. As part of the general private flying program, Wing Commanders of the Civil Air Patrol were invited to become NAA National Councilors, because of their outstanding interest in private flying.

In 1944 NAA chapters were increased from 54 to 100. The Robert J. Collier Trophy, awarded annually by the NAA for the most outstanding achievement in aviation, the results of which have been demonstrated conclusively in the preceding year, was presented to Capt. Luis De Florez, USNR, for his work in development of synthetic training devices for U. S. Naval aviation. The Frank G. Brewer Trophy for accomplishment in the field of aviation education was awarded to Dr. Edgar Fuller, assistant director of the CAA education division.

#### **Society of Automotive Engineers**

The Society of Automotive Engineers Aeronautical Standardization Program continued at an accelerated pace and with expanded activities. As a result of requests from the industry and the Government for additional projects to be handled by the SAE Aeronautics Division, one new Subdivision, five new Committees and 19 new Subcommittees were established in 1944. This increased the total number of members working on the Aeronautical Standards Committees from 215 to 450. These 450 committee members represented outstanding technicians from the industry and Government in their various fields of specialized engineering activity. Activities included development of design and dimensional standards for aircraft engines, propellers and accessories, as well as specifications for materials and processes



#### HELLDIVER RETURNING TO CARRIER

A Navy Curtiss SB2C dive bomber approaching for a landing on its Essex-class aircraft carrier.

used by the manufacturers of aircraft engines, propellers, accessories and airframes. In addition, the committees were called upon to coordinate industry opinion on proposed or existing Government standards and specifications with a view to making these standards and specifications more practical and satisfactory to the industry. During 1944, the SAE participated in a U. S. Aeronautical Standardization Mission to Great Britain at the joint invitation of the Society of British Aircraft Constructors and the Ministry of Aircraft Production. The purpose of the mission was to explore ways and means of collaboration during the rest of the war and in the immediate postwar period, and to establish necessary personal and administrative contacts for handling the desired aeronautical standardization between the two countries. The results of this visit were very encouraging, and it was apparent that increased collaboration between the two nations leading to the standardization of aeronautical equipment could be anticipated.

The SAE published 30 new and revised Aeronautical Standards and Aeronautical Recommended Practices (AS and ARP Series). The number of SAE Aeronautical Material Specifications (AMS Series) used by the industry was increased to 336 with the distribu-

tion of 37 new and 58 revised specifications. This series of specifications received the endorsement of the Army Air Forces and the Navy Bureau of Aeronautics for use on military aircraft. More than 2,910,000 copies were distributed. In 1944, two Aeronautical Information Reports and several restricted reports were prepared. The SAE Manual of Aircraft Engine Drafting Room Practice was revised. A total of 429 technical papers were presented at nine SAE national meetings and at local meetings of 28 SAE sections and five SAE groups.

The SAE Manly Memorial Award for the best paper presented at an SAE meeting on theory, practice, design, construction or research in the field of aircraft power plants, parts or accessories, was presented to J. O. Almen of General Motors Corporation for his technical paper, "Shot Blasting to Increase Fatigue Resistance." The SAE Wright Brothers Medal for the best paper on aerodynamics, structural theory or research in the field of airplane design was awarded to C. E. Pappas of Republic Aviation Corporation for his technical paper, "Determination of Fuselage Moments." The Daniel Guggenheim Medal was presented to Lawrence D. Bell, president of Bell Aircraft Corporation for achievement in aeronautics during 1944.

#### Aircraft Owners and Pilots Association

The Aircraft Owners and Pilots Association worked to make non-scheduled flying more useful, safer, less expensive and more fun. A.O.P.A. aimed to be to the pilot what auto clubs were to motorists; especially when motoring was new. It was a non-profit pilots' organization, and membership was open to pilots only. During 1944,



VOUGHT F4U-1D CORSAIR

The Navy and Marine Corps fighter carrying two 1,000-lb. bombs plus its regular striking power of six .50-cal. machine guns.

A.O.P.A. rendered many services to member pilots. Government officials were contacted to solve individual problems sent in by members. The pilot advisory service assisted members in such matters as wartime regulations, airport facilities, pilot, aircraft, and radio licenses, employment, sale and purchase of aircraft, tow-in and repair service for aircraft after forced landings or crack-ups; legal advice specializing in aviation matters; a reduced rate on Driv-Ur-Self automobiles throughout the country. The Association conducted a legislative branch for the purpose of reflecting pilots' viewpoints on proposed regulations; assisted in removing and preventing the erection of airport obstructions; offered special privileges to its membership at A.O.P.A.-designated hotels; designed plans for Airhavens (attractive homes built around landing fields) and continued its fight for simplified Federal regulations; fought successfully for the enactment of regulations beneficial to civil aviation and for the elimination of rules considered detrimental.

The Association's program also included, when conditions should permit, arranging of special flights; operation of a travel bureau to assist pilots wanting to fly abroad; publication of an airport directory and radio guide for cross-country flights, including the rating of airport equipment and services; testing and rating of aircraft and accessories; advocacy of minimum insurance rates for pilots and planes; the quicker action on Approved Type Certificates for newly developed aircraft and a vigorous campaign for more landing strips, airports and seaplane bases located close to city centers.



THE BELL JET-PROPELLED P-59

The twin-engine, jet-propelled Airacomet produced by Bell Aircraft.

## CHAPTER X

### NEW THINGS IN THE AIR

Our Flyers Sent Overseas With the Best Possible Aircraft—Increased Speed up to 500 Miles an Hour—The Development of Jet Propulsion—Our New Fighters and Bombers—Work of the Manufactures of Planes and Engines.

**W**HILE our airmen were performing such extraordinary feats of skill and daring against the enemy over the world's battle fronts, the American people could derive considerable satisfaction in knowing that these heroes they had sent overseas were using the best possible flying equipment. The aircraft manufacturers of the United States turned out the record number of 96,369 war planes in 1944, and the engine builders produced 256,571 aircraft engines, besides spare parts. Moreover, month by month the manufacturers made improvements in the planes and engines, so that they could be flown against the enemy at greater speeds, at more advantageous altitudes with longer range, with increased firepower or heavier bomb capacity, and with better performance than the machines the enemy used against them. That, combined with the fact that our airmen were the best-trained of any belligerent, accounted for the improved safety records during our third year of war and the ability of our airmen to shoot down from three to 10 enemy planes for every American machine lost in aerial combat. Our attrition rate was much lower, compared to the vastly increased amount of combat flying. While the builders made innumerable improvements in existing models, improvements dictated by actual experience in the war, they also were developing new aircraft, some with speeds in the 500 miles an hour range, planes with greater firepower and bombers much larger and more powerful than those already in action.

Advancement in the aeronautical sciences spurted ahead on the heels of new developments in the field of aircraft propulsion which promised to open an entire new era in the science of flight. While continuing to improve conventional aircraft types, engineers of industry, the military services and Government research laboratories turned increasing attention to jet-propulsion and rocket-propulsion applications to aircraft and guided missiles. So quickly had jet-propulsion developments progressed that two types of jet-propelled fighters were known to be in production, while military leaders warned the enemy of even more spectacular turbine and rocket-powered weapons



soon to come. Capable of super speeds and particularly efficient at high altitudes, the jet plane was outstanding for ease of control and lack of vibration. Without propellers, the jet plane obtained its forward thrust through the continuous rearward discharge of air at high velocity.

Behind the story of jet propulsion was the gas turbine engine which made possible the new means of thrust. Consisting of a combustion chamber and turbine, a rotating "wheel with blades", the turbine engine lacked pistons and cylinders. In its application to jet propulsion, the air was sucked in through the nose, compressed in a blower, heated, expanded and ejected at high velocity through a tail nozzle.

Though turbine application for jet thrust was successful, the turbine's brightest future might be for turning propellers, alone, or in combination with a jet. Some engine experts believed that turbine engines up to 10,000 horsepower would be available for giant aircraft within the next decade. Behind the gas turbine development were new advances in metallurgy. The turbine principle had been known for years but only recently had metallurgical research provided the metals to withstand the heat and power stress of such engines.

Vast strides in the application of rocket propulsion to aircraft and guided missiles were made in 1944, and a most comprehensive program of research and development in this field was proceeding at top speed in the nation's laboratories. While much of the experimental work was guarded closely as secret, some rocket-propulsion applications had emerged completely from the experimental stage, and had gone into production.

Nearly every fighter plane in the Pacific theater was equipped with rocket firing devices, and public announcements indicated that the armed services were pushing production of millions of dollars worth of these weapons for use both by aircraft and land vehicles. For the most part, current production rockets were of the type which were guided by pre-set gyroscopes, but research into radio-controlled rockets was reported to be at an advanced stage. America's first "robot," which went into production early in 1945, for service-test and developmental purposes, used a rocket for take-off and jet-propulsion for flight.

Application of rocket propulsion to assist the take-off of heavily-loaded bombers was under way. Experiments in rocket-assisted take-off already had shown that bombers could become airborne at higher weight, which meant greater range or greater bomb load. It was predicted that this means for assisting take-off likewise would increase the payload of postwar civil transports.

While probing further into the possibilities of the new and more radical designs of aircraft, including pilotless planes and guided missiles, refinements in more conventional military aircraft continued to

give our pilots an ever-mounting edge in their performance against the enemy. Many new models of helicopter or rotor-wing aircraft made their appearance, with nearly as many different types of control devices as there were experimental models. Payload, performance and general utility were improved greatly. Aerodynamic refinements, with new shapes for wings, fuselage and tail surfaces, further reduced drag and increased speed of our fighting planes. Continued improvement was made in conventional aircraft engines, increasing their service life and reliability. A new type cylinder fin for a radial engine achieved better cooling and increased power utilization. A new engine cooling fan was credited with increasing the rate of climb by 20 per cent. This fan boosted the payload of some types of planes by several thousand pounds. Improved cylinders, better fuels, lubricants and refinements in supercharging increased the horsepower output of many engines. Two engines, one an aircooled, the other a liquid-cooled type, were announced as exceeding 3,000 horsepower.

Propeller design was advanced in 1944. One notable development



#### JET PROPULSION ASSISTS TAKE-OFF

Here is a Martin Navy PMB Mariner twin-engine flying boat in a quick take-off during Navy tests with two jet propulsion engines installed to assist in getting the plane into the air with heavier loads.



REAR VIEW OF BELL P-59 AIRACOMET

Showing the tail pipe nozzle of the right thermal jet engine and the high, upswept tail.

was the application of reversible propellers as landing brakes for multi-engine aircraft. By reversing propeller pitch, after the plane touched the ground, pilots were able to shorten the landing roll of large bombers by nearly half. New means of avoiding and eliminating ice formations on aircraft propellers through circulation of hot exhaust gases through hollow propeller blades was reported to be emerging from test stages.

Power plant improvements combined with continued aerodynamic refinements in the shapes of wings, fuselage and tail surfaces, had pushed the top speed of several of our fighter planes to around the 500 mile-an-hour mark. Speeds of jet propelled aircraft were reaching beyond this mark. As aircraft speeds began to approach the speed of sound, around 750 miles, many new problems faced aeronautical scientists. Research laboratories of the Government and the industry sought to overcome the effects of compressibility. Encountered at extreme speeds, compressibility consisted of shock waves which upset the normal aerodynamic forces acting upon the wings. At least one new wing flap indicated some help towards the solution.

The following pages describe the work of the leading aircraft and engine builders.

Aeronautical Products, Inc., Detroit, Mich., which since the start of war had been on expanded schedules producing precision parts for aircraft engines, also developed a helicopter embracing the ideas of Alfred Jackson, company president, and Frank Dobson, chief engineer.

The first model made many successful flights in 1944, and late in the year its successor, A-3, a refinement of the first ship, went into the air. The A-3 was a 2-place, dual control helicopter for which the company claimed a top speed of about 100 m.p.h. A third model, with the engine mounted vertically directly under the rotor, was nearing completion. Following is the company's description of the A-3:

"The Aeronautical Products A-3 helicopter is a single-rotor ship which is very similar in external appearance to a conventional light plane. This is due to the fact that the engine is mounted at the front of the fuselage instead of being buried in the center as in most other designs. The forward mounting of the engine allows the passengers to be placed near the center of gravity of the ship and also makes possible a very simple and easily serviced engine installation. In addition, the engine cooling is simplified. The power plant is a Franklin 6-cyl. aircooled engine of 298 cu. in. displacement which develops 135 h.p. at 2750 r.p.m. The engine is mounted horizontally, with a fan directly above it blowing air down around the cylinders. Because of the forward mounting of the engine, air ducts are very short, and the flight



#### AERONAUTICAL PRODUCTS HELICOPTER

Model A-3 designed and built by Aeronautical Products, Inc., Detroit, Mich.

tests with the fan disconnected have shown that the power taken by the fan is so small that its effect on performance cannot be detected. Drive from the engine is by belts to a horizontal shaft, and then through a bevel gear drive to the main rotor shaft, which rotates at about 250 r.p.m.

"The main rotor is 30 ft. in diameter and has three blades which are mounted so that they can flap freely in a vertical or horizontal plane. The position of the blade is determined by the balance between lift, centrifugal force and engine torque, and can be varied by moving the controls as noted below. The incidence of the blades is controlled by a system of linkages which balances completely all loads on the control system, thus eliminating stick vibration which has been very objectionable in some helicopters. Control of the ship is by a stick which varies the angle of the blades during each revolution. When the stick is moved forward, the blades on the right hand side of the ship are twisted on their axes to a larger angle with the air while those on the left hand side are twisted to a smaller angle with the air. The blades rise as they travel toward the rear on the right hand side, and reach their highest point when directly aft. They drop again as they move forward on the left hand side, and reach their lowest point directly in front. To an observer, it looks as if the rotor had been tipped forward, and the effect is the same as if it were—that is, the ship is pulled forward by the inclined force of the rotor. When the stick is moved sideways, the rotor appears to tip sideways, and the ship moves as before in the direction in which the stick is moved. There is also another lever which varies the angle of all three blades together to control the lift. This lever is interconnected with the throttle to keep the engine r.p.m. approximately constant as the lift is changed.

"Steering is by means of a variable pitch propeller at the tail of the ship, rotating at about 1200 r.p.m. The pitch is controlled by rudder pedals similar to those used on a plane. In forward flight or hovering, the pitch of the tail rotor blades is adjusted to counteract exactly the torque required to turn to the main rotor, so the ship does no turn in either direction. To turn to the right, the right rudder pedal is depressed. This increases the pitch of the tail propeller, which pulls the tail of the ship to the left, thus producing a right turn. In case of engine failure, the rotor is kept turning by the air forces acting on it, and is automatically disconnected from the engine by a freewheeling mechanism."

Aeronca Aircraft Corporation, Middletown, O., was devoting its facilities to production of rudders, elevators and torque tubes for the C-46 transport, elevators for the B-17, and parts for the B-29 and Curtiss Helldiver. During the first two years of war, Aeronca had produced trainers and liaison planes for the Army Air Forces. The company had a complete line of light planes ready for production upon removal of wartime restrictions.

Beech Aircraft Corporation, Wichita, Kans., maintained the dollar volume of its 1944 production slightly in excess of 1943 sales, after adjustment for renegotiation, while at the same time accomplishing a major change-over in facilities and principal type of output. During 1944, facilities formerly devoted to production of the plywood AT-10 Beechcraft transitional twin-engine trainer were completely altered, to make possible large-scale, rapid output of complex, heavy all metal wing and nacelle assemblies for the A-26 Invader attack bomber. This change necessitated not only construction and tooling up of highly mechanized production lines, but the retraining, in metal-working skills, of thousands of employees who formerly had been trained only in wood-working. In addition, it was necessary to hire and train large numbers of new employees, to replace the 1944 portion of the more than 3,855 Beechcrafters who had joined the armed forces since the start of war.

The extensive Beech subcontracting system, which utilized facilities, labor and skills of scores of manufacturers, large and small, throughout the Southwest and Middle West, carried a larger share of the production load than at any time since its inception in 1939. For example, a Grand Rapids, Mich., subcontractor who in 1942 and 1943 supplied thousands of pairs of complete plywood wings for the AT-10 Beechcraft, assumed the job of routing out from solid aluminum alloy billets the intricately shaped, precisionally dimensioned spar caps for A-26 Invader wings. Despite the obvious difficulties of this major shift in type of production, Beech output of A-26 wings and nacelles remained on or ahead of schedule throughout the year. Inspired by knowledge that the A-26 was, according to the Army Air Forces, one



A V-TAILED BEECHCRAFT

A butterfly tail installed on an AT-10 trainer by the Beech Aircraft Corporation.

of our most urgently needed and critical weapons, Beechcrafters cheerfully worked long hours of overtime, often on a seven-day week, to keep up the record of on-schedule production which they had maintained throughout the emergency. One result of their efforts was the renewal of the Army-Navy "E" award, making the fourth consecutive time that this honor had come to Beech Aircraft.

At the same time that production was getting under way on A-26 wings, Beechcrafters continued to produce very substantial numbers of Model 18 Beechcraft all metal twin-engine planes, in the AT-7 navigation trainer, UC-45 personnel transport and F-2 photographic versions. Production of these types was gradually cut back toward the end of 1944, but the usefulness of the Model 18 Beechcraft to American and allied air services proved such that it remained one of the few non-tactical aircraft on order throughout 1944 and into 1945.

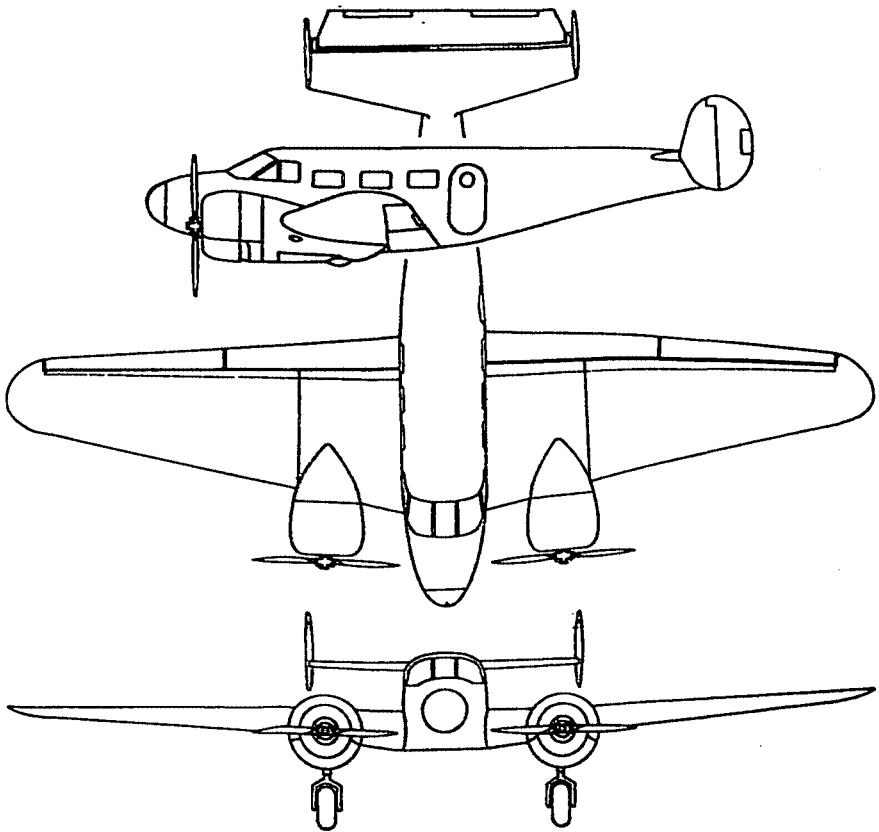
The number of women employed at Beech Aircraft during 1944 rose to a total exceeding 40 per cent of all employment; and their record for effort and accomplishment was excellent. Also notable was the good showing made by physically handicapped employees, whose numbers increased during the year to 23 per cent of total employment, as the result of a company policy originated to ease the manpower shortage and free the largest possible number of eligible male employees for military service. Manpower utilization at Beech was appraised as excellent by Government authorities. Beechcrafters reinforced their on-schedule production performance during 1944 in many other ways. They consistently maintained some of the lowest absenteeism and turnover rates in industry. They invested better than 20 per cent of their gross earnings in war bonds, as in previous years. Many hundreds of employees gave their own time, without extra compensation, to duties connected with active membership in the Beech Reserve Guards, Reserve Guardettes, and Volunteer Firemen, which were organizations functioning in military fashion to safeguard life and plant facilities in emergencies.

Construction and flight testing of the prototypes of a new and important combat airplane, entirely Beech-designed, were completed in 1944; and results of the tests were highly favorable. Volume production was attained during 1944 on a quantity order placed by the Army Air Forces for the Beechcraft continuously variable controllable pitch propeller, on which Beech possessed exclusive manufacturing and selling rights under the Roby patents. Approved type certificates were granted on two models of the Beechcraft propeller. Prototypes of the new propeller were submitted to other aircraft manufacturers for testing. An unique type of empennage, employing neither horizontal nor vertical tail surfaces, was developed experimentally and successfully test flown on many occasions, as one item in Beech Aircraft's continuous program of engineering research. First installed on an AT-10 Beechcraft twin-engine advanced trainer, the new empennage com-

bined horizontal and vertical stabilizers, rudder and elevators into two elements, making a V-shaped tail group. Conventional controls were used, and flight tests indicated satisfactory characteristics.

Beech made financial news in 1944 by being the first manufacturer in the Middle West to qualify for a line of credit amounting to a total of fifty million dollars, under the Regulation V loan plan. Undertaken by the Fourth National Bank in Wichita as agent, and a group of co-operating banks in other cities, mostly located in the Midwest and Southwest region, this revolving credit agreement simplified the company's financial operations.

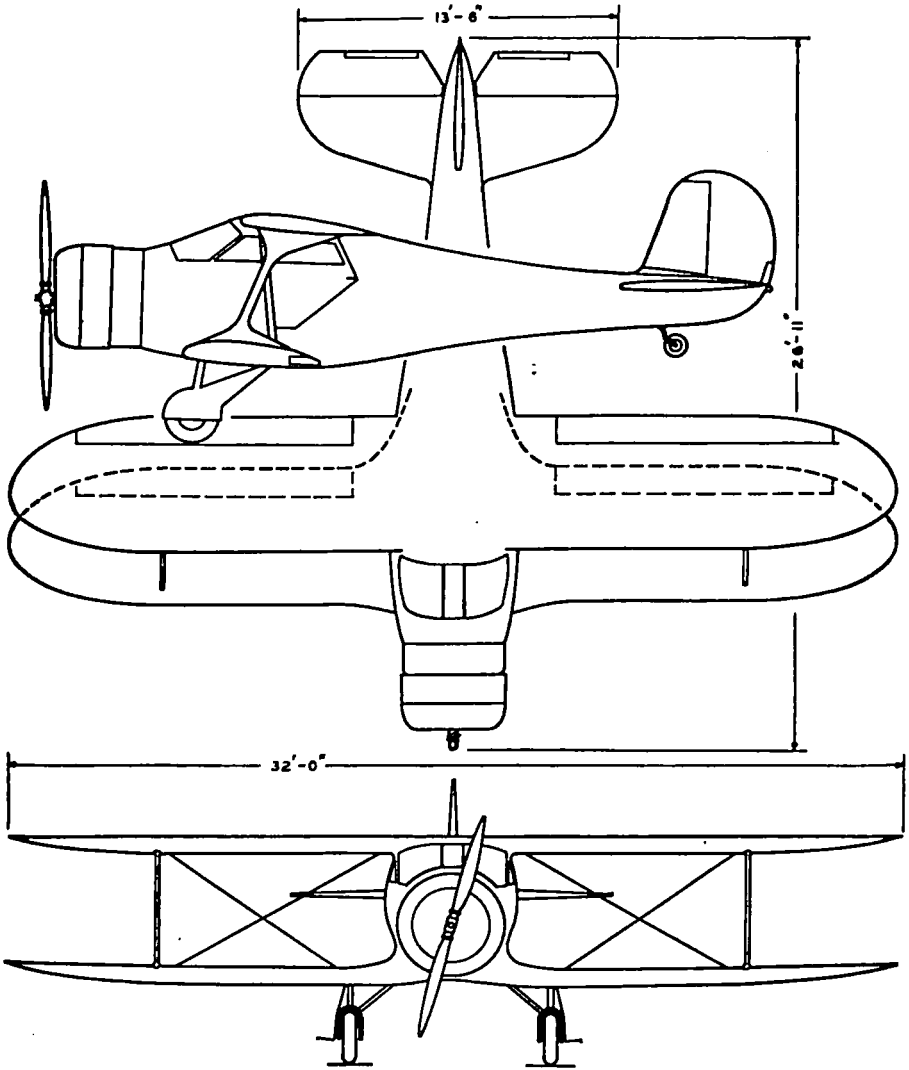
Arrangements were completed late in 1944 with Dymaxion Dwelling Machines at Wichita to investigate the possibilities of prefabricated housing units of a special type. Construction of a prototype Dymaxion Dwelling Machine, utilizing aircraft technology, processes and non-



BEECHCRAFT MODEL 18

Various adaptations of this twin-engine monoplane were used by the Army Air Forces and Navy air forces as navigation or bombing trainer, utility or personnel transport, or photographic plane. It was powered by two 450 h.p. Pratt & Whitney Wasp Junior engines.





#### BEECHCRAFT PERSONNEL TRANSPORT

Used as a utility transport also, the Army designation was C-43 and the Navy designation GB-2.

critical aircraft materials, was commenced at the plant of a Beech subcontractor who rented the necessary facilities to Beech for this purpose. Military authorities were understood to be interested in this project because of its possibilities for suitable housing for military units under climatic extremes of heat and cold encountered in various war theaters. Its potentialities for easing the manpower situation, by providing satisfactory housing in critical labor areas where homes for workers were lacking, and long-range possibilities for postwar rehabilitation and renewal housing also held much interest.

Beechcraft's only corporate subsidiary, its wholly-owned Material Distributors, Inc., at Wichita, completed its first full year of operation in 1944 with a noteworthy record. An outgrowth of the activities of the Beech Conservation and Salvage department, which in previous years attained nation-wide recognition for effectiveness in reducing consumption of critically scarce materials, the new corporation was formed originally to expedite the redistribution and prompt reuse in war production of materials and items rendered surplus in Beech's operations by engineering changes and contract cutbacks or cancellations. Its operations were enlarged almost immediately to offer a like service to other war contractors, and also to act as a finding service for manufacturers in need of materials. To accomplish these results, a master inventory of all surpluses was prepared—the only compilation of its kind known to exist—listing all surplus items of record among reporting war contractors. This master inventory, which included more than 100,000 different items, was kept constantly current as to additions and withdrawals among surplus stocks throughout the nation.

It was possible for Material Distributors, Inc., to refer buyers to surplus stocks located nearest their own factories, thus saving long-distance transshipments, and easing strain on war-crowded transportation facilities, as well as getting surpluses into use quickly, without intermediary warehousing or rehandling. Through the efforts of this Beech subsidiary, surplus materials having a cost value of more than four and a half million dollars were moved. At least one shutdown was known to have been prevented on a critical war production line, and long delays were averted in many instances.

Long-range preparations looking toward the eventual resumption of peacetime business went forward at Beech Aircraft, to the limited extent consistent with paramount and unceasing emphasis on the needs and obligations of the company's extensive war production schedules. The groundwork was laid for an efficient, large scale commercial sales organization, to cover a world-wide market for Beech products. Design improvements were completed and successfully flight-tested on the Model 17 five-place negative stagger biplane, for possible military use and for the ultimate benefit of commercial buyers. Preliminary design surveys were made, indicating the practicability of increased seating capacity and payload in an improved Model 18 all metal twin-engine Beechcraft transport, making this fast, versatile airplane even better adapted to the needs of feeder air lines and executive users.

Bell Aircraft Corporation, Buffalo, N. Y., continued production of reciprocating engine and jet propelled fighter airplanes in its facilities in Buffalo and Niagara Falls, N. Y., swung into important production of B-29 Superfortresses at its huge plant in Marietta, Ga., near Atlanta, and maintained scheduled deliveries of gun mounts and other

ordnance materiel for the Army and Navy in its Burlington, Vt., factory. Early in 1944, Bell figured prominently in a most important aviation event, when the U. S. Army Air Forces and British Royal Air Force revealed jointly that they had developed jet-propelled military planes, and that the Bell-designed and built fighter plane for the air forces was being powered by General Electric internal combustion turbine engines.

The Bell P-59A Airacomet served its great purpose as a "flying laboratory" used intensively in research into this new field of flight to gain additional knowledge of jet propulsion and its possible applications for the future. Besides serving that purpose adequately and well, the Bell jet-propelled planes also were used extensively in training pilots to fly the new type of aircraft. While still fulfilling orders on the P-59, Bell meanwhile did not relax efforts and experimentation to develop new and improved planes powered by thermal jet engines.

Although heavy demands were made on Bell production on three fronts, the company branched off on an earnest scale into research and development of rotary aircraft, with considerable promise. The Bell helicopter incorporated important principles of stability in flight and precision control. The rotary aircraft was test flown for a full year in Gardenville, N. Y. In May, 1944, in a special showing for Civilian Air Patrol personnel, the Bell helicopter became the first aircraft in American history to fly indoors when it demonstrated its handling and stability qualities inside the 65th Armory in Buffalo. In further proof of its maneuverability, the helicopter was flown before a crowd of 45,000 celebrating Fourth of July in Buffalo's Civic Stadium, the rotary aircraft successfully wending its way around fireworks displays and strands of wire installed for temporary lighting and telephone service on the ground.

Bell's Niagara Frontier Division facilities in Buffalo and Niagara Falls turned out P-63 Kingcobras and P-59 Airacomets and won its third renewal of the Army-Navy Production E Award, while the Georgia Division continued to meet schedules in its production of the Boeing B-29 Superfortresses. The Marietta facilities, originally designed for assembly only, took on fabrication of the Superfortresses in a labor area where it was necessary to train an almost complete production force from a populace unfamiliar with manufacturing procedures.

For the first six months of 1944, Bell was engaged in the production of three fighter plane models in its Frontier Division—P-39 Airacobras, the Kingcobras and the jet-propelled Airacomets. Both of the latter planes were introduced to the assembly lines at a time when Airacobra production was just starting to taper off. In June, 1944, the Airacobra, a combat plane in action since the earliest days of the war, went out of production, clearing the way for the P-63 Kingcobra. Almost 10,000 P-39s had been built for the Army Air Forces and air arms of allied nations, 9,000 of which were produced in slightly more

than two years. Because more than half of Bell's fighter plane production was being lend-leased to Russia, Lawrence D. Bell, president of the company, sought to establish closer technical and engineering relations with the Soviet Air Force. He communicated directly with Marshal Josef Stalin and obtained permission to send a delegation of Bell technical representatives to Moscow. A four-man mission headed by Leighton W. Rogers, spent the winter of 1943-44 in Russia, working closely with the Soviet Air Force, gathering technical data and helping the Russians to acquire complete utilization of Airacobras. Shortly after the return of the mission, the Red Army revealed that its top-ranking ace, Col. Alexandre Pokryshkin, had used the P-39 almost exclusively in his forays against the Germans. At last report, he was credited with 63 enemy planes, 48 of which had been shot down while he was flying an Airacobra.

On other battle fronts, the cannon-carrying Airacobra was besting opposition at a superior ratio. Early in 1945, first combat reports of its successor, the P-63 Kingcobra were being awaited. The Kingcobra



#### THE BELL HELICOPTER

A two-place rotor machine produced by Bell Aircraft.

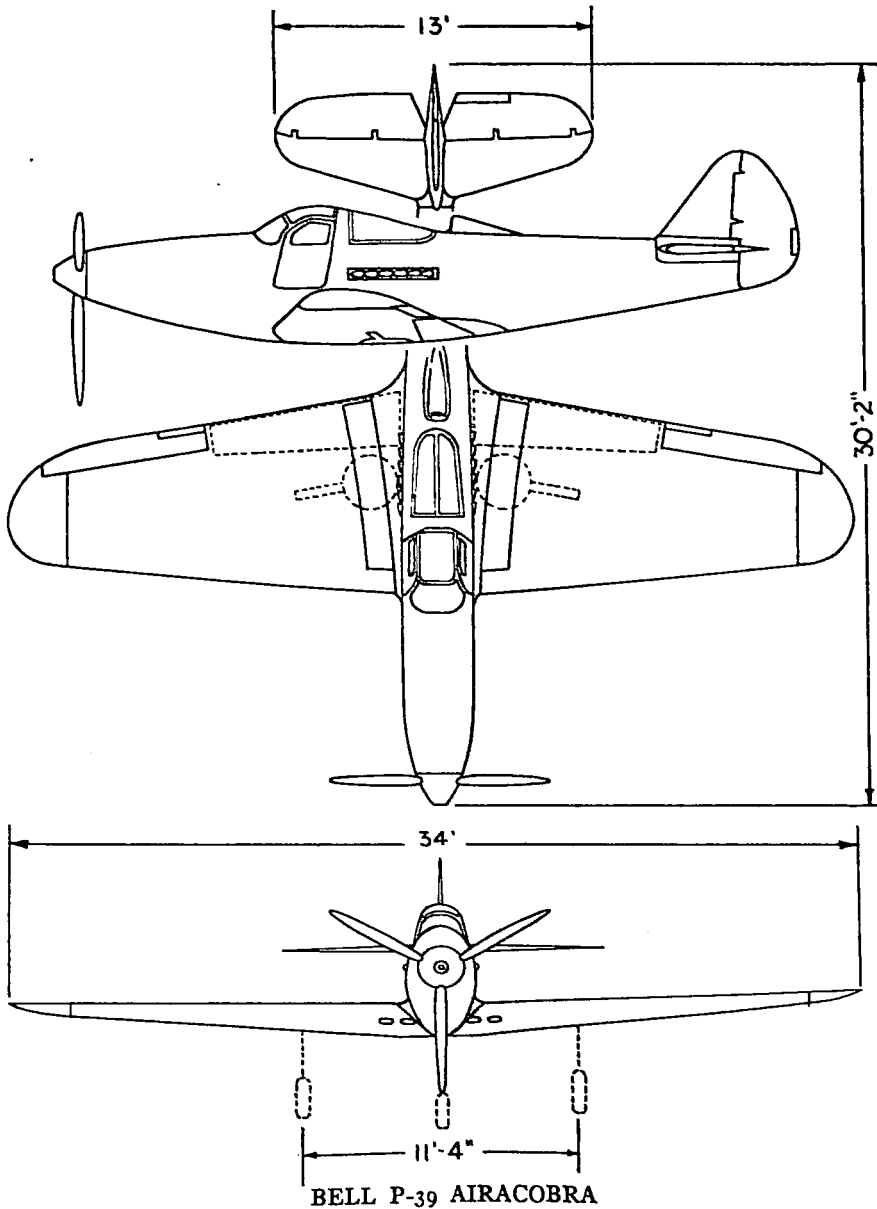
could fight efficiently at 35,000 feet, while the P-39's best level was 16,000 feet. Yet as a medium altitude, single-engine, short range interceptor, the Airacobra found few equals, and contrary to its design qualifications, the P-39 could give a good account of itself fighting at 30,000 feet.

Airacobra production evolved through 21 different model designations, the final of which was the Q-30. Starting with the Q series, armament of the plane was changed for the first time since the D series, when the plan originally was produced. Designed around a 37-mm. cannon, firing through the propeller hub, the Airacobra carried more heavy armament into the war than any other plane of its size. Airacobras up to the Q series carried, in addition to the 37-mm. cannon, two .50-cal. fuselage machine guns synchronized to fire between propeller blades, and two .30-cal. free firing guns in each wing. With the Q series, a .50-cal. free firing machine gun, underslung in a streamlined blister, supplanted the two 30s in each wing, making the later Airacobras' total armament one 37-mm. cannon and four .50-cal. machine guns. The latest version of the P-39s had four-blade propellers.

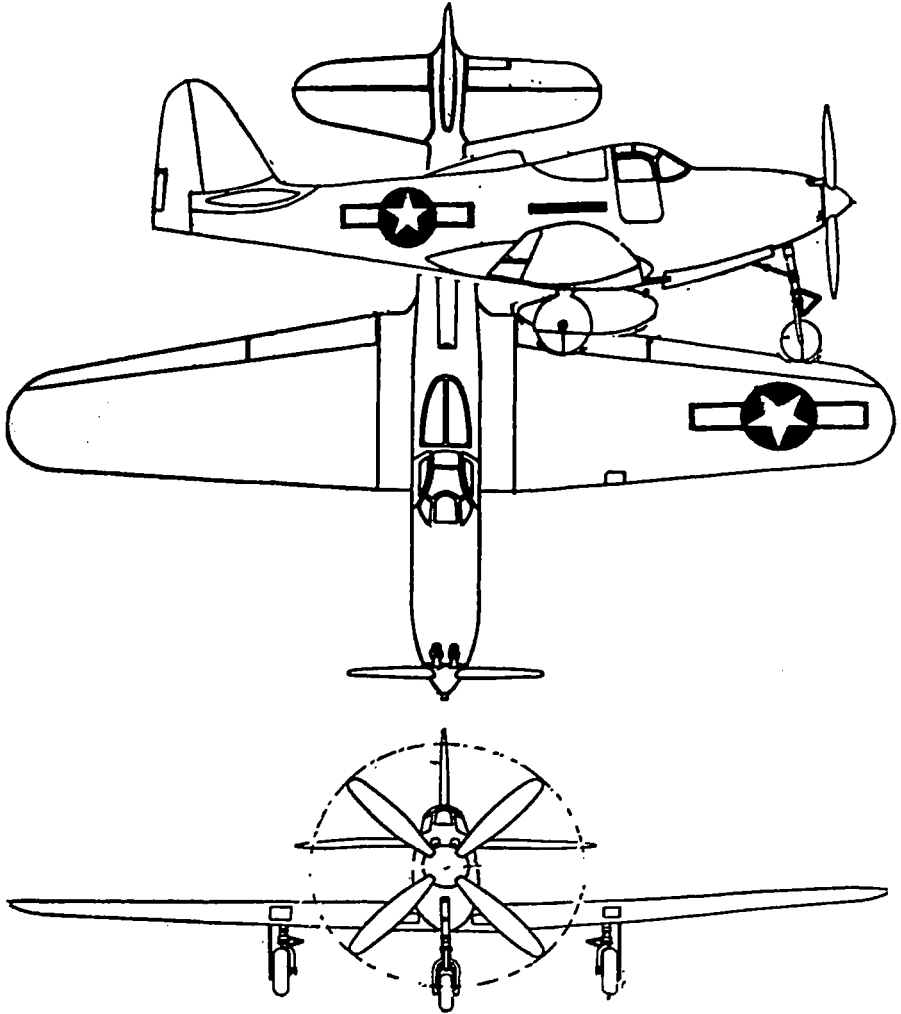
With the Airacobra going out of production, the Army permitted more detailed information on the construction and performance qualities of this sturdy, dependable fighter craft. A low-wing cantilever monoplane, the structure of the P-39 was all metal with stamped or pressed metal ribs and bulkheads, and it was covered with a flush-riveted stressed skin. The fuselage was built in two sections. The forward section consisted primarily of two main longitudinal beams with a horizontal upper deck between. The girders extended the length of the forward section, from the nose to the bulkhead aft of the engine. The engine was housed in the fuselage aft of the pilot, supported by the longitudinal beams. Also supported by the girders were the propeller reduction gear box, extension drive shaft, fuselage guns, ammunition and pilot's cabin. The pilot's cabin was set in front of the engine integral with the fuselage. The aft section was of metal monocoque, and it supported the tail unit. Both sections were bolted together. The P-39 wing section is NACA 0015 at root and modified NACA 23009 at tip. The center section of the wing was integral with the forward fuselage, and tapering outer-sections had three spars, front, rear and auxiliary. The tail unit was cantilever monoplane type. The fixed surfaces were all-metal and the movable surfaces had metal frames and were fabric covered. A single Allison V-1710-85 engine used in the P-39Q-30 Airacobra had a military rated horsepower at sea level of 1017 b.h.p. at 3,000 r.p.m. and a war emergency horsepower at altitude of 1,418 b.h.p. at 3,000 r.p.m. at 9,000 feet, military rated altitude. The plane had a maximum speed at altitude of 382 m.p.h. and a service ceiling of 32,000 ft. Its initial climb was 3,230 ft. per min. at war emergency power. Empty the plane weighed

5,967.3 lbs. and loaded 8,051.3 lbs. Its span was 34 ft., length 30 ft. 3.4 in., height 12 ft. 3¼ in. The gross wing area of the P-39 was 213.2 sq. ft., and net wing area was 197.7 sq. ft.

Detailed information concerning the construction and performance of both the P-59 Airacomet and P-63 Kingcobra, the two other Bell-built fighter planes, remained on the restricted list, but some data was



This single-seat interceptor fighter was powered by an Allison engine.



### BELL P-63 KINGCOBRA FIGHTER

Powered by an Allison V-170-93 1,325 h.p. engine.

released. The Airacomet, first American jet-propelled fighter plane, had a span of 45 ft. 6.208 in., was 38 ft. 1.675 in. long and 11 ft. 11.75 in. in height, and had a gross weight of more than 10,000 lbs. The gross wing area was 385.8 sq. ft. It carried one 37-mm. cannon and two .50-cal. machine guns. It utilized two General Electric jet-type internal combustion turbine engines, with nacelles located beneath the wing adjacent to the fuselage. Except for the large nacelles on the in-board wing, and the absence of a propeller and the long upswept tail, the jet plane resembled in characteristic design other Bell fighter planes. The tail unit consisted of a horizontal stabilizer, vertical fin, dorsal fillet, rudder, elevator with trim tabs and fillet assemblies.

The P-63 Kingcobra was a single-engine (Allison V-170-93 1,325 h.p.) single-seat high altitude fighter that resembled, on a larger scale its predecessor, the Airacobra. It was one of the first American planes incorporating the low drag, laminar flow type wing. It also was in the 400 m.p.h. class with a service ceiling rated at 35,000 ft. plus. The Kingcobra had 38 ft. 4 in. wing spread, was 32 ft. 8 $\frac{3}{8}$  in. in length, 12 ft. 7 in. high and had a gross wing area of 248 sq. ft. Its gross weight was 8,442.3 lbs.

With an eye to its wartime potentialities and a thought for the future, Bell developed a revolutionary type helicopter. The rotor was rendered independent of the mast by the stabilizing device, and the rotor tended to remain in a horizontal plane. This development not only contributed to stability in flight, but also promised to increase simplification of controls when such craft should be made available to the public. The two-bladed rotor used on Bell helicopters also permitted a simplified hub design. A conventional anti-torque propeller was used on the tail of the craft, and a three wheel landing gear, characteristic of all Bell planes, also was utilized. A Franklin engine, rated at 160 h.p., of the horizontally opposed air-cooled type, was mounted vertically, directly aft of the pilot's compartment.

Several models had been built and flown by January, 1945. One had an enclosed cabin and automobile type doors capable of carrying a passenger alongside the pilot. Another model had a single seat and an open cockpit. The two-place Bell helicopter also had dual controls. Generous sections of transparent plastic were incorporated in the cabin design, affording maximum vision for both pilot and passenger. Rotor, mast, transmission and engine were mounted integrally, and were set



BELL'S B-29 PRODUCTION

View of the Bell Aircraft Corporation's bomber plant at Marietta, Ga., showing production of the Boeing B-29 Superfortress.





#### BELLANCA TRAINER PRODUCTION

AT-21 trainers being assembled at the Bellanca plant in New Castle, Del.

in the fuselage in soft rubber mounts to reduce vibration. The span of the rotor was 33 ft. and the diameter of the anti-torque propeller was about five ft. The main rotor blades were of solid wood construction, with a steel insert in the leading edge, which aided in mass balancing. The steel insert added strength to the blades. The anti-torque propeller was variable pitch, with two solid wood blades. It was driven by a tubular shaft, and was controlled by a cable and pulleys.

Always successful in obtaining full utilization of manpower, even during the height of the industry's tremendous expansion program, Bell's Niagara Frontier Division succeeded in increasing the pounds of airplane produced per employee, while the overall working force of the division was substantially reduced.

Bellanca Aircraft Corporation, New Castle, Del., in 1944 resumed manufacture of complete airplanes. A contract for construction of a number of AT-21 twin-engine Crew Trainer airplanes was completed well within the specified delivery time. These airplanes were completed and test flown at Bellanca Field, New Castle. The field had been improved by a hard surface runway, 2,700 ft. in length so as to avoid delays in testing the airplanes due to weather conditions. The production of the complete AT-21 airplanes went forward without interference with other lines of work conducted by Bellanca, such as machining of gun turrets, construction of wing tip floats, ailerons, flaps and engine cowling, and delivery in large quantities of various types of fuel tanks, oil tanks, electrical junction boxes and other items for installation in combat and cargo aircraft for the United Nations.

Looking to the future, the Bellanca sales organization instituted a

series of advertisements, the purpose of which was to determine the exact features desired by the flying public in postwar years. A questionnaire form known as the Bellanca Aircraft Quiz was developed and sent out in response to written requests. The results were gratifying. The answers indicated on the Quiz returns were to serve as a guide for design and construction of the company's peacetime products. From the results of this Quiz, the following is an indication of the peacetime plane desired by the majority: "Single-engine, three- or four-place land plane with 140 miles an hour top speed, 125 miles an hour cruising speed and a 500-mile cruising range. They prefer a fixed low-wing monoplane of all metal construction (although this preference is evenly divided with plastic or steel-wood-fabric construction). Retractable landing gear is the favorite, and this again is divided between tricycle and two-wheel types."

Boeing Aircraft Company, Seattle, Wash., marked the year 1944 with two major achievements. First was the completion and successful test flights of its new giant of the air, the C-97 military transport, a two-deck counterpart of the Boeing B-29 Superfortress. Second was the conversion of Boeing's large Plant 2 in Seattle from record-breaking output of B-17 Flying Fortresses to all-out production of B-29 Superfortress assemblies, and the establishment of the Wichita plant as the leading producer of the B-29's country-wide manufacturing pool.

The Boeing C-97, with wings, engines, tail surfaces and landing gear identical with those of the B-29, but with a fuselage 12 ft. longer and with more than twice the volume of the Superfortress, set a coast-to-coast speed record on a flight from Seattle, Wash., to Washington, D. C., averaging 383 m.p.h. with a payload of 20,000 lbs. The time for the 3,323-mile flight was 6 hrs., 3 min. and 50 sec. The previous coast-to-coast record for large airplanes, held by the Lockheed Constellation, was 6 hrs., 57 min. and 51 sec. for the 2,300-mi. flight from Burbank, Calif., to Washington, D. C. The previous fastest time of an airplane, regardless of type or size, was made by a P-51 Mustang fighter, which flew the 2,446 miles from Los Angeles to New York, with one stop enroute, in 6 hrs. and 31 min. The comparative average miles per hour speeds of the three airplanes were: Boeing C-97, 383; Mustang, 376 and Constellation, 329.

The two decks of the Boeing C-97 were achieved by building, in effect, one fuselage on top of another, the upper section being longer and the two streamlining into each other. The bottom section was the same diameter as the B-29 but the top section was considerably larger. A cross-section of the airplane resembled an inverted figure 8. The C-97 was 110 ft. 4 in. long, its wing span 141 ft. 3 in. and its height 33 ft. 3 in. An unusual feature of the airplane was a pair of great loading doors which opened under the rear of the fuselage, with a drive-up ramp which was let down from within. The ramp was self-

contained in the airplane and was retracted into the plane by an electrically powered cargo hoist, so that no special equipment was needed in the field to load or unload the transport. The transport was capable of carrying more than 100 fully equipped troops for long distances at exceptionally high speeds. Its cabin was pressurized for comfortable flying at high altitudes. The transport was powered by four Wright Cyclone engines of 2,200 h.p. each at take-off. Propellers were Hamilton Standard four-blade, with a diameter of 16 ft. 8 in.

The C-97 was the prototype of the Boeing postwar supertransport, the Stratocruiser, an airplane of high performance and low direct operating cost. The Stratocruiser was to be powered in the postwar era with engines expected to develop as much as 3,500 h.p. each at take-off. It was to have a maximum speed of 400 m.p.h., a cruising speed of 340 m.p.h., an operating range of 3,500 mi. with ample fuel reserves, and an operating ceiling of 30,000 ft.

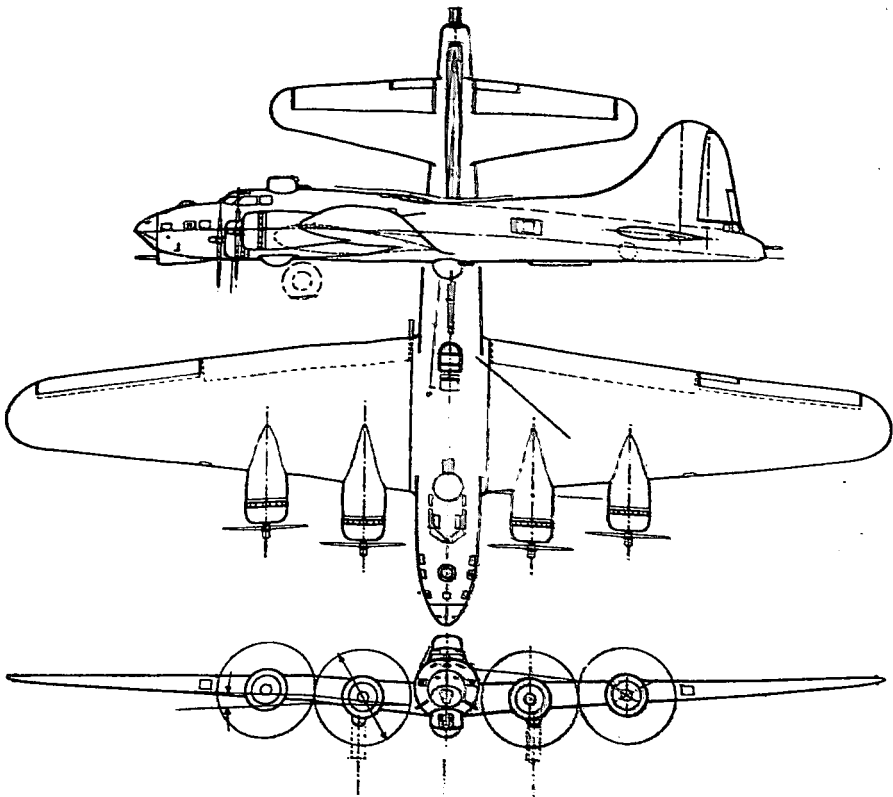
The two decks of the Stratocruiser were to make possible many interior arrangements for passengers and for combinations of passengers and cargo. A day-coach model would accommodate as many as 100 passengers in luxurious comfort. A sleeper would have berths for 36 persons for night travel and seats for 72 for day travel; and in addition would have a well-appointed combination observation, dining and cocktail lounge. An all-cargo version would have a capacity of 35,000 lbs. Boeing estimated that passenger versions of the Stratocruiser would have a direct operating cost of as low as one cent a passenger mile and cargo versions of 5 cents a ton mile.

The conversion of the Boeing Plant 2 in Seattle from B-17 to B-29 production, in scope and complexity, was without parallel in the aviation industry. In March, 1944, Boeing reached its peak of B-17 Flying Fortress production, establishing a four-engine world's record by turning out almost one an hour for the two main shifts. At the end of that month Boeing began the gigantic task of converting the plant to B-29 output. The Army specified that Boeing would have to continue to turn out B-17's in large quantities, but in gradually decreasing numbers, ending such output in March of 1945, the end of the conversion period, with delivery of more than 100 B-17's for that month. Because of the necessity of keeping up B-17 production, conversion had to be a gradual one. At the time it started, all available floor space in the factory was devoted to Flying Fortress production; and it was necessary at the start to squeeze a B-29 jig here and there in between B-17 jigs and assembly lines. But inch by inch, foot by foot, the Flying Fortress work gradually was compressed into smaller areas while B-29 work was expanded.

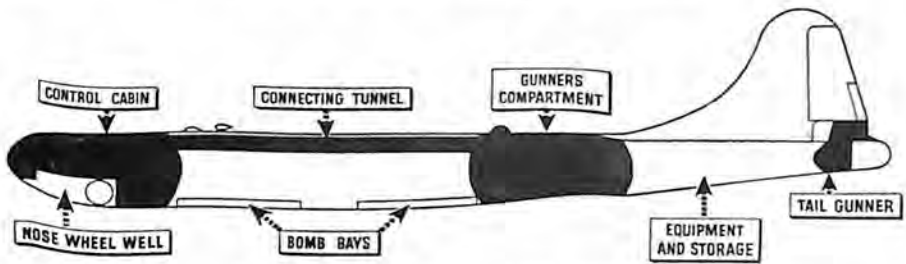
The plant's three B-17 final assembly lines first were reduced to two, and then to one as B-29 jigs began to occupy more and more of the floor space. In some shops employees kept on at B-17 production while air hammers were breaking up concrete floors on one side of

them, and cement mixers were pouring new concrete floors for the heavier B-29 jigs on the other. The conversion work was nearing completion early in 1945, and by spring the Boeing Plant 2 and its branch plants in six western Washington cities were devoted exclusively to output of B-29 parts and subassemblies, which were trucked to the Boeing plant at nearby Renton for final assembly. This arrangement, with all final assembly at Renton, was worked out because it was found that more B-29's could be completed a month under this arrangement than if each of the two plants made completed bombers. With conversion of Plant 2 completed, Boeing B-17 Flying Fortresses were manufactured only by the Douglas and Lockheed plants in California, under a manufacturing pool arrangement from which the B-29 production pool was copied. Production rate at the two California plants was increased to offset in part the loss of B-17 production at the Boeing plant.

It was the Boeing plant at Wichita, Kans., however, which was in the main responsible for the Army Air Forces' spectacular and effective B-29 bombing offensive on Japan and Jap-held territory. During 1944 the plains of Kansas shook with the thunder of more B-29's than



THE BOEING B-17G FLYING FORTRESS



PRESSURE SECTIONS OF THE B-29

The pressurized sections of the Boeing B-29 Superfortress, including the 35-ft. tube connecting control cabin and gunner's compartment are indicated in black on this drawing.

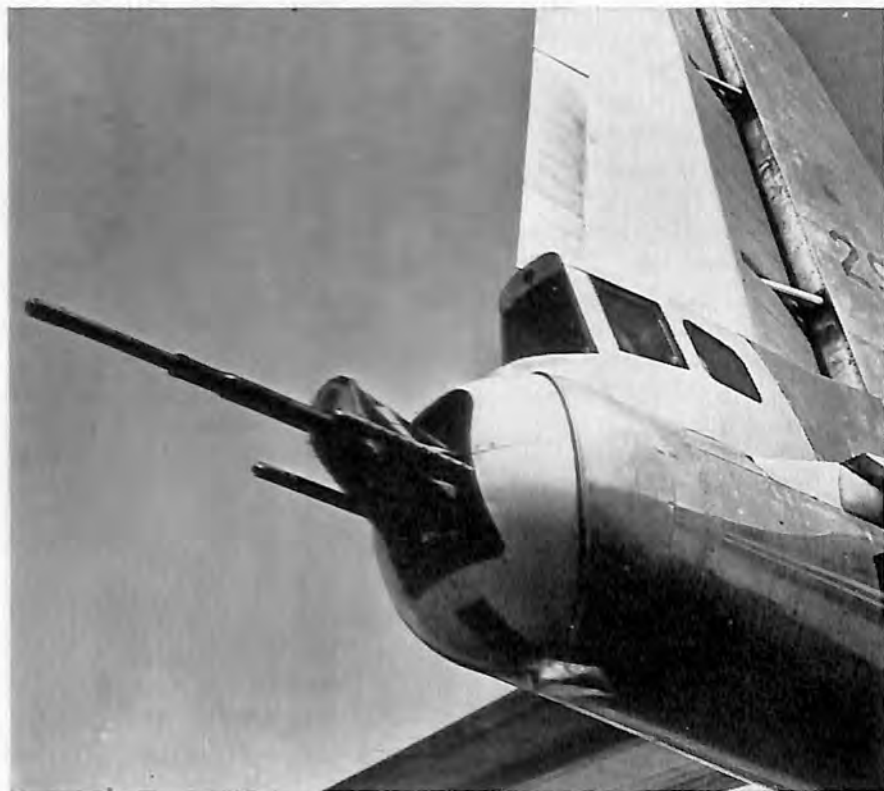
were to be found in the rest of the country, for the Wichita factory was in mass production of the big bombers, was the "lead horse" of the B-29 production pool. All the B-29's used in the early raids on Japan, and most of those employed in 1944 missions, claimed Wichita as their birthplace. In January, 1945, the Boeing Wichita plant was producing 100 B-29 Superfortresses a month.

Another high point for Boeing came in June, 1944, when the first wave of Superfortresses hit Japan proper. This and subsequent raids resulted in the removal of much of the secrecy which previously had cloaked the big bomber.

The Army had announced that the B-29 was powered with four Wright Cyclone engines of 2,200 h.p. each but little else about the airplane generally was known. But after the bomber saw actual combat it was announced that the B-29, an all metal monoplane, had a wing span of 141 ft. 3 in., a length of 99 ft. and a height of 27 ft. 9 in. It had tricycle, completely retracting landing gear with dual wheels throughout. The B-29 had a pressurized cabin for comfortable flying at high altitude. Its gross weight was 130,000 lbs. It had double bomb bays to increase its bomb load. No actual bomb capacity was announced but the Army published the fact that a B-29 had carried up to 10 tons in bombs. Superfortresses operating over Japan made bombing trips as long as 3,600 miles round trip. One hundred and sixty-five 55-gallon drums of gasoline, or 8,800 gal., were required to fly a B-29 on a normal mission.

Armament of the Boeing Superfortress consisted of 10 to 12 .50 cal. machine guns plus one 20 mm. cannon. Ordinarily each of the four turrets on the fuselage—upper and lower forward turrets and upper and lower rear turrets—had two .50 cal. machine guns each. On some of the bombers the upper forward turret had four such machine guns. The tail turret had two .50 cal. machine guns and the .20 mm. cannon. The normal ammunition load carried on each B-29 mission was 1,000 rounds for each .50 cal. gun and 120 rounds for the 20 mm. cannon. All guns were fired by remote control, the gunner having no manual

contact with his weapons. Except for the tail gunner, who sat directly above his guns, other gunners were removed from their weapons and sighted from three blisters in the center of the fuselage or from the nose. Elimination of all possible human error in sighting and firing the guns was a feature of the B-29. This was accomplished by use of automatic computers, which corrected for range, altitude, temperature, air-speed, gravity pull and parallax (the distance between the gunner and his guns). Under the manual gun control system, gunners were trained to "lead" their targets. "Leading" meant firing at a point ahead of a moving target so bullet and target would arrive at this given point at the same time. Manual gunners also made manual corrections for range, gravity pull and other factors. The computers in the B-29's firing system relieved the gunner of all those worries. He aimed his sight directly at the target and, through a series of electrical-control and drive units, the guns were brought to bear at a point where bullet and target would meet, correction being made automatically for all factors that could interfere with the course of the bullet. Another



TAIL TURRET OF THE B-29

The deadly firepower of the tail turret of the Boeing Superfortress is shown in this photograph of the turret with its two .50-cal. machine guns and its 20-mm. cannon.

feature in the bomber was the central fire-control system, similar to that used on battleships but never before applied to an airplane. Under this arrangement a B-29 gunner could, if the need arose, take over control of more than one turret at a time and direct the entire firepower of the combined turrets at one target. This resulted in the greatest utilization of the Superfortress' armament. The remote control of the turrets also contributed to the aerodynamics and speed of the B-29, as the turrets were small because the gunners were not enclosed for purposes of operation.

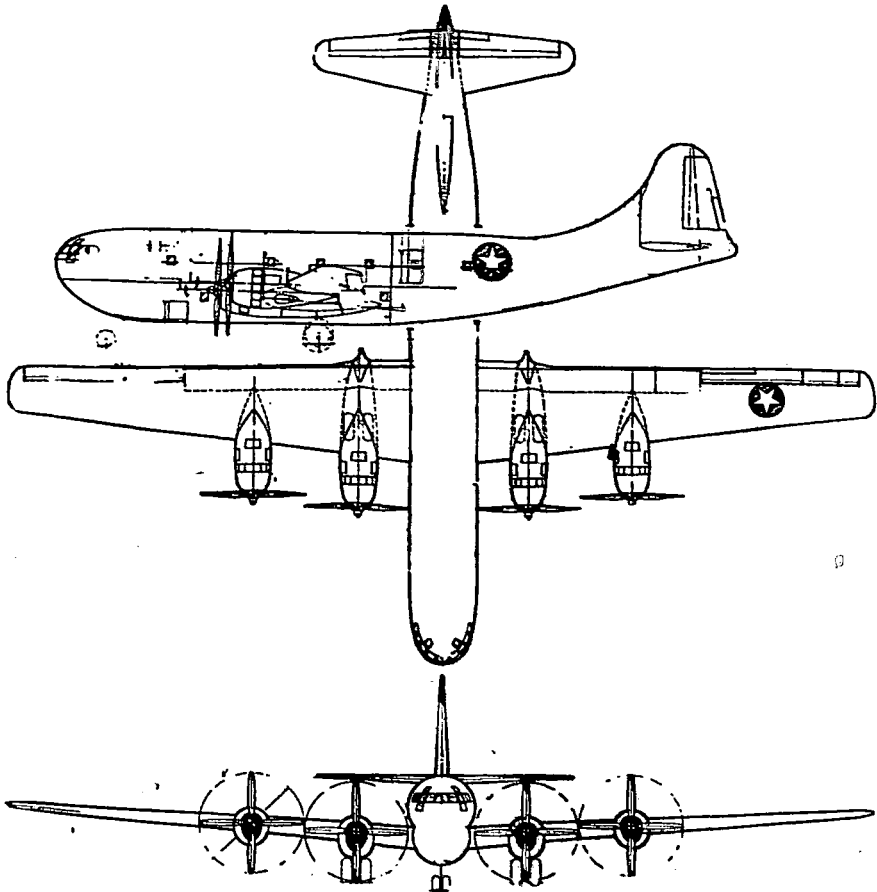
The Boeing B-29 was being produced by one of the most widespread manufacturing pools ever established in American industry. When the Army Air Forces decided that the huge Boeing bomber was to spearhead the attack on Japan proper, it decided also that the bombers would be needed in greater quantities than even the widespread facilities of the Boeing organization could supply. Hence, there was organized the B-29 production pool, a coast-to-coast enterprise patterned after the manufacturing agreement under which Douglas and Lockheed had been building Boeing B-17 Flying Fortresses. Boeing-Seattle, where the B-29 was designed and developed, was given, as was the case in the B-17 set-up, the responsibility of supplying engineering information, manufacturing ideas and master gauges. In the Seattle area, the Boeing plant at Renton was designated as the final assembly area for B-29s with Boeing-Seattle and its branch plants supplying subassemblies and parts to the Renton plant.

The Boeing plant in Wichita, where the first production models of the B-29 were built, was given the job of turning out completed Superfortresses, with outstanding success as described previously. The Martin plant in Omaha, Neb., and the Bell plant in Marietta, Ga., also were designated as factories where completed Boeing bombers were to be manufactured. In addition, Chrysler, General Motors, Goodyear, Hudson, Briggs, Cessna, Murray, A. O. Smith and many other firms from coast to coast were included in the production pool to build subassemblies and parts for the Boeing bomber.

Another Boeing accomplishment started late in 1944 and completed in 1945, was the reconditioning of five Boeing Stratoliners, which were returned to Transcontinental & Western Air after two and one-half years of transport flying with the Army Transport Command. These five Stratoliners, built for TWA by Boeing in 1939, were taken over by the ATC at the outbreak of the war, establishing an enviable record of innumerable ocean crossings and millions of miles of flight without a serious mishap. One set a record in 1943 of 17 ocean crossings in 22 days. The Stratoliners still were "going strong" when given their honorable discharge from the ATC. Their old wings were replaced with the sturdier wings of the B-17G Flying Fortresses, wings which repeatedly had proven their exceptional durability in combat. They allowed an increase in load from 45,000 to 54,000 pounds. The 1,200

h.p. Wright motors of the B-17G also were installed, as were B-17G landing gears and new propellers. Horizontal stabilizers were moved back three feet and new tail surfaces installed. The luxurious state-rooms which were removed when the Army took over the Stratoliners were not replaced, but instead more seats were added so that 38 passengers could be carried instead of 33. The pressure systems for the cabins, which enabled the Stratoliners to fly at high altitudes without discomfort to passengers and which also were removed when the Army began operating the airplanes, were not reinstalled, awaiting the end of wartime restrictions on necessary materials.

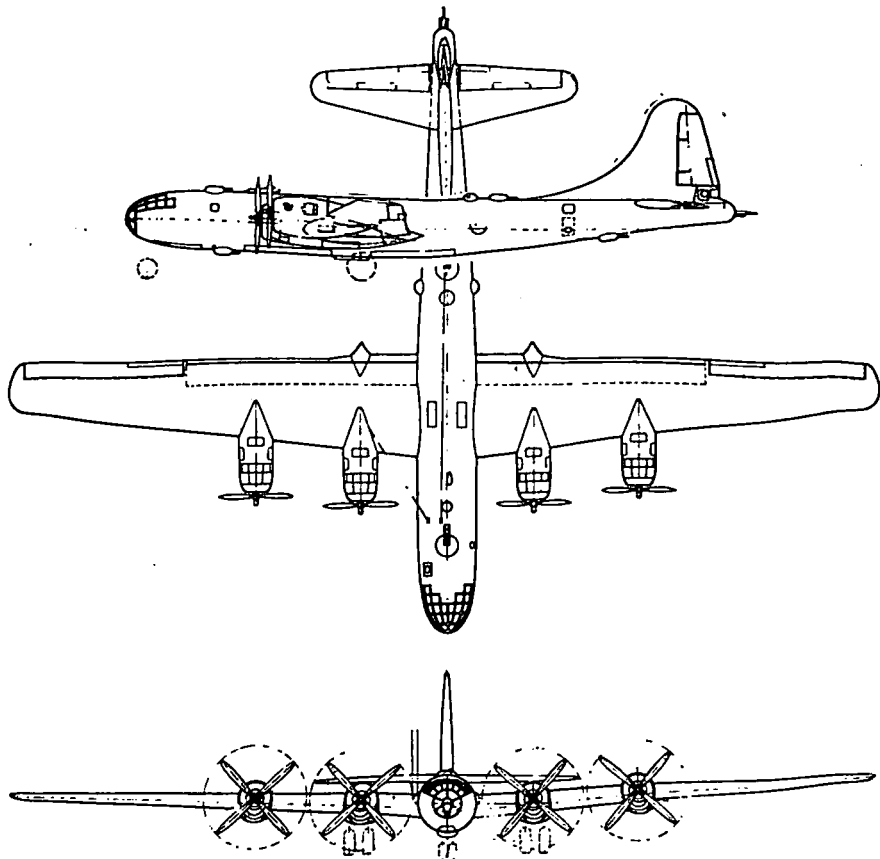
A milestone in America's meteoric rise to air power during the war was passed in 1944 when at Boeing-Wichita the 10,000th Boeing Kaydet was built. These sturdy little two-place trainers, standardized for use both by the Army and Navy, had been used by more American pilots than any other plane. Hundreds of famous aces made their first solo flights in these Boeing Kaydets.



BOEING C-97 MILITARY TRANSPORT

Powered by four Wright Cyclone 2,200 h.p. engines.





### THE BOEING B-29 SUPERFORTRESS

It is powered by four Wright Cyclone 2,200 h.p. engines.

The Boeing branch-plant program, established in 1943 to alleviate in part a critical manpower shortage by taking work to areas where manpower was available, was expanded in 1944. Six branches originally were established in five western Washington cities. In 1944, the Everett branch was doubled and a new unit to the Aberdeen branch was established in nearby Hoquiam. The \$750,000 in-plant feeding program at the Boeing Plant 2 was put into operation with a cafeteria seating 1,600 persons and a food center from which 40 hot food trucks and snack bars operated throughout the plant. Construction of a new cafeteria was started at the Renton-Boeing plant.

Boeing also put into operation its \$750,000 wind tunnel, the fastest large wind tunnel ever built. Man-made winds approaching the speed of sound were created there to test models of airplanes of the future and to aid in the perfection of airplanes already under construction. Named the Edmund T. Allen Memorial Aeronautical Laboratories in

honor of the famed Boeing test pilot who lost his life in an airplane test accident, the new wind tunnel was a modern research unit, complete with model design and construction facilities and computing laboratories as well as actual testing quarters. It had numerous experimentation conveniences and refinements never before built into any single tunnel, and was streamlined for efficiency of operation. Model planes with wing spans up to 11 ft., or full-scale airplane sections of the same maximum size, could be tested in the new Boeing tunnel. The tunnel's tremendous flow of air was created by a great propeller-like fan 24 ft. in diameter. The fan consisted of 16 laminated spruce blades. It was mounted on the end of a 37-ft. solid steel drive-shaft, 16 in. in diameter, which connected the fan with the motor and clutch. The synchronous electric motor, built by Westinghouse, had a rating of 18,000 h.p. and maintained a constant speed of 514 r.p.m. The speed of the fan was regulated by a great magnetic coupling, or clutch, several times larger than any previously built. While the motor had a constant speed, the clutch could move the fan at any desired speed. Thus, tests could be made under all wind conditions. An intricate Boeing-designed system of balances, capable of measuring with great accuracy lifts from one-tenth to 8,000 lbs., recorded all forces acting on the model being tested—lift, drag, yaw, pitch, roll and side force. The tunnel bore was a complete, continuous-return structure which followed an approximately rectangular course 450 ft. in length. It varied in size from 8 by 12 ft. at the throat, or test section, to  $27\frac{1}{4} \times 27\frac{1}{4}$  ft. at the largest part. The tunnel was soundproofed throughout and even at its highest operating speed the noise was scarcely audible in adjoining quarters. This was due to the fact that the tunnel bore was built of thick concrete, and also to the numerous modern facilities and equipment with which it was operated.

Cessna Aircraft Company, Wichita, Kans., reconverted its plant facilities for subcontract work on tail surfaces and other components for the Boeing B-29 and engine cowls and landing gears for the Douglas A-26. Cessna planned to produce a line of metal, single engine, personal planes after the war.

Commonwealth Aircraft, Inc., Kansas City, Kans., successors to Rearwin Aircraft and Engines, was building CG-4A gliders for the Army Air Forces and also was in production on hydraulic assemblies for four major aircraft plants. The company planned to produce several models of light planes after the war.

Consolidated Vultee Aircraft Corporation, San Diego, Calif., with its 11 manufacturing divisions throughout the United States, increased production in 1944 over the previous year despite the most critical manpower shortage ever experienced. The company delivered approximately 128,170,000 pounds of aircraft and spares, compared to 126,000,000 pounds delivered in 1943. Total number of planes delivered in 1944 amounted to 9,354, of which 5,095 were heavy bombers

and transports. It was disclosed at the end of 1944 that Consolidated Vultee had delivered 30,126 airplanes and equivalent spares since Pearl Harbor.

Throughout 1944, the Liberator B-24 and PB4Y were the company's most important products. However, in the late fall it was announced that the company was engaged in production of a new type "search" plane for the Navy, designated as PB4Y-2, and the Dominator B-32, superbomber for the Army Air Forces. Production of Liberator B-24 types tapered off at both the San Diego and Fort Worth plants to make way for production of the new types. It appeared that the B-32 and PB4Y-2 would be the company's major projects during 1945.

Other airplanes manufactured by the company in 1944 included Coronado PB2Y-3s, Catalina PBY-5s, Valiant BT-13s and BT-15s, Vengeance A-35s, Sentinel L-5s, and Reliant AT-19s. The company also built the Navy TBY torpedo bomber and the Lightning P-38.

Consolidated Vultee was able to maintain mass production standards in 1944 by utilizing a large number of time-saving ideas, many of which were suggested by employees. Approximately 31,000 proposals for improving manufacturing methods were submitted by employees. One-fourth of them were adopted by the company, with total savings amounting to approximately 16,000,000 man hours.

Major manufacturing developments included a master tooling dock, which greatly reduced the time required for constructing assembly jigs and fixtures. A new riveting device, which eliminated the need for rivet buckers on numerous production jobs, contributed to increased production. Other developments included a new synthetic rubber product, which greatly facilitated the process of sealing aircraft fuel tanks; an "airflow laboratory" which was used in testing engine air ducts; and an "electric brain", which helped test pilots fly new airplanes by recording vital instrument data at a ground radio station.

Looking forward to development of very large types of airplanes, Consolidated Vultee, in cooperation with the Navy Bureau of Aeronautics, financed construction of an 8,500 ft. runway on Lindbergh Field in San Diego, in front of the main plant. The project cost approximately \$4,000,000 and provided San Diego with one of the longest and best constructed runways in the country. It was designed to withstand loads of the largest planes now contemplated.

Construction of a \$524,000 wind tunnel was started by the company in San Diego. Scheduled for completion in 1945, the new wind tunnel would test 10 ft. models at very high speeds.

The company's manufacturing plants were engaged exclusively on military projects. However, one light plane scheduled for postwar production was announced by the company. Known as the Voyager 125, it was powered by a 125 horsepower Lycoming engine, and was a 3-place plane. It was designed at the Stinson division and combined

the safety and reliability of prewar Stinson aircraft. It cruised at 112 m.p.h. and had a range of 470 miles.

The Consolidated Vultee Liberator B-24 was a high-wing monoplane constructed for the Army Air Forces by Consolidated Vultee Aircraft Corporation at San Diego, Calif., and Fort Worth, Tex. It had four Pratt & Whitney R-1830-C4G turbosupercharged engines, a semi-monocoque fuselage, a double or single rudder tail assembly, and hydraulically retractable tricycle landing gear. Its wing span was 110 ft., its length 66 ft. 4 in., and its height 17 ft. Empty, it weighed about 34,933 lbs. Carrying a gross weight of more than 56,000 lbs. it took off over a 50-ft. obstacle in less than 3,950 ft., climbed to a service ceiling of 36,000 ft., had a top speed of more than 300 m.p.h. and flew a maximum distance of more than 3,000 miles. The first Liberator featured a double-rudder tail assembly and had provisions for only two machine guns. Latest models of the airplane had single-rudder tail assemblies and carried 10 or more machine guns. Liberators were used for bombing, photographic, patrol, and miscellaneous other missions.

The Liberator Express was a cargo-transport version of the Liberator B-24 bomber. It was produced by Consolidated Vultee Aircraft Corporation at San Diego and Fort Worth. It was designated the C-87 by the U. S. Army and the RY-1 by the U. S. Navy. Its performance was slightly better than that of the B-24, due to the fact that



#### CONSOLIDATED VULTEE LIBERATOR ASSEMBLY

More than 6,000 B-24 bombers rolled down this assembly line in the San Diego plant. The line moved toward the final station at the rate of  $8\frac{1}{2}$  inches a minute.

it carried no armament; but overall dimensions were the same. Besides a crew of four men, it could carry 21 passengers or a pay load of more than 6,000 lbs.

The PB4Y-1 was the first of a series of heavy, land-based "search" planes constructed for the U. S. Navy by Consolidated Vultee Aircraft at San Diego. It was a modified version of the Army B-24D, differing from the latter in that it carried a different type of armament and extra radio equipment. It had four Pratt & Whitney Twin Wasp engines, a semi-monocoque fuselage, a double-rudder empennage, and hydraulically retractable tricycle landing gear. Its dimensions and performance were approximately the same as those of the Liberator B-24.

The PB4Y-2 was named Privateer, and was a land-based patrol bomber produced for the Navy. The single tail assembly and side gun turrets distinguished it from the PB4Y-1. It had a top speed of more than 250 m.p.h. and range of more than 3,000 miles. Gross weights varied from 62,000 to 65,000 lbs. The fuselage was seven feet longer than the original Liberator. The extra space provided room for radio and extra detection equipment. Six power operated turrets, each with two 50 cal. machine guns, provided protection. The Privateer was powered by four Pratt & Whitney 1,350 h.p. engines with turbo-superchargers giving it a service ceiling of 20,000 ft.

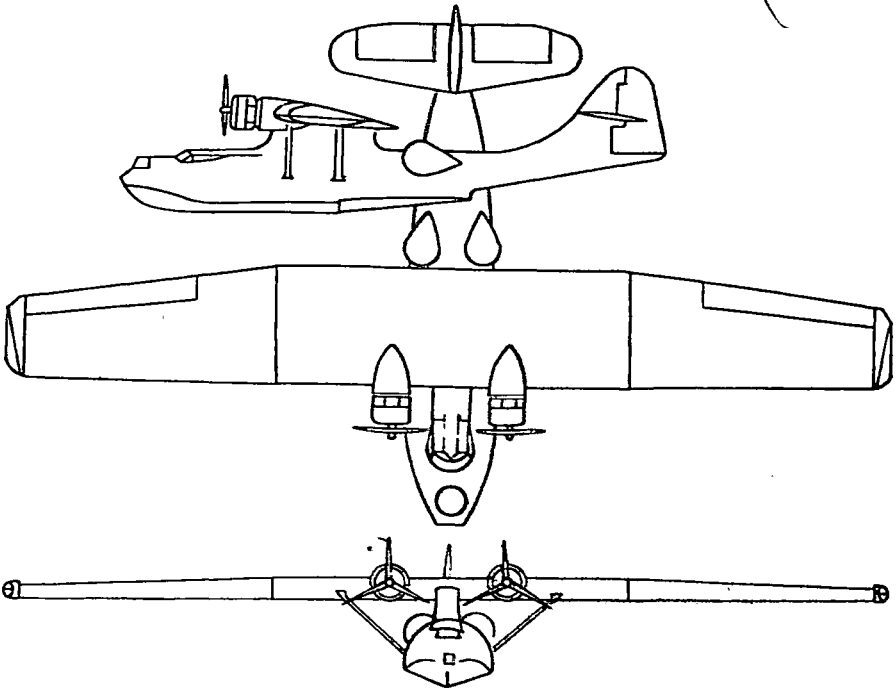
The Coronado PB2Y-3 was the third of a series of medium-range airplanes constructed for the U. S. Navy by Consolidated Vultee Aircraft Corporation at San Diego. One of the world's largest flying boats, it was used as a patrol plane, bomber, torpedo launcher, cargo carrier and transport. It was a high-wing monoplane with four 1,200-h.p. engines, a rugged metal hull, a double-rudder empennage, and retractable wing-tip floats. With a gross weight of 66,000 lbs., it had a range of more than 2,900 mi. and a top speed of more than 200 m.p.h. It had a wing span of 115 ft., a maximum height of 27 ft. 6 in. and a length of 79 ft. 3 in.

Having been in production since 1935, the Catalina patrol bomber was one of the oldest types serving the Allied cause. Latest versions of this sturdy flying boat were the PBY-5 and the PBY-5A, which were identical except for the fact that the latter was an amphibian with hydraulically-retractable tricycle landing gear. The PBY-5 was a parasol monoplane with a semi-cantilever wing, a hull with watertight compartments, a single-rudder empennage and retractable wing-tip floats. Powered by two Pratt & Whitney R-1830-92 engines, it had a wing span of 104 ft., a length of 63 ft. 10 in. and a maximum height of about 18 ft. 10 in. It had a gross weight of about 35,000 lbs., a cruising speed of about 125 m.p.h. and a range of approximately 4,000 miles. PBY-5As were being produced by Consolidated Vultee Aircraft Corporation at New Orleans, La.

Constructed by the Nashville division of Consolidated Vultee Aircraft Corporation, the Vengeance A-35 was a dive bomber designed

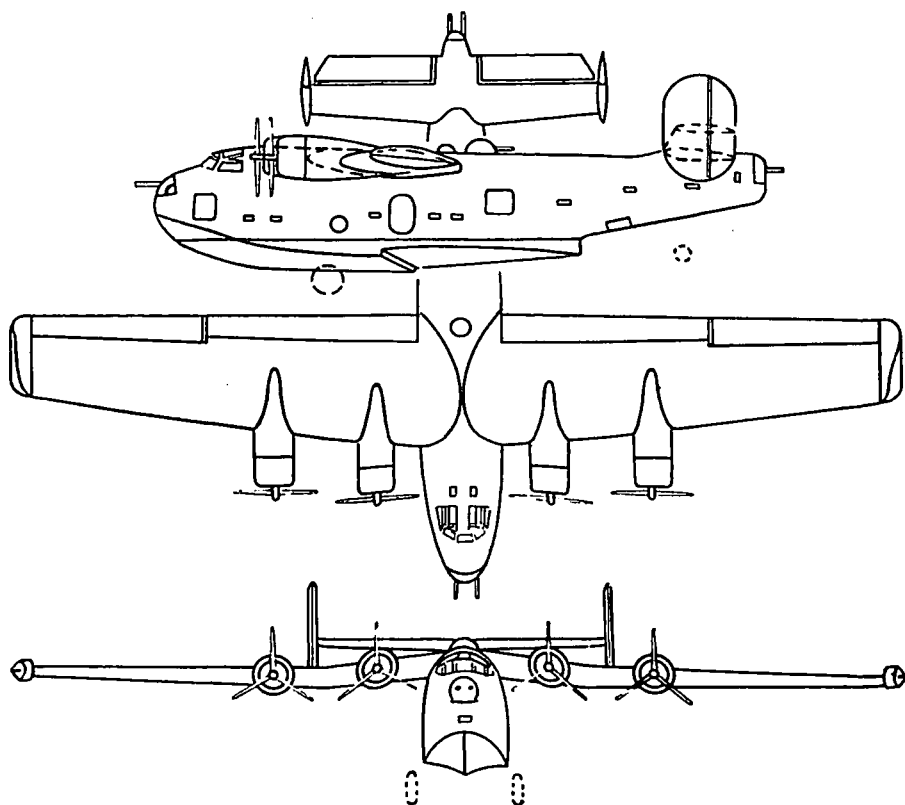
for the U. S. Army and prominently used by the British, who named it the DB-72. A monoplane, it had a wing span of 45 ft., a length of 40 ft. and a height of 13 ft. Powered by a 1,700 h.p. Wright Cyclone engine, it carried a crew of two to a service ceiling of about 20,000 ft. at a maximum speed of more than 250 m.p.h., or for a maximum distance of more than 1,500 miles.

First airplane to be constructed on a mechanized assembly line was the Valiant BT-13, which went into production for the Army Air Forces at the Vultee Field division of Consolidated Vultee Aircraft Corporation in 1940. It was the same as the BT-15, except for the fact that the latter was powered by a 440 h.p. Wright engine. BT-13s and BT-15s built for the U. S. Navy were designated respectively SNV-1 and SNV-2. The Valiant was a two-place monoplane, powered by an R-985-AN-1 Pratt & Whitney engine. It had a low cantilever wing, a semi-monocoque fuselage, a single-fin empennage and conventional non-retractable landing gear. It had a wing span of



#### CONSOLIDATED VULTEE CATALINA

This long-range patrol bomber was powered by two Pratt & Whitney engines rated at 1,200 h.p. each. As a flying boat it was known as the PBV, while the amphibian was designated PBV-5.



### CONSOLIDATED VULTEE CORONADO

This Navy long-range patrol bomber, PB<sub>2</sub>Y-3 had four 1,200 h.p. Pratt & Whitney engines.

42 ft., length of 28 ft. 10 in., and height of 12 ft. 4 in. With flaps it took off and cleared a 50-ft. obstacle in 1,175 ft., climbed to 10,000 ft. in 13 min., flew at a maximum speed of 164 m.p.h. at a service ceiling of 16,500 ft. and landed over a 50-ft. obstacle with flaps in a distance of 1,125 ft. It was used exclusively as a basic trainer.

Constructed by the Stinson division of Consolidated Vultee Aircraft Corporation, the Reliant AT-19 was a low-wing monoplane with a 290 h.p. Lycoming engine, a semi-monocoque fuselage, a single-rudder tail assembly and hydraulically retractable landing gear. Its length was 29 ft. 4 in., height 8 ft. 7 in., and wing span 48 ft. With a gross weight of approximately 4,000 lbs. it had a service ceiling of 14,000 ft. and a maximum speed of 141 m.p.h. It was used by the Army Air Forces as a navigational trainer.

Commonly called the "Flying Jeep," the Sentinel L-5 was a light reconnaissance plane constructed for the Army Air Forces by the Stinson division of Consolidated Vultee Aircraft Corporation.

Powered by a single 190 h.p. Lycoming engine, it had a maximum length of 24 ft. 1 in., wing span of 33 ft. 11 in., and a height of 7 ft. 1 in. At a service ceiling of 15,800 ft. it carried a gross weight of 2,158 lbs. and had a top speed of 129 m.p.h. A monoplane, it had a high semi-cantilever wing, fabric-covered fuselage, single-rudder empennage and conventional non-retractable landing gear.

The Voyager 125 was considered for postwar production in the United States. It was designed by Stinson division engineers of Consolidated Vultee Aircraft Corporation, and combined the safety and reliability of the prewar Voyager 105 with the ruggedness and utility of the Sentinel L-5. Powered by a 125 h.p. Lycoming engine, it cruised at 112 m.p.h. and had a range of 470 miles. Besides a pilot, it carried two passengers and baggage.

Curtiss-Wright Corporation, Airplane Division, Buffalo, N. Y., with branch plants at Kenmore, N. Y., St. Louis, Mo., Columbus, O., and Louisville, Ky., had a production record of about 72,500,000 lbs. of military aircraft in 1944. Its output of P-40 Warhawk fighters, C-46 Commando transports, SB2C Helldiver Navy dive bombers, and its latest production model, the SC-1 Seahawk scout seaplane, was an increase of 65 per cent over 1943 and 17 times 1940 production, all of which won E awards.

Curtiss Warhawks, a type which had been in the air war long before Pearl Harbor, scored new victories against the Japs in the Leyte campaign, as well as on other fronts. When the last Warhawk came off the assembly line at the Buffalo plant in December, 1944, to make way for augmented production of Commando Transports, more than 15,000 P-40 planes had entered the fight against the Axis Powers and they had been used by the air forces of 28 nations. The latest of the series was the P-40N Warhawk. It was a low-wing cantilever type fighter, with a span of 37 ft. 4 in., length 33 ft. 4 in., height 10 ft. 7 in., weight about 9,000 lbs., speed more than 350 m.p.h., range about 1,000 mi. and ceiling over 30,000 ft. Its single Allison V-1710 12 cyl. V-type liquid-cooled engine turned a Curtiss Electric three-blade, multi-position constant speed propeller. It could carry auxiliary wing tanks and bombs. It had six .50-cal. machine guns, three in each wing.

The Curtiss Helldiver, first the SB2C-1, (then the SB2C-2 which was on pontoons) followed by the third and fourth of the series, was both carrier and land-based. It carried an exceptionally heavy bomb load over a long range for a combat plane with only one engine. Helldivers fought the enemy in 23 different areas, from Tarawa to Manila, Rabaul to the Ryukyu Islands only 200 mi. from Japan. They played a great part in the Second Battle of the Philippine Sea and later victories in Asiatic Waters. The Helldiver had a wing span of 49 ft. 8 in., length 36 ft. 8 in., height 15 ft. 1 in. and weight about 14,000 lbs. The SB2C-1 had a 1,600 h.p. Wright Cyclone engine with Curtiss Electric three-blade propeller, and carried one 20-mm. cannon, flexible machine



guns and bombs. The fourth of the series, the SB2C-4 Helldiver, was powered by a 14 cyl. Cyclone engine and Curtiss Electric four-blade propeller. It carried two 20-mm. cannon in its wings, dropped 1,000 lbs. of bombs from the wing racks while the pilot could open the bomb bay doors and release another bomb load exceeding 1,000 lbs. Or he could fire eight large rocket projectiles from his wing racks.

The Curtiss C-46 Commando was one of the world's largest twin-engine airplanes. It had a wing span of 108 ft. 1 in., length 76 ft. 4 in., height 21 ft. 9 in., wing area 1,360 sq. ft. and a maximum weight of 50,000 lbs. It was powered by two 2,000 h.p. Pratt & Whitney twin-row Wasp engines with Curtiss Electric four-blade propellers. Its speed was more than 250 m.p.h., ceiling over 25,000 ft. and tactical radius 800 miles. Its main cabin could carry a large number of troops and equipment, while two belly compartments held very heavy cargoes.

The Commando was seeing service on air routes throughout the world, both with the Army, which designated it C-46, and the Navy, which called it the R5C. The huge ships flew men and munitions, gasoline and oil over the treacherous Hump of the Himalayas from India into China, and transported most of the fuel for Gen. Chennault's 14th Air Force and for the B-29 Superfortresses based on the mainland. They were used as flying repair shops in remote sections of China, and they served as flying ambulances with the Marine Corps to evacuate wounded from Pacific fighting zones. The peacetime version of the war-tested Commando transport, was to be known as the CW-20, featuring, among other things, passenger safety, more passenger comfort, many personalized conveniences, maintenance accessibility, and economy of operation.

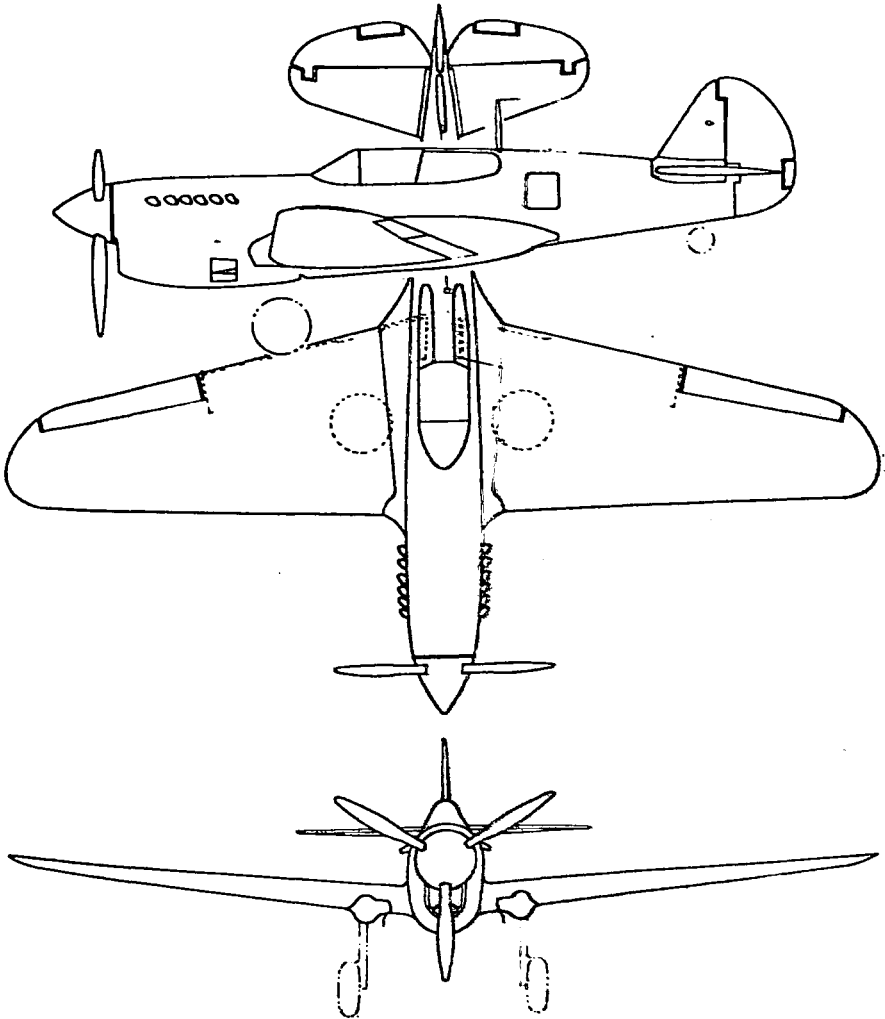
The CW-20 transport was designed to supply the needs of the medium-range air line traffic market. While a Curtiss-Wright survey established the fact that 85 per cent of the air line business in this country consisted of trips not exceeding 600 mi., the Commando—proven under the stress and strain of war—had a maximum range well exceeding this, and could take off and land on the average airport.

The C-46 Commando was in mass production at the Curtiss-Wright plants in Buffalo, Kenmore, St. Louis and Louisville. During 1945, the Louisville plant was to add modification of B-29 Boeing Superfortresses to its program. The two programs—assembly of C-46 Commandos and modification of B-29s—were to be carried on simultaneously, with assembly being handled in one 1,500 ft. production line, and modification in a second 1,500 ft. line running parallel. The C-46 program was to be completed in mid-1945, with production gradually easing to allow for a build-up of B-29 modification, which was expected to utilize full operations at the Louisville facility when the C-46 contract was completed.

The Columbus Curtiss-Wright plant received the Army-Navy E on November 19, 1944, when it passed 12 consecutive months ahead

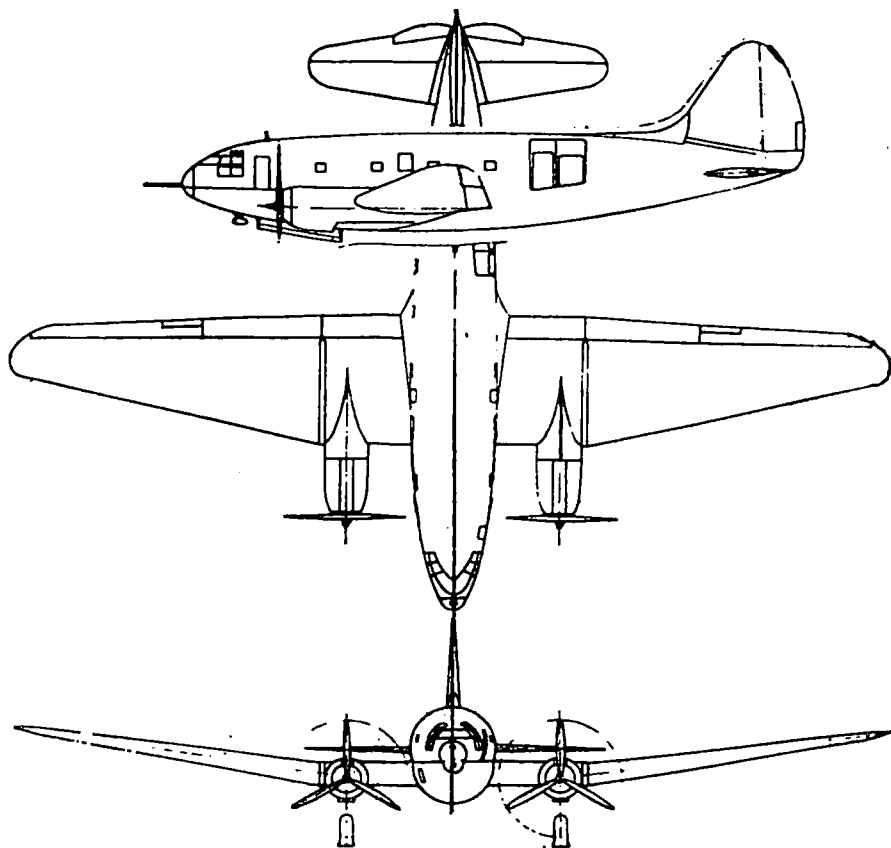
of schedule on Helldiver production. That plant had produced more than 4,000 combat planes, mostly Helldivers, besides the equivalent of 800 others in spare parts. Early in 1944, the Columbus plant completed the contract for the Curtiss SO3C Seagull, naval scout and observation ship. Curtiss-Columbus scored another honor when it led the Columbus heavy industries group in safety for the first six months of 1944. In March, it was announced that Curtiss-Columbus led the aircraft industry in the number of certificates awarded by the War Production Board for suggestions.

Under Curtiss-Wright license, two Canadian aircraft builders, Canadian Car and Foundry Company and Fairchild Aircraft, were



**CURTISS WARHAWK**

More than 15,000 of these fighters were produced for Allied air forces.



#### CURTISS COMMANDO

The C-46 Army transport, powered by two Pratt & Whitney 2,000 h.p. Wasp engines and Curtiss electric propellers.

producing Helldivers. Meanwhile, the Airplane Division looked toward the future with coordination of a well-integrated and expanded research program destined to put wings on new ideas. The "next airplane" was the goal of the Airplane Division Research Laboratory at Buffalo, where rapid strides in aircraft development were made during 1944. One of the world's fastest wind tunnels, an unsurpassed altitude chamber, the latest in aircraft development and testing equipment and various other scientific laboratories were available at the Research Laboratory to contribute efforts to secure consistent improvement in aircraft performance accompanied by lower costs, reduced operating expenses and increased passenger comfort and safety.

Continuing development of techniques contributing to increased, more efficient production was another highlight in the Airplane Division. The St. Louis plant, for example, adopted the water jet quench in the heat treatment of aluminum alloys as the most efficient method of preventing distortion during the operation, and at the same time

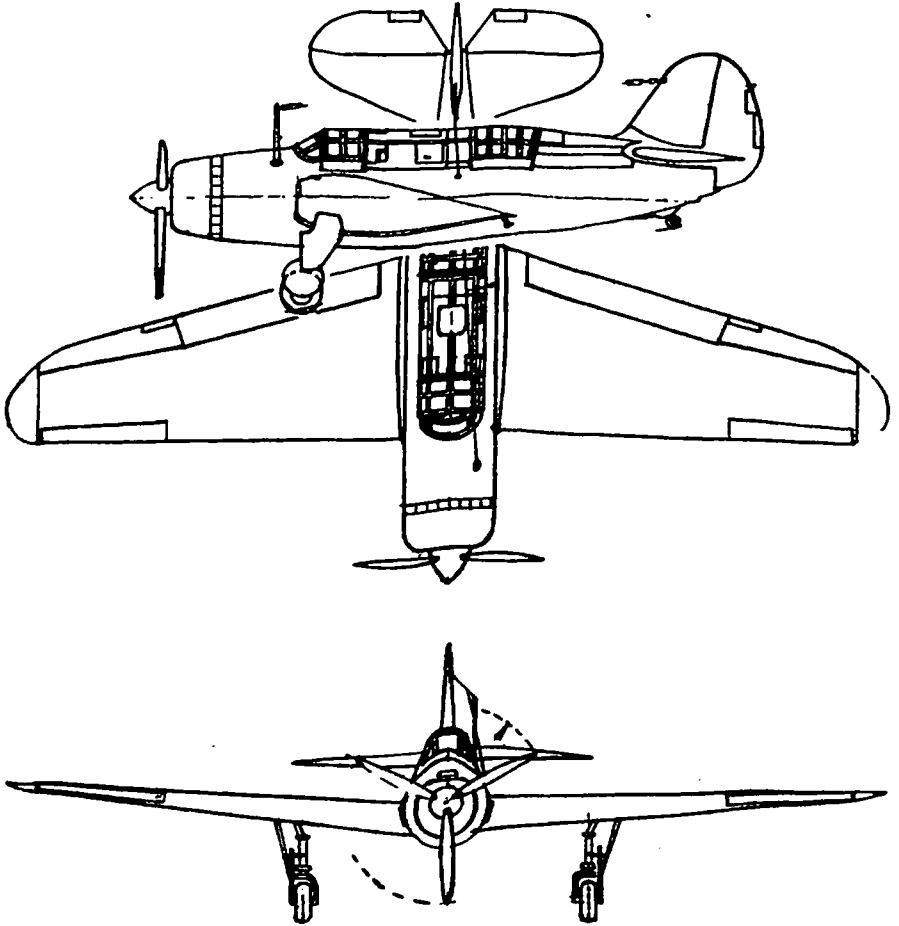
obtaining a quench rapid enough to prevent intergranular corrosion. In the Kenmore and Buffalo plants, too, many production innovations were put into operation during the year. Materials which formerly were trucked through the aisles were delivered to definite departmental locations and assembly stations by inter-departmental conveyor systems. These overhead conveyors consisted of three loops, each of which was nearly 5,000 ft. long, making a total length of approximately three miles. More accurate setting and checking of many hydraulic devices, a definite factor in speeding production, was made possible by setting apart a special enclosed area with special equipment. It was found that most minor adjustments, which formerly did not show up until the plane was nearing the last stations on the assembly line, were eliminated by this new procedure. Similar savings were made through setting up of a like room where all instruments were checked and adjusted. Wherever possible, instruments were proved before they were installed in the airplane on the production line.

An experimental plastic tooling program in the Kenmore and Buffalo plants became a definite production process with many post-war possibilities. Used extensively as draw-die punched and stretch press forms, these and other plastic tools were developed by the joint efforts of the plaster pattern and the plastic tooling groups operating as a unit. The production of finished plastic tools, nearly eliminating the extensive handshaping formerly required, and the quality and quantity of the production runs firmly established the Curtiss-Wright Buffalo plant as a leader in this field, not only in this country but in



#### CURTISS COMMANDO PRODUCTION

View of the Louisville, Ky., plant of Curtiss-Wright Corporation Airplane Division with Army Air Forces C-46 Commando transports nearing completion.



### CURTISS HELLDIVER

The Navy SB<sub>2</sub>C dive bomber used in Pacific operations.

England. Recent allocation of more than 9,000 sq. ft. of floor space and the installation of the most advanced types of equipment for handling and processing plaster and plastic materials indicated the state of development of this new process.

Many individual production improvements included savings of 500 per cent in weight resulting from a new type of small assembly drilling fixture made of "compreg" or "super wood". This new material was plastic impregnated and laminated wood which, although one-sixth the weight of steel, was sufficiently strong and stable to serve tooling purposes. A former steel fixture which weighed about 70 lbs. was replaced with one made of "compreg" weighing slightly over 10 lbs. The light weight let the operator handle it more easily, while it also held complete sets of detail parts, such as a small pulley bracket assembly, so that all parts could be drilled in one operation, which was

not possible in the former steel fixtures. These advantages combined with greater speed in producing the fixture were responsible for the ever-increasing use of these "compreg" drill fixtures.

The stretch press, that unusual and versatile machine which grasped a sheet of metal or an extrusion between its giant jaws and stretched it over a form, was credited with more savings with each passing week. Stretching forms made of plastic made it possible to produce, in one piece, wing fillets and match angle fairings (some of which measured 14 ft. in length) which were formerly produced in three or more individual sections and riveted or spotwelded together. Both labor and shipping were saved by a new process whereby it was possible to vulcanize a damaged rubber de-icer boot without removing it from the leading edge where it was installed. Prior to this development, it was necessary to remove the entire boot and return it to the factory for repair.

Finishing operations for machined parts were reduced substantially through additional applications of carbide tooling. The use of these tough cutting tools allowed the cutting and feed speeds to be increased, thus reducing time in the machines. They also produced a superior finish which in many cases eliminated the extra finishing



#### CURTISS HELLDIVER PRODUCTION

Navy SB2C dive bombers under construction at the Columbus, O., plant of Curtiss-Wright Corporation Airplane Division.

operation. New induction soldering equipment, placed in operation in the latter part of 1944, reduced the soldering time of a typical electrical gang disconnect plug containing 30 wires, from 30 minutes per plug to 30 seconds. This method, which was under continuous investigation throughout the year, showed savings which were more than "substantial" when applied to the full extent of its range in soldering electrical connections.

Another improvement in the production of electrical harnesses, the nerves of an airplane, was a continuity checker by means of which all electrical harnesses were proved for correct electrical connections before leaving the electrical harness room. Time-consuming troubles which developed from incorrect wiring in final assembly were virtually eliminated by this checking method. Thousands of suggestions were received from employees, who contributed many practical ideas which resulted in time and material savings to be made in practically every department of the Curtiss-Wright airplane plants.

Douglas Aircraft Company, Santa Monica, Calif., with five other plants located at El Segundo and Long Beach, Calif., Chicago, Ill., Tulsa and Oklahoma City, Okla., continued to contribute a substantial share to the nation's air power in 1944. For the second consecutive year it contributed by weight one-sixth of all the airplanes produced in this country. In 1944 Douglas completed production on two famous models and started production on a new attack bomber the A-26 Invader, which Army Air Forces predicted would become "one of the most effective weapons of the air arm."

At the same time, Douglas continued schedule production of its two transport planes—the C-47 Skytrain and the C-54 Skymaster. In addition, the company also continued to build its share of the huge Boeing Flying Fortress and the Consolidated Liberator, both four-motored bombers which, with its own Skymaster, made it the only company in America producing all three models of four-engine military aircraft.

The first of the Douglas battle veterans on which production was suspended through the development of superior models was the Douglas Dauntless. This dive bomber known to the Navy as the SBD and to the Army as the A-24 was heralded by the Navy as being the backbone of the aerial offensives in the Pacific from Pearl Harbor to Guadalcanal. When the last of the SBDs rolled off the line at the Douglas El Segundo plant, 5,936 had been produced. The Navy released information which stated that from Pearl Harbor until April, 1944, Douglas SBDs had flown 1,189,476 operational hours; 25 per cent of all operational hours flown off aircraft carriers were flown by the SBD. Marine SBDs flew 26 per cent of all Marine operational hours during that time. In spite of the fact that it was superseded by faster carrier-based planes, the SBD maintained the lowest ratio of losses per mission of any plane operating in the South Pacific theater.

The Douglas A-26 Invader was one of the fastest bombers ever built. It could strike at tree-top altitudes with a minimum of exposure to anti-aircraft fire; and was designed specifically for operations against enemy aircraft on the ground, naval vessels, landing parties, docks, troop concentrations, gun emplacements and supply dumps. It had an extremely flexible selection of machine guns and cannon, bombs and fuel load, so that its offensive striking power was adaptable to almost any combat mission. Its wing was the NACA low-drag, laminar flow airfoil; and a new double slotted flap reduced landing speed and assisted take-off.

The Douglas SBD Dauntless Navy dive bomber had a wing span of 41 ft. 6¼ in., length 32 ft. 1¼ in., height 12 ft. 10 in., gross weight 8,933.8 lbs., carried a crew of two with two .50-cal. fixed machine guns, two .30-cal. flexible machine guns and a 1,000-lb. bomb. It was powered by a Wright Cyclone 1,000 h.p. engine, had 243 m.p.h. maximum speed and a service ceiling of 24,900 ft.

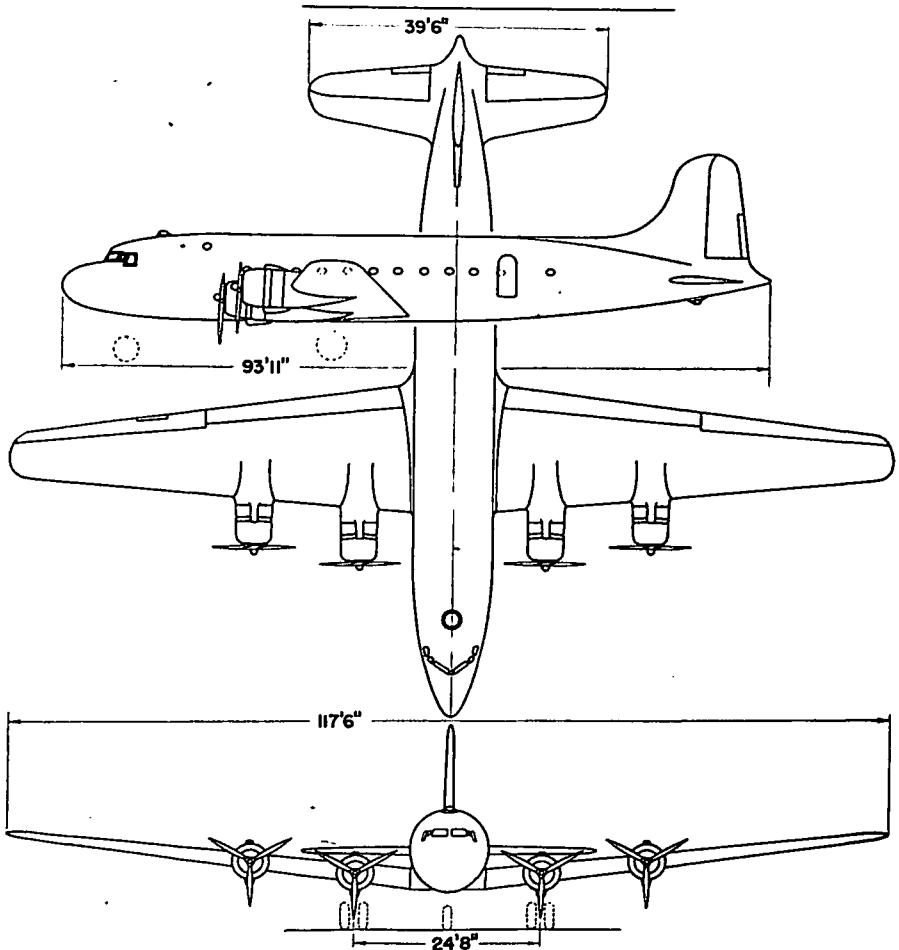
The Douglas A-20G Havoc had a span of 61 ft. 4 in., length 47 ft. 3 in., height 18 ft. 1 in., wing area 464.1 sq. ft., gross weight 20,000 lbs. and service ceiling of 25,300 ft. It was powered by two Wright Cyclone 1,600 h.p. engines with Hamilton Standard propellers, carried a crew of three with six .50-cal. forward firing machine guns, two others in upper rear turret and another in lower rear; also four 500-lb. bombs. Its maximum speed was 352 m.p.h. service ceiling 25,300 ft. and range 1,050 miles.

The Douglas military version of the DC-3 transport was C-47 Army, R4D-1 Navy and its name was Skytrain. It carried a crew of four and 28 passengers. It had a wing span of 95 ft., length 64 ft. 5½ in., height 16 ft. 11 in., wing area 987 sq. ft., gross weight 29,000 lbs., power loading 12 lbs. per h.p., net weight 16,970 lbs. It had two Pratt & Whitney Wasp 1,200 h.p. engines and Hamilton Standard propellers. Its high speed was 230 m.p.h., cruising at 185 m.p.h., service ceiling 24,100 ft. and range 2,125 miles.

The Douglas DC-4 Skymaster carried a crew of five and 44 passengers. It had a span of 117 ft. 6 in., length 93 ft. 11 in., height 27 ft. 7 in., wing area 1,457 sq. ft. Its power plant was four Pratt & Whitney Wasp engines with 1,450 h.p. for take-off, and Hamilton Standard propellers with 13-ft. blades. Its maximum speed was 280 m.p.h., cruising speed 239 m.p.h., wing loading 48.9 lbs. per sq. ft. with 71,300 lbs. maximum gross weight, normal fuel capacity of 2,877 gal. with ranges from 3,610 mi. to 4,680 mi. with extra fuel tanks.

The Douglas DC-6 carried a crew of five and 50 passengers as a day plane or 24 sleeper and two sit-up passengers. Its span was 117 ft. 6 in., length 100 ft. 7 in., height 28 ft. 5 in., wing area 1,457 sq. ft. It was powered by four Pratt & Whitney Wasp engines rated at 2,100 h.p. for take-off, and Hamilton Standard 13-ft. propellers. Its high speed was 334 m.p.h. with 63,500 lbs. gross weight, cruising at 278





DOUGLAS C-54 SKYMASTER ARMY TRANSPORT

m.p.h. Its normal fuel capacity was 2,577 gal., with ranges from 2,715 mi. to 3,540 mi. with extra fuel tanks.

In September, 1944, the last A-20 left the line at the Douglas Santa Monica plant, the 7,098th of a victorious series of deadly twin-engine bombers produced continuously for more than five war years by the Douglas company. The original Havoc (known as the Boston for Lend-Lease) was the 7-B completed in prototype in 1936 and made ready for flight two years later. In 1938, the French government ordered 100 of the 7-Bs. Invasion by Germany prevented delivery to France, and Great Britain took over the French order of the export version which later became known as the A-20. These A-20s subsequently saw model changes ranging up to the A-20K when the last of the Havocs was produced. During the entire time it was in battle section, it proved to be one of the most versatile attack bombers and its battle chores were many. It could bomb from relatively high levels

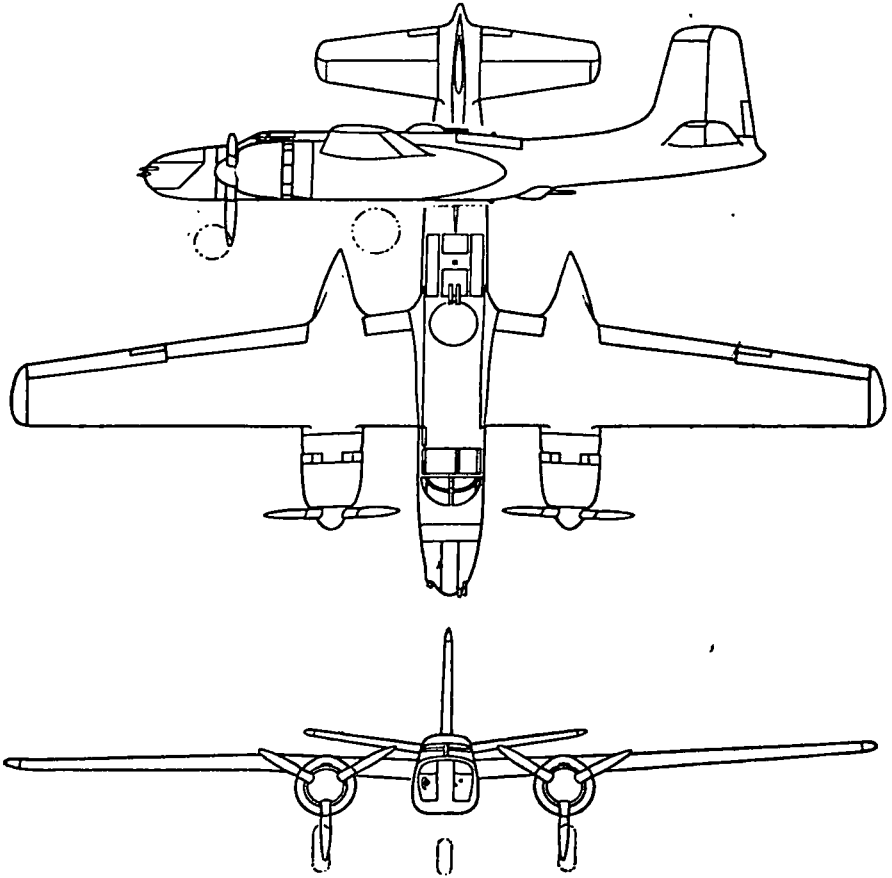
or it could sneak-bomb at low levels. It was extremely fast and ideally suited for strafing operations. One version, the P-70, was the first really effective night fighter against German bombers. It was the versatility and power of the A-20s that helped to stop Rommel in North Africa and check the Jap advance over the Owen Stanley Mountains, and made history during the siege of Stalingrad. For this war contribution of more than 2,500 units the Russians erected a statue to the A-20 in Moscow.

The newest Douglas plane, christened in battle during 1944, was the A-26 Invader. It replaced the A-20 as a fast, deadly and most versatile attack bomber, according to official Army releases. Designed to carry an extremely flexible selection of machine guns, cannons,



#### DOUGLAS C-54 ASSEMBLY

Interior of the Santa Monica plant showing construction of Skymasters. They were powered by four Pratt & Whitney Wasp engines.



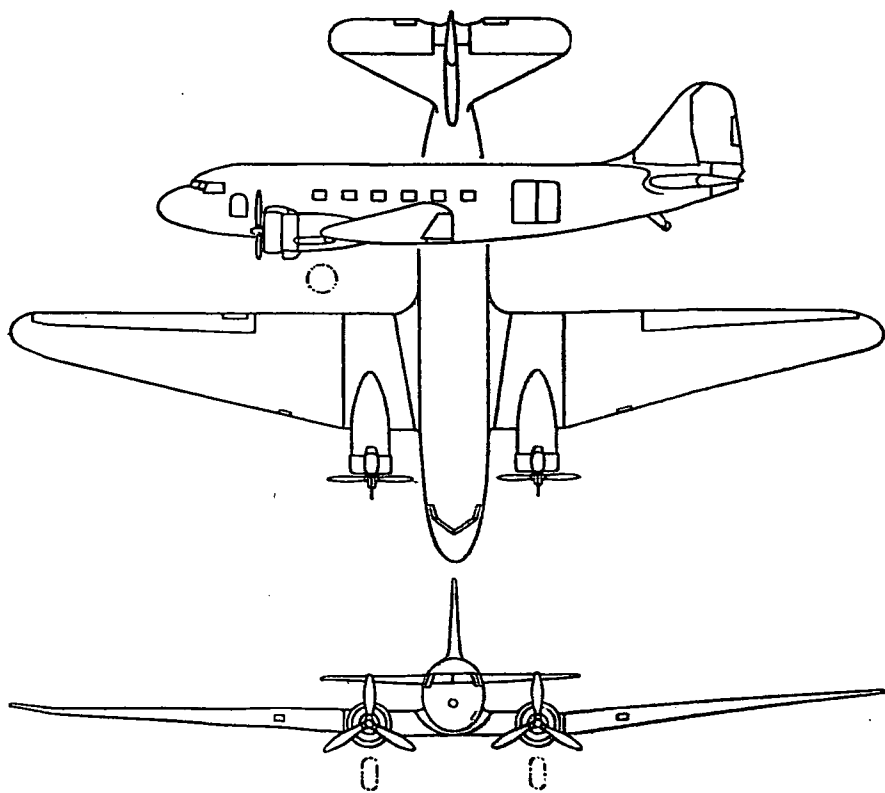
DOUGLAS A-26 INVADER ATTACK BOMBER

bombs and fuel, its striking power proved that the Invader could be adapted to almost any combat situation. Security reasons prevent a description of the Invader's performance. More than \$43,000,000 worth of these planes were on order in 1944 at the Douglas Long Beach plant alone.

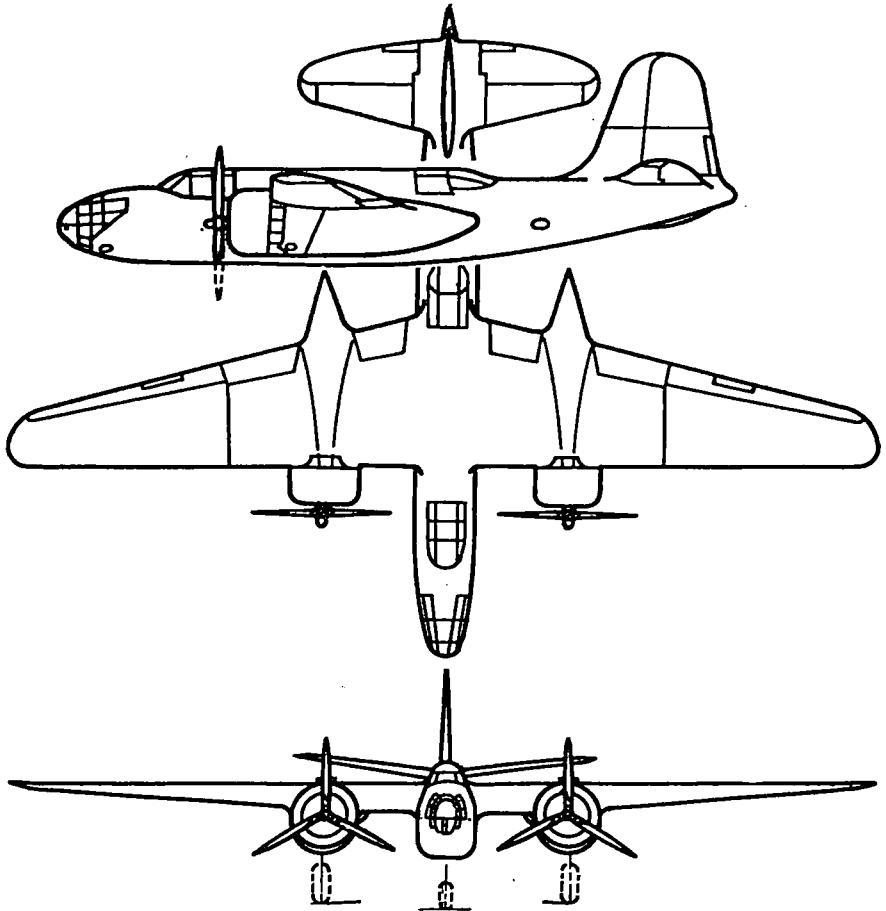
The Oklahoma City plant was producing Douglas C-47s, military version of the famous DC-3 commercial transport. Production of the C-47s was an outstanding accomplishment of the company during 1944. More than 8,000 of these planes were produced. Early in January, 1944, the Materiel Command requested that the company produce 300 Skytrains over and above its W-8 schedule, with a completion date of June 30th for the 300th plane. Douglas officials were highly skeptical about being able to produce 300 extra Skytrains even though Long Beach and Oklahoma City were both producing this model. Scarcely had the request for 300 beyond schedule come through when General H. H. Arnold asked that the original figure be increased by a third.

By a Herculean effort on the part of employees and some production miracles, the company produced 401 C-47s over and above regular schedule with the 401st plane completed June 2 or 28 days ahead of the deadline and just four days before the invasion of Normandy.

Battle records of the C-47 were numerous and valiant. It spearheaded the invasion of Normandy in an "endless stream" of C-47s towing gliders across the English Channel to drop men and supplies in support of the invasion efforts. As "Work Horses of the Air", C-47s carried thousands of men and hundreds of thousands of tons of food and munitions to battle fronts all over the world. According to official figures, C-47s evacuated 20,000 wounded from New Guinea in five months, 17,000 from Guadalcanal, 1,000 from Alaska, 18,000 from Tunisia, 14,000 from Sicily, and up to the invasion of France, for which figures were not available, all the allied casualties flown out of Italy. The total of wounded moved by air in the first two years of the war exceeded 125,000 men. In several instances, supplies and men flown to advance positions in C-47s were the means of turning the



DOUGLAS C-47 SKYTRAIN



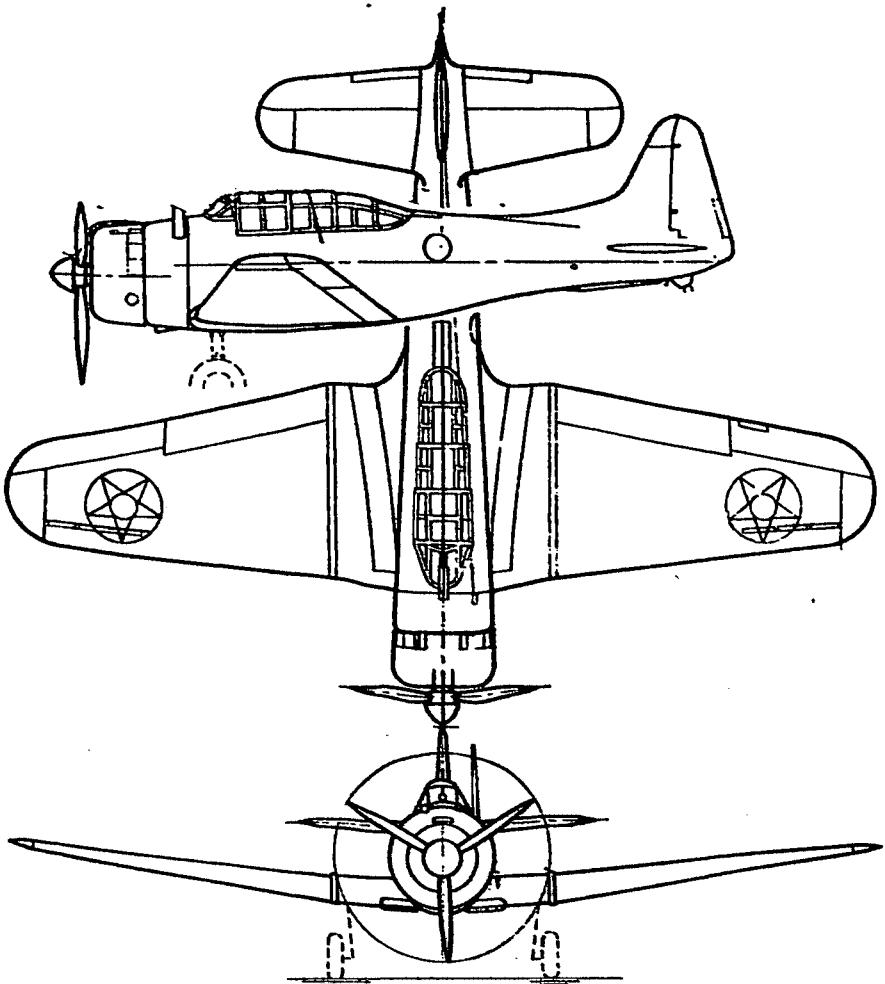
DOUGLAS DB-7B—BOSTON

tide of battle in favor of the Allies. Although in commercial service the Civil Aeronautics Board restricted these planes to a gross weight of 25,200 lbs., military exigencies loaded them to grosses in excess of 31,000 lbs., and there were instances of over-water hops with gross weights of 35,000 lbs. C-47s were flown by the ATC, the Troop Carrier Command, and, as R4Ds, by the Naval Air Transport Service in practically every theater of operation.

During 1944 a number of DC-3s, taken over by the Army early in the war and converted to military use, were returned to their air line owners and, after reconversion, were again flying regularly scheduled domestic routes. The company announced that it would produce no more DC-3s since the surplus of C-47s, which could be converted to domestic airliners after the war, was sufficient to meet the needs for several years to come. Supplanting the DC-3 in the company's production picture was the DC-4 which, during the war had become as

famous as its predecessor under the Army designation of C-54 Skymaster. Skymasters were produced at the Santa Monica and Chicago plants where modern and efficient production lines were established to turn out these huge four-engine transports. Like the C-47, the C-54 was flown by both Army and Navy. In the latter case, its designation was the R5D. With a cabin the size of a box car, the C-54 carried a normal payload of 10 tons for a distance of 1,500 miles non-stop. It could handle four times the DC-3's normal load.

Primary use of the C-54 was intended for long-range personnel transport to widely separated and distant fields of military operation. However, it quickly developed that this plane was also the ideal carrier for general cargo, ordnance equipment, litter patients and military supplies. Provisions for transporting these various cargo types necessi-



DOUGLAS SBD-3 and A-24

The SBD-3 was the Navy version and the A-24 was for the Army Air Forces.

tated a considerable amount of design change. For ease of loading large objects, the standard passenger door was replaced with a large cargo door, through which bulky items could be loaded. Accordingly, necessary ramps, reinforced floor, hoist power winch and cables were designed and installed.

All transport planes used by the Troop Carrier Command were Douglas, as were 59 per cent of those used by the Air Transport Command, and 50 per cent of the Naval Air Transport Service. At the beginning of 1945, the C-54 was averaging 600 round trips a month across the North Atlantic alone, flying day and night, winter and summer. The C-54s were flying the longest scheduled air route in the world—11,000 miles from Florida to India in three and one-half days. This flight was over two oceans and four continents. In ATC service they were flying four main Pacific routes—between San Francisco and Hawaii, from Honolulu to the Fiji Islands and on to Australia.

Douglas Aircraft, with its fine war production record, had over \$150,000,000 worth of contracts for peacetime planes. Among these models to be produced were the DC-4, the DC-6 and DC-7. The DC-4 would carry 44 passengers and a crew of five as well as mail and express at a cruising speed of 339 m.p.h. Four Pratt & Whitney engines would provide 4,400 h.p.

The DC-6 which is seven feet longer than the DC-4 and with 6,800 h.p. from four engines would cruise at 334 m.p.h. with a gross load of 63,500 lbs. at 60 per cent rated power, carrying 50 passengers and a crew of five.

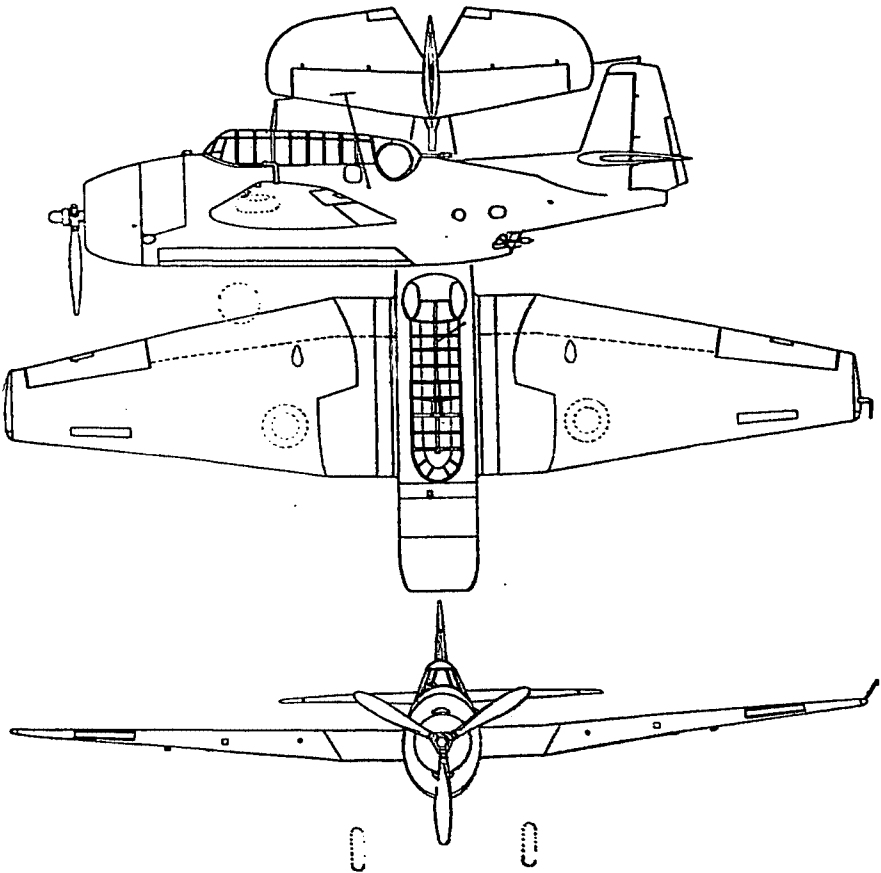
The DC-7 was in the mockup stage, and was to be a 108-passenger transport with a crew of 13. Four engines would give it a cruising speed of approximately 300 m.p.h. and a cruising altitude of 20,000 ft.

Eastern Aircraft Division of General Motors Corporation, Linden, N. J., was in production on two Grumman planes for the U. S. Navy. They were the FM-2 Wildcat and the TBM-3 Avenger. The Wildcat was in general use on escort carriers. It had a speed of over 300 m.p.h., service ceiling of 32,000 ft., carried four .50-cal. machine guns and rocket launching tubes. It was powered by a Wright 1,350 h.p. Cyclone engine, and with extra fuel tanks had a range of 1,650 miles. The Avenger, primarily a torpedo plane, also was used for scouting, rocket attacks, bomb runs and smoke laying. It carried a crew of three, as many as six machine guns, had a speed of 280 m.p.h., and could carry a one-ton torpedo or its equivalent bomb load. Four rocket launchers were located under each wing; one in each set being interchangeable with a machine gun.

Engineering and Research Corporation, Riverdale, Md., builders of the certified spinproof and stall proof personal plane, Ercoupe, manufactured several tooling machines that played an exceedingly important part in the aircraft industry. Aircraft manufacturers in the Allied countries were using the Erco sheet former, the shrinker, riv-

eter, stretcher and the propeller-profiler. The propeller on every Allied plane was ground on an Erco profiler. At the outbreak of this war, Engineering and Research Corporation suspended the manufacture of the Ercoupe and concentrated on production of war material for the Army and Navy. Erco was the first builder of radar parts in the United States. It also built gun turrets for Army planes, and designed and built the new spherical gun turrets for the new PB4Y2, the Navy version of the B-24.

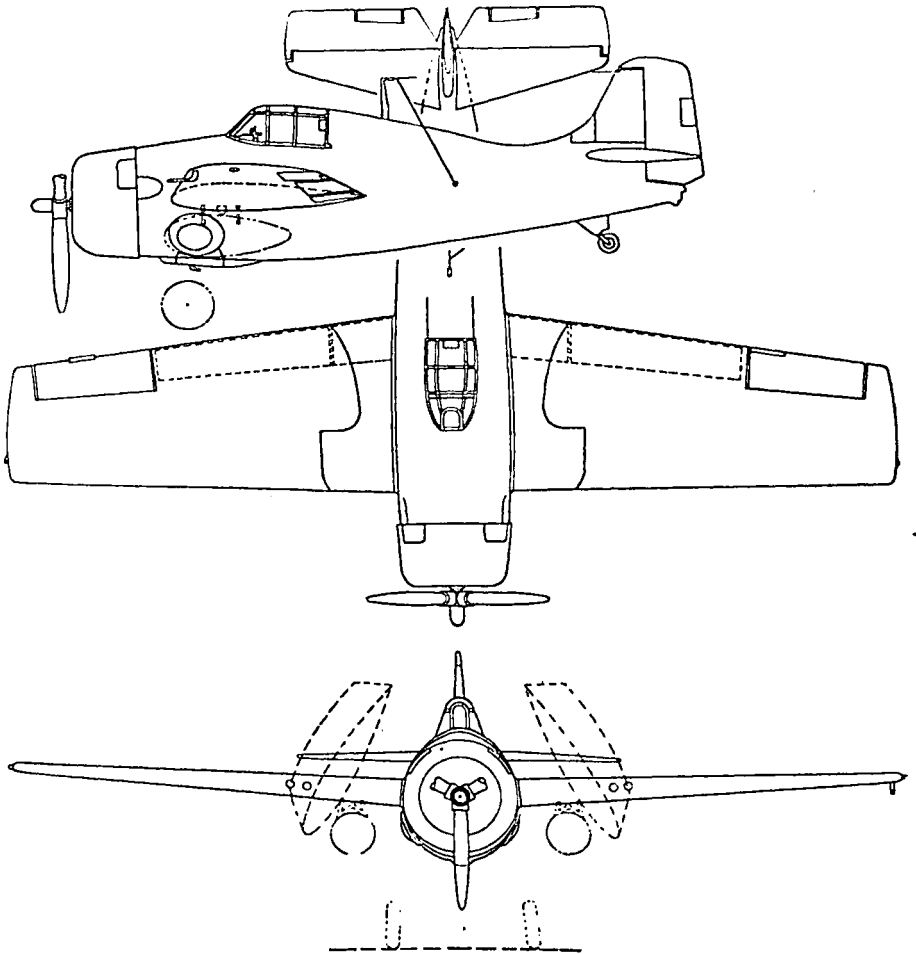
Erco was widely known for its development of the Ercoupe, which was a two-place plane designed for personal use. It was a low-wing monocoque of all metal construction, except for the fabric covering of the outer wing panels, and was powered with a 65 h.p. engine, giving it a top speed of 117 m.p.h. and a cruising speed of about 100 m.p.h. Two unconventional design features were used in the Ercoupe. The



NAVY AVENGER TORPEDO PLANE

A Grumman-designed torpedo plane manufactured for the Navy by Eastern Aircraft Division of General Motors Corporation.





#### NAVY WILDCAT FIGHTER

This Grumman-designed Navy fighter is manufactured by Eastern Aircraft Division of General Motors Corporation.

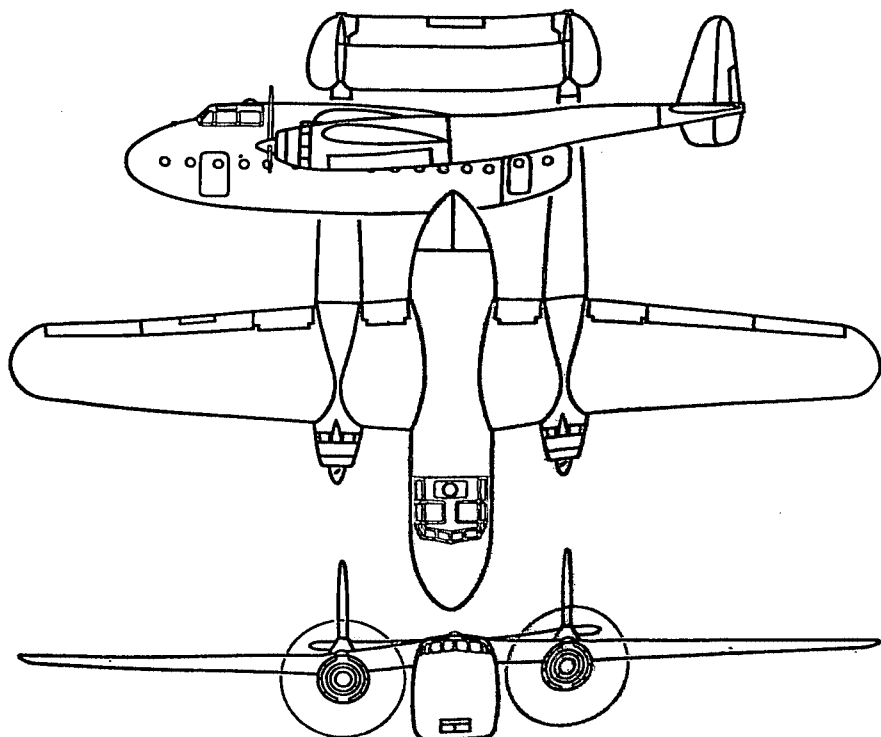
plane was made spinproof and provided with effective lateral control at all speeds, which prevented loss of control at low speeds. The control system was simplified by linking both the ailerons and rudders to the control wheel, which entirely eliminated the rudder pedals. The tricycle landing gear was used, and with it the airplane could be landed up to twice the minimum speed without tendency to leave the ground after the first contact.

Fairchild Aircraft Division of Fairchild Engine and Airplane Corporation, Hagerstown, Md., developed the C-82 Packet military cargo plane—the first of the type to be designed solely for carrying vehicles and heavy cargo over long distances. The Packet could carry a 2½-ton truck, a half track, armored car or a light tank. It had a

wing span of 106 ft. 6¾ in., length 75 ft. 10¼ in., height 26 ft. 4 in., gross weight 42,000 to 50,000 lbs., weight empty 26,530 lbs., wing area 1,400 sq. ft., two cargo compartments—one 8 ft. by 8 ft. by 28 ft. and the other 6½ ft. by 8 ft. by 10 ft. It was powered by two Pratt & Whitney R-2800 double Wasp engines of 2,400 h.p. each and Hamilton Standard propellers, and had a range of about 3,500 miles. It carried a military crew of five.

Designed by Fairchild in cooperation with the Army Air Forces, the C-82 Packet was nicknamed the "flying boxcar" because of its 2,312 cu. ft. cargo capacity. It was of all metal construction of twin boom type. Fairchild had new plant facilities at Hagerstown which were to be devoted to production of this cargo plane. In the older plant at Hagerstown, Fairchild continued to produce complete wing panels for the Navy Martin PBM-3 Mariner on accelerated schedules.

Fairchild had produced more than 5,000 PT-19 and PT-26 trainers for the Army Air Forces and for 23 other nations when the contracts were cancelled in April, 1944. Production was continued on the UC-61K Forwarder until October, 1944, when the military order was completed. The Fairchild AT-21 Gunner, a Duramold twin-engine



**FAIRCHILD C-82 PACKET**

This new Army Air Forces cargo transport is powered by two Pratt & Whitney Double Wasp engines.



#### FAIRCHILD C-82 CARGO PLANE

This Army Air Forces freighter was named *The Packet*. It was powered by two 2,400 h.p. Pratt & Whitney Wasp engines and had 2,312 cu. ft. cargo capacity.

advanced trainer, also was kept in production until completion of orders in October.

Fleetwings Division of Kaiser Cargo, Inc., Bristol, Pa., was engaged in a number of confidential projects of a military nature, and continued production of wings, fins, rudders and ailerons, tail surfaces and hydraulic valves. In order to facilitate and improve production, Fleetwings enlarged facilities to include two test laboratories, an X-ray and a photo laboratory. A system of engineering metal drawings plus photoprint resulted in faster and more accurate production of templates, jigs, tools and fixtures. Part of the Fleetwings program for 1945, included an experimental airplane.

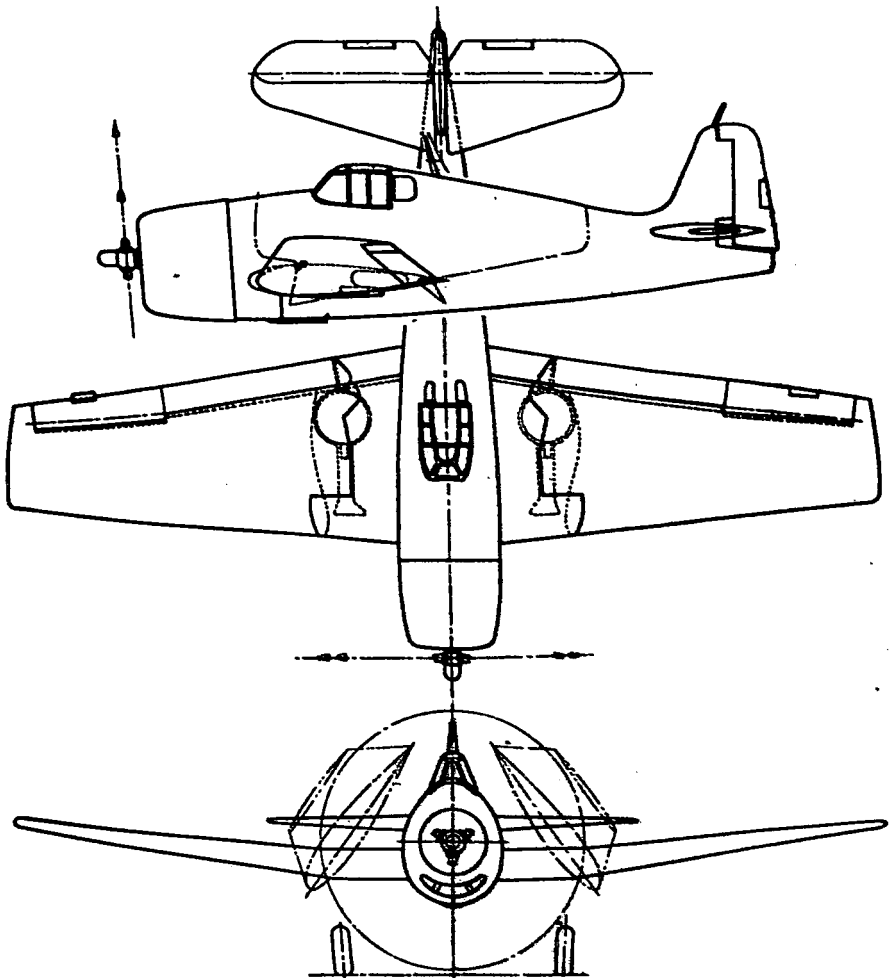
General Aircraft Corporation, Astoria, N. Y., continued production of cargo gliders, while a subsidiary, Tennessee Aircraft, of Nashville, Tenn., was making parts for prime contractors.

Globe Aircraft Corporation, Fort Worth, Tex., completed its prime contract for 600 AT-10 twin-engine trainers several weeks ahead of schedule. An AT-10 spares contract also was completed ahead of schedule. After completing these contracts, Globe undertook subcontracts for pilot's compartments of the C-46 *Commando*, sub-assemblies of the C-82 *Packet*, and for small parts for various other war planes. Globe also completed its prime contract for rework of AT-17 and UC-78 airplanes in 1944.

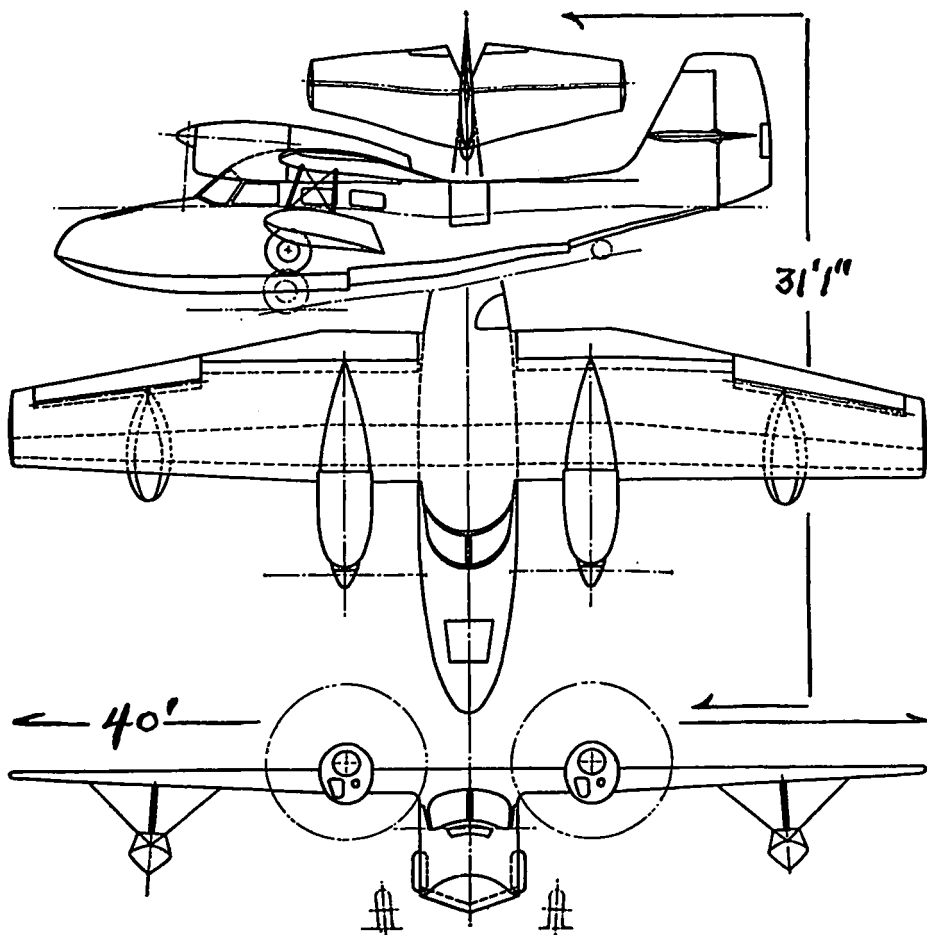
Announcement was made of Globe's postwar personal airplane Model GC-1A, the *Swift*, a two-place, low-wing monoplane. Flight

results with the 85 h.p. Continental engine were announced as maximum speed 135 m.p.h.; cruising speed 125 m.p.h.; landing speed (with flaps) 42 m.p.h.; landing speed (without flaps) 47 m.p.h.; rate of climb 700 ft. per min., and range, 600 miles. The Swift had a wing span of 29 ft. 4 in., overall length 20 ft. 4 in., height overall 6 ft. 2 in., gross weight 1,570 lbs., empty weight 1,010 lbs. and a baggage allowance of 50 lbs.

Goodyear Aircraft Corporation, Akron, O., the nation's sole producer of lighter-than-air ships for coastal patrol and convoy work, a major producer of Chance-Vought designed Corsairs for the Navy and Marine Corps, and a manufacturer of parts for some other 16 military planes, went through a period of plant conversion with an enviable record of meeting production schedules. Completing its airship program which saw scores of non-rigid blimps, ranging in size



THE GRUMMAN F6F-3 HELLCAT



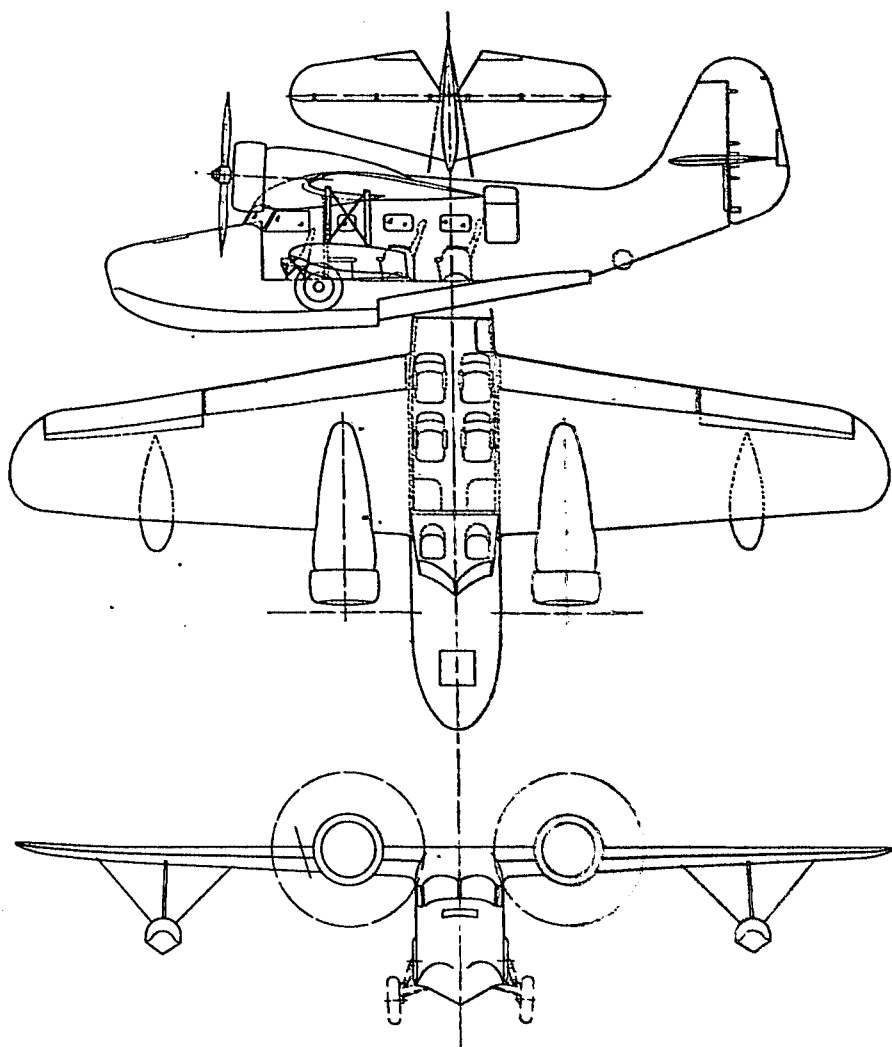
THE GRUMMAN WIDGEON

A five-place amphibian for the U. S. Coast Guard and U. S. Navy.

from the L-type, a primary trainer of 125,000 cu. ft. capacity (helium); the G-ships, advanced trainers of 195,000 cu. ft. capacity; K-ships of 425,000 cu. ft. capacity and M-ships of 725,000 cu. ft. capacity for actual patrol and escort work, Goodyear turned over those manufacturing facilities to production of tail surfaces for Lockheed's P-38 Lightning, wings and flaps for Grumman's Hellcat. Corsair fighter planes moved off the production lines for the Navy, the Marine Corps and for the Air Arm of the British Royal Navy. Bomb bay sections and tail surfaces for the Boeing B-29 Superfortress were produced on schedule after reconverting one entire plant from Martin B-26 wing construction. Production of wing panels and tail surfaces for the Northrop P-61 Black Widow continued in high gear. Other major contracts at the Akron plants included control surfaces for the Martin B-26, PBM-3 and PBM-5, Sikorsky XR-5 tail cones, and em-

pennages for Grumman Avengers. Wheels and brakes for most of the plane models built in the United States were produced in increasingly large quantities. Operations at the Litchfield Park, Ariz., plant included construction of wings and other component parts for the Lockheed PV-2 and modification of the Consolidated Vultee PB4Y-1 and PB4Y-2 for the Navy.

Grumman Aircraft Engineering Corporation, Bethpage, N. Y. was in production on four different models of military aircraft. Major



#### GRUMMAN GREY GOOSE

The JRF-5 and JRF-6B. An eight-place utility amphibian, used by the Navy air forces and U. S. Coast Guard, powered by two Pratt & Whitney Wasp Junior 400 h.p. engines.

production model was the F6F-5 Hellcat for the Navy. In addition, the company introduced the F7F Tigercat, a new twin-engine Navy fighter about which no information had been released. Other production models were the JRF Grey Goose and the J4F Widgeon. In July, 1944, a new plant was opened at Bethpage. Designated Plant 5, it housed the entire engineering staff and experimental department under one roof.

The Grumman Hellcat had a wing span of 42 ft. 10 in., and length of 36 ft. 6 5/8 in., more power, more speed and a faster rate of climb. It was in the 400 m.p.h. class. It first saw action in September, 1943, and proved vastly superior to the best planes that the Japs could send up against it. The Hellcat had the typical Grumman folding wing, permitting the plane to be stowed in the smallest possible space on a carrier. The Grumman J4F-2 Widgeon was a utility amphibian used principally by the Navy and Coast Guard for coastal patrol. It carried a depth charge, for anti-submarine work, besides other weapons. The Widgeon had two Ranger 6-cyl. 200 h.p. engines, carried a crew of five, had a wing span of 40 ft., length 31 ft., height 9 ft., wing area 245 sq. ft., power loading 11.25 lb. h.p., wing loading 18.37 lb. sq. ft., weight empty 3,075 lbs., useful load 1,425 lbs., gross weight 4,500 lbs., max. cruising speed 138 m.p.h. and ceiling 15,000 ft.

The Grumman JRF-5 Grey Goose was a utility and patrol amphibian used by the Navy, Army Air Forces and Coast Guard for operations in remote regions inaccessible to land planes, for submarine patrol, photography, light cargo, personnel transport and rescue missions. It was larger than the Widgeon, had a wing span of 49 ft., length 38 ft. 4 in., height on wheels 12 ft., wing area 375 sq. ft., gross weight 8,000 lbs., empty weight 5,600 lbs., useful load 2,400 lbs., cruising speed at sea level 171 m.p.h., max. speed at 5,000 ft. 201 m.p.h. and service ceiling 22,000 ft.

Kellett Aircraft Corporation, Upper Darby, Pa., at the beginning of 1945 was starting its 17th year of aircraft manufacturing, having been continuously active since early in 1929 in production and development of rotary-wing aircraft and as an aircraft parts subcontractor. A large proportion of the production was in the subcontracting division. Kellett produced ailerons and flaps for the Republic Thunderbolt, stabilizers for the Curtiss Helldiver, engine mounts for the Consolidated PB4Y, welded parts for the Grumman Wildcat and Avenger, parts for the Martin Mars, fairings for the Chance Vought Corsair and many other individual items. The company was operating eight plant units in various sections of Philadelphia and suburbs. Meanwhile, Kellett proceeded with its development work for the Army Air Forces in the helicopter field, which Kellett engineers had studied for many years.

Lockheed Aircraft Corporation, Burbank, Calif., added to its 1945 production program two new types, the four-engine C-69 Constellation

troop and cargo transport and a fast jet-propelled Army fighter. The company's 1944 production was concentrated, as in the previous year, on the spectacular Lightning P-38 Army fighter, in its 18th version as the L model, and the Boeing B-17 Flying Fortress. Production of these two ships was up to schedule every month of 1944. In addition Lockheed continued heavy production of a new modified version of the Ventura Navy search bomber, the PV-2. Total production for the year was nearly 85,000,000 lbs., or 5,858 aircraft units. This production was maintained through increased manpower efficiency, because employment dropped from a wartime high of 90,000 in 1943 to about 60,000 at the end of 1944.

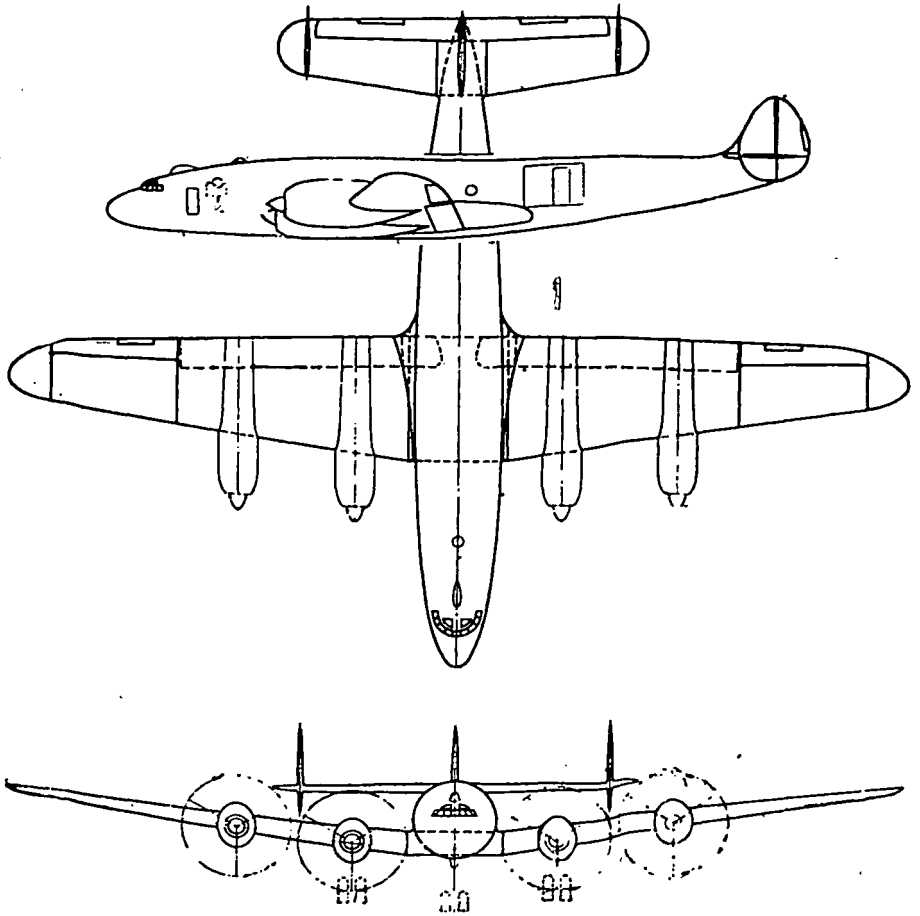
Lockheed had in production for early service in the war theaters the P-80 Shooting Star, the new Army Air Forces jet-propelled, propellerless combat plane. Its single turbine engine, developed by General Electric, had twice the power of former jet engines. That and a new type wing helped to make the Shooting Star much faster than conventional planes. It was extremely maneuverable, had a pressur-



#### BUILDING LOCKHEED CONSTELLATIONS

The C-69 Constellation transport assembly line at the Lockheed Aircraft Corporation's main plant in Burbank, Calif.





THE LOCKHEED CONSTELLATION

This huge transport was powered by four Wright Cyclone 2,200 h.p. engines.

ized cabin for altitudes above 40,000 feet, could carry heavy loads of ammunition or bombs, and had a range comparable to that of other fighters. The fire hazard was low because the engine used a fuel similar to kerosene instead of gasoline. The Shooting Star was on the high priority list. Besides being built at the Lockheed plants it also was on a production line at the Kansas City, Kans., plant of North American Aviation.

During 1944, the first of the giant new Lockheed Constellations was put in service by the Air Transport Command of the Army Air Forces, and the 8,800 h.p. ship met all tests in requirements for troop and cargo transport. Capable of carrying 64 passengers and a crew of five at speeds approaching modern fighter speeds, the Constellation could maintain 26,000 ft. altitude on three engines and could climb on any two engines. A program of accelerated tests designed to prove the serviceability of the Constellation was conducted by the Army Air

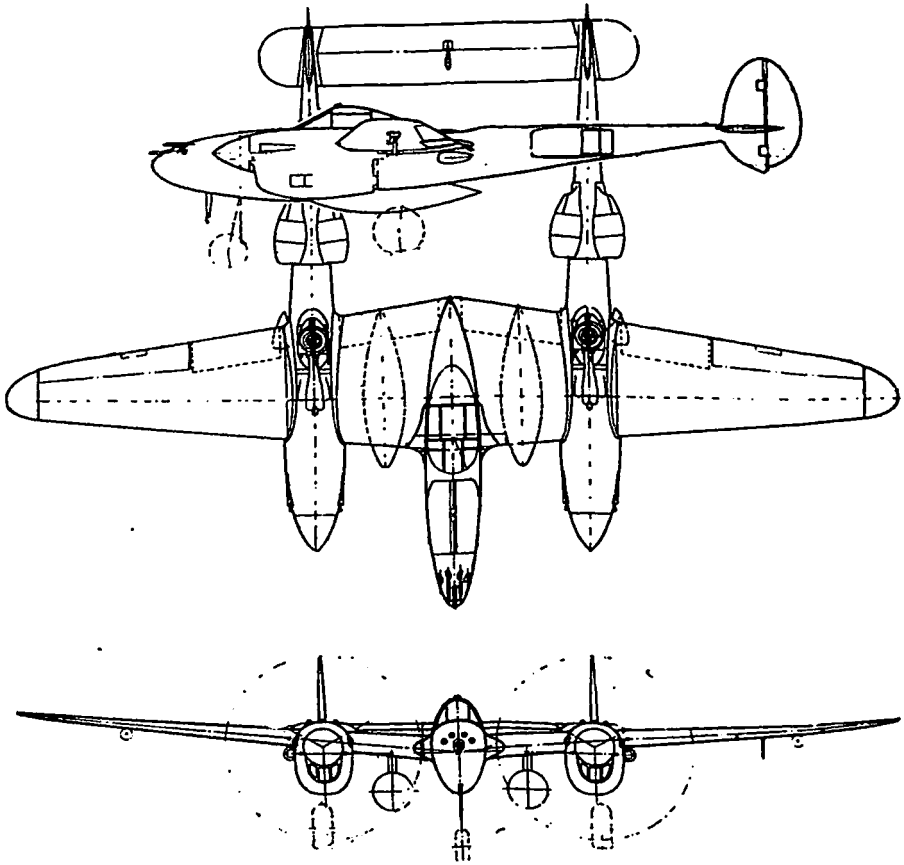
Forces at Wright Field, with the big plane successfully completing the grueling trials in record time. The development of a Lockheed-designed hydraulic booster control for the Constellation system assured easier, safer and more efficient operation of that and other large ships of the future. In April, 1944, on a routine delivery flight from Burbank to Washington, D. C., the Constellation set a transcontinental record for transport aircraft, covering the 2,300-miles in 6 hrs. 58 min. at an average speed of 330 m.p.h.

The Constellation was ideal for carrying great numbers of troops or heavy cargo loads over vast distances, a major requirement in pending operations against Japan. With the expanding production of the ship scheduled for 1945, it was believed that they soon would be in service in the Pacific theater. The Constellation was powered by four Wright Cyclone 2,200 h.p. engines.

The Lockheed Lightning P-38, even in its earlier models, had established itself as one of the finest all-around fighting planes in the world. In 1944, a new L model was produced in which the horsepower of the two Allison liquid-cooled engines was increased from the old figure of 1,150 to 1,500 h.p. With that 3,000 horsepower built into its slender twin nacelles leading back in the familiar twin booms to the connecting horizontal stabilizer, the P-38 became the highest-powered fighter airplane in the world and increased its own high altitude performance, particularly its climb, far above anything that it had been able to accomplish previously. It had a wing span of 32 ft. and length of 37 ft. 10 in.

The P-38 had established itself as a most versatile airplane regardless of type. It was used in combat as a high altitude fighter, a low altitude fighter, an escort fighter, a fighter-bomber, an interceptor, a night fighter, a low-altitude attack and ground strafing plane, a smoke screen layer, a tank buster and a photo-reconnaissance plane which, known as the F-5, had become a standard photo plane of the Army Air Forces. The Lightning also was equipped as a glider tower, and was used experimentally as a torpedo plane.

Development of a sensational new dive flap by Lockheed engineers in 1944, permitted the P-38 to enter the speed range of air compressibility without encountering lack of stability or control. Two small hinged pieces of metal on the underside of the wing, which could be extended during dives, prevented buffeting of the wing and permitted rapid recovery from high speed dives. Hydraulic aileron boosters gave the new P-38 increased maneuverability and greater control. With its range increased by droppable fuel tanks, permitting it to escort bombers on their longest missions, the P-38 also was capable of carrying bomb loads of 4,000 lbs. on both high altitude and low level missions. Lightnings equipped with deadly new rocket installations wrought havoc with enemy armor and transport in Europe and the Philippines. Gross weight of the ship was increased to 18,000 lbs.



### LOCKHEED P-38L LIGHTNING FIGHTER

Powered by two Allison 1,500 h.p. engines.

with an overload capacity of 21,400 lbs. The Army reported that the latest version of the P-38 was capable of speeds in excess of 425 m.p.h. in level flight.

In the Pacific theater, particularly, the P-38 Lightning won new laurels as the first ship to land on Leyte and Luzon. Major Richard Bong, holder of the Congressional Medal of Honor, flew his P-38 to victory over 40 Jap planes, marking him as the nation's outstanding ace. Two Consolidated-Vultee plants, at Downey, Calif., and Nashville, Tenn., joined Lockheed in 1944 as prime contractors on P-38 fighters.

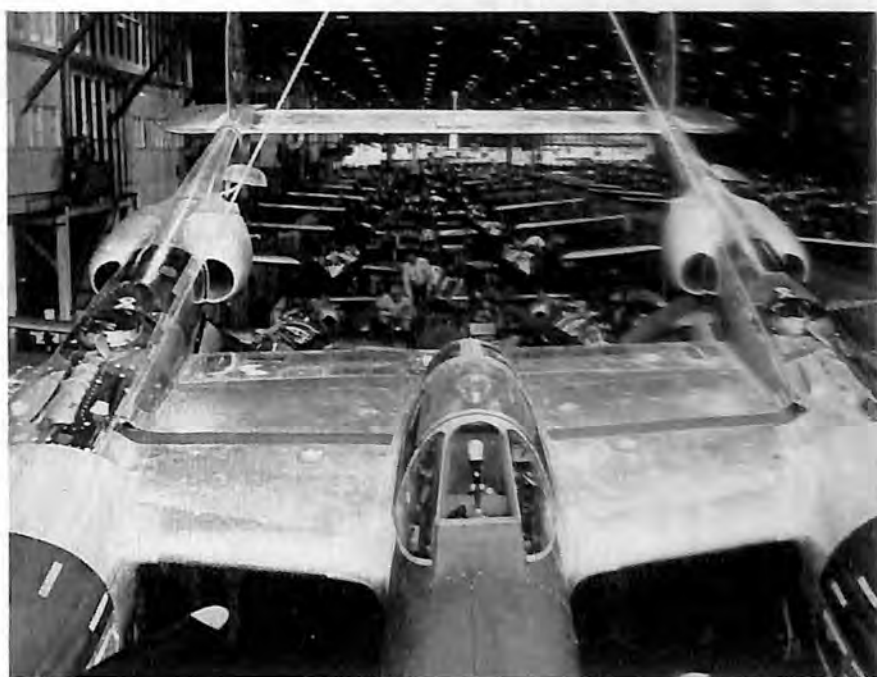
The Lockheed PV-1 Ventura was the Navy's first land-based twin-engine combat patrol plane with long range, plus offensive and defensive armament. It generally was equipped to carry depth charges or a standard torpedo in its enlarged bomb bay, and was heavily armed by machine guns protecting all vital points, as well as in the nose for strafing or attack purposes. It carried more radio equipment than any

other plane then built by Lockheed, and could land at less than 80 m.p.h. as could both the P-38 and the Constellation. It was a highly successful sub-buster and was described as "fiercer, farther and faster" than the Lockheed Hudson which it resembled. In fact, it replaced the Hudson which went out of production in 1943. Droppable gas tanks and fuselage tanks gave the PV-1 unusually long range for submarine patrol and seeking out enemy shipping. Powered by two Pratt & Whitney 2,000 h.p. Wasp engines, the ship had a wing span of 65 ft. 6 in. and normally carried a crew of four. A new version of the Ventura, the PV-2, was in production at Lockheed early in 1945.

Lockheed continued to build B-17 Fortresses under the Boeing-Douglas-Lockheed pool and with the announcement that Boeing had dropped B-17 production to concentrate on the B-29, the Fortress project assumed new importance for Lockheed in 1945. In October 1944, it was revealed that the great Fortress pool had turned out more than 10,000 B-17 Flying Fortresses.

The Flying Fortress was one of our greatest bombers in the European theater of the war. A majority of the high altitude daylight precision attacks against German industries and other installations had been made by our Air Forces in Flying Fortresses.

Lockheed in 1944 employed more than 60,000 men and women.



P-38L LIGHTNING FIGHTER ASSEMBLY

Built in half the time it took 12 months previously, this Lightning fighter is shown leaving the mechanized assembly line at the Lockheed plant.

working in 100 geographical locations in 18 nations on five continents. The Lockheed Employees Recreation Club, a non-profit organization incorporated in California and including the former Vega Employees Recreation Club, was the largest industrial recreation club in the world. This club during 1944 operated one \$500,000 cafeteria and commissary serving 60,000 meals daily, 24 hours a day. Early in 1945, it opened a second large cafeteria.

Subsidiary corporations were Lockheed Overseas Corporation, Lockheed Air Terminal, Inc., and Pacific Finance Corporation of California. Lockheed operated 18 manufacturing plants in Southern California; service bases and modification centers in California, Texas, Northern England; liaison offices in Washington, New York City, Rio de Janeiro, Cleveland, Detroit and Chicago; and its corps of service representatives lived and worked with combat units on every front. Lockheed's job-training department, as well as its wartime transportation system, were nationally known as models of their type. Outstanding among the many Lockheed enterprises designed to further the cause of aviation, and particularly to bring the prosecution of the war to a quick and successful conclusion through the use of air power, was the Lockheed Service Empire in which men and women were busy in many parts of the world keeping American-made airplanes of many types in the air. The largest was the Lockheed Overseas Corporation service assembly and modification base in Northern Ireland which was turned over to the Army Air Forces in 1944. Other bases were located in England, with smaller units in Iceland, Africa, India, the South Pacific and the Aleutians. A modification base for Army Air Forces planes located at Dallas, Texas, and a new one for the Navy built in San Fernando Valley, near the main factories at Burbank were among the largest and most important in the world. A customer service division was in full operation at Lockheed Air Terminal, Burbank, Calif.

Lockheed's 1945 program embraced continued on-schedule production of the P-38 Lightning, continued on-schedule production of the B-17 Flying Fortress, the creation of a production line of Constellation transports, accelerated production of the new Navy PV-2 Ventura, and establishment of a production line for the new secret fighter.

McDonnell Aircraft Corporation, St. Louis, Mo., was in peak production on airframes and parts for military aircraft. It built the AT-21 gunnery trainer and increased production of McDonnell Structomold plastic gun turret parts and ammunition boxes. McDonnell also had designed a helicopter for postwar development.

The Glenn L. Martin Company, Baltimore, Md., was in production on three types of military aircraft. They were the B-26 Marauder medium bomber, the PBM Mariner Navy patrol bomber and transport-cargo plane, and the A-30 Baltimore attack bomber for the R.A.F.

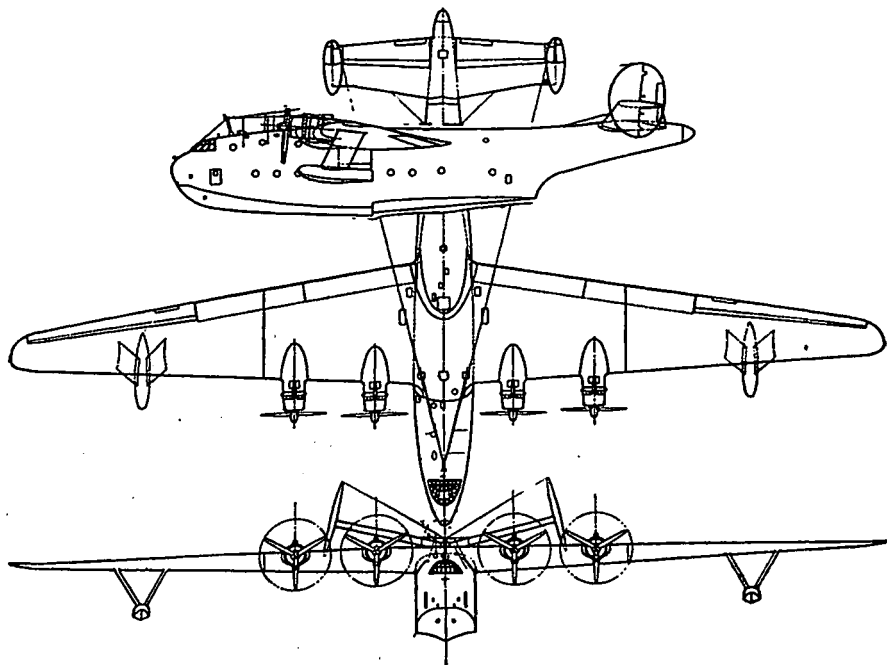
through Lend-Lease. The Martin company was constructing B-29 Superfortress nacelles at Baltimore, while the Glenn L. Martin Nebraska Company, at Omaha, was assembling the entire B-29 as one of the three major contractors in the B-29 program. Further headway was being made on the Navy's order for 20 Mars (or JRM) flying boats to be used as giant transport planes. Meanwhile, the Martin company continued to hold its place as a leading supplier of power-operated turrets, having constructed more than 30,000 of the electric turrets for Marauders, Liberators, PV2s, Havocs, Baltimores, R.A.F. Lancasters and Sunderlands, and the B-32s.

The 70-ton Mars prototype was operating steadily between Alameda, Calif., and Pearl Harbor. In fact, during November, 1944, it flew 33,600 miles and carried more than 300,000 lbs. of cargo in its seven round trips. It maintained a utilization factor of 9.7 hrs. a day in the air. The JRM-1, the production version of the Mars, to be completed during 1945, was to be even larger and more efficient than the prototype. External changes included substitution of a single rudder tail for the twin rudder tail, lengthening of the bow and second step by four ft. to provide added cargo space, and enlargement and redesign of the main and aft cargo hatches. Inside the giant hull it had been stripped of shower baths, pressurizing equipment, mess tables and lounges. One bulkhead was removed completely, and frames with openings wide enough to permit the passage of such heavy equipment as jeeps, field guns and aircraft engines were substituted for the remaining bulkheads on the main cargo deck. The number of bunks was



#### MARTIN MARAUDER ASSEMBLY

Final assembly of Army Air Forces B-26 Marauder bombers in the plant of The Glenn L. Martin Company, Baltimore, Md.



#### THE MARTIN NAVY MARS

It is powered by four 2,000 h.p. Wright Cyclones.

reduced from 36 to eight, four of which were located on the flight deck in the space formerly occupied by the pilots' lounge. New equipment on the JRM included more than a ton and a half of tie-down fittings, skid strips and engine dolly tracks, a 5,000-lbs. capacity power cargo hoist on an overhead track running out under both wings. While primarily designed for cargo carrying, the JRM Mars had built-in fittings to permit its instant conversion into a hospital ship, a passenger transport or troop carrier. It could accommodate 84 litter cases with 25 attendants; or 50 passengers in reclining chairs; or 132 troops and their equipment, with the men seated. It also would carry seven jeeps and even greater numbers of field pieces or aircraft engines. Sixty-nine manufacturers in 37 cities from 12 States were turning out sub-assemblies for this largest production airplane. The new Mars was to weigh  $72\frac{1}{2}$  tons.

It was another banner year for the Martin B-26 Marauder, which was a deadly precision-bombardment airplane used by the Army Air Forces, the French and the R.A.F. The Marauder also was proving one of the safest Allied airplanes in combat, with a loss ratio of less than four-tenths of one per cent for the entire war up to the end of 1944. It also was proving adept at fighting off enemy attackers, downing enemy planes at the rate of four to one B-26 downed by enemy aerial effort. As of September 30, 1944, the Marauder had completed over 82,000

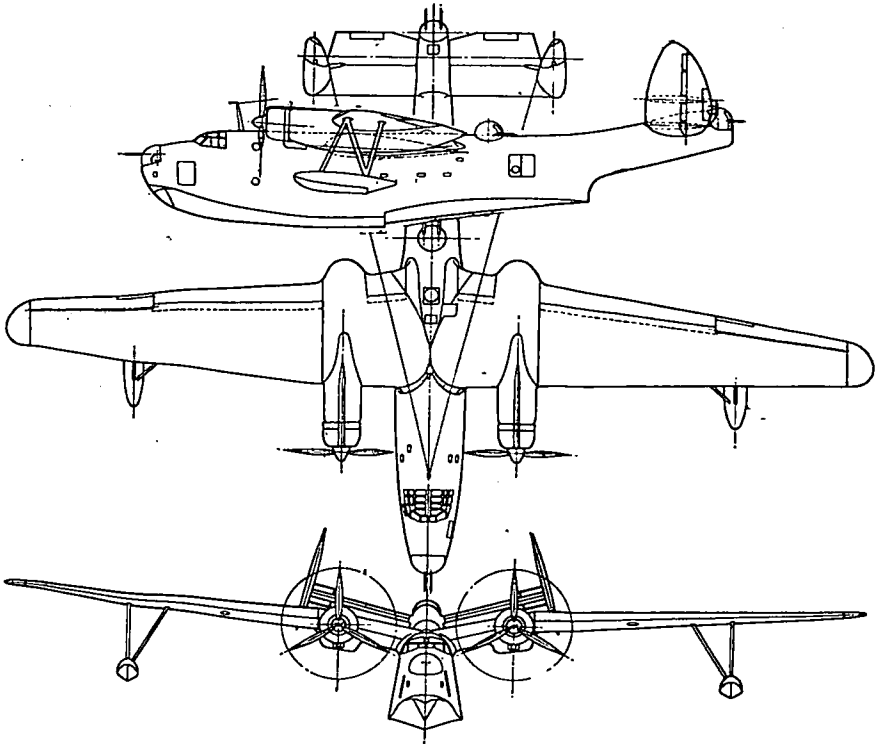
sorties in its three major theaters: The European Theater, the Mediterranean Theater and the Southwest Pacific. It had dropped over 112,000 tons of bombs; lost 336 to enemy flak and fighters (twice as many were downed by flak as fighters) and downed 424 enemy planes. Its targets were the invasion coast and softening-up forays against Nazi troop concentrations and artillery defenses, the V-1 bomb launching sites, enemy airfields during the first half of 1944. On D-Day, Marauders flew five major missions; then moved across from England to France, where they worked in close cooperation with the ground forces. On D-Day alone there were only two spans across the Seine River. All the others had been blasted away by the B-26s and fighter-bombers, leaving the Germans few, if any, avenues of retreat through Northern France. After that the Marauders were blasting enemy troops, fuel dumps, bridges, ammunition dumps and other key work in aiding ground forces. They wound up the year by bombing the Siegfried Line and other targets in Germany. In the Mediterranean Theater, Marauders were being used to do pin-point bombing during 1944 against Rome, Cassino, the Abbey of Mt. Cassino, Florence, Toulon and other historic areas, where the Nazis had established principal bases. And the B-26s did their job well, for they received commendations from Lt. Gen. Ira Eaker and Major Gen. John K. Cannon for "stealing the air show" at Cassino and Florence.

Durability was another feature of the Marauders. More than 250 of them completed 100 missions each. "Hell's Belle II" was the first to enter the charmed circle on May 1, 1944. One week later, the "Mild and Bitter" completed its century mission. By December, "Bar Fly" had completed 164 missions to lead the others for the year. Further changes were made in the Marauder construction. The wing was tilted in the later models so that the angle of incidence was changed by three degrees upward. Other improvements to increase combat safety were made.

The contract on A-30 Baltimores ended, except for the spares program, on May 1, 1944. But the R.A.F. was using the Baltimore with great effect in the Mediterranean Theater, both as an attack bomber and a patrol plane along the Tyrrhennian and Aegean Seas. Thus it was carrying on its fine work started in the North African campaign. However, the British were using more and more Marauders, because of the longer range for patrol work in the Mediterranean.

The PBM Mariner patrol bomber, weighing 25 tons, shifted its emphasis from the Atlantic and Caribbean, where it had assisted in combatting the U-boat menace, to the Pacific, where it assumed a heavy patrol burden as the Navy added new territories. The Pacific was no new field, as Mariners had pioneered air transport routes to Australia earlier in the war. As the Gilberts and Marshalls were captured, the PBMs gained 360,000 square miles of water to patrol against Jap submarines. It was a Mariner which discovered the Jap





THE MARTIN PBM-3 MARINER

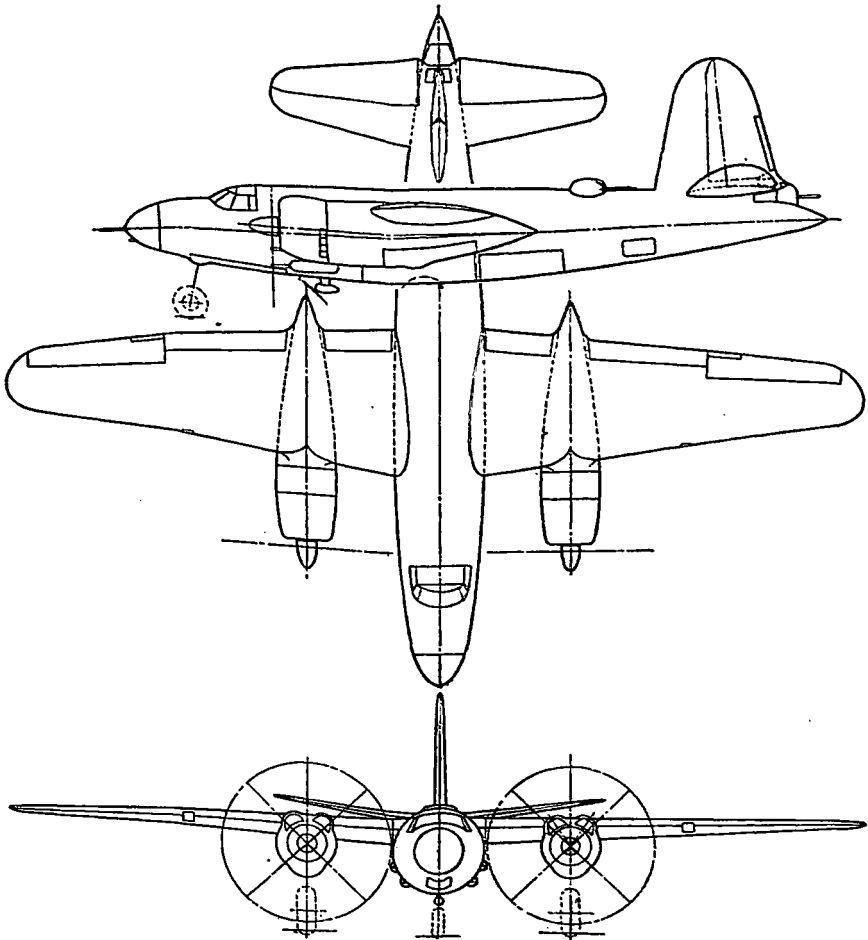
Fleet with steam up near Saipan and radioed the news to Admiral Mitscher's Task Force 58, resulting in that great aerial triumph. A PBM damaged a Jap carrier, which was quite an achievement for the heavy patrol bomber. PBM Mariners also were serving on "Dumbo" rescue missions—following Air Forces planes to pick up those who might be downed through enemy action—a great morale factor for our crews.

At Omaha, The Glenn L. Martin-Nebraska Company was producing B-29s and meeting every schedule for its second consecutive year. In fact, it was consistently ahead of schedule on the Superfortresses as part of the largest aircraft program ever undertaken in the United States. A number of factors contributed to the Martin company's increased aircraft production. Through intense research in operational planning, position installations on conveyors and newly-introduced equipment, the manufacturing departments were able to offset the loss of about 25,000 employees to the armed forces. More women were added to the manufacturing sections.

The year 1944 was the 35th year of continuous production for the Martin company. Looking to the future, Martin was planning development of military aircraft—in keeping with the Martin tradition as a pioneer bomber manufacturer—and also planning to play a leading

role in development of both domestic commercial aircraft and over-ocean flying boats larger than the Mars.

A number of new developments were brought forward by Martin engineers, other than those directly tied in with military and civilian aircraft. Among them were the axonograph, a trimetric projection instrument; the material hardness certifier; the spin dimpler, for dimpling the high-stress alloys; work in plastic sandwich materials; the legimeter, which predetermined whether or not a drawing would reproduce satisfactorily; further developments on the Mareng Cells, which, in addition to providing flexible fuel tanks for aircraft, permitted the use of boxcars and other dry-freight vehicles for transportation of oil and gasoline; vibration-detecting equipment, widely used in testing aircraft; electric harness testers; rivet-heating apparatus;



**THE MARTIN B-26 MARAUDER**

It is powered by two Pratt & Whitney 2,000 h.p. Wasp engines.

Marvinol, the new chem-elastic designed to replace rubber as a standard material for many articles; and an improved diluent system for cold-weather starting of internal combustion engines of buses, trucks and automobiles.

The Meyers Aircraft Company, Tecumseh, Mich., had discontinued its light plane production for the duration of the war, and was devoting its facilities to subcontract work.

North American Aviation, Inglewood, Calif., was in production on nine different models for the armed forces, including versions of the B-25 Mitchell bomber, P-51 Mustang fighter and trainer series. Airplanes built at North American Aviation's four plants in Inglewood, Kansas City, Kans., and Dallas, Tex., were the B-25 Mitchell, (H, J and eight-gun nose models); P-51 Mustang, (C and D models); AT-6D and SNJ-5 Texan and RAF Harvard trainers, and North American-built B-24 Liberator bombers.

The Inglewood plants produced the B-25H and P-51D. The entire production of Mitchell bombers was transferred to the Kansas City plant in July, 1944, to permit the California plant to devote all its facilities to building the Mustang. Conversion of the Inglewood plant solely to fighter production was accomplished in record time, with employees removing the tracks and overhead conveyor lines for the bomber virtually on the tail of the last Mitchell progressing down the line. Subassembly work for the increased fighter program was well under way by the time the final B-25 rolled out the factory doors. Although virtually all sections of productive floor area were in some way affected by the conversion, production was not disrupted in any portion of the factory, and completions were on schedule. Testimony to the steadfast production record at Inglewood was the winning of the fifth Army-Navy E award by employees in that plant, the latest E given for one year instead of the customary six months.

North American's Dallas plant, which produced all the trainer series, also built P-51C and D Mustangs, and B-24 Liberator bombers. The B-24 contract was concluded in November, 1944. Facilities used in production of the bomber then were converted for production of the Fairchild-designed C-82 Packet cargo-transport, actual assembly to begin in 1945. North American was awarded a fixed price contract by the Army Air Forces after being successful in the first competitive bid called for since the beginning of the war.

The 5,000th B-25 Mitchell produced at North American Aviation's Kansas City plant rolled off the line on December 1, 1944, just two weeks short of three years after the first bomber was completed in that Government-owned facility. In addition to fly-away planes, the plant also built the equivalent of 788 Mitchells in component spare parts. When the Kansas City plant received its Army-Navy E flag in October, the award ceremony also marked the delivery to the Government of 30,000 airplanes built by all North American Aviation

plants since the German invasion of Poland in September, 1939. An equivalent of 6,535 airplanes in spare parts also was built in that period, making a total of 36,535 aircraft built in just five years and one month.

North American Aviation established a number of production records for the aircraft industry during 1944. In October, the combined production of the three plants was 1,734 complete airplanes and equivalent spare parts, the highest total ever achieved in one month by any aircraft company. For the last six months of 1944, over 1,500 airplanes were delivered each month from the three plants. Throughout the year, the Texas division of North American produced one out of every 15 airplanes built in the United States. Out of approximately 60 aircraft plants in the country, the average monthly production rate for the Dallas plant exceeded the highest number of airplanes ever delivered in one month from any other single aircraft plant. For six months of the year over 600 planes per month were delivered from Hensley Field adjacent to the plant. In comparison with 1943, North American Aviation in 1944 produced 82 per cent more airframe pounds, while the number of airplanes accepted showed an increase of 63 per cent over the previous year.

Increased production achievements enabled the company to reduce the average cost to the Government of its P-51 Mustangs by more than 18.5 per cent over the cost on January 1, 1944, and were instrumental in effecting a reduction of 26.5 per cent in the cost of B-25 Mitchells during the same period. For 1945 North American Aviation had contracts to build more than 15,000 airplanes, including more than 8,000 P-51 Mustangs and an undisclosed number of three new secret types. Regarding two of the new secret types, company engineers were working on designs for fighter planes 30 per cent faster and with a rate of climb nearly double that of present fighters, and also bombers designed to be 50 per cent faster and have operational ceilings from 25 to 30 per cent higher than current models. Production of one of the new types was to be in the Kansas City plant. In addition, the Kansas City plant was given a contract to build the new high priority Lockheed fighter on which the Army Air Forces required additional quantities. The new contract would not effect the number of B-25's to be built at Kansas City.

Three new models of the B-25 Mitchell, which already had won distinction in its early versions, were added to the list of planes the Allies used with such devastation against the enemy during 1944. The B-25H, world's most heavily armed airplane, mounted a 75 mm. cannon, in addition to 14 .50-cal. machine guns. That model featured a top turret moved forward to just aft of the pilot's cockpit, tail turret, and side turrets, besides the introduction of two package guns mounted on either side of the fuselage, and 4 guns in the nose. Effectiveness of the firepower of these bombers was described by W. H. Cunningham,

7th Army Air Force correspondent, who wrote: "A great many American lives were saved and the Central Pacific timetable undoubtedly was speeded up by the introduction of cannon-carrying Mitchells into the Marshall Islands campaign. The performance of the cannon in knocking out Japanese bases and keeping them neutralized during and after the capture of Kwajalein and Eniwetok was amazing."

Sister ship of the B-25H was the B-25J, designed with the same armament innovations except that the cannon was replaced by the conventional bombardier's compartment, which mounted two instead of four .50-cal. machine guns in the nose. Against Nazi forces throughout Europe, the Mitchells continued their steady pounding of targets which they had begun in the early days of the African campaign. In August, 1944, B-25's in the Mediterranean theater completed their 30,000th combat sortie, the day after they flew their 1,500th combat mission. A 12th Army Air Force Mitchell bomb group also established a new AAF high record for precision of pinpoint targets by placing 90.4 per cent of bombs in assigned target areas during the month of September. In the China, Burma, India theater, the Japanese were plagued by both the H and J models of the Mitchell, which specialized in hitting transportation lines. The "Burma Dental Clinic" was the name given one group of Mitchells because of accuracy in destroying enemy bridges, while another group called the "Burma Bridge Busters" knocked out its 100th bridge of the year on November 8, 1944. The PBJ-1, Navy and Marine Air Forces' designation of the B-25, was used extensively in the Pacific theaters for bombing, strafing and patrol work. An outstanding group was the Marine Squadron known as the "Flying Nightmares", which harassed the Japs with daring night raids, giving the enemy no respite. Gen. Dwight D. Eisenhower used a Mitchell for transport in France and England. Gen. Eisenhower also tested firsthand another North American plane when he flew over the German lines shortly after the invasion of France in a P-51 Mustang specially adapted to carry a passenger. Major Gen. Elwood R. Quesada, head of the 9th Air Force Fighter Command, piloted the plane.

In September, 1944, the company announced another version of the Mitchell, designed with eight .50-cal. machine guns in the nose, setting a new high for concentrated destructive power with a total of 14 forward firing guns. This was produced at Kansas City. The Army Air Forces created a new use for the Mitchells during 1944, by utilizing returned combat ships for advanced training purposes under the designation of AT-24. By progressing student pilots to AT-24s, the transitional and advanced training phases were combined, speeding up the flow of pilots to keep step with the increased production of planes.

The Model H B-25 Mitchell had a wing spread of 67 ft. 7 in., length 51 ft. 3 $\frac{3}{4}$  in., height 16 ft. 4  $\frac{3}{16}$  in., wing area 609.8 sq. ft.,

with ammunition and 2,000 lbs. of bombs gross weight over 30,000 lbs., ceiling 23,800 ft. Its speed was over 300 m.p.h. It was powered by two Wright Cyclone 1,700 h.p. engines with Hamilton Standard three-blade propellers and carried a crew of five, all with interchangeable positions. Its armament included a 75 mm. cannon and four .50-cal. machine guns in the nose, two .50-cal. guns on each side of the fuselage outside pilot's section, two .50-cal. guns in upper turret, two of the same as waist guns and two others in the tail—a total of 14 machine guns.

The Model J Mitchell carried a crew of six and its armament consisted of 12 machine guns. Its power plant was two Wright Cyclone 1,700 h.p. engines with three-blade Hamilton Standard propellers. Its speed was more than 300 m.p.h. and ceiling 25,500 ft.

During 1944, design of North American's Mustang fighter was changed to incorporate a "teardrop" canopy, Model D, affording the pilot complete vision in all directions. Another modification was to build the Mustang as a photo-reconnaissance plane, identified by the Army Air Forces as the F-6. It was the only fighter type modified to carry its full complement of machine guns and bombs or extra fuel tanks, in addition to the aerial cameras installed in its fuselage. At the close of the year, a license to manufacture P-51 Mustangs was granted the Australian government.

On the home front, two Mustangs established a new transconti-



#### B-25 MITCHELL BOMBER PRODUCTION

Assembly lines of Army Air Forces B-25 Mitchell bombers at the Kansas City, Kans., plant of North American Aviation.

mental speed record, when Col. Clair Peterson of the Army Air Forces flew a stock model P-51 from Los Angeles to New York—a distance of 2,464 mi. in 6 hrs. 31½ min. At his heels was Lt. Col. Jack Carter, who flew another stock model P-51 non-stop over the same route in 6 hrs. 39½ min. Col. Peterson, who landed in Kansas City for refueling, averaged 378.54 m.p.h., while Col. Carter averaged 370.8 m.p.h.

In combat, Mustangs proved their effectiveness as long-range escort fighters and as fighter-bombers. When the shuttle bombing raids on Europe began in the Summer of 1944, Mustangs were the fighters picked to escort the heavy bombers, including the first Italy-to-Russia flight on June 2, and the first England-to-Russia flight on June 21, which culminated in the 7,000-mile triangle raid back to English bases. In clashes with the Luftwaffe over Europe, Mustangs maintained a better than 7-to-1 ratio over the Germans in fighters destroyed. Mustang pilots continually stepped up the records for planes destroyed in the European theater of operations. In March and April, 1944, Col. Donald Blakeslee's group destroyed 235 planes in the air and 128 on the ground, while on April 8, the group set a record for one mission, blasting 31 German planes out of the skies. Later, the record was bolstered by Mustang groups to a destruction of 38 German planes in one day, and a squadron record of 24 planes shot down on one mission. Among Mustang aces in England were Capt. Don Gentile with 30 planes to his credit, and Major George Preddy 30½; and in Italy Major Herschel Green 18; Capt. James Varnell 17, and Major Sam Brown 15½.

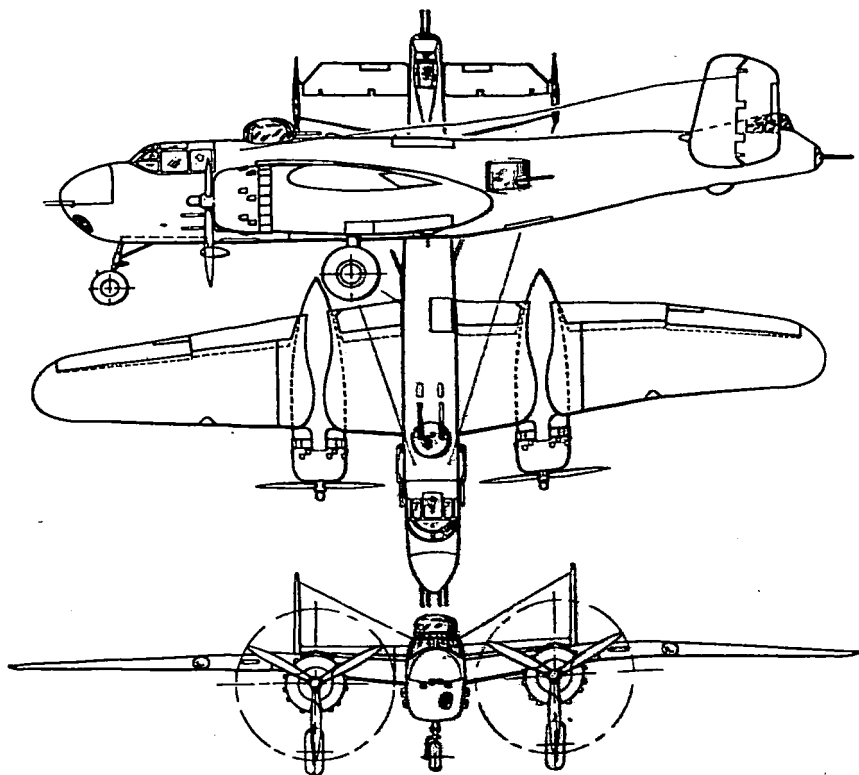
July, 1944, saw the end of service for the A-36 Mustang as fighter-bombers, after one year and several weeks of continuous combat. In that time, the 86th Fighter-Bomber Group of the 12th Air Force, flying A-36s carried out 1,500 missions and 14,000 sorties, dropped 10,344,000 lbs. of bombs and fired 3,000,000 rounds of .50-cal. ammunition. A total of 2,572 enemy vehicles were destroyed, 2,405 damaged; 591 railroad cars destroyed, 1,714 damaged; 46 locomotives destroyed, 35 damaged; two transports, three freighters, two destroyers and one light cruiser sunk, 10 others damaged; 23 enemy aircraft shot down and 23 damaged.

Outstanding A-36 in the theater was "Baby Carmine", which completed 230 missions, with 209 hrs. and 20 min. of flying time without an engine change. Mustangs also worried the Japanese in the CBI theater with their strafing, rocket, and bombing attacks on transportation and shipping, besides destruction of Jap planes in the air. One squadron was labeled "Yellow Scorpions" by Jap pilots, because of the toll it took of enemy planes and its daring raids on shipping, particularly in the harbor of Hong Kong.

The Model D of the P-51 Mustang had a wing spread of 37 ft. 5/16 in., length 32 ft. 3¼ in., height 13 ft. 3¼ in., wing area 233.19

sq. ft. and weight 10,000 lbs. The cockpit was under a transparent single unit teardrop canopy. The Mustang carried six .50-cal. machine guns. It was powered by a Packard-built Rolls Royce Merlin 1,600 h.p. engine; and according to War Department reports, it had a speed of about 450 m.p.h., ceiling above 40,000 ft. and a range of about 2,000 miles.

Although North American AT-6 Texans played their most vital role on the home front by training thousands of cadets, they also served on the war front, notably in Greenland. Equipped with skis, in many instances they assisted in the rescue of crews of bombers and transports forced down on ice and snow-covered terrain. At the end of 1944 AT-6s replaced the BT-13 trainers in basic pilot schools, thus giving cadets more flying time in airplanes more nearly like those they were to fly in combat. A record for continuous service was established by an AT-6A at Napier Field, Ala., when it completed its 5,000th hour of flying time. The plane averaged 3 hrs. 43 min. of time a day, or about 111½ hrs. per month, flew about 75,000 mi., or



#### NORTH AMERICAN B-25H MITCHELL BOMBER

This Army Air Forces bomber is powered by two Wright Cyclone 1,700 h.p. engines and as armament carries 14 .50-cal. machine guns and a 75-mm. cannon.





U. S. Army Air Forces photo

#### FIREPOWER OF THE P-51 MUSTANG

Shown here are the six .50-cal. machine guns on the North American Aviation Mustang Army fighter. The cartridge belts being carried represent the amount used by only one gun on a flight. Thirty-six men would be required to carry all the ammunition used by the Mustang on every sortie.

about 30 times around the world. The plane had used up seven engines and at the time of the record the eighth was installed. Brazil was granted a license to manufacture the Texans, making the third foreign licensee along with Noorduy Aircraft Company in Canada and Commonwealth Aircraft Corporation in Australia.

The California division of North American Aviation spent 202,040 engineering hours on the B-25 Mitchell, and 842,085 hours on the P-51 Mustang during 1944, making design changes on the planes. This increased their effectiveness under all combat conditions. The B-25 engineering hours expended by the Kansas City plant totaled

842,428, while the Dallas plant used 152,091 hours on the P-51 Mustang and 195,314 hours on the Texans and Harvards.

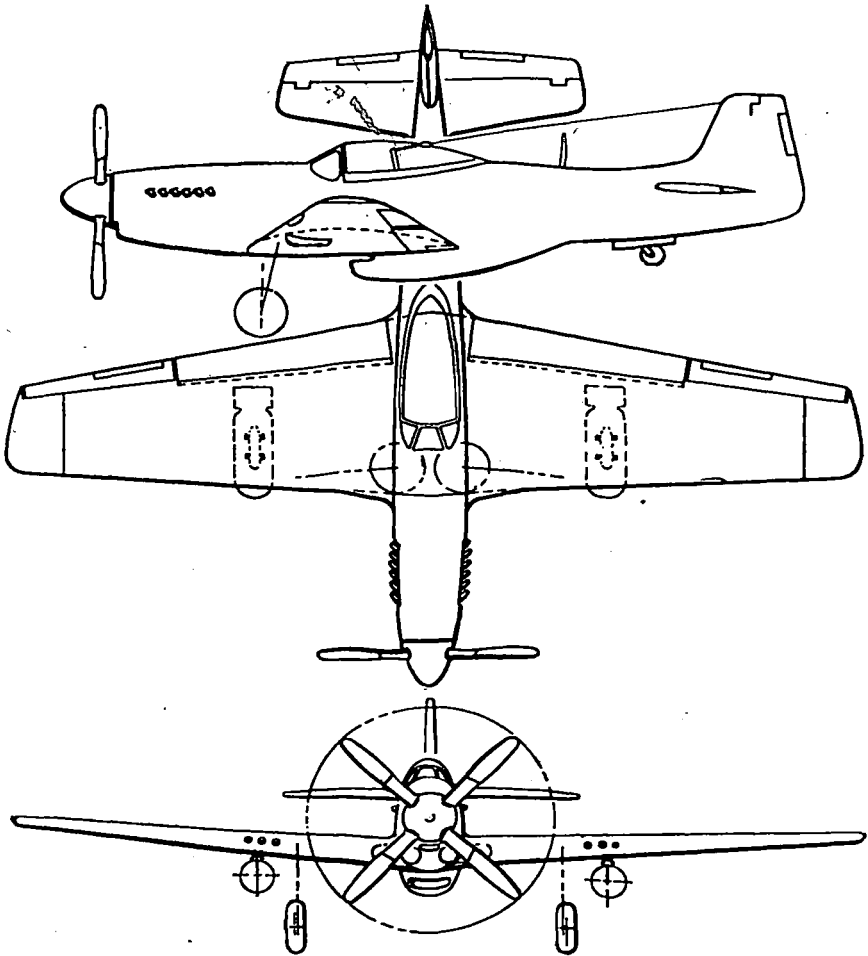
Increased production in all North American Aviation plants was possible by development of more efficient manufacturing processes, reducing manhours per pound. In Inglewood, comparing statistics of January to those of December, 1944, there was a 49 per cent reduction of manhours required per lb.; Kansas City a reduction of 63 per cent; and in Dallas 64 per cent less manhours were required per lb. to produce both the Mustangs and Texans. Besides continual improvement in conveyor systems in all plants, North American built the first outdoor engine run-up conveyor line in the aviation industry, at its Inglewood plant. All engine run-up operations formerly accomplished at various locations on the company's field were stationized and performed on this continuously moving line. Each Mustang was gassed, engine oil and coolant tanks filled, the engine subjected to a full power run, and radio check made before the plane was disconnected automatically from the line. Tanks containing supplies of engine oil, coolant fluid and gasoline were located underground at various stations along the line.

North American Aviation's process for the forming of thermo-setting laminated sheet materials was further extended to include



P-51 MUSTANG FINAL ASSEMBLY

One of the final assembly lines for the Army Air Forces fighter at the Inglewood, Calif., plant of North American Aviation.



NORTH AMERICAN P-51D MUSTANG

An Army Air Forces fighter, powered by a 1,600 h.p. Packard-built Rolls Royce Merlin engine.

many additional parts for all planes. Approximately 300 formed parts were used on the B-25 Mitchell bomber, while the P-51 Mustang fighter was produced with 40 formed parts, 60 molded parts, and over a hundred flat machined parts of laminated material.

A manufacturing improvement that saved many manhours was the installation in North American's Kansas City plant of a machine gun conveyor line, which speeded the assembly of the 12 .50-cal. guns required for the B-25J and the guns mounted on another version of the Mitchell. The company continued its extensive use of Field Service representatives who relayed to North American engineers vital information concerning the operation of Mitchells and Mustangs

under combat conditions. Of the 104 representatives, 64 were stationed overseas at bases in Alaska, Australia, Brazil, Canada, China, England, France, Hawaii, India, Italy, and throughout the Southwest Pacific.

Besides their conscientiousness in "staying-on-the-job", which made it possible for North American Aviation to increase productivity in all four plants, company employees further aided the war effort by submitting 11,301 suggestions for improvements in manufacturing processes. Of this number, 27.8 per cent of the suggestions were accepted and awards totaling \$82,761 given out in war bonds and stamps.

Northrop Aircraft, Inc., Hawthorne, Calif., was in heavy production on its P-61 Black Widow night fighter for the Army Air Forces, and at the same time was devoting about 30 per cent of its facilities to new and secret war projects. The Black Widow, meanwhile, was laying a course of darkness and sudden death for the enemy in the midnight skies over two major fronts. It was a two-engine, three-place pursuit plane painted a dull black, which rendered it practically invisible when it flew into the rays of enemy searchlights.

The P-61 Black Widow had a wing spread of 66 ft., length 48 ft. 9 in., a crew nacelle 33 ft. 10 in. long and only 49 in. wide. It was powered by two Pratt & Whitney 2,000 h.p. Twin Wasp engines. Its armament consisted of 20 mm. cannon and in a revolving turret four .50-cal. machine guns or other combinations fired by remote control. It had a high speed and exceptionally long range, and could stay up over enemy territory for hours searching for bombers.

Speed, maneuverability, heavy firepower and the "cat's eyes" imparted by radar in the midnight skies, made the big and powerful pursuit ship a formidable adversary on the western front and in the far reaches of the Pacific. Hundreds of Nazi and Japanese planes were reduced to junk heaps by the "black magic" of the Widow, which was the first plane specially designed for the job of night-fighting. Enemy supplies, installations and mobile equipment flamed into ruins under her .50-cal. machine guns and 20 mm. cannon, and long troop columns were broken up by the onslaught of the savage night fighter, which also blew up many ammunition trains.

As the invasion army slammed hard at German forces in France, Black Widows went along—striking at enemy mechanized convoys, troop columns, supplies and aircraft. They ranged into Germany at night and struck down enemy raiders over Allied lines. The deadly results were recorded in news dispatches after D-day, which credited Black Widows with being "largely responsible for 239 German planes destroyed and 209 probables." Junkers 88's, FW-110's and Messerschmitts alike were prey for the Black Widows, which showed themselves capable of destroying anything in the air—including the lethal German buzz bombs that were sped across the channel toward England. From an American base in Belgium, Capt. Tadas J. Spelis and



U. S. Army Air Forces photo

#### TOP TURRET OF THE BLACK WIDOW

The revolving turret on top of the crew nacelle houses four .50-cal. machine guns, and elsewhere there are 20-mm. cannon.

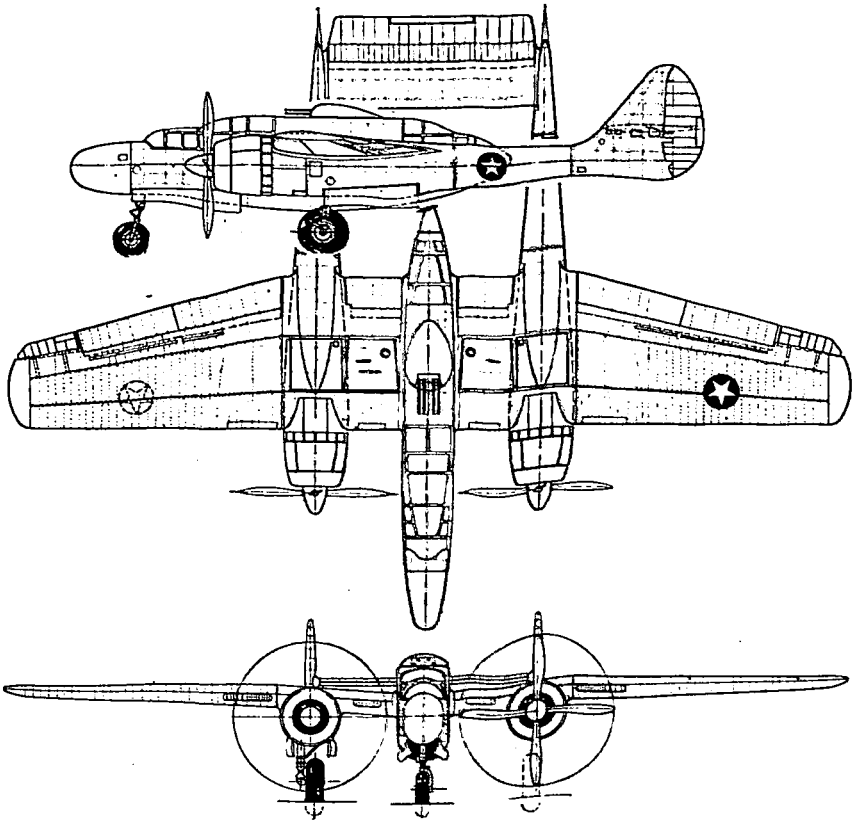
his Black Widow went out to prowl the darkness and risked head on collision with a robot bomb, approaching within 400 feet before letting go with his 20 mm. cannon. So close was Capt. Spelis that he had to take his plane right through the blast of the bomb, but he landed safely with his blackened plane's left rudder, left aileron and half its left elevator burned off. Many other Black Widow pilots joined the grim game of destroying buzz bombs. One Ninth Air Force squadron commanded by Lt. Col. Oris B. Johnson knocked down five of them, in addition to scoring 11 German planes, five probables and two damaged, along with the destruction of 16 enemy locomotives. Col. Johnson reported that the Germans were attempting to meet the Black Widow menace by sending jet and rocket propelled planes against them.

The spectacular night fighter was used effectively in defense and intruder missions. When von Runstedt gathered his forces and

pounded a salient through the Allied lines late in 1944, Black Widows were credited from unofficial sources at the front with having had a large share in the job of hammering back the bulge. It was described as a "holiday of hell" when the P-61's swarmed over the breakthrough area to dissipate aerial strength mustered by the enemy.

Meanwhile, the Black Widow was earning the respect of pilots in the South Pacific. Their sentiments were expressed by Lt. Dudley C. Bray, who returned from combat saying: "One's first reaction to the thought of exclusive night fighting, which is finding and destroying enemy planes in the blackness of night, is dread because of being deprived of vision. But it is worrisome only until one has had actual experience. Then the feeling of strangeness and eerie detachment disappears and one has the comforting feeling of a magnificent plane and confidence in its instruments. You feel you are really the master of this new element."

How the Black Widow mastered its element was shown when



**NORTHROP P-61 BLACK WIDOW**

This Army Air Forces night fighter is powered by two 2,000 h.p. Pratt & Whitney engines and carries a crew of two or three.

ground forces bestowed on it the name of "South Pacific Sandman" for its success in driving off Jap bombers which had been keeping them awake night after night. The night fighters knocked down twin-engine enemy bombers which were raiding Biak and Owi islands; smashed Jap attacks on the B-29 Superfortress bases on Saipan; broke up Jap attempts to sink American shipping participating in the Philippines invasions. It was in the latter area, near Mindoro, that Major Carroll C. Smith became the first Black Widow ace by knocking down four Jap planes in a single night, bringing his total score to seven.

Night pilots everywhere were having success. "When I let go with both the .50's and the cannon, the Jap was a beautiful orange ball spinning into the sea."

"I let fly all my guns at the first Nip. He shuddered and his tail fell off. The Black Widow takes you out, knocks 'em down and brings you home safely again."

"We just closed in on one of the Jap planes in the darkness and let him have it with two bursts of gunfire. Then he rolled over on his back and lunged straight into the sea. We hit the second plane soon afterward and it exploded into a million pieces." Such was the effectiveness of night fighting.

Northwestern Aeronautical Corporation, St. Paul and Minneapolis, Minn., produced the Waco-designed CG-4A and YCG-13A troop carrier and cargo gliders. Numerous improvements were added to increase the effectiveness of the glider as a weapon of offense and to provide additional safeguards for protection of its airborne troops. A deceleration parachute was added, and it gave a lower landing speed to permit a steeper glide path and shorter landing run, enabling the glider to get into very small fields. Crash protection was increased materially by the use of an improved type of crash skid. The company also produced jettison fuel tanks for fighter aircraft to supplement the capacity of the standard internal wing tanks, thus permitting increased fighter protection for heavy bombers on long flights. The Northwestern tank was of welded aluminum construction with a capacity of 310 gal. The tanks helped to give the fighter a range of about 16 hours.

Piper Aircraft Corporation, Lock Haven, Pa., manufactured over 5,000 Piper Cub Grasshoppers, officially designated as the L-4, for the Army, even though it was necessary to divert many man hours in order to meet schedules on other smaller contracts. Concurrently, a substantial production of aircraft spare parts was carried on to keep abreast of the military requirements, including contracts for the Army, Navy, Signal Corps, General Electric, Boeing, Bellanca and R.C.A.

The Piper L-4, adapted from the commercial J-3 Cub tandem trainer to meet military demands, was a two-passenger cabin, high-wing monoplane with a wing span of 35 ft. 2½ in., overall length 22 ft. 4½ in., height 6 ft. 8 in., gross weight, 1,220 lbs., empty weight

743 lbs., useful load 477 lbs., top speed 90 m.p.h., service ceiling 9,800 ft. and range at cruising speed with 12 gallons of fuel 205 miles. Its endurance at operating speed with 12 gallons of fuel was  $2\frac{3}{4}$  hrs., rate of climb 450 ft. per min., take-off over 50 ft. obstacle within 737 ft., land over 50 ft. obstacle within 605 ft., time to climb 5,000 ft., 15 minutes. It was powered by a Continental A65-8, 65 h.p. motor and fixed pitch, wood, two blade, 6-ft. propeller.

Piper Cub Grasshoppers were put to many military uses. Cubs did everything from supplying cadets with their introduction to flight, to acting as air taxicabs for top ranking Army and Navy officials. Stationed on all battle fronts as well as on the airfields of Continental United States, Cubs saw action with the tank corps, cavalry, infantry and air forces, during which they directed artillery fire and troop movements, delivered vital messages and spotted enemy infiltration. The L-4's ability to fly at low speeds, land on and take off from small restricted areas, such as roadways and pastures, its exceptional maneuverability and the ease with which it could be handled, rendered it ideal for the duties required of it. The fact that the Cub was serviced and repaired easily, and at the same time comparatively invulnerable to enemy ground fire and attack from unfriendly aircraft, made it additionally valuable in the combat zones. It was used in the invasion of Europe and practically all Pacific island campaigns.

The Piper Aircraft's AE-1 ambulance plane, produced for the Navy, was placed at many fields where personnel of that branch of the service was trained. A conversion of the 100 h.p., three-passenger cabin J-5C Super Cruiser, this ambulance Grasshopper was equipped with a hinged turtle-deck and enclosed litter. If medical care could not be given to injured personnel on the spot, the casualty was made comfortable in the AE-1 litter under the turtle-deck, and flown quickly to a base hospital. The Piper ambulance plane was particularly well suited for this important work by virtue of its ability to get into and out of unusually small fields and isolated spots which were accessible by no other means than by light plane.

A quantity of training gliders, also were manufactured for the Army by Piper Aircraft. These were designated as the TG-8. The glider, with a gross weight of 1,160 lbs. and a wing span of 35 ft.  $2\frac{1}{2}$  in., carried a pilot and two students.

To compensate for 75 per cent of the personnel lost to selective service since the war's beginning, more women workers were hired and the tempo of the plant's intensive training program was stepped up. More than a third of the total working force was women. The training program included courses in skilled welding, tool designing, machine shop work and engineering drafting. Classes designed to prepare and train supervisory personnel also were conducted.

The production floor space of the Piper plant was increased some 50 per cent after 1942, and totaled over 250,000 square feet. As the



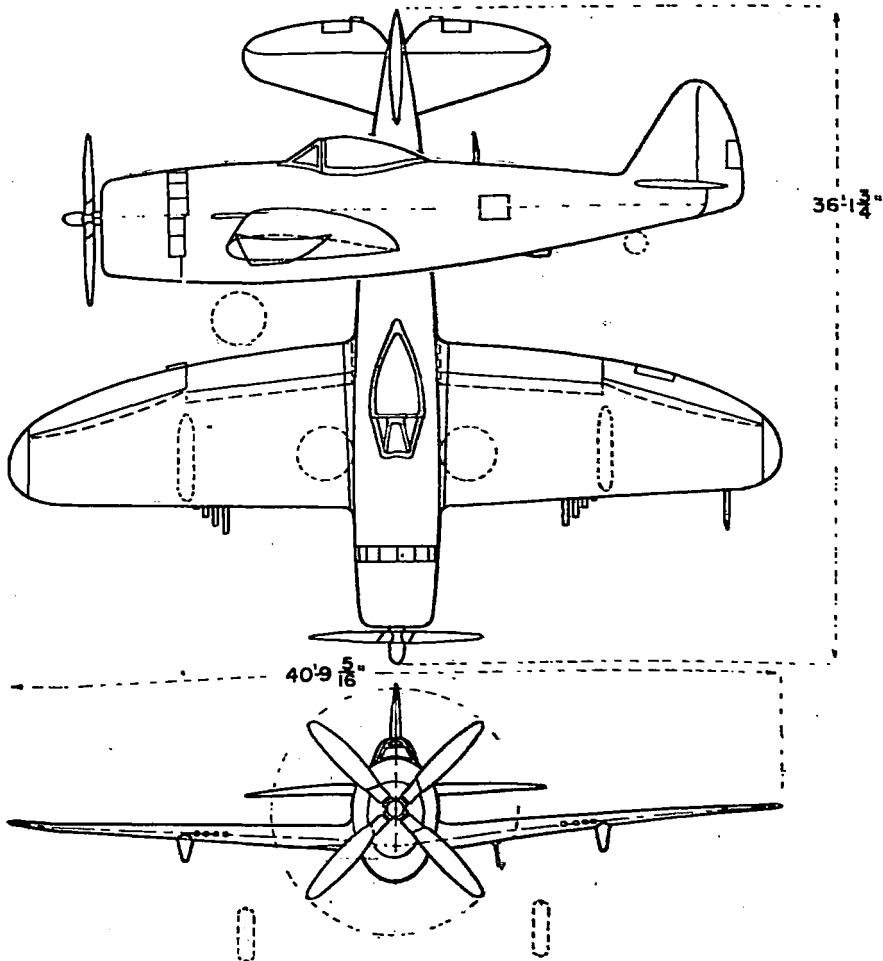
building program was carried out, the new structures were erected to maintain a steady flow of materials along the production lines. Adjacent to the Piper plant was the Lock Haven Airport and the Susquehanna River. The former was utilized for test flying aircraft and giving flight instruction, while the latter made an ideal sea-plane base.

Republic Aviation Corporation of Farmingdale, N. Y., and Evansville, Ind., was at peak production on the P-47 Thunderbolt which first went into combat over Europe in early 1943. Its main purpose, at that time, was high-altitude escort of our Army Air Forces big bombers which were carrying out strategic daylight bombing. The P-47 Thunderbolt carried the fight to the enemy and progressively penetrated deeper and deeper into the heart of Germany as our bombers continuously sought out new targets. A few months later, jettison gasoline tanks were employed for the first time. This made it possible to have fighter escorts for the daylight bombers on long-range missions. As an ever increasing number of Republic Thunderbolts arrived at overseas stations and more missions were flown, experience showed that this airplane was ideal for other types of missions, as well as high-altitude escort. Penetration support, area support, straggler, target, and withdrawal escort came to be all in a day's work for Thunderbolts aiding bomber missions.

Late in 1943, the Republic P-47 Thunderbolt started striking out on its own as a fighter bomber. Installations quickly were provided for carrying bombs ranging in size up to 1,000 lbs. under the wings and belly. Provisions for carrying rockets were installed as well. This provided an extremely effective equipment against enemy gun replacements, ground troops and mechanized equipment, including the heaviest types of tanks.

Another new trick was uncovered a few months later. When a particular type of mission was completed, the Thunderbolts would "hit the deck" as they raced home and spray all military installations in their path with their eight .50-cal. machine guns. So effective were these attacks that separate offensive sweeps by Thunderbolts soon became another part of the daily routine in air force wherever Thunderbolts were located. Thus, the P-47 Thunderbolt developed into an all-purpose fighter and bomber plane with the ability to more than hold its own against the enemy whether the mission be a high-altitude escort, dive bombing, or low level ground strafing. The outstanding characteristics of the P-47 Thunderbolt were a Pratt & Whitney Wasp R-2800 twin-row 18-cyl. 2,000 h.p. radial aircooled engine, with both geared and turbine superchargers and four-blade Curtiss electrically controlled, constant speed multi-position propeller. The dimensions of the P-47 Thunderbolt were wing span 40 ft. 8 in., length 36 ft. 1 in., height 14 ft. 2 in. and tread width 15 ft. 6 in. The Thunderbolt weighed over 13,500 lbs. (fully loaded plus bombs or external

tanks over 16,000). It had a speed of over 450 m.p.h. and a ceiling of approximately 40,000 ft. Its armor was eight .50-cal. machine guns, four in each wing, and in some cases six rockets. The construction of the Thunderbolt was a low-wing, single-place, all-metal monoplane with a single tail, oval-shaped fuselage with elliptical wing. The cockpit was enclosed by an electrically operated "bubble" canopy which afforded the pilot 360-degree vision. Aside from being electrically operated, this canopy was fully jettisonable by the pilot in case of an emergency. The pilot was fully protected by armor plate installed in the rear of the cockpit from the bottom of the seat to the top of his head and in front by armor plate and bullet proof glass in the flat front



#### REPUBLIC P-47 THUNDERBOLT

An Army Air Forces fighter powered by a Pratt & Whitney Twin Wasp 2,000 h.p. engine.

section of the windshield. A bomb shackle was installed in the belly of the airplane for the purpose of either carrying an external fuel tank or for an alternate installation of a bomb.

The Thunderbolt was on active duty in all the allied theaters of war, and it knocked out enemy planes on an average of  $4\frac{1}{2}$  to 1. As an all-purpose fighter-bomber-plane, it more than held its own against the enemy whether the mission was a high-altitude "ramrod" or a "rhubart" on the deck.

Robertson Aircraft Corporation, Robertson, Mo., was in production on the third prime contract for CG-4A gliders for the Army. The company also manufactured parts for other plants.

Ryan Aeronautical Company, San Diego, Calif., early in 1945 was at work on \$58,000,000 worth of orders for new Navy fighting planes, which were to create heavy manufacturing schedules far into 1946. Details of the new Ryan fighter were restricted. When Vice Adm. Marc Mitscher, commander of the famous Task Force 58, came to San Diego late in 1944, he put the new Ryan plane on the list of things the Navy needed badly. In order to comply with the Navy's urgent request for utmost speed in production of its fighting plane, Ryan launched its fifth expansion program since 1938. This was a million-dollar building project started in December, 1944, to provide a huge subassembly manufacturing building and a 330-ft. two-story office building. The Defense Plant Corporation allotted \$1,012,250 worth of new production machinery, plant equipment and testing devices. Many unique laboratory and manufacturing devices, in addition to specialized instruments and test equipment to complete Ryan's extensive flight test program for the Navy, were included in the allotment. Factory yard areas used for outdoor production work were increased by 82,500 sq. ft. Ryan activities continued to expand so rapidly that the company had to establish offices, shops and warehouses at eight locations in San Diego, apart from the plant.

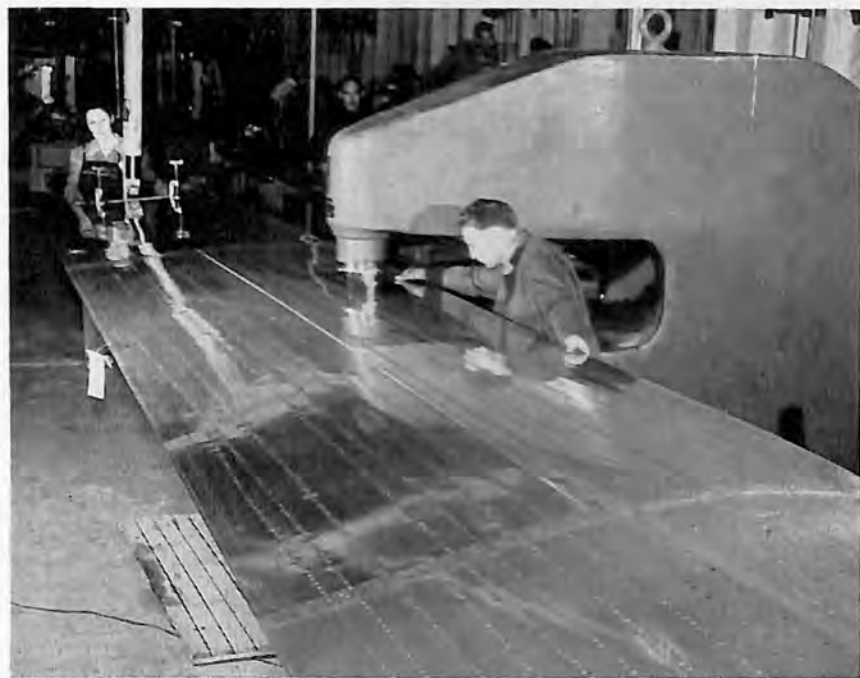
Keeping pace with manufacturing expansion, a recruiting program to enlarge Ryan's employment force by 35 per cent got under way. While employment in some aircraft plants was decreasing due to cut-backs, Ryan was entering its greatest period of expansion. Radio, billboards, newspaper and magazine advertising and a personal-contact drive by scores of veteran Ryan employees were used to recruit hundreds of new employees. The higher levels of management personnel of the company also were expanded.

Ryan management went to considerable lengths to encourage employees to make suggestions which might help speed production. It established a special patent department. Any idea suggested by Ryan employees which seemed to have value for wider use was put into patent-application form and submitted to the U. S. Patent Office with drawings and models. If the patent was granted, Ryan took responsibility for exploiting the product and securing royalties from users.

Several Ryan employees were receiving payments under the company's efforts in their behalf. At the same time, Ryan's shop suggestion system, through its war production drive committee and its cash awards for particularly helpful suggestions, were attracting a steadily-growing stream of ideas from employees. More than a thousand ideas were submitted during 1944.

In addition to the huge order for Navy planes, Ryan's backlog was swelled by contracts for exhaust manifold systems to be used on planes of other companies. Ryan was producing additional exhaust systems and components for the Boeing B-29 Superfortress, the Douglas C-54 Skymaster, Republic P-47 Thunderbolt and other war planes of Grumman, Northrop, Douglas, Bell, Martin, Consolidated, Lockheed and Curtiss-Wright, and for Goodyear blimps. Ryan manufactured the majority of Superfortress exhaust systems. To meet these expanded production schedules, Ryan installed far-reaching new methods.

A process for maintaining the corrosion resistance of past-aged aluminum alloy was developed so that higher strength aluminum could be used in manufacturing aircraft. Ryan's new fighter plane was the first in production to take full advantage of the light weight of high-



#### AUTOMATIC RIVETING SAVES LABOR

One of the eight hydraulic riveting machines in the Ryan Aeronautical Company plant. Each machine sets 12 rivets at a time.



#### MAKING ALUMINUM ALLOY EXTRUSIONS

Forming an aluminum alloy extrusion on a wiping machine at the Ryan Aeronautical Company's plant. This forming device, which is used to form extrusions, stringers and other airplane structures, has a rotating table and a hydraulic ram pressure applicator.

strength, post-aged aluminum in both design and production. About \$100,000 was saved in the costs of stress-relieving and de-fluxing stainless steel manifold parts by the use of the Ryan-developed sodium carbonate salt bath furnace. This eminently successful salt bath for heat treating these types of stainless steel, cut by 75 per cent the processing time for stress-relieving and de-fluxing manifold parts. A huge new spar cap milling machine was installed in the plant to turn out spar caps at a greatly stepped-up rate of about one every 10 minutes, not including original set-up time. Large multiple hydraulic riveting machines, in combination with a Ryan-designed overhead monorail conveyor system, were saved 15,000 manhours a month in riveting aircraft structures. Several important studies, resulting in new techniques for production, were carried on in the Ryan laboratory, among them several welding and brazing fluxes, one of which was a flux which made possible for the first time the furnace brazing of 18-8 stainless steel with zinc-free copper alloy. Advanced work in the determination of new formulae for stainless steel stock, from formability studies, and special research in the field of automatic atomic hydrogen

welding expedited production of exhaust manifold equipment. Ryan continued to make its innovations available to other major aircraft manufacturers.

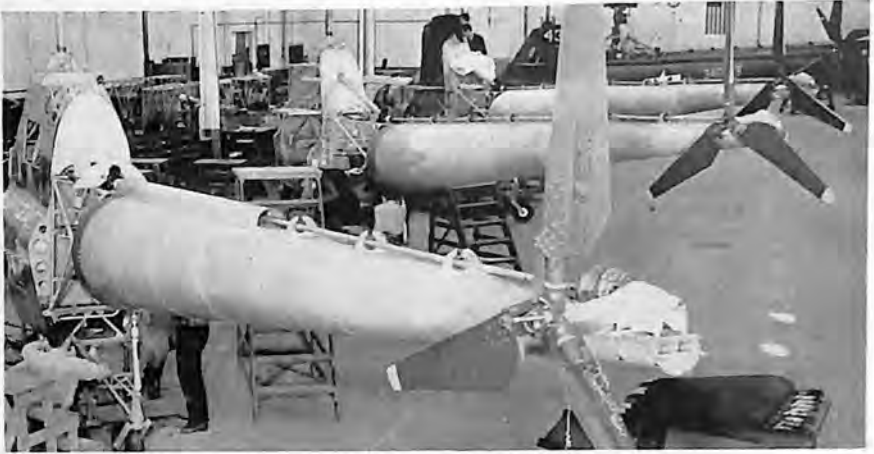
The Sikorsky Aircraft Division of United Aircraft Corporation, Bridgeport, Conn., continued development of rotary wing craft through 1944, while the Sikorsky Model R-4 was being produced in quantity by the world's first helicopter production line. At the beginning of 1945, approximately 150 Sikorsky helicopters of various models had been produced. Sikorsky helicopters were the only type in quantity production. The R-5, a larger machine, powered by a Pratt & Whitney R-985 450 h.p. Wasp Junior engine, was ready for quantity production in the Bridgeport plant. Another improved model, the R-6, developed, tested and carried to the production pilot model stage at Bridgeport, was started into production by Nash-Kelvinator, licensee, at Detroit. The R-6 had a Franklin 235 h.p. engine.

On March 2, 1944, piloted by Col. Frank Gregory, one of the Army Air Forces Sikorsky R-4 helicopters flew from Washington, D. C., to Patterson Field, Dayton, O., 387 airline miles, in four hours and 55 minutes, part of the trip being over the Alleghenies. The Sikorsky helicopter participated in a long list of missions of mercy possible only to an aircraft capable of controlled flight. Behind the Japanese



#### RYAN EXHAUSTS FOR B-29 BOMBERS

Experts of Ryan Aeronautical Company at line-up jig for stainless steel sections of an exhaust manifold system for Superfortress engines.



#### SIKORSKY R-5 HELICOPTERS

View of the final assembly line of late model helicopters under construction at the Sikorsky plant.

lines in the Burmese jungle it alighted to rescue American wounded. It carried serum and medicine to isolated ships and outposts. It even lowered emergency fire-fighting equipment at an otherwise inaccessible point on a long railroad trestle in New York's Jamaica Bay.

As the production of Sikorsky helicopters increased, so did the training of pilots. At the beginning of 1945 there were 262 pilots qualified to operate the Sikorsky models. Of this group 67 were trained at the Sikorsky plant, 85 were trained at Chanute and Wright Fields, by Army Air Forces, while at Floyd Bennett Field; under the Coast Guard, four Army, six Navy, 12 British and 68 Coast Guard pilots became adept at helicopter control. A score of men trained abroad by the RAF and British Navy completed the roster of five separate services using the Sikorsky helicopter.

Taylorcraft Aviation Corporation, Alliance, O., rolled off its assembly line the last of its famous L-2 series of liaison-observation planes on an Army Air Forces contract. A number of important military subcontracts, in addition to the L-2 contract, had necessitated expanded operations to the limit of the main plant and extending into several rented buildings at other places in Alliance. These activities included the manufacture of parts and assemblies for flying boats, helicopters and transport planes. Shortly after the conclusion of the L-2M contract, the company obtained a large subcontract from the Douglas Aircraft Company for the manufacture of complete tail assemblies and ailerons for the new A-26 attack bomber, the Invader. In order to handle the greatly increased business, Taylorcraft completed an addition to its main factory building which more than doubled previous manufacturing space. At the same time, employment was increased

and a large amount of new machinery was installed. The company's payroll became the largest of any industrial plant in the city of Alliance.

While the plant was fully occupied on a three-shift, seven-day week basis, Taylorcraft's engineering and experimental departments, managed with a very small force and largely through after-hours work, to complete prototypes of two of three projected postwar personal planes, the B-12B, a two-place, side-by-side deluxe cross-country plane, an expanded and modernized version of the B-12, and the Model 15 four-place, all-purpose family plane.

The B-12B had a 75 h.p. engine instead of the 65 h.p. in its predecessor. The cabin was entirely redesigned and  $4\frac{1}{2}$  in. wider. The cabin area also was expanded in length with a more spacious baggage compartment. Other innovations included a one-piece molded sun-proof Plexiglas windshield, sun visors, main fuel tank in wing, slide type trim tab control in roof, and "glide control" spoilers in the wings. The Taylorcraft 15 was of conventional welded steel tubing design, a high-wing monoplane powered by a 125 h.p. 4-cyl., horizontally opposed, aircooled engine. It had a newly designed airfoil employing slots and slotted flaps. It was equipped with an electric self-starter, engine-driven generator and heavy-duty battery. It had spacious cabin arrangements with split type individually adjustable front seats, and newly designed Oleo-air shock absorbers for especially comfortable landings. A third projected postwar Taylorcraft model was under development, the all-metal, two-place side-by-side Model 12, designed for mass production and low selling price, a general utility airplane suitable for training and private flying purposes.

During the war period, with commercial aircraft production prohibited by Government wartime restrictions, the sales facilities of the



FIRST HELICOPTER ASSEMBLY LINE

Sikorsky R-4B helicopters for the U. S. Army Air Forces under construction at the plant of Sikorsky Aircraft Division of United Aircraft Corporation at Bridgeport, Conn.





U. S. Navy photo

#### CORSAIR USES JET-ASSISTED TAKE-OFF

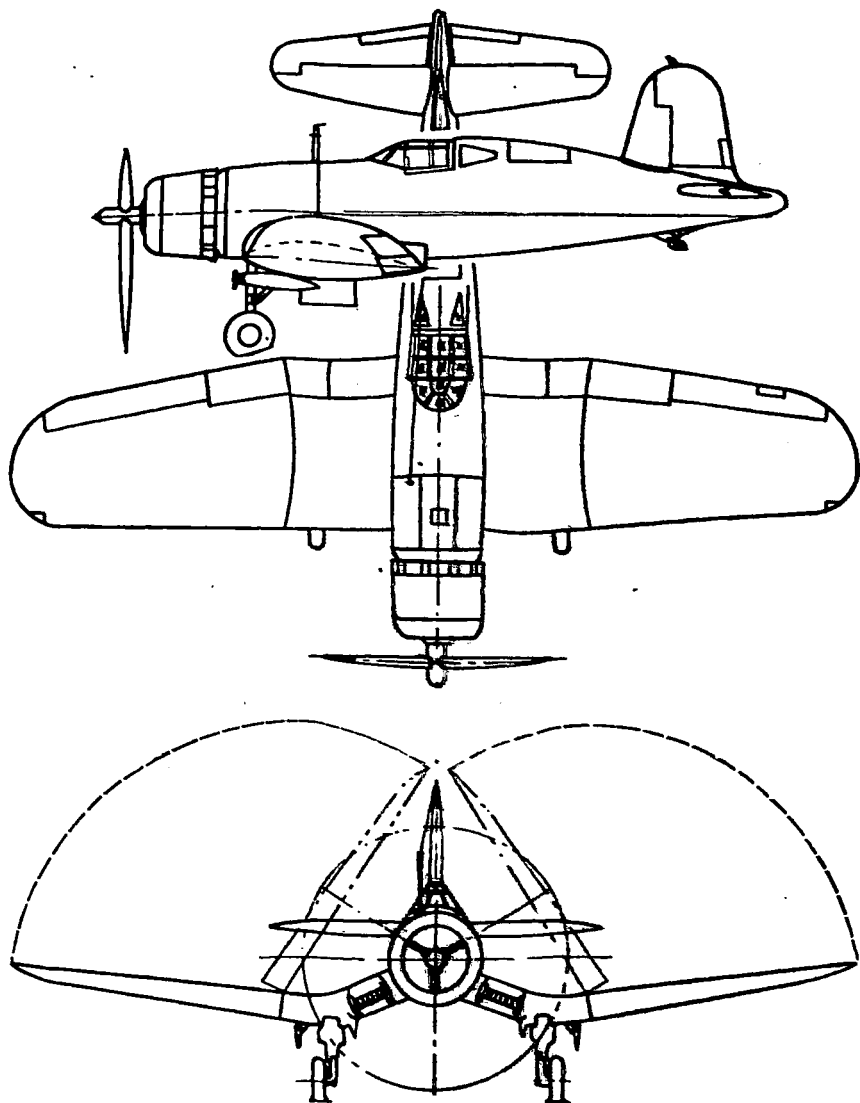
Jet units, reducing normal take-off runs from 33 to 60 per cent or allowing for increase in loads, augment the take-off power of this Chance Vought F4U-1 Corsair fighter as it roars down the deck of an aircraft carrier. JATO, as these jet-assisted take-offs are known in the Navy's air arm, were of particular value on the restricted areas of carrier decks. Resembling bombs, except that they are affixed to the fuselage of the plane rather than under the wings or enclosed in bays, jet units contain solid propellant which includes oxygen, and are ignited by electrically-controlled spark plugs. The escaping stream gives the plane its thrust.

Taylorcraft company were being used in reorganization and strengthening of its distributing system.

The Chance Vought Aircraft Division of United Aircraft Corporation, Stratford, Conn., continued peak production on the F4U Corsair, fast Navy fighter. Battle-ready Corsairs moved from the assembly lines with clocklike regularity throughout 1944 and into 1945 despite extensive plant rearrangement and many refinements in the design of the gull-winged airplane. Approximately 525 major engineering changes and about 2,500 minor production changes were made on the Corsair during 1944. Especially noteworthy was the addition of "twin pylons" under the center section for carrying two 1,000-lb. bombs. Among the other important changes were a water injection system to provide emergency power, re-designing of the entire hydraulic system, replacing of cartridge starters with electrical starters, installation of a new clear-vision sliding cockpit section, modification of the tail wheel and tail wheel yoke, and a relatively simple change in the landing-gear shock-absorbing strut which brought improvement in carrier landing characteristics. The Vought Corsair was in the 400 m.p.h. class, with wing span of 41 ft., length 33 ft. 4 in., height 16 ft. 1 in., service ceiling over 35,000 ft., range over 1,500 mi. armament of six .50-cal. machine

guns, with facilities for 2,000 lbs. of bombs. It was powered by a Pratt & Whitney 2,000 h.p. Wasp engine and Hamilton Standard three-blade propeller.

Outstanding among the Corsair's accomplishments in the combat zones was its highly successful adaptation by the U. S. Marine Corps as a fighter bomber and dive bomber. Previously, during the Solomons campaign, the Corsair had been used exclusively as a fighter. How-



**CHANCE VOUGHT CORSAIR**

This single-seat carrier-based Navy fighter was powered with a Pratt & Whitney Double Wasp engine rated at more than 2,000 h.p.

ever, with Jap fighters growing scarcer in some areas, other uses were devised for the Corsair. Carrying 500- and 1,000-lb. bombs, Marine Corps pilots blasted the fortifications and garrisons of Mille, Jaluit, Wotje, Maleolap and other by-passed Jap islands in the Central Pacific in almost daily neutralization raids. Toward the end of 1944, the Navy department announced that Naval and Marine Corps aviators were going aboard aircraft carriers equipped with Corsairs. Earlier strategy had dictated the use of Corsairs for shore operation. Carrier-based Corsairs were first reported in combat with the Marines during raids on Formosa and the China Coast.

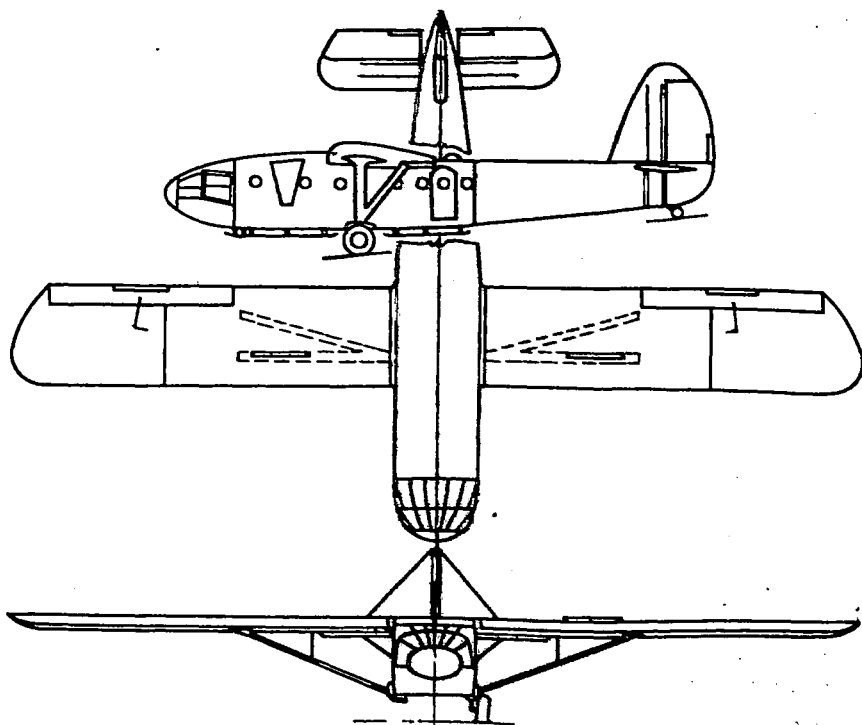
Corsairs, flown by Marine Corps pilots, played an important role in the Allied invasion of Peleliu and the Philippines. They used tree-top level bombing and strafing to blast Jap soldiers from caves and strongly fortified positions only a few hundred yards from the Allied airstrip on Peleliu. The Corsair's versatility proved itself again with its adaptation as a night-fighter. Pacific islands, newly captured from the Japanese, required night protection against reprisal raids by Jap aircraft based on nearby islands still in enemy hands. Corsairs provided the protection. The first night squadron, a Marine Corps unit, compiled a record of only one pilot lost in more than 4,000 hours of Central Pacific night combat flying; making night take-offs and landings from coral airstrips illuminated only with portable lighting equipment.

Corsairs won the plaudits of the British Navy for performance aboard carriers of the Fleet Air Arm in the Far Eastern war theater. Acting as escorts for dive bombers, Corsairs participated in assaults on Japanese positions on Java and Sumatra.

On the production front, Chance Vought's achievements twice brought a renewal of its Army-Navy E award in 1944. A moving conveyor line system, which had been installed during 1943, was altered and virtually all production departments were relocated, with a resultant gain in manufacturing efficiency and output. All the plant changes and rearrangements, as well as the design advances made in the Corsair, were characterized by a systematic preplanning which made it possible to incorporate them without any halt in the scheduled flow of completed airplanes. Subcontractors continued their splendid contribution to the building of the Corsair. The value of their help can best be gauged by the fact that, in dollar value, subcontractor companies accounted for approximately 55 per cent of the manufacturing work on the Corsair. The year brought about a decided improvement in the handling of spare parts. An operational quota system for the shipment of spares to Naval and Marine bases in the United States and abroad was set up and put into operation late in 1943, and was continued with excellent results through 1944. Under this system, an "A" quota, which was a standard "packup" containing parts for operating squadrons at advanced bases, was shipped concurrently with ap-

proximately each 10 Corsairs; a "B" list, which contained readily replaceable parts for the support of airplanes at major bases, was shipped out concurrently with each 50 aircraft, and a "C" list, which included overhaul parts, was shipped with each 100 airplanes. That method of handling spare parts was instituted at a period when demands for complete airplanes were accelerating, and thus required the most diligent work by all the departments concerned in order that all parts required on the three lists could be furnished without interference in regular Corsair production. In the early stages of the war, it was found that an immense amount of material from many sources was arriving at destinations badly corroded and with boxes broken open and equipment damaged. As a result, it became evident that conventional methods of packing required a marked improvement. Therefore, Chance Vought effected further refinements in the operational quota system early by seeing to it that all material was thoroughly preserved and packaged in special boxes which would withstand rough handling and almost any climatic condition likely to be encountered.

Expansion and improvements of plant and office facilities were



THE WACO CG-13 ARMY CARGO GLIDER



#### THE WACO ARMY CG-15A GLIDER

Fourth model of the motorless troop and cargo gliders developed for the Army Air Forces by Waco Aircraft Company at its plant in Troy, O. The CG-15A carries 16 fully equipped troops or 4,000 lbs. of cargo.

continued. The principal additions were a large North factory extension, two test hangars, an experimental hangar and office building, enlargement of the engineering department and a new administration building.

The efforts of thousands of employees played a major part in the company's on-schedule output. Relations between management and labor remained at a high level and not a single man-hour was lost through labor trouble. Vought employees made a further direct contribution toward increasing plant output by submitting approximately 5,000 suggestions during 1944. During the first 10 months, 4,144 suggestions were received and 1,275 awards were made, totaling \$16,800.

Waco Aircraft Company, Troy, O., continued to devote its efforts to a variety of war activities. Production of the Waco CG-4A operational glider, designed and developed by Waco in 1941, continued until November when the plant's facilities were realigned for production of a fourth Waco glider model. Other manufacturers throughout the country, working under Waco engineering service agreements, continued to produce CG-4A's, and two, Northwestern and Ford, built both Waco CG-4A's and CG-13A's. Waco's service division continued to supply parts for the 600 Waco UPF-7 secondary trainers, and the numerous Waco cross country cabin ships, used by the C.A.A. war training contractors, and by private flight operators and owners. Other Waco facilities continued to be devoted to subcontracted items. The company produced Curtiss P-40 rudder pedals, Republic P-47 motor mounts, and miscellaneous items for several other concerns.

The Waco CG-13 superglider was a high wing monoplane giant, fabric-covered over a framework of thick steel tubing. Wings and tail surfaces were all wood frame covered with plywood. It had a wing spread of about 85½ ft. and an overall length of more than 54 ft. Its gross weight was more than 17,000 lbs. of which about 10,000 lbs. were useful load. Designed for troops, mechanized equipment or any combination, it could carry 42 fully equipped soldiers or a 105 mm. howitzer, its mobile units and full gun crew. It was towed at a speed of not more than 175 m.p.h. and had a landing speed of about 80 m.p.h.

Early in 1945, Waco went into production of its fourth glider developed for Army Air Forces operations. It was the CG-15A 16-place troop and cargo glider. It had a wing spread of 62 ft. 2½ in., length 48 ft. 10 in., height 12 ft. 8 in., gross weight 8,000 lbs., empty weights 4,000 lbs., wing loading of 12.8 lbs. per sq. ft. and could be towed at speeds ranging from 62 to 180 m.p.h. It had a tricycle landing gear.

#### Engine Manufacturers

Aircooled Motors Corp., Syracuse, N. Y., makers of Franklin aircraft engines, continued in military production exclusively, producing Franklin engines of its own design for liaison planes, trainers and for several special military projects. Development work was continued on new service engines, and production was started on several which previously had been in the development stage. In addition to Army and Navy production, orders were undertaken for Franklin engines for War Training Service and for the Brazilian Government. Aircooled Motors also produced a new helicopter engine designed for postwar applications, and already powering several experimental non-military helicopters. These developments climaxed a four-year history of pioneering in power for rotary wing aircraft, which began when a Franklin engine powered Sikorsky's first successful helicopter, the VS-300.

Allison Division, General Motors Corporation, Indianapolis, Ind., produced two new type engines. One was the V-3420 with 24 cyl. and 2,600 h.p. rating, one of the world's most powerful aircraft engines. They were used to power the XB-19A, modification of the world's biggest land plane that had been a flying laboratory for the Army Air Forces since its construction by Douglas in 1941. The engines greatly increased the speed and load carrying capacity of that giant plane. The second new Allison engine was an improved model of the V-1710 capable of more than 1,500 h.p. Production also was continued on the F type engines with both right and left hand rotation for the Lockheed P-38 Lightning which continued to turn in excellent combat performances in every theater.

A significant move in the light of experience in adapting airplane engines to airframes was the establishment of the Allison installation

engineering department and the further extension of flight test facilities at Indianapolis.

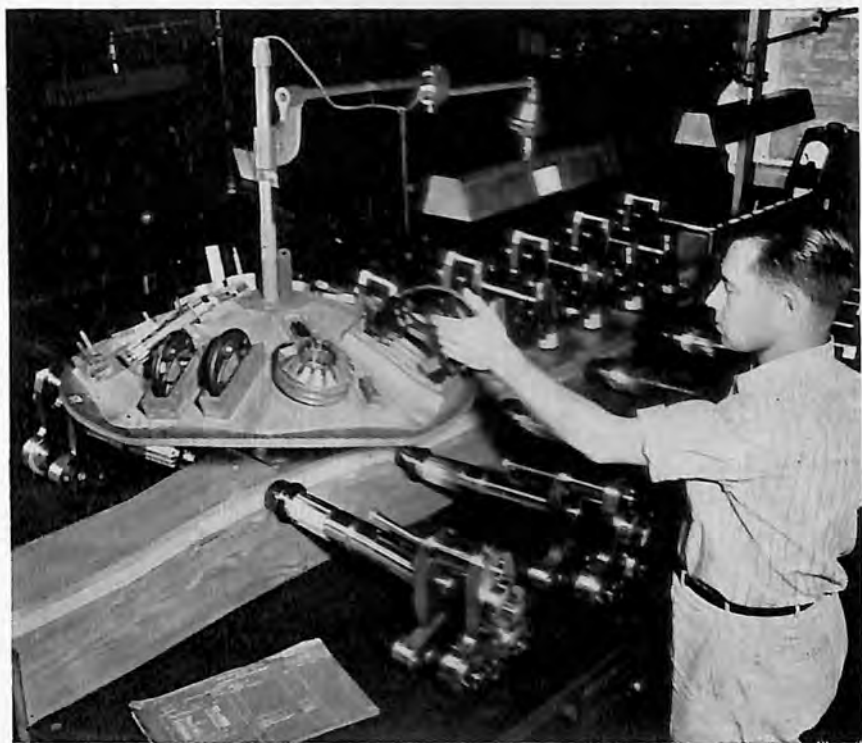
Allison also was given a production schedule on jet propulsion engines of the General Electric design. These units which were to be built in increasing quantities during 1945 were to power new Army combat aircraft. That program together with decreasing production schedules on the V-1710 engine production necessitated considerable plant rearrangement. Additional Defense Plant Corporation commitments amounting to \$15,000,000 were secured to cover tools and machinery and the construction of test cells for the jet propulsion units. At the beginning of 1945, Allison production of engine units had passed the 65,000 mark, raising total horsepower output of the Allison organization close to one billion.

Continental Motors Corporation, Muskegon, Mich., continued to build its A65-8 (65 h.p.) engine in large quantities for the armed services and the war training service operators; and also supplied many W670 (220 h.p. radial) engines to the Government for primary trainers. Thousands of the W670-9A engines were manufactured in the Muskegon plant for the Navy for installation in the amphibious tank. Continental Aviation and Engineering Corporation, a subsidiary of C.M.C., completed its contract on the Pratt & Whitney R-1340 engine; and tooled up and produced the Rolls-Royce engine for the British Government. Continental's Detroit plant continued to build the Wright R-975 for tank installations. Development work forged ahead on Continental's new line of C series engines and the new C75 was given an A.T.C. and the C85, C115, C125, and the C140 engines were advanced to final stages of development. The C75 and C85 engines were 4-cyl., horizontally-opposed, aircooled, direct drive engines incorporating an electric starter and engine driven generator. The C115 and C125 engines were 6-cyl., horizontally-opposed, aircooled, direct drive engines with electric starter and engine driven generator, and the C140 engine was the same as the C115 and C125 except that the C140 was equipped with a geared prop drive. The basic C140 also was developed to ratings as high as 250 h.p. Fuel injection was studied and developed still further. Tests were conducted on the engines in order to secure take-off ratings on them suitable for the use of controllable pitch propellers. Extensive research was conducted on jet cooling, with favorable results. Continental Aviation and Engineering Corporation's Detroit plant practically completed the development work on a new design, the I-1439-9, a 12-cyl. inverted vee type engine.

General Electric Company, Schenectady, N. Y., at the request of the Army Air Forces, undertook to manufacture the aircraft gas turbine engine similar to the Whittle jet engine developed in England. This gas turbine, as well as other models of different design, was developed and flight-tested in the Bell jet-propelled plane in 1944. The

advantages of the aircraft gas turbine lay in simplicity, ease of manufacture, lack of vibration, relatively low weight, negligible use of lubricating oil, ease of cooling, and the elimination of continuous ignition, the reduction in number of instruments required, ability to use either kerosene or gasoline as fuel, and the possibility of very high-speed airplane performance.

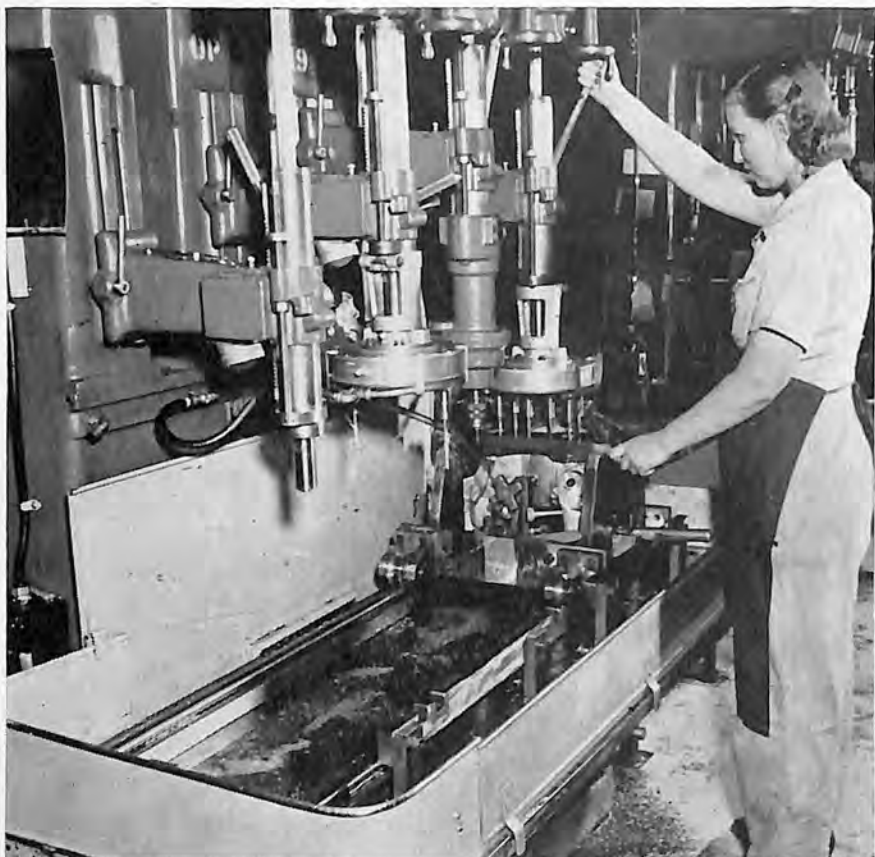
Early in 1945, General Electric announced its new turbine engine for the Army Air Forces jet-propelled fighter, the Lockheed P-80 Shooting Star. The company believed this new engine to be the most powerful in the air at the time. It had twice the power of all former models of American jet engines, which also had been produced by General Electric. The new engine burned a kerosene-like fuel which reduced the fire hazard as compared to gasoline engines. It required no warm-up, developing enough power for take-off in less than a minute, and could be replaced in a plane in less than 15 minutes. In operation, air supplied to the engine was rammed into vents and through ducts into the power plant where it was compressed by a swiftly revolving impeller, then passed to a combustion chamber



#### NEW INSPECTION TURNTABLE

Developed by the Jacobs Aircraft Engine Company, it speeds the handling of special gauges for inspecting dimensions of a radial engine crankshaft.





#### WOMEN HELP BUILD AIRCRAFT ENGINES

One of the women in the Jacobs Aircraft Engine plant is completing a multiple unit operation on a cylinder head.

where fuel was burning at a very high temperature. This caused the air to expand and increased its velocity. Then passing through a blazing hot turbine wheel, the air and gases went out the jet exhaust at the rear of the plane, causing the forward drive.

Jacobs Aircraft Engine Company, Pottstown, Pa., continued volume production of Jacobs and Pratt & Whitney engines for basic and advanced trainers, personnel transports and various types of utility airplanes for the U. S. Army and Navy, and Canadian and British air forces. The company's own plant was devoted principally to production of the Jacobs L-4MBB (Army Model R-755-9) seven-cyl., aircooled, radial engines. The large Government-owned plant built by the company in 1942 concentrated on production of Jacobs-built Pratt & Whitney Wasp and Wasp Junior engines. The many contributions to production efficiency and safety developed by Jacobs personnel before the war, augmented by further innovations in 1944,

resulted in substantial savings to the armed forces, together with a remarkably high safety record and low absentee rate in the company's plants. Production schedules were exceeded consistently. Part of Jacobs facilities were converted to a Navy rocket projectile program toward the end of 1944, because of decreased demand for training engines. Jacobs also had several new engine models under development.

Kinner Motors, Glendale, Calif., was in production on its line of Kinner radial engines ranging from 100 to 350 h.p., and also was manufacturing Wright engine assemblies under Government contract. Late in 1944, the company purchased Gladden Products Division, Glendale, which was to continue manufacture of hydraulic equipment.

The Lycoming Division of The Aviation Corporation, at Williamsport, Pa., was in production on opposed series models of aircraft engines which were used in many war theaters under varying conditions. Subcontract work was taken on. Numerous parts for two types of high-powered aircraft were produced in volume. Four-blade propeller hubs, tank shoes, rods and crankshafts for auxiliary power units were turned out by the Lycoming Division.

Pratt & Whitney Aircraft Division of United Aircraft Corporation, East Hartford, Conn., continued as a leading producer of aircraft engines. While turning over to licensees the manufacture of most existing models, Pratt & Whitney Aircraft in 1944 undertook the much more difficult job of shifting to the building of more advanced and more powerful models. Despite this undertaking, its own production accounted for about one out of every six engines bearing its name, and about 20 per cent of the total Pratt & Whitney horsepower. An increasing number of engines and engine models were being manufactured by its production team, which consisted of Ford, Buick, Chevrolet, Nash, Jacobs and Continental, licensees, and Pratt & Whitney Aircraft of Missouri, Government-owned plant at Kansas City operated for the Government by Pratt & Whitney Aircraft.

Pratt & Whitney Aircraft in 1944 ceased manufacture of single-row engines, the R-1340, 600-h.p. Wasp, and the R-985, 450-h.p. Wasp Junior, for the duration. The production of those models was taken over completely by Jacobs Aircraft. Ford and Nash concentrated on the 2,000-h.p. R-2800 Double Wasp. Buick and Chevrolet built the 1,200-h.p. R-1830 Twin Wasp. Buick also started production of the 1,450-h.p. R-2000 Twin Wasp, while Chevrolet started on the 2,100-h.p. R-2800 Double Wasp. Continental produced the R-1340 Wasp and Pratt & Whitney Aircraft of Missouri the 2,100-h.p. Double Wasp. Production of engines, power sections and spare parts at the Kansas City plant increased rapidly, passing the 1,200,000 h.p. per month mark in November, 1944.

The changing nature of Pratt & Whitney Aircraft's war job from that of being practically the sole producer of its engines to that of being the leader of a production team was reflected by virtual stoppage of



#### WASP ENGINES ON ASSEMBLY LINES

Final assembly lines at Pratt & Whitney plant, Twin Wasps under construction on the right and Double Wasps at the left.

expansion of manufacturing facilities during 1944, although larger test houses to accommodate more powerful engines were being readied for use as the year ended. Projects completed or initiated, all designed to increase the division's effectiveness, included the building of three mile-long heavy-duty runways at its Rentschler Field airport, designed to accommodate the heaviest airplanes; the construction of an engineering laboratory and test building for the installation engineering department, and the construction of a thermodynamics laboratory building. Also nearing completion was the wind tunnel of the United Aircraft Corporation, which was to be used in part by Pratt & Whitney Aircraft.

Outstanding developments were the increased demands for the previously unannounced R-2000 Series 1,450-h.p. Twin Wasp, used in the Douglas four-engine C-54 Skymasters, and the Double Wasp R-2800, with substantially increased powers, used in three new two-engine airplanes, the Northrop P-61 Black Widow, the Douglas A-26 Invader and the Fairchild C-82 Packet. This latter engine also was used to power improved versions of the battle-ried Republic Thunderbolt and the Navy fighter twins, the Vought Corsair and the Grumman Hellcat.

The 2,000-h.p. Double Wasp continued to power the Curtiss-Wright two-engine C-46 Commando and the Martin two-engine B-26 Marauder. The 1,200-h.p. R-1830 Twin Wasp and a later and higher powered version of this engine were in heavy use in the Consolidated Vultee four-engine bomber, the B-24 Liberator, used by both Army and Navy in all combat theaters. This engine type also powered the Douglas C-47 and C-53 Skytrains and the Consolidated Vultee PBV Catalinas and Coronados.

Single-row Wasps and Wasp Juniors were installed in more training airplanes than any other type. They also powered the Beechcraft UC-43 and C-45, Cessna's C-78, the Noorduyn-built UC-64, the Grumman JRF, the Howard GH and the Vought OS2U. During 1944 the curtain was lifted partially on the postwar plans of the domestic air lines. These revealed that Pratt & Whitney Aircraft engines were to power a large percentage of the peacetime transports. Announcements made by the end of the year indicated that air lines had ordered 70 Twin Wasp-powered DC-4s, commercial model of the C-54, and 74 Double Wasp-powered DC-6s, a larger and faster version of the four-engine Skymaster.

Ranger Aircraft Engines Division of Fairchild Engine and Airplane Corporation, Farmingdale, N. Y., utilized its extensive plant facilities to increase production of the Ranger 6- and 12-cyl., inline, inverted, aircooled type engines. The Ranger engines were used by the air forces of the United Nations in the Fairchild Cornell (PT-19, PT-26), the Grumman twin-engine J4F Widgeon amphibian, the Fairchild UC-61K Forwarder (6-cyl. installations), and the twin-engine, plastic-bonded wood AT-21 Gunner built by Fairchild, using the Duramold process. The Gunner had two 12-cyl. Ranger engines.

The new Ranger plant, with facilities augmented by a second plant in a nearby community, made possible the increased production necessary to fulfill the training plane demands of the Army and Navy air forces. The outlying plant housed small parts machine shop and material supply departments that fed the Farmingdale plant with finished parts and subassemblies. Wherever possible, line production methods were used. Even in several small parts departments and the machine lines that processed castings, straight line methods were employed. Assembly also was carried out in straight lines, with the en-

gines carried on assembly frames pulled by an arrangement of endless chains laid flush with the assembly floor. Among the special machines in use were 6-spindle Potter & Johnson turret lathes which carried 52 tools and performed 24 operations with only one setup for fabrication of cylinder barrels. Later in 1944, wartime requirements called for the cessation of training plane production, and therefore Ranger switched production to combat plane requirements.

Supercharger assemblies, gear reduction assemblies and small parts were produced for the Packard Rolls-Royce engines used in the P-51 Mustang and mass production was obtained on Andover auxiliary power units. These were used in the B-29 and other large bombers and cargo planes. Ranger had several development projects under way for the Army and the Navy. Rocket motors were being produced for the Navy in large quantities.

The Warner Aircraft Corporation, Detroit, Mich., continued production of the R-550-3 and the R-500-7 aircooled radial engines for use in the Sikorsky R-4B helicopters and Fairchild UC-61A airplane. Limited quantities of the Scarab, Series 50 (125 h.p.), Super Scarab, Series 50 (145 h.p.) and Super Scarab, Model 165 (165 h.p.) engines were produced for the civil coastal patrol, War Training Service and Civil Air Patrol. Production was continued on the Warner hydraulic brake control unit for military aircraft at the Detroit and Grand Rapids plants. In addition, two new engines were made available. One was the Super Scarab, Model 185 7-cyl. aircooled radial engine rated 200 h.p. for take-off and 180 h.p. normal. The other was a modified version of Model 185 in which the engine was mounted in a horizontal position with the propeller shaft vertical. It was fan-cooled for submerged installation.

Wright Aeronautical Corporation, Paterson, N. J., achieved its peak of production in 1944; building of factories ceased; and every effort was directed to obtaining the maximum possible output per square foot of floor area in the seven Wright plants in Paterson, N. J., and Cincinnati, O. The total number of both men and women employees increased steadily throughout the year, because of an intensive recruiting program carried on through the medium of press and radio. A large employment office was opened in New York where prospective candidates were interviewed, tested and completely processed so they could report for work at any of the plants on the following day. Employee training programs were developed further and refined, with particular emphasis being placed on in-plant training. The use of special-purpose, automatic machine tools was increased still further, and there was a marked increase in the percentage of women employees, who were found well suited for operating this type of equipment. Returned war veterans also were re-employed in increasing numbers, with special attention being paid to those with physical disabilities.

Manufacture of both the 7 and 9 cyl. models of the Wright Whirlwind was discontinued entirely in the Wright plants, the entire production of Whirlwind 9's being left in the hands of Continental Motors Corporation for use in tanks and tank destroyers. The Wright Cyclone 9 of the G-200 series, rated at 1,200 h.p., continued in high production to meet the requirements for Boeing Flying Fortresses, Douglas C-49 cargo carriers, and other bombers and freighters for the armed forces, many of these engines being produced under a license arrangement by the Studebaker Corporation. A new model of the Cyclone 9 series was introduced. It was the R1820 C9HC, rated at 1,350 h.p., with a weight of only 0.97 lbs. per h.p. and lightest of its type produced. The outstanding feature of this engine, apart from the forged aluminum alloy cylinder head, was the application of a new type of cooling fin applied to the cylinder barrels. Known as the W fin, it consisted of a series of half rings formed from aluminum strip into the form of an exaggerated letter W and caulked into shallow dovetail grooves cut into the outer wall of the barrel. The new development, in addition to reducing the weight of the cylinders, made it possible to increase the cooling area greatly and was largely responsible for the 150 h.p. increase in the output of this engine.



#### WRIGHT CYCLONE ENGINE ASSEMBLY

Wright Cyclone 18-cyl. engines on a power-operated assembly line at one of the plants of Wright Aeronautical Corporation.

Production of the Wright Cyclone 14 in the A series, rated at 1,600 h.p., was reduced progressively, due to the increasing demand for the Series B of 1,700 h.p. The last engine of the A model was delivered in October, 1944. The B series, however, continued in full production, with the entire facilities of the Cincinnati plant devoted to it. These engines powered the North American B-25s in the first raid on Tokyo and also were used in the Curtiss Helldivers.

The development of extremely large, long-range aircraft brought an increasing demand for the Cyclone 18 with its new rating of 2,200 h.p. The large new Wright factory at Wood-Ridge, N. J., was placed in full production on this engine, which also was manufactured in quantity by the Dodge Chicago Plant, Division of Chrysler Corporation, under a licensing agreement. Early in 1945, the Wright Cincinnati plant was converted to the production of this engine which was used on the Boeing B-29 Superfortress, the Lockheed C-69 Constellation, both military and commercial, the Martin Mars Navy cargo plane, and the Curtiss Commando Army Transport.

In addition to the development of the W fin, used on the Cyclone 9s, 14s, and 18s, the Wright Aeronautical Corporation introduced the application of engine cooling fans in both the propeller speed and gear driven types, and started production of a 1,200 h.p. Wright turbosupercharger. Considerable research and development work was carried out on gas turbine engines with a view to placing these in production at the earliest possible moment.



ONSRUD BEVEL MILLER A-92

It housed four cutter motors, two on each end, which traveled on bridge arms and could be tilted to machine bevels on flat sheet aluminum alloy stock.

## CHAPTER XI

### PROGRESS IN AVIATION EQUIPMENT

New Developments in Aircraft Accessories Contribute to Success of Our Air Forces—Improvements Made in Standard Equipment  
—Work of the Leading Companies.

**C**ONTRIBUTING to the success of American aircraft in all phases of the war in the air were the improvements made in all kinds of aviation equipment. They ranged all the way from more efficient propellers, new compasses and radar to better machinery for building and servicing aircraft and especially designed facilities for airports and shops. Great strides were made in aviation instrumentation, particularly in the field of radio electronics. Although concealed for the most part under the cloak of wartime secrecy, reports filtered in from the war theaters, hinting at new devices which enabled aircrews to "sight" unseen enemies and to bomb targets through the overcast. Radio electronics promised to be the key to all-weather flying. One of the most important developments in aerial navigation was that of the flux-gate type compass, which achieved a finer degree of accuracy than ever before, regardless of plane position with respect to magnetic North. Another was the first true-air-speed indicator which combined into one instrument the airspeed indicator, altimeter and thermometer. The work of the leading companies in developing aviation equipment is described in the following pages.

Acme Aluminum Alloys, Inc., Dayton, O., had an engineering staff working with the aircraft industry developing processes for breaking production bottlenecks. Among its specialties were heat-treated aluminum castings, patterns, tools and the designing of new tools.

Adel Precision Products Corporation, Burbank, Calif. and Huntington, W. Va., introduced two new products, a power package intended for personal plane use and a self-locking sheet metal lock fastener, Staylock, valuable in saving time on assembly operations. The new Adel power package was a compact unit supplying fluid pressure, and provided personal aircraft with a means for actuating retractable landing gear, wing flaps, air brakes and similar hydraulically operated devices. The motor driven pump delivered fluid under 300 p.s.i. pressure at the rate of .40 gal. per minute; with a power requirement of only 298 watts at 12 volts. The entire unit weighed only 4.5 lbs. empty. Small as the unit was, it embodied a complete power system consisting of a motor-driven gear type fluid pump, a



transparent reservoir for containing fluid, an adjustable-thermal relief valve, and a four-way selector valve connected to a manual control handle.

The Adel Staylock was a one-piece self-locking resilient sheet metal fastener for use with the approved AAF sheet metal screws. It was termed the all around fastener because it had 360 degree tensioned engagement with screw threads, giving great strength and providing excellent locking efficiency. It could be used repeatedly, a feature made possible by an ingenious new design that conserved the locking power indefinitely and promoted its ability to resist vibration. Staylock sizes and types included fasteners for Nos. 4, 6, 8, 10 and 14 sheet metal screws, in flat types, angle brackets and saddle nuts.

The Aerco Corporation, Hollydale, Calif., was in wartime production on its line of landing gear assemblies, especially engineered to specifications.

Aero Supply Manufacturing Co., Corry, Pa., designed and produced a large line of high alloy, precision made fuel valves, pumps and strainers, engine controls, bolts and other aircraft hardware.

Aeroproducts Division of General Motors Corporation, Dayton, O., developed the dual rotation propeller for the Army Air Forces. The propeller was designed for big planes with higher powered engines. The dual rotation propeller, latest of the three and four-blade single rotation, automatic, constant speed Aeroprops already in use on combat planes, featured unit construction and simplicity of installation and maintenance. This feature was a part of the basic design of the Aeroprop which was built with its own self-contained power source, thus eliminating accessory power connections. The company reported production of three and four-blade Aeroprops had tripled the goal which had been set at the end of six years of development. The hollow steel, ribbed blade, which was the basis of the Aeroprop, was strengthened by new brazing methods, and production was doubled. Designs for a negative pitch propeller were also completed. Propellers of various sizes and designs were delivered to the Army and Navy on experimental contracts.

The Aeroquip Corporation, Jackson, Mich., developed a line of hose lines and self-sealing couplings. The hose had detachable fittings in three pieces which could be removed and used many times. Aeroquip couplings permitted disconnection of liquid-carrying lines without loss of fluid and reconnection without inclusion of air.

Aircraft Accessories Corporation, Burbank, Calif., increased production, manufacturing facilities and personnel to keep up with the constantly expanding requirements of the airplane manufacturers. A new product was the new AAC Brake Valve for the foot pedal operation of brakes on planes weighing in excess of 12,000 lbs. Other new products included were ultra high frequency radio beam transmitters and precision radio components.

Aircraft Engineering Products, Clifton, N. J., specializing in the exacting work of engineering and manufacturing hydraulic equipment for airplanes, devoted its extensive facilities to this production which required close machine work, heat treating, micro-finishing, grinding to micro-finishes, and a great variety of plating and anodizing processes. Assistance was rendered to producers of special items requiring dynamic balancing contributing to the development of exacting products.

Aircraft Hardware Manufacturing Company, Inc., New York, makers of many types of constructional hardware for aircraft, continued manufacture of its standard line of bolts, nuts and turnbuckles. The firm's stainless steel department was expanded with special screw machine parts and swedging terminals being among the most important items in sales.

Aircraft Screw Products Company, Long Island City, N. Y., developed new portable and stationary power tools for installing its Heli-Coil and Aero-Thread Inserts, while expanding applications for these inserts in original installations, salvage, maintenance and field servicing of aircraft engines, accessories and parts. The inserts were made of precision-shaped stainless steel or phosphor bronze wire to protect tapped threads in aluminum, magnesium and other metals with relatively low tensile strength.

Aircraft Welders, Inc., Wichita, Kans., was at peak production on all-welded steel aircraft parts for several manufacturers, including motor mounts, nacelle frames, tail wheel forks, landing gears and wing fittings. The facilities of the company included a completely equipped machine shop, arc and gas welding department, sand blast shop, paint room, heat treating section, tube bending department, and most important, a complete engineering service.

Al-Fin Corporation, a subsidiary of Fairchild Engine and Airplane Corporation located at Jamaica, N. Y., was engaged in development of a new process for chemically bonding pure aluminum to steel or other ferrous metals. The process was used extensively in the construction of cylinder barrels for the Ranger 12 engine. Use of pure aluminum fins chemically bonded to the steel barrels resulted in the Ranger 12 delivering more horsepower per pound of weight than any comparable aircraft engine. The Al-Fin process of chemically bonding aluminum and steel into an integral whole offered advantages in innumerable industrial applications where highly efficient heat transmission with saving of weight was desirable. It also proved useful in structural applications where thermal problems were not involved.

The Aluminum Company of America, Pittsburgh, Pa., made available its new high strength alloy 75S for plane manufacture. This alloy contained approximately 90 per cent aluminum, with magnesium, zinc and copper as its major alloying constituents. It was commercially available in the form of alclad sheet and extruded shapes. Tensile

strength of 75S-T (fully heat treated temper) extruded shapes such as were used in aircraft wing beams, was approximately 88,000 lbs. per sq. in. In clad sheet form 75S-T had a tensile strength of approximately 77,000 lbs. per sq. in., while the tensile yield strength of extruded shapes was about 80,000 lbs. per sq. in. Tensile yield strength of Alclad 75S-T sheet was 67,000 lbs. per sq. in., which was about 50 per cent higher than that of 24S-T. Practically all the new war planes were utilizing the high strength of 75S extrusions for wing spars, and many others employed 75S sheet and extrusions for wing and fuselage structures. A number of models were being redesigned to utilize alloy 75S, either to save weight or to give increased strength for heavier loads. A special purpose aluminum alloy, 76S, was developed by Alcoa for propellers. It was a heat treatable alloy with magnesium and zinc as its principal alloying constituents. Alloy 76S had a higher endurance limit than the aluminum alloys previously used for this purpose. Stepped aluminum extrusions were available to plane manufacturers. They reduced the amount of metal which must be removed to produce a taper, thereby speeding production. Stepped extrusions provided a large integral section from which the attachment fitting was cut out, thereby avoiding the added weight and cost of a splice.

The Aluminum Company of America also developed light weight aluminum alloy landing mats designed for the speedy construction of emergency landing fields. The landing mats were built up from a number of aluminum sections, each approximately 15 in. by 10 ft. These "planks" were ribbed and pierced with flanged holes for increased stiffness. Assembly was effected by fitting adjacent planks together by means of a slide lock. Each plank in the aluminum mat weighed approximately 35 lbs. as compared with 70 lbs. for the same size plank made of steel. Another development of significance to aviation was the Alcoa aluminum gasoline drum. Tens of thousands of these were being manufactured by Alcoa for service in the China-Burma-India theater of operations where they were used by our Air Transport Command to carry vital fuel over the "Hump".

The American Chemical Paint Company, Ambler, Pa., was producing chemicals for use in war production, primarily metal cleaning chemicals and allied products, preparatory to final finishes. Company chemists and technicians cooperated with metal fabricators and with the Army and Navy in planning equipment and adapting products to new and diversified requirements. Laboratory research developed new uses for standard ACP products and new ones to solve many metal treating problems. These developments shortened cleaning operating schedules, enabled fabricators to obtain the chemically clean surfaces necessary for protective finishes, improved and speeded drawing operations, and saved steel by confining the action of pickling baths to the removal of scale. Among the ACP products were the

metal cleaners Deoxidine and Deoxylyte, Rodine which limited acid pickling of iron and its alloys to removal of scale, pickle bath toners to improve finish and save acids, Cuprodine (a powdered chemical which when dissolved in dilute sulphuric acid, produced a bright copper coating on steel surfaces), Cuprotek to protect against rust, Lithoform to make paint stick to galvanized iron, Kemick which was a chemical paint for hot surfaces, and many other chemical products.

The American Flange & Manufacturing Co., New York, was at peak production on its Tri-Sure Closure, which provided a seal, plug and flange for hermetically sealing gasoline drums, among other uses. More gallons of American gasoline and oil were transported in 1944 than at any time in history. Most of it at the final stage of its journey—and often from the start—was shipped in drums. They had to travel thousands of miles under every conceivable condition. They had to be stored in the open, in snow and ice, in desert sands and dust storms, in torrential rains; and in amphibious landings, rolled ashore through the surf. The protection of Tri-Sure closures, which were used increasingly since Pearl Harbor in all theaters of the war, permitted shipment and storage of millions of gallons of high-octane gasoline without leakage, seepage, contamination or waste.

The American Gauge Company, Dayton, O., designed and pro-



AT A NEW BASE IN NEW GUINEA WILDS

Fitted with Tri-Sure Closures, the fuel drums have crossed the Pacific with contents unimpaired.

duced a large line of gages and tool room accessories built for extreme accuracy in manufacturing precision products. The line included hole and thread checkers, amplifying gages, bench centers, radius dressers and lapping plates.

The American Propeller Corporation, Toledo, O., a subsidiary of The Aviation Corporation, turned out increasing quantities of hollow steel propeller blades for Army and Navy requirements, primarily for installation on the Curtiss Helldiver plane and the Bell P-39 Airacobra. Monthly production figures during the later months of 1944 were greater than at any time since operations were started in May, 1942, since which time approximately 75,000 hollow steel propeller blades had been delivered. Experimental models of so-called paddle blades were manufactured and tested, and these blades were scheduled to go into production in 1945 for Army and Navy use on combat planes.

American Tube Bending Company, New Haven, Conn., used its 35 years of experience in bending tubing to meet the specifications of the manufacturers of war equipment. The company's vastly expanded facilities included equipment for bending, swaging, expanding, flanging, and beading of tubing in all metals, as well as heat treating and finishing of parts as required. Gas and electric welding together with gas and induction brazing played a large part in the fabrication of a finished tube. The company also increased facilities for experimental work in cooperation with aircraft engine builders.

Atlantic India Rubber Works, Inc., Chicago, Ill., with production facilities devoted to war work, added greatly to its lines of Airwin molded and extruded aircraft parts. The further refinement and development of Atlantic Vacuum Lifters for use in the safe handling of sheet metal was a great help to the aircraft industry, and it was winning favor in practically every sheet metal shop in the country.

The B G Corporation, New York, produced ceramic aircraft engine spark plugs in increasing quantities for the Services, and carried on intensive development work on ceramic plugs for the high output engines, with the result that they were in production early in 1945. B G planned to have at an early date a full range of such plugs for all aircraft engines. A new electrical checking device for testing ceramic spark plugs was developed. The new B G flexible, completely sealed ignition harness was in production, and other designs were in process for new engines and installations.

B. H. Aircraft Company, Long Island City, N. Y., continued to supply the Government and the aircraft industry with fabricated sheet-metal parts of various kinds and styles.

The Bell Company, Inc., Chicago, Ill., produced hydraulic fluids to meet Air Forces specifications. Both mineral oil and castor oil types were available. Bell had accomplished considerable research on hydraulic fluids to operate at extremely low temperatures, and this information was available to the industry.

Belmont Radio Corporation, Chicago, Ill., was engaged on numerous research projects concerned with the military use of radio, radar and other electronic equipment. One of the projects involved extensive studies in tropicalization—the prevention of fungus growth in electronic equipment; and this was being carried on in the new Belmont research laboratory in Chicago, under direction of Wilfred F. Horner, former assistant in biology at Marquette University and later instructor in biological science at Loyola University, Chicago. The entire problem of tropicalization was under the general supervision of William L. Dunn, Belmont's director of engineering and research, who had launched an intensive program in cooperation with the U. S. Signal Corps which had established standards of fungus control on electronic battle equipment based on experiences in the South Pacific campaigns.

Recent completion of the Belmont laboratory, built as a \$70,000 addition to the Chicago plant, provided the most modern equipment and facilities for the study. Specimens of hundreds of different types of fungi and bacteria from all parts of the world were collected. Their growth was being studied in connection with such materials as cotton, rayon, celanese, rubber, glass, various plastics and metals. The effectiveness of current methods of fungus control were being tested and efforts were being made to improve the application and use of different kinds of fungicides. The studies were not limited to the microscopic air borne fungus of the South Pacific, but also included many types of fungi and bacteria growth common in more temperate climates. It was believed that these growths, which could be contracted at the time of manufacture but were ordinarily harmless, were accelerated by the heat and humidity of the tropics to the point where they caused the deterioration of electronic equipment unless proper safeguards could be established. Although the work was confined to material for military use, the findings were bound to result in better radios for export markets as well as for Florida, the Gulf Coast and Southern California, sections where fungus growth long had been a problem.

Bendix Aviation Corporation, Pacific Division, North Hollywood, Calif., was in peak production on its line of Altair hydraulic controls, and radio accessories.

Bendix Products division, South Bend, Ind., mid-west center of Bendix Aviation Corporation's extensive engineering, development and production activities in the fields of aircraft carburetors, landing gear shock struts, wheels, brakes and wheel and brake combinations, electrically power-driven gun turrets and other related aircraft and ordnance devices, continued its output at high levels. The Stromberg aircraft carburetor section of Bendix Products further increased its vast war output by bringing into volume production the Illinois division of Bendix Aviation Corporation in Chicago. The Illinois divi-



#### THE CHIN OF A FLYING FORTRESS

Flying Fortress bombardiers doubled as emergency gunners to man this electric power "chin turret" which protected the Forts against frontal enemy attacks. The "chin turret" shown in this cutaway view was developed by engineers of the Bendix Products Division of Bendix Aviation Corporation, the Army Air Forces, and the Boeing Aircraft Company to discourage head-on assaults by Nazi and Jap pilots. The bombardier sighted and fired the two .50-cal. machine guns by remote electrical controls.

sion, staffed by more than 75 per cent women workers trained as carburetor technicians, mass produced Stromberg Aircraft "Injection Carburetors" exclusively for larger type aircraft engines. To meet increased requirements of United Nations air forces for Bendix-Stromberg aircraft carburetors, Bendix continued high level production, at a total rate of tens of thousands of units per month, in Chicago and in

three other plants located in South Bend, Ind., Wayne and Owosso, Mich.

In 1945 virtually all new airplanes delivered to the armed forces were to be equipped with Stromberg carburetors, the majority of which were to include the Stromberg Electric Primer Valve, which



#### MIDGET AND GIANT STRUT

The smallest and one of the largest shock-absorbing landing gear strut and wheel assemblies mass produced at the mammoth South Bend Products division of Bendix Aviation Corporation. The small strut equips an Army primary trainer plane. The large strut, which weighs 421 lbs., equips one of the heaviest American bombers now in the air over Europe.



controlled a supply of gasoline directly to the engine manifold, to facilitate starting. Stromberg Aircraft "Injection Carburetors," which automatically and accurately metered proper fuel-air ratios to engine superchargers at all engine speeds, independent of changes in altitude, temperature or throttle position, were improved continuously.

Intensive research, in cooperation with aircraft engine manufacturers and the Army and Navy, resulted in improvements in altitude and temperature compensation, constant head idle metering, which permits long-range operation of fast fighter escorts at low cruising powers on missions with slower bombers; and improved acceleration for large valve overlap engines. Service improvements were facilitated by a world wide staff of Stromberg service engineers who maintained close liaison with aircraft fuel equipment operational problems on fighting fronts.

Stromberg engineers' long-time research in aircraft fuel equipment brought forth direct injection as a new product during the year. The new direct injection systems, designed for use with Stromberg metering control, gave a positive, equally divided charge of fuel into each engine cylinder. This equipment was adopted for two of America's major large-bomber airplane and engine combinations and production was placed under way at the Eclipse Machine division of Bendix Aviation Corporation in Elmira, N. Y., and Bendix Products division to support total planned requirements.

During 1944 Stromberg carburetor engineers, in collaboration with other Bendix divisions, developed new conceptions and advanced coordination of engine power controls planned to eliminate many duties of the flight crew, and, at the same time, obtain ultimate performance in engine operations.

The Bendix Products landing gear department further increased its contribution to the war effort by shipping nearly as many pneumatic landing gear struts in a single month as it turned out in the entire year of 1940. Struts were produced at South Bend and Wayne, Mich., plants for 26 types of aircraft, ranging from trainers to multi-engine bombers.

The Bendix segmental rotor disc brake, product of more than five years of research, was further perfected for a variety of aircraft applications and was in volume production. Further developments were under way. Intensive research continued in aircraft wheel structures, power brake valves and brake master cylinders to cover a full range of aircraft requirements. Volume production continued at South Bend on electrically power-driven gun turrets—the top turret which equipped the North American B-25 bomber and the "chin turret," developed to protect the forward approaches of the B-17 Flying Fortress. Bendix Products had delivered more than 20,000 turrets to the air forces since Pearl Harbor.

The Benwood Linze Company, St. Louis, Mo., and its subsidiary

the B-L Electric Co., pioneered in developing the application of electrical rectifiers, and they were supplying aircraft battery rectifiers and others to meet any requirement. The engineering staff, including electrical, electro-chemical, mechanical engineers, physicists and chemists, were designing and developing many applications for selenium and copper sulphide rectifiers.

Boston Insulated Wire & Cable Co., Boston, Mass., manufactured aircraft insulated wires and cables covering the entire range from small instrument wire to motor leads and large power cables. The company produced electrical cable items used in aircraft, such as shielded wire, bonding cable, braid shielding, antenna wires, and types of radio hook-up wires, radio cables and cords; and also specially designed multi-conductor cables for electrical instruments, turrets, gunfire controls, inter-communication and radar. These cables, constructed particularly for use on aircraft, were light in weight, small in diameter, extra flexible to withstand shock and vibration, covered with flame-proof, oil and moisture-proof sheath using materials to stand a wide range in temperature from 120 to -50 degrees Centigrade. The company designed and manufactured even in small quantity, for experimental models, multi-conductor cables employing the exact size and number of conductors, proper insulation and color coding for each circuit, and shielding where required, to suit the particular needs of the apparatus. As a result, over 200 different cable constructions were produced and identified by B.I.W. cable numbers.

The Botany Worsted Mills, Passaic, N. J., in cooperation with Pan American Airways developed serviceable and attractive fabrics in far lighter weights than those currently used, thereby increasing the gasoline or cargo loads and the earning power of aircraft. An entirely new approach to a lightweight blanket, providing necessary warmth, produced the "Slumber Cloud" blanket, in which no comfort was sacrificed, but the weight greatly reduced, and strength and durability actually improved over the customary equipment formerly carried. Along with the development of the lightweight blanket, new materials for side-wall, seat covers and curtains were worked out and tested over a period of two years, demonstrating that savings of up to 43 per cent in weight still would provide more serviceable and attractive materials. These fabrics were tested in actual flight under all possible conditions, in all parts of the world, for three years, with highly satisfying results. When military requirements should decrease, production of Botany's flying fabrics was to be expanded to meet all the demands of the aviation industry.

Breeze Corporations, Newark, N. J., expanded its plant structures, equipment, personnel and research facilities while in production on equipment for aircraft, anti-aircraft, tanks, ships and ground defenses. New developments included a faster and more efficient technique for manufacturing aircraft armor plate which stood exacting tests and



#### BOTANY FLYING FABRICS

Botany Worsted Mills developed a line of wall lining, berth curtains, seat upholstery and blankets of light weight to permit carrying greater pay loads.

gave air crews greater protection and increased confidence. Two types of armor plate for aircraft were made by Breeze—homogeneous and face hardened. Homogeneous armor plate required only heat treatment (heating, quenching and tempering) of alloy steel to give it the high toughness necessary to withstand high explosive shock. Face-hardened armor plate needed special processing before heat treating. It required a thin layer of high carbon case on the projectile striking side which, after heat treating, became hard. With a tough back, this hard surface tended to break up the nose of the striking projectile, thus providing adequate protection against high velocity.

To provide this hard case on face-hardened armor plate, the usual method was to use pack carbonizing, in which the steel was packed in

powdered carbon compound. This required a long cycle of carbonizing. Breeze developed a process whereby the steel was heated in furnaces of molten carbonizing salts, in which the face of the steel plate picked up the carbon. This materially reduced the time required to complete the carbonizing cycle. The liquid bath cycle was further shortened by Breeze research to such an extent that the output of the furnaces was increased greatly.

Production of Breeze cartridge type engine starters was accelerated further and a larger type starter was produced to meet the requirements of more powerful engines. The Breeze starter secured its energy from a cartridge using a slow burning fuel to generate the required power at a controlled rate, providing ample torque without damaging the engine parts. This starter made no drain on the airplane batteries, as the current required to fire the cartridge was no more than that supplied by an ordinary flashlight cell.

Further improvements were made in the design and production of Breeze radio ignition shielding for high tension ignition and secondary wiring systems to safeguard the operation of aircraft and insure uninterrupted transmission of vital communications.

A new series of multiple circuit electrical connectors having improved contacts was perfected and produced in accordance with the latest AN specifications. Manufacturers in vast quantities of flexible shielding conduit and fittings, Breeze developed new bench and hand type swaging machines for use in attaching ferrules to the flexible conduit. Other aircraft accessories on which production was speeded materially included tab controls for operating aileron, rudder and elevator trim tabs, internal tie rods especially adaptable for gliders, flexible tachometer shafts and adapters and remote control drives for radio tuning devices.

Burklyn Co., Los Angeles, Calif., developed an instant release hinge by which ammunition chutes could be removed instantly from aircraft machine guns; and later, the hinges had a wide variety of uses. They were made in four standard model lengths from two to six inches, and served the dual purpose of conventional hinges and an instant release device for hand removal of hinged parts. They were made in several designs of locking and non-locking types, and were adaptable to map tables, folding seats, hatch covers, inspection doors and housings for electrical equipment.

California Flyers, Inc., Los Angeles, Calif., were awarded additional contracts on some of America's most needed airplanes, and they continued to devote all buildings, time and facilities, to the production of aircraft components and assemblies for the Government. A complete staff of certified instructors and other qualified personnel were organized for the educational program when conditions permitted.

Cannon Electric Development Company, Los Angeles, Calif., supplied electrical connectors for aircraft electrical circuits, including



#### CANNON ELECTRIC CONNECTORS

An operator assembling the DP Rack type.

radio, instrument, motors, batteries and other applications. The company also manufactured direct current solenoids for the operation of hydraulic valves, mechanical clutches, firing machine guns, arming and releasing bombs, locking retracting gears and other applications. Two new A-N connector designs were developed, the AN3101, a portable receptacle, and AN3107, having new spring-type coupling device. A new battery connector, No. 11749 and 11751, for use on batteries conforming to AN-W-B-141 specifications became available. This radically designed connector facilitated and speeded connection and disconnection of aircraft batteries under all conditions, particularly in extremely cold temperatures; and decreased fire hazards. Cannon Electric's "DP" line of connectors, having coaxial contacts and used in rack type radio assemblies, were produced in large quantities for new instrument equipment demands.

Carney Engineering Company, New York, organized in 1942 by Henry C. Carney, an experienced aircraft production specialist, developed new methods of assisting prime contractors in tooling up and

acquiring the skilled technicians essential to fast quantity production of military equipment. Contractors using the Carney service included Bell Aircraft Ordnance Division, Higgins Aircraft, Colonial Radio Corp., Greer Hydraulics, S. Blickman & Co., General Instrument, Thompson Aircraft & Engineering Co., Pass & Seymore, General Analine & Film Corp., and others. Early in 1945 the company expanded its activities to cover all phases of engineering, including management, production, research, design, tooling, training, organization and construction.

The Champion Spark Plug Company, Toledo, O., found its expanded capacity of ceramic insulated aircraft spark plugs taxed to the limit by demand from the Services, air lines and private pilots. By specializing on spark plugs, the research and experimental departments were able to keep pace with rapid developments in aircraft engines. The latest additions to the Champion ceramic aircraft spark plugs were the RC-34-S and RC-35-S, both with built-in resistors designed to retard gap growth and increase the time between spark plug overhauls. They had the approval of the Services and were in wide use.

Chandler-Evans Corporation of South Meriden, Conn., makers of aircraft engine carburetors, pumps and Potek-Plugs, was acquired by Niles-Bemont-Pond Company, West Hartford, Conn., during 1943. The new CECO carburetor testing plant in Ohio reached its large maximum planned monthly quota for testing CECO carburetors manufactured under subcontract. The South Meriden plant continued to increase monthly production of fuel pumps, water pumps and accessories. The growth of the company's Protek-Plug department was so great that it became necessary to open a third plant in Wallingford, Conn., to handle this activity. The Wallingford plant also housed the company's service department and service school for training domestic and foreign CECO service men and field engineers as well as for familiarization of Army and Navy personnel with CECO products.

Chicago Aerial Survey Company, Chicago, Ill., developed new photo apparatus for the Services, including a stereoscopic camera, a stereo viewing machine, measuring comparator and stereoscopic projector. The company adapted the automatic film speed control to the continuous strip camera. It also continued manufacture of the "Sonnet" aerial camera.

Chicago Wheel & Manufacturing Company, Chicago, Ill., was in peak production on mounted wheels and small grinding wheels for abrasive work, specializing in small sizes of wheels three inches in diameter and smaller.

C. P. Clare and Company, Chicago, Ill., was in production on the Clare Type K sealed-in relay, designed for precise operation at any altitude. It had no bearings nor anti-vibration springs, and uniform armature movement was assured by use of a fatigueless beryllium copper hinge, heat treated and designed to provide a wide margin of

safety. The relays could be custom built to manifold specifications.

The Cleveland Pneumatic Tool Company, Cleveland, O., manufacturer of aerols (air-oil shock absorbing landing gear units) and Cleco pneumatic tools, marked its fiftieth anniversary in June, 1944, but did not pause in essential war work to celebrate the event. Incorporated in 1894, this company, originally organized to build and market both electric and pneumatic appliances, concentrated engineering, manufacturing, and sales efforts solely on the latter when the present name was adopted in 1899. A wholly-owned subsidiary, Cleveland Pneumatic Aerol, in Euclid, O., continued to produce aerols for the Army and Navy air forces in growing quantities. Although established as the largest straight-line producer of aerols in the world, owing to a slight cutback in Service orders for its principal aircraft product, machinery and plant were altered to produce rocket shells on a mass basis for Army Ordnance.

The parent company continued to increase its output of pneumatic tools, rock drilling, and mining equipment as well as turning out automotive shock absorbing equipment (Cle-Air spring control unit) for use on Army rolling stock. This unit also was being tested for use on tanks, ambulances and railway equipment. A frictionless ball-bearing screw also was developed. It promised a multitude of war and post-war uses.

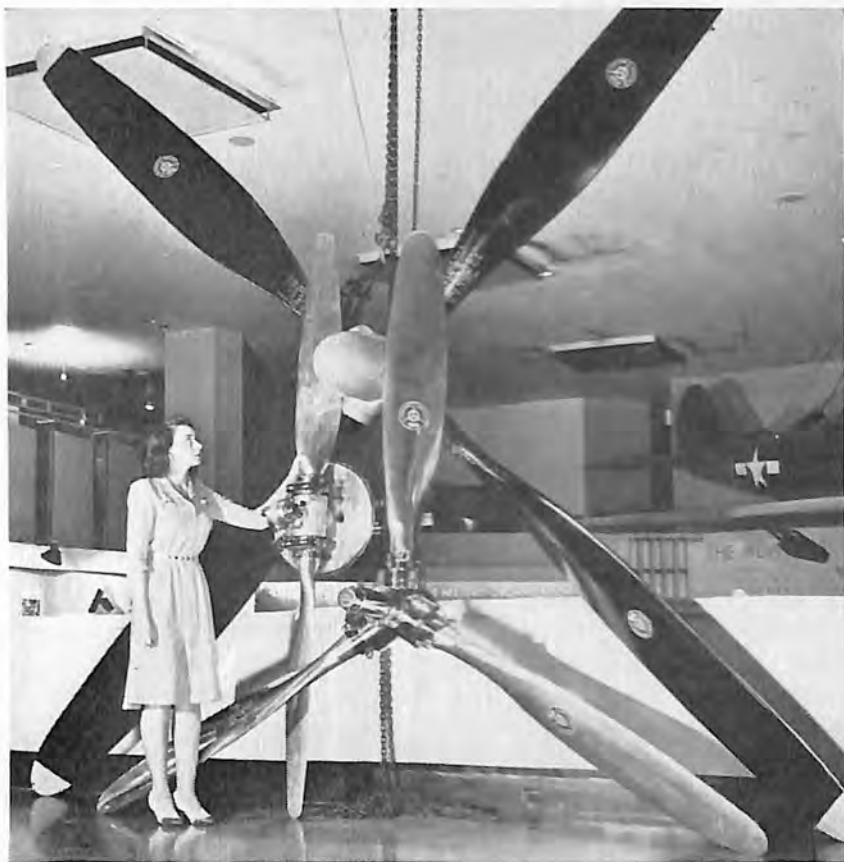
Clifford Manufacturing Company, Boston, Mass., extended its facilities for serving the aircraft industry with basic materials for engine cooling and cooling control. It manufactured the Hydron thin-wall extruded tubing for aircraft radiators, oil coolers, intercoolers and heat interchangers, for liquid and aircooled engines; and also turned out the Hydron thin-wall hydraulically-formed metallic bellows for use in all types of temperature and pressure control devices for engine cooling systems, carburetors and superchargers.

Cox and Stevens Aircraft Corporation, Mineola and Great Neck, N. Y., continued production of its load adjuster, the standard balance computer for the Army Air Forces, the Navy and the British. The Model VW navigational computer, intercept officers kits, and plotting equipment continued to be standard production items. The aircraft electric weighing kit, which was the standard Army and Navy weighing device, was in large scale production. Work was completed on an improved model of this equipment for 1945 production. The new kit was known as the ES-5 Model. It had a weighing capacity of 150,000 lbs. in three 50,000 lb. weighing cells, rather than the 120,000 lb. total capacity of the previous model. The overall weight of the complete unit was reduced from 70 to 50 lbs. The company also developed and manufactured the universal plotter for aircraft and marine navigation.

Crescent Insulated Wire & Cable Co., Trenton, N. J., manufactured for the airplane industry large quantities of electrical wires and cables used in the construction and servicing of airfields and related

facilities, as well as for lighting, power and portable cables in aircraft. Crescent's Imperial Neoprene Jacketed Portable Cable and Permacord were heavy duty types of portable cables and cords, giving maximum protection from abrasion, crushing, heat, oils, greases and weathering. They were used widely for portable drills, tools, and other industrial appliances in aircraft factories, and servicing facilities at airfields.

Curtiss-Wright Corporation, Propeller Division, Caldwell, N. J., achieved new production records in its output of electric propellers for the United Nations fighting planes. In terms of horsepower for propellers shipped, based on available engine ratings, the 1944 output totalled 76,961,225. The new high in production for 1944 brought the



#### CURTISS-WRIGHT PROPELLERS

The largest propeller ever to fly in this country, an 18 ft., 2 in. Curtiss Electric, is shown here with two other pioneer developments in aircraft propellers by the Curtiss-Wright Corporation. One is a two-blade propeller manufactured in 1928—the first electric controllable pitch propeller. Also shown is the first three-blade electric controllable propeller. The huge hollow steel four-blade propeller was designed to harness more than 3,000 horsepower.



total output of the Propeller Division since 1938 to approximately 200,000,000 horsepower on the same basis. Outstanding engineering developments by the Propeller Division included aerodynamic braking, the first practical application of reverse thrust propellers as landing brakes for large multi-engine land planes; production of an 18 ft. 2 in. propeller, the largest four-blade hollow steel propeller ever to fly in this country; the application of reverse thrust to provide braking for Navy blimps, and quantity production of new-type wider blades which assisted in giving the Republic P-47 Thunderbolt a 30 per cent faster rate of climb.

Accomplished by turning the propeller blades to a negative angle to create a backward thrust, aerodynamic braking added new safety, passenger comfort and economy to the landing of large airplanes, as well as materially reducing the landing roll and permitting emergency landing in smaller spaces and on wet or icy runways. It reduced taxiing time, increased maneuverability on the ground and reduced brake wear.

Efficiently harnessing 3,000 horsepower and more in the stratosphere, the 18 ft. 2 in. propeller produced by the Curtiss-Wright Propeller Division for service tests on the Army Douglas XB19-A, world's largest land plane, effected a 20 per cent saving in weight over a propeller of comparable diameter with four solid aluminum alloy blades, and increased the useful load of the airplane approximately 650 lbs. through this weight reduction. Handling and landing of the newest and largest blimp, the M-1, designed for the U. S. Navy, was greatly facilitated by the first adaptation of fully controllable reversible aircraft propellers to lighter-than-air craft. Application of this new feature enabled the blimp, largest non-rigid airship yet to be constructed in this country, to come to a virtual standstill in the air by reversing the blade angles of its propellers to create reverse or backward thrust. The new wider blades developed for the P-47 Thunderbolt were shipped overseas in quantity only eight months after entering the drawing board stage. The new hollow steel blades, designed to take advantage of increased engine horsepower in the Thunderbolt, enabled the fighters to outclimb enemy aircraft without sacrificing maximum level speed. The development of automatic synchronization, another feature pioneered by Curtiss, was continued; and its application was extended to several new multi-engine aircraft. Likewise, Curtiss hollow steel propeller blades were designed for use in many new aircraft and produced in a wide range of sizes and shapes. The Propeller Division also put in use a proving ground for the "propellers of tomorrow" where propellers up to 30 ft. diameter and liquid and air-cooled engines of 5,000 h.p. and more could be tested. Located at Caldwell, N. J., the twin-cell ground laboratory was the largest privately-owned propeller test facility in the country and probably in the world. At the same time the Propeller Division installed new equip-

ment in its experimental engineering laboratory, equipped with the most advanced type of electronic vibration apparatus, where the component parts of propellers were tested. Employees of the Indianapolis plant were awarded the Army-Navy E for excellence in production and the Caldwell-Clifton plants received an additional star on their flag, representing renewal of previously won E awards.

Denison Engineering Company, Columbus, O., produced its model HSPT<sub>3</sub> "hydroilic" spark plug tester, which developed air pressure up to 750 lbs. per sq. in. within 15 sec. and maintained it at least a minute. Testing time averaged only 30 sec. per plug. The plug was seated in an adapter, and action of the cylinder clamped the plug into an air-tight chamber. The desired voltage and pressure were selected, and the action of the plug recorded. Safety features included forcing the operator to move two levers—one with each hand—in opening or closing the clamping mechanism, thus making it impossible for him to have his hands in or about the clamping mechanism where he might be injured. Also, the circuit to the spark plugs was completed only after the plug was clamped into position, and the circuit was automatically broken when the clamp was released. The operator, therefore, could handle the plug in complete safety. The stand was a welded steel frame mounted on swivel casters and equipped with start-stop push buttons, high and low pressure air gauges, low pressure needle valve, adapters, oil level gauge, high voltage connector, low voltage terminal and operating levers.

The Dow Chemical Company, Midland, Mich., was producing approximately half of the country's magnesium output in plants located in Michigan and Texas. In Michigan, where magnesium was manufactured from salt brine, recent expansion in facilities resulted in two new plants, one at Ludington, and the other at Marysville. These plants began production in the spring of 1943. Magnesium made possible greater range, altitude, speed and more payload for America's fighting planes. It was estimated that magnesium in aircraft averaged 1,000 pounds per plane, mostly in the engine and wheel castings. Magnesium also was used in accessory housings and airframe parts. Resultant total weight saving in a bomber was at least 500 pounds. Still other uses were in main landing gear fittings, tail wheel oleo housings and the main auxiliary oil tanks on several of the latest fighters. Another new fighter used magnesium sheet in fairings, doors, flaps and control surface coverings. Dow also built wings for the Navy Bureau of Aeronautics, which were 17 per cent lighter than other types. They successfully passed flight tests and were undergoing extensive service tests. Another Dow magnesium wing, designed with thick skin to attain a more simple structure and a smoother surface, possessed improved aerodynamic qualities.

Dow improvements in fabricating methods and surface finishing treatments resulted in improved service results and in saving of



#### DURAMOLD ELECTRONIC PROCESS

Laminations of the proper thickness for the spar flange of a plane are assembled in the channel of a jig after phenolic adhesive is applied. Electrodes form the sides of the jig, and compressed air provides accurate uniform pressure for molding. An operator "tunes" the circuit of the high-frequency generator for proper heat and the heavy flange is molded and cured by electronic processing.

production time. Deep forming draws had to be done hot in the case of magnesium, but that proved to be an advantage rather than a drawback, because the springback problem encountered in cold forming was eliminated. It made possible deep draws in one operation and with a single set of dies. Salt water corrosion of magnesium was reduced sharply by development of superior surface treatments, among them the Dow No. 7 treatment, which was covered by Army and Navy specifications. New types of paints and the development of new alloys in which the iron and nickel contents were practically eliminated also helped to control corrosion.

Welding methods were improved. In the case of arc welding, the shielding of the weld area by an inert helium gas prevented oxidation of the molten material and permitted welding of larger areas than formerly.

Duramold Division of Fairchild Engine and Airplane Corporation moved from New York to a large modern plant in Jamestown, N. Y., at the beginning of 1945 for the purpose of acquiring increased manufacturing facilities. During 1944 the Division had greatly expanded production of aircraft parts made of plastic bonded plywood molded under heat and pressure by the Duramold process. Among the parts made by Duramold were wings and tail surfaces for the Cornell trainer (PT-19, PT-23, PT-26) series, the wings, fuselage and empennage of the AT-21 Gunner, the nose and rear sections of the C-82, expendable gas tanks for the F4U Corsair and A-20 Havoc, ferry fuel tanks for the A-26 Invader, and many other new parts. Duramold continued research into improved structural materials, better and more lasting finishes, and more efficient methods of fabrication. It developed and utilized an outstanding method of heat curing of plastic bonded wood structural assemblies. Termed electronic processing, the method made use of high frequency electric currents which were shot through laminations to cure in a few minutes heavy sections which otherwise might require hours for setting at normal room temperatures. The process offered the advantage not only of speeding production time but of reducing the number of costly jigs and fixtures and production floor space. Special jigs and fixtures were devised for the electronic processing which held assemblies in position with uniform fluid pressure to insure thin, strong glue lines essential to maximum strength.

Durham Aircraft Service, Inc., Flushing, N. Y., designed and produced an aircraft spark plug gap-setting machine which was put into use by the Services. One of the gap-setters gapped more than 500,000 plugs without requiring any maintenance other than changing the feeler gages after every thousand plugs due to wear. An operator without training could gap four or five thousand plugs in a working day. Durham also specialized in hydraulic and electrical fittings and valves.

Dzus Fastener Company, Babylon, N. Y., developed a radically new self-locking nut. Its inventor was William Dzus who also created the spiral-slot cowl fastener widely used on aircraft. Mr. Dzus developed the new self-locking nut after years of experiments. The new nut was all-metal, extremely simple, temperature and oil-proof, had full and undisturbed threads throughout its length, and permitted absolute precision fastening without cotter pins or wiring.

Eagle Parachute Corporation, Lancaster, Pa., devoted all its facilities to the manufacture of combat and life-saving parachutes and their related items for the war. About 80 per cent of its products were produced for the Army Air Forces, and about 17 per cent for the Navy's



#### AERIAL CAMERA COLD WEATHER TEST

Eastman Kodak technician prepares to test a camera at low temperatures more severe than any it will meet in a plane at 40,000 feet or more.

Bureau of Aeronautics. Ten different types of parachutes were manufactured for the Army and the Navy air branches. In addition to the complete parachutes, many thousands of spare harnesses, packs, canopies and pilot chutes were produced. The Eagle Parachute Corporation, original exclusive supplier of specially designed parachutes to the United States Forest Service, continued to furnish that agency its parachutes for fighting fires in our western forests. The Forest Service also used Eagle chutes in outfitting and training a Mountain Search and Rescue Section of the Second Air Force. Development work on an improved type of parachute was under way at the Eagle plant. A canopy was designed to function with a minimum degree of oscillation, a low rate of descent and improved stability. A single point release, quick-detachable harness also was designed.

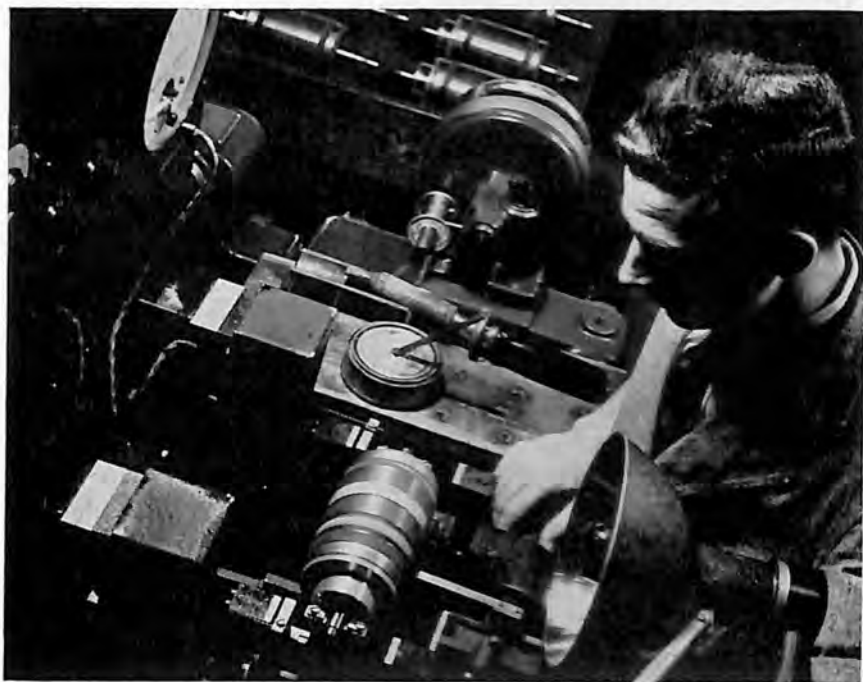
The Eastman Kodak Company, Rochester, N. Y., maintained rapid development of specialized processes and materials and equipment for aerial photographic work.

The year 1944 saw the completion of important production pro-

grams by Eastman for the Army and the Navy and steady efforts to complete others within specified periods extending into 1945. The rate at which Kodak's mechanical and optical facilities produced special military and naval equipment maintained Eastman in the forefront of suppliers of lenses and optical devices. Most of this production consisted of instruments for the control of gunfire, such as gun and tank telescopes, panoramic telescopes, aiming circles, range finders, and optical and mechanical gunsights for the Army and the Navy.

Because of the Government's requirements for Kodak's primary products, the material and equipment of photography, the Eastman Kodak Company greatly increased production and was the principal source of supply for the many and varied photographic needs of a war in which photography is being utilized fully.

Eclipse-Pioneer, Division of Bendix Aviation Corporation, Teterboro, N. J., attained peak production of its many vital aviation accessories and instruments. Engineering refinements and improved production facilities contributed to achieving this excellent production record. A new altitude testing laboratory was designed and constructed to solve the problems encountered with instruments and ac-



#### ECLIPSE GENERATOR INSPECTION

Balancing generator armature, Gisholt Dynetric Balancer, at plant of Eclipse-Pioneer Division, Bendix Aviation Corporation.



#### ECLIPSE PRECISION WORK

Measuring air pump rotor end clearances at the plant of Eclipse-Pioneer Division of Bendix Aviation Corporation.

cessories in high altitude flying. The main test chamber was a cylindrical shell of welded steel, with an inside diameter of 8 ft. and overall length of 30 ft. The length of the cabin section was 10 ft., the altitude section 20 ft. Ports and observation windows permitted visual study of equipment under test. Specially designed outlets provided electrical connections and connection for manometers and thermo-couples. Cooling to sub-zero levels was accomplished by means of a 275 h.p., 3-stage, Freon-12 mechanical refrigerating system. The low barometric pressures of substratosphere and stratosphere levels were duplicated by means of a 115 h.p. 2-stage vacuum pump system. Special apparatus provided fully automatic control of temperature and pressure, individually or in combination. There was no temperature-pressure condition existing between the earth's surface and the stratosphere that could not be duplicated in the Eclipse-Pioneer altitude testing laboratory.

Production was increased on Eclipse aviation engine starters to

meet pyramiding requirements of the military services. Development of airborne accessories for jet propulsion aircraft received considerable attention. Outstanding was the development of a lightweight starter weighing 27 lbs. 4 oz. for starting jet-propulsion type engines. The starter consisted of a heavy duty electric motor, a single stage planetary gear train, a friction disc clutch and an automatic jaw engaging mechanism. Considerable effort was devoted to developing lightweight starters for conventional aviation engines which resulted in the design of direct cranking electric starters, weighing approximately 20 lbs. less than previous designs. One model weighing 28 lbs. and consisting of a heavy duty electric motor, three planetary gear trains in series, a friction disc drive clutch and an automatic jaw engaging and disengaging mechanism, started engines rated at more than 2,500 h.p. Another model weighing but 23.5 lbs. was designed for engines incorporating a three to one ratio of engine starter drive shaft to engine crankshaft. This starter incorporated a heavy duty electric motor, two planetary gear trains in series, a friction disc drive clutch



#### BUILDING ECLIPSE GENERATORS

Assembling generator armature in the winding department of Eclipse-Pioneer Division of Bendix Aviation Corporation.



and an automatic jaw engaging and disengaging mechanism. In addition, a lightweight starter was designed for operation from 110 volt DC aircraft electrical systems. Development of starters energized by alternating current also was carried on.

Eclipse-Pioneer designed several new engine-driven alternators to meet the increased requirements for alternating current to operate radio sending, receiving and detecting equipment. They had increased performance characteristics and a saving in weight. In addition, a series of constant frequency, self-excited alternators incorporating centrifugally operated drives were developed, providing 50, 100, 250 and 750 VA for electrical instrument operation. These alternators were mounted on the accessory drive pump pad and delivered 115 volt, 400 cycle, 3 phase alternating current. Motor generators with integral carbon pile voltage and frequency regulators were refined to give improved performance characteristics. Many of the engine driven DC generators also were redesigned to give improved performance characteristics and to speed production. Carbon pile voltage regulators, accepted as an improvement in aircraft electrical system regulation, were redesigned for improved performance characteristics; and several new models were designed to meet increased operating ranges. Mechanical and electrical stabilizers also were designed to prevent voltage from exceeding predetermined settings.

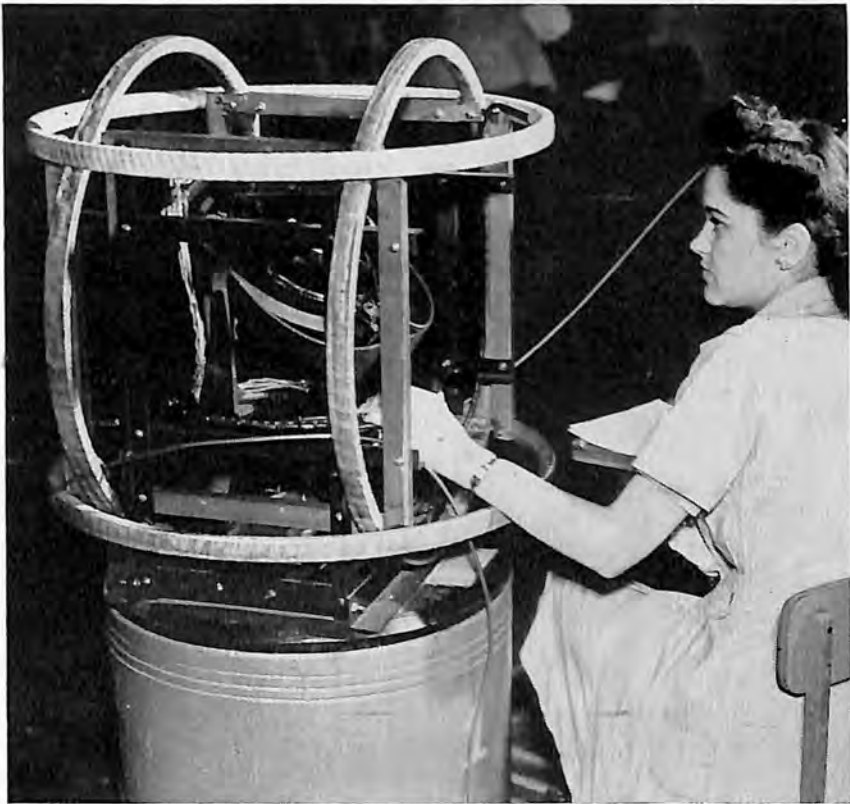
Recognizing the importance of operating valves and control equipment in attaining more effective ice removal with the new types of inflatable de-icers, Eclipse-Pioneer carried on development work, and many of the late military airplanes were equipped with the new Eclipse manifold-solenoid de-icing system. It afforded distinct advantages over previous systems, and was finding wide acceptance on large aircraft. Similar installations for smaller aircraft were being developed. Much work was done on standardization of de-icer systems into two or three basic types for applications to all types of aircraft. For example, a new self-contained electric driven Eclipse roots blower and snap-action distributor combination unit was developed for fighter aircraft. The Eclipse electronic de-icer control was redesigned, effecting a weight saving of 6.5 lbs. over the previous model. The electronic de-icer control provided complete flexible control of the de-icer system to suit the particular kind of ice encountered. Units were operating in Canada and on regular transatlantic aircraft.

Eclipse engine driven air pumps for vacuum operated instruments and de-icers were in quantity production, and engineering effort was directed mainly toward simplification of design and improvement of altitude performance. Cabin superchargers for large aircraft were investigated and several high output variable speed Eclipse centrifugal blowers were designed for aircraft undergoing development. Much work was devoted to multi-stage units in an attempt to keep down speeds, weight and envelope size. A new light-weight, compact fluid

pump was designed and placed in production. Altitude tests of the three gear pumps showed superior altitude performance characteristics, resulting in its increasing application on internal combustion heaters where dependable altitude performance is essential.

A new Eclipse cabin control valve was developed and flight tested. Smaller and lighter than existing valves, it had an extremely wide range of control, and would regulate accurately at negligible air flows, making it particularly effective on fighter aircraft where cabin leakage in the past had resulted in difficult control problems.

As a result of field service, Eclipse electric actuators were redesigned to provide improved operation and longer service life. Increasing acceptance of electric actuators for operating bomb bay doors, lowering and retracting landing gear and actuating wing flaps resulted in design of a complete line to meet the many and varied operating requirements of aircraft both in production and undergoing design. Eclipse servo control systems, consisting of servo motors with integral



PIONEER GYRO FLUX GATE COMPASS

Final tests on the Pioneer gyro flux gate compass at the Philadelphia plant of Bendix Aviation Corporation's Eclipse-Pioneer Division.

autosyn follow-up, autosyn transmitters and amplifiers all interconnected, were developed to operate from power source of aircraft both in production and undergoing design. They provided remote, automatic, coordinated control of aircraft main engines, elevators, rudders, flaps, aileron control surfaces and any other function requiring positive straight line or rotary motion with or against opposition to effect an accurate adjustment.

Eclipse-Pioneer's automatic engine controls received considerable engineering attention, resulting in the development of supercharger regulators designed to perform dependably at high altitudes. Aircraft supercharger regulators complete with provisions for war emergency power were placed in quantity production. Automatic engine boost controls were designed for large aviation engines. Collaboration with aircraft engine manufacturers continued, resulting in the development of a number of new accessories for jet-propulsion aircraft and conventional airplanes still in a confidential classification.

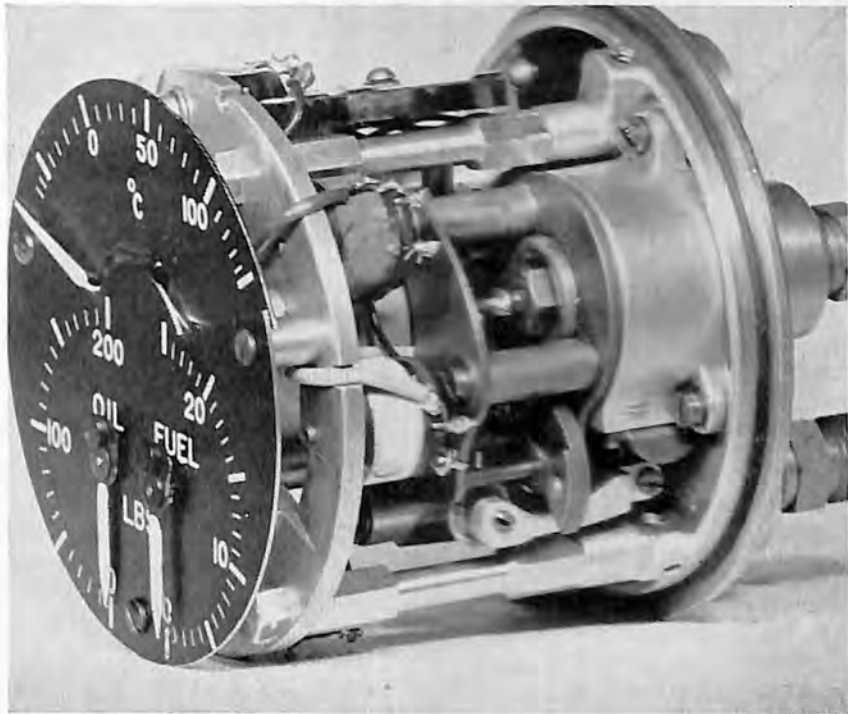
The Pioneer Instrument section of the Eclipse-Pioneer Division, at its Philadelphia plant was in peak wartime production on its gyro flux gate compass system for air force and transport navigation. Improvements were made in the compass. The directional signal was fed into the computer of the air position indicator, which was a four-unit navigational aid developed for military and long-range operations. It provided a continuous register of true air position in latitude and longitude, and the air miles traveled. The computer unit integrated the air mileage and direction factors. Pioneer increased production on its gyro-stabilized drift meter, and maintained peak production of its Autosyn instruments for measuring and remote indication of engine r.p.m., fuel flow and pressure, liquid level, and manifold, oil and temperature pressures. Pioneer placed in production a complete new line of Magnesyn remote-indicating instruments. The Magnesyn system was free from errors resulting from voltage variations and temperature changes. Friction torque of brushes and sliding contacts, as well as bearing friction of rotor weight, were overcome by means of small bearings and jeweled pivots, the pivots supporting a total rotor weight of one gram. Pioneer also stepped up production of its accelerometers, airspeed indicators, altimeters, electric gyro-horizon controls, air-driven and electric turn-and-bank indicators, rate-of-climb indicators and suction gages.

Thomas A. Edison, Incorporated, West Orange, N. J., which entered the aeronautical field in 1939, through its instrument division, expanded its line of aircraft instruments and aeronautical accessories. Production of the Edison design of moving magnet ratio type thermometer indicator for the Army and Navy was continued both at the Edison plant and by another contractor working to this design at Army Air Forces' request. The Edison engine gage unit, which combined in one case an electrical thermometer indicator, an oil pressure gage and

a fuel pressure gage of the vented type, was produced both in the style incorporating a non-ratio thermometer and in the new AN form with ratio type thermometer. Design was completed and production begun on an improved form of vented fuel pressure gage such that operating pressures as high as 30 lbs. per sq. in. could be applied to the vent connection with pressures as high as 60 lbs. per sq. in. to the fuel connection without damage to the instrument or sacrifice of accuracy.

A production design was completed for the Edison aircraft fire detection system in which the detector units, each containing a thermocouple, were located in the area to be protected and connected to a relay which responded to the current generated when flame or hot gases struck the thermocouples. The system was compensated for the relatively slow rates of temperature change encountered in normal flight but responded quickly to rapid rates of temperature rise, indicating the presence of fire within one to five seconds after its outbreak. The system was not damaged by fire. When the flame had been extinguished, the system so indicated, and was ready to respond to any recurrence of fire.

Edison also made various special applications of the novel moving



EDISON ENGINE GAGE UNIT

Showing enclosed capsule fuel pressure gage.

magnet type of electrical instrument which eliminated hair springs and substantially reduced instrument weight, and also of the enclosed capsule type of differential pressure gage. The Edison line of thermostatic switches and thermal timing relays found numerous aeronautical applications. They were distinctive in that they were completely sealed in glass and operated in a vacuum or in an atmosphere of inert arc-quenching gas. That construction provided an electrical contracting device which had high current breaking capacity both on AC and on DC in a small size, with the capacity independent of altitude.

Edo Aircraft Corporation, College Point, N. Y., went through another period of limited expansion in order not only to accomplish the Army and Navy's need for float gear, but also to assist in the fabrication of F6F fighters by manufacturing a number of subassemblies on a subcontracting basis. Floats for the Navy were largely for the SC-1. These floats incorporated a number of unique features not previously tried. Edo-equipped OS2U airplanes were standard float observation planes of the United States Fleet, serving throughout the world. Edo received from the Navy a limited production order for single-seat scout seaplanes. This ship was entirely an Edo design, details of which were held secret. Work for the Army Air Forces included completing of production orders for L-1A and C-47 amphibious floats, and the fabrication of standard floats for L-4 and L-5 airplanes. These two latter models, except for color of paint, were the well known Edo pre-war models which equipped the light planes such as Pipers, Aeroncas, Luscombes, Taylorcrafts and Fairchilds.

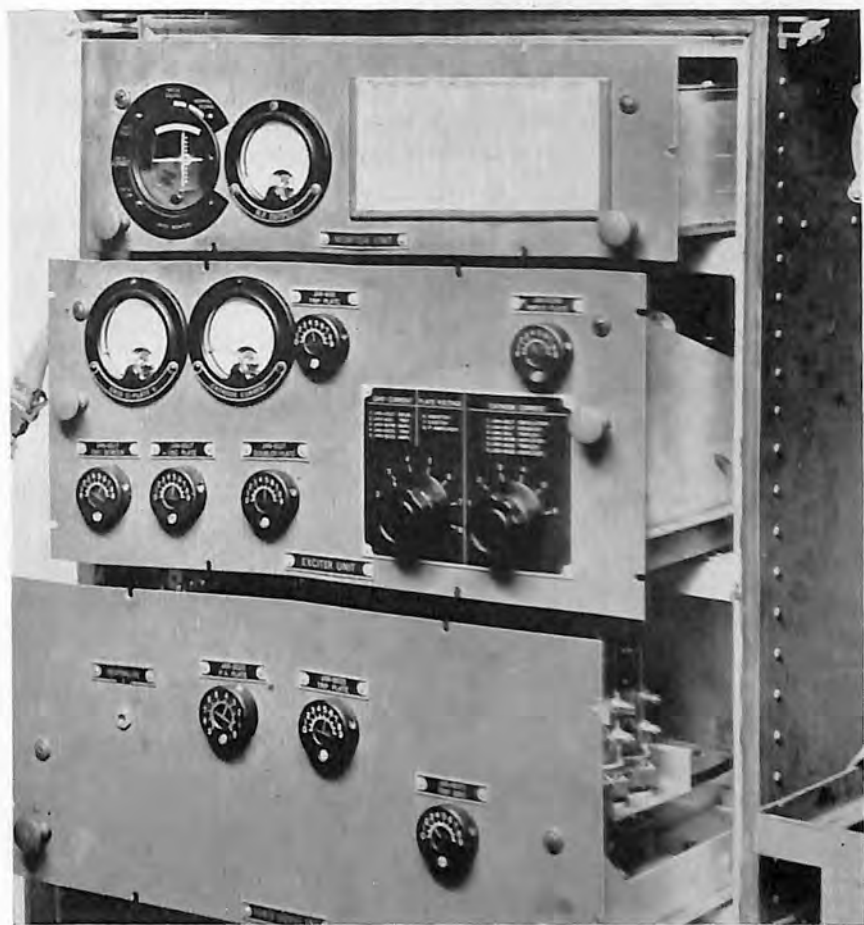
Eisemann Corporation, Brooklyn, N. Y., devoted a major part of its production facilities to magnetos for ultimate use on helicopters.

Engineering and Research Corporation, Riverdale, Md., was in production on several secret devices for the Army and Navy, and was supplying aircraft manufacturers with its special line of Erco sheet metal working machinery, including automatic punching and riveting machines, hydraulic stretching presses, shrinkers and stretchers, sheet metal formers and propeller profiling machines.

The Exact Weight Scale Company, Columbus, O., was in wartime production of scales with mechanical overweight and underweight indication for balancing connecting rods, pistons, propeller blades and other moving parts. The high speed at which war planes were compelled to operate required the closest weight tolerances, especially in the manufacture of moving parts. The Shadowgraph scale, also manufactured by The Exact Weight Scale Company, had a shadow indication and was used for very close industrial weighing, approaching laboratory accuracy on a production basis. It also was used for close balancing of connecting rods, pistons, impregnating valves, controlling molded parts and the production weighing of numerous other parts used in airplanes.

Federal Products Corporation, Providence, R. I., developed and

produced new and improved precision measuring instruments, including dial indicators and dial indicator gages for dimensional control in aircraft and engine construction. The new Federal instruments included a micrometer comparator, a height gage, a series of snap gages with a retractable lower anvil and a series of J and W perpendicular indicators. A new "cushioned" movement was developed and applied to some of Federal's regular catalog gages. The new Federal electronic comparator was ready for distribution. It was a positive and accurate measuring instrument for high speed production or rapid final inspection. Red and green limit lights showed immediately any variation in specified dimensions. Federal also produced a balanced line of thickness, bore and caliper gages, as well as internal and external com-



FEDERAL GLIDE-PATH TRANSMITTER UNIT

Part of a portable instrument landing system developed for war operations by Federal Telephone & Radio Corporation.

parators, super-sensitive concentricity gages, cylinder gages, cylinder diameter, Arnold grinding, hole and inspection gages; and further, a parallelism gage among several other types.

Federal Telephone and Radio Corporation, Newark, N. J., manufacturing associate of the International Telephone and Telegraph Corporation, was in accelerated production of radio and other communications equipment, selenium rectifiers, high-frequency cable, vacuum tubes, crystals and transformers, radio aids to aerial navigation and related electrical equipment. After nine years of research, Federal developed its "pulse time modulation," a new system of radio communication permitting voice and facsimile transmission and reception on as many as 12 channels at one frequency, simultaneously, without interference. It offered advantages in air traffic control and aerial navigation besides general communication.

Federal added to its blind landing equipment an improved glide path system, and portable systems were produced for the Services. Federal increased production of its instantaneous direction finder, used to locate the exact geographical spot from which radio signals emanate, and a light compact airborne model planned for future production would automatically guide a pilot on a true course in the direction of a selected incoming signal. Federal products also included range stations, marker beacons, transmitters, high frequency cables, h.f. transmission lines, selenium rectifiers, a new well-regulated filtered power supply for testing instruments and controls, a new inverted failure relay, a new automatic selector [Series 810] providing multi-circuit control and so small that it could be held in the palm of the hand, an 810 lever key requiring less than half the usual space but permitting more than 300 switching combinations, a newly developed high frequency 200-kilowatt tube for high power broadcast and industrial heating applications, a new rugged, compact power tube for high frequency heating applications, and 1, 3, 7 and 25 kilowatt Megatherm high frequency heating units.

Firestone Tire & Rubber Company, Akron, O., added to its vast line of military products by reconverting a gun plant to quantity output of rocket launchers for combat planes. The rocket launching tubes, were 10 ft. long and  $4\frac{1}{2}$  in. in diameter. Three tubes were formed into a cluster and were mounted under the wings of aircraft, one cluster under each wing. The launchers were made from either magnesium or from plastic-hardened paper. A complete launcher produced from magnesium weighed only 85 lbs., and a paper one still less. The launchers were discharged electrically, and each tube fired only one rocket shell before reloading became necessary. While many details of the launching method and the rocket itself remain secret, military authorities have credited the rockets with an important role in the conquest of Saipan and in other American offensive operations. The Firestone-built launchers were adjustable to fit P-38 Lightnings, P-39

Airacobras, A-20 Havocs and A-36 Invaders. They were held in place by attachments similar to those used when auxiliary gasoline tanks or bombs were fastened to the aircraft.

Firestone solved one of the most difficult service problems by developing a new tool for loosening large airplane tire beads from the rims. In the past, caterpillar tractors and half-tracks frequently were rolled across the tires to break them from the rims, but with the new tool a woman could do the job in a few minutes. A metal bar, hooked at one end, with an adjustable lever attached near the straight end of the bar, and two detachable hooks made up the bead-loosening tool.

Firestone acquired G & A Aircraft, Inc., formerly the Pitcairn Autogiro Company of Willow Grove, Pa.

The Flex O Tube Company, Detroit, Mich., was in peak production on Government specified aircraft flexible hose assemblies for oil, fuel, instrument, oxygen, supercharger and hydraulic actuation.

Flightex Fabrics, Inc., New York, was operating on a three-shift basis producing aircraft fabrics under the trade name of Flightex for the Army and Navy air services and the aircraft manufacturers. Among the products was a special fabric for gliders.



#### COMPLETING ROCKET LAUNCHERS

These women in the Firestone plant at Akron, O., are fitting the wires which operate the electric firing mechanism on the launchers fitted under the wings of the plane in clusters of three.



Foote Bros. Gear and Machine Corporation, Chicago, Ill., was in peak war production on precision gears for aircraft engines. Its output was over a million of these gears a year. Other precision power-transmitting equipment for new aircraft was produced by Foote Bros. which set up an aircraft devices division. The company also produced gears to turn the gun turrets on bombers, to raise and lower under-carriages and to transmit power to helicopter rotors.

The Formica Insulation Company, Cincinnati, O., produced several grades of materials for aircraft. Its grade CNP-11 forming stock could be shaped by heating the sheet material in a high temperature oven for a short period prior to molding. Grade MF Formica was developed for high frequency applications where only a very low electrical loss was permissible. Grade FF-41 produced a non-burning high arc resistant laminated material which would not support fire, and therefore was of value as instrument board panels. Grade AAA-79 replaced applications where asbestos fabric base grades had been used, and was as strong as the AA material while taking a smoother finish. Formica airplane control pulleys were in mass production. A new factory produced Pregwood for propeller blades.

General Controls Company, Glendale, Calif., with a background of 15 years' experience in manufacture of automatic pressure, temperature, and flow controls for industrial and commercial use, pioneered the application of automatic control valves and temperature controls in the aviation field. Foremost was the development of a line of \*hi-g electro-magnetic control valves for regulation of hydraulic fluid, gasoline, lubricating oil, water and vacuum. \*Hi-g indicated positive ability of the control to operate in any position regardless of vibration, change of motion or acceleration. These flow control valves were furnished in 2-way, 3-way, and 4-way types capable of handling pressures up to 3,000 p.s.i. with fluid connections from  $\frac{1}{8}$  in. to 3 in. i.p.s., flanged or with tube connections. Their light weight, compactness and long operating life were expressed in millions of repetitive operations. A further development in the line of automatic shut-off valves was the \*hi-g electric motor-operated valve for gasoline, lubricating oil and hydraulic fluids. Fluid connections were  $\frac{3}{4}$  in. to 3 in. i.p.s., flanged or with tube connections. General Controls Company also pioneered the application of automatic coolant temperature controls and lubricating oil temperature controls for both liquid and aircooled aircraft engines, and also cabin heating temperature controls of all types for transport and combat planes.

The General Electric Company, Schenectady, N. Y., designed and produced the armament systems for the new Army Air Forces bombers and night fighters which first saw combat in 1944, the B-29 Superfortress, the A-26 Invader, and the P-61 Black Widow. These systems all provided remote control of the uninhabited turrets from strategic sighting stations elsewhere in the airplane. It marked a new era in

aircraft armament, because it was the first time that the inherent flexibility of electric control had been used to join all turrets on a combat airplane into an integrated armament system. The result was greater protection with fewer guns. These new armament systems were designed to provide gunfire accuracy hitherto unknown in airplane turrets. The B-29 Superfortress was equipped with remote computers that automatically calculated all the necessary corrections to point the guns so they would hit the target when the gunner was aiming directly at it. Remote-control armament on the B-29 also permitted keeping the gunners in pressurized compartments without additional complications. General Electric also was applying remote-control armament systems to other new airplanes yet to see combat.

The General Electric Company's important work on development and production of jet-propulsion engines is described in Chapter X.

Nearly 300,000 turbosuperchargers of G-E design had been produced since Pearl Harbor. Combat planes in high production using turbosuperchargers were the P-38 Lightning, P-47 Thunderbolt, B-17 Flying Fortress, B-24 Liberator and the B-29 Superfortress. The latest models of turbosuperchargers supplied air to engines of twice the horsepower and maintained full power to considerably higher altitudes without any increase in weight over the early models. General Electric, in cooperation with Pan American Airways, conducted extensive flight testing of all their aircraft products with a fleet of various types of airplanes on loan from the Army Air Forces.

General Electric expanded production of high-tension ignition systems for Pratt & Whitney 18-cyl. aircraft engines to supply requirements for the P-47, P-61, A-26 and C-46. Several features improved the performance of these systems over those of conventional design. Combination half-speed magneto distributor units with no internal gearing resulted in fewer parts, increased reliability and simplified maintenance. The minimum number of parting lines required, and unique gasketing methods, reduced the radio noise level. Adequate spacing, and use of improved plastics and ceramics, improved high-altitude operation and reduced high-voltage failure of parts. Filling of the ignition shielding assembly eliminated moisture and acids. Reports from combat theaters indicated wide acceptance of these systems. Development work continued on a high-frequency, lower-voltage system employing special spark plug units. This system provided relief from the many common ignition problems due to high voltage, including altitude operation, plastic failures and moisture difficulties. It also fired badly fouled spark plugs, improved plug life, and had a low starting speed.

The G-E automatic pilot was being produced in quantity for both Army and Navy airplanes. The feature of G-E autopilot was its system of electric-driven gyros, which permitted better operation at high

altitude. Signals were picked off electrically, amplified electronically, and fed into an electric transfer valve. In addition to the relief pilot, there were other pilots available for special applications.

The General Electric Company was actively engaged in development of systems for use in aircraft applications. Working closely with aircraft manufacturers and users, G-E engineers were able to make far-reaching and significant improvements in generating systems, for example, by proper protection of the system against fault, and the rapid clearing of system faults when they occurred. Other systems which were being developed and improved included automatic temperature control, automatic synchronizing of wing flaps and trim tabs, and remote positioning of such control functions as throttles, waste gates and air surfaces. All G-E investigations involved the characteristics of motors, control, generators, relays, circuit breakers, regulators, and other devices required for complete and over-all systems in aircraft. As the work progressed, the knowledge and experience was shared not only with the Army Air Forces, the Navy and the aircraft manufacturers, but also with the civil air lines who were to be ultimate users of much of this equipment in the postwar era.

Active General Electric production embraced the following: aircraft gas turbines, auxiliary-engine generators, cabin superchargers and control, control devices, dynamotors, electrically heated flying suits, gear-driven superchargers, generator regulators and reverse-current relays, ignition accessories, instruments, lighting accessories, magnetos, main engine generators, motors, plastics, propeller control devices, radio transmitters and receivers, solenoid switches, transformers, turbosuperchargers, turbosupercharger regulators, turret-control equipment, and wiring and wiring devices.

Globe Steel Tubes Company, Milwaukee, Wis., developed a tubing for aircraft parts, named Globeiron, possessing high magnetic permeability, and continued to produce 83 different parts used in aircraft construction, including welded stainless steel tubes named Gloweld, which first were welded and then cold drawn to remove all indication of flash and weld. Globe tubes were made from all alloys, including seamless carbon, alloy and stainless steel. They combined structural strength with adaptability and uniformity, and were machined easily. Metal oxygen bottles for airmen parachuting from high altitudes were made of Globe seamless steel tubing.

The B. F. Goodrich Company, Akron, O., was at peak production on a great variety of aeronautical accessories, including de-icers, tires, aircraft hose, bullet-sealing fuel cells, exposure suits and life rafts. The aircraft tires in sizes generally used in military operations were converted to about 70 per cent synthetic rubber. Nylon was used extensively in the development of extra high pressure tires to meet increasing load demands. The new Rotovane tire, designed to rotate before the plane lands and thus avoid wear and damage, was further

developed. A pressure-sealing zipper was developed to hold gases.

Grimes Manufacturing Company, Urbana, O., designers and manufacturers of aircraft lighting equipment, introduced several new types of lights for aviation service. An improved ultra-violet light with integral control was developed for instrument panel illumination. This Grimes Model B-2930A was designated as Army Type C-8. Experiments also were conducted with red lighting for instruments, and a small individual instrument unit was produced for Navy service. Two new electrically retractable sealed-beam landing lights were made available for fighter aircraft. One of these, Model D-3040, should find wide application in postwar smaller aircraft. Grimes expanded its activities in the small motor field and successfully applied its plastic-enclosed light-weight motor to numerous aircraft services.

The Guiberson Corporation, Dallas, Tex., its plants equipped with specially designed machine tools, complete hydro-press and drop hammer facilities for sheet metal forming in both aluminum and stainless steel, and with heat-treating, parkerizing and cadmium plating departments, produced a wide variety of aircraft parts from small, individual units to large assemblies. In the parent plant Guiberson manufactured aircraft welded tubular structures for prime contractors, jigs and fixtures, and machined aluminum castings and forgings, in addition to the production of chemical mortar shells and oil field tool equipment. Large quantities of turbo supercharger duct couplings of Buna-N type synthetic rubber were produced, in addition to normal production of Guiberson oil field equipment, including packer rubbers and swab cups. The Aircraft and Heater Division, with an enlarged engineering staff, continued to produce highly specialized aircraft parts for Douglas, Lockheed, Boeing, Consolidated Vultee, Globe and others. New, fast techniques for engineering and producing unusually difficult sheet metal parts, including new and intricate types of baffles, were developed. The division also manufactured engine mounts for a large bomber (on the restricted list) which was considered by aeronautical engineers to be one of the most difficult types of welded high stressed assemblies, because of the close tolerances involved. Other products included exhaust manifolds, camera mounts, machine gun mounts, fire walls, exhaust collector rings and intricate cooling ducts and baffles, requiring highly skilled drop hammer operators, punch press operators, welders and assembly men.

Guiberson also opened an additional plant for the fabrication of a complete hot air heater duct system for use in the B-17 Flying Fortress. This system consisted of approximately 1,000 subassemblies, which were fabricated almost entirely of sheet aluminum alloy and stainless steel. They were supplied to Boeing, Douglas and Lockheed. This plant also manufactured tail cone assemblies, bomb hoist assemblies, and other restricted major aircraft components.

Guiberson continued development work on its radial aircooled

Diesel engine for aircraft use, and worked on several restricted experimental programs in its recently improved experimental research laboratory.

Gulf Oil Corporation, Pittsburgh, Pa., was in peak production on its complete line of aircraft fuels and lubricants.

The Hallicrafters Company, Chicago, Ill., manufacturers of short-wave radio communications equipment, was responsible for many improvements in constructional details of equipment. Some changes in design were made to expedite production and make possible the use of unskilled help. Others were prompted by reports from the field indicating possible improvements from an operational standpoint. Hallicrafters took over the former Buick plant in Clearing, Ill., making a total of nine factories in the Chicago area operated by the company. The plant was used for the production of the SCR-299 mobile radio communications truck and its variations, the SCR-399 and SCR-499. The assembly line for the BC-610 transmitter, Hallicrafters pre-war Model HT-4, used in this unit, also was located in Clearing. Completely self-contained in a truck and trailer combination, the SCR-299 was capable of communication by voice or code over distances of several hundred miles day or night. Using the whip antenna mounted on the truck, it transmitted from North Africa to London and with the larger antenna used in semi-permanent locations, it was easily capable of transoceanic communication. Hallicrafters increased production of several of its communications receivers, including Models SX-28, S-36, S-29 and several special purpose receivers. The Hallicrafters S-35 panoramic adapter was used in monitoring activities by the Federal Communications Commission.

Hamilton Standard Propellers division of United Aircraft Corporation, East Hartford, Conn., together with its four licensees, reached a new high in production during 1944. At its East Hartford plant, preparations for the quantity production of new and more highly developed propeller models continued, with installation of new machinery and an increase in engineering and experimental activity. The four licensees, Nash-Kelvinator of Lansing, Mich., Frigidaire of Dayton, O., Remington-Rand of Johnson City, N. Y., and Canadian Propellers of Montreal, Canada, swung into high gear on production of Hamilton Standard propellers for thousands of the nation's warplanes. The shadow plants at Norwich, Conn., and Westerly, R. I., continued to occupy an important place in the division's production picture. Having filled its war-born purpose, and as a result of changing military requirements, the plant at Darlington, R. I., was closed at the end of 1944, and its machinery absorbed by the other plants.

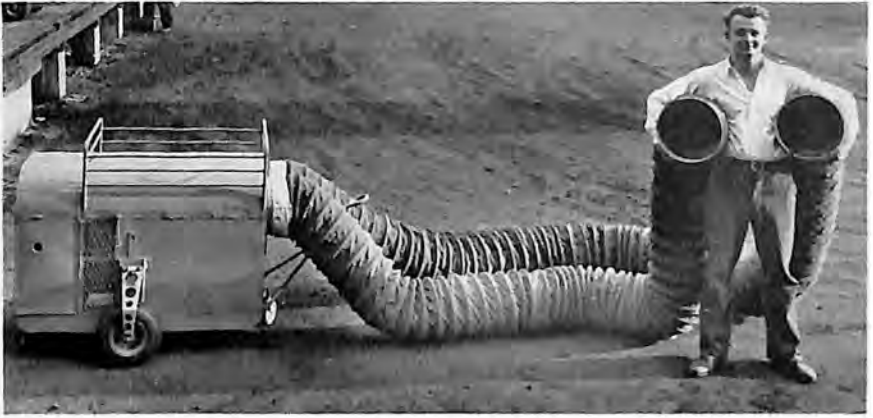
In January, 1945, the division and its American licensees produced the 500,000th Hamilton Standard propeller, setting a world record for production in this field. The figure, carried from 1932 when the first Hamilton Standard controllable-pitch propeller was produced,

highlighted the tremendous war record of the company and its licenses. More than 80 per cent of the total was produced after December 7, 1941. The company installed a number of new quantity-production machines for blade grinding. With them, propeller blades were "stropped" by an endless abrasive belt to desired tolerances, and their introduction into the blade shaping procedure was described as an outstanding change in modern blade manufacture. A chemical de-icing lacquer for aircraft propellers, developed and marketed by the company during the year, immediately found wide acceptance.

New and improved airliners for post war service were to use Hamilton Standard hydromatics. Included were the Douglas DC-4 and DC-6, Consolidated Vultee's Liberator liner, Martin Model M-202 and the Fairchild C-82 Packet cargo plane. A hydromatic propeller returned to the factory for overhaul after serving Transcontinental & Western Air for 13,881 flying hours, was returned to the air line with recommendations that the useful life of the hub be extended to 15,000 hours. It set a new record for length of propeller service.

The Harris-Seybold-Potter Company, Dayton, O., was in expanded production on the Morrison Metal Stitching Machine, a war-time development that had put stitching into a new category. It had become a precision operation. The machine provided a fast, versatile method of fabricating or assembling such materials as heat treated aluminum alloys, tempered and annealed stainless steel, cold-rolled steel, cork, wood, asbestos, plastic, rubber and canvas in any combination and thicknesses up to  $\frac{3}{4}$  in. In a single operation, the machine formed its own stitch of .051 zinc coated high carbon steel wire, which would stand a 200-hr. salt spray test, drove and clinched it. This method effected an average saving in time of over 70 per cent. The machines were simple to operate, only one operator being required, with no special skill. Maintenance was reduced to a minimum, as Morrison Stitchers were ruggedly built. They were produced in four models, and consisted of an arm stitcher, a bottom post stitcher, a 90-degree angle head machine right hand arm and another with left hand. There were also two postwar models which were fast replacing many lighter, less durable steel stitchers.

Harvey-Whipple, Inc., Springfield, Mass., was supplying the Army and Navy air forces with increasing numbers of its specially designed and improved heater for preheating aircraft engines and cabins and, among other military auxiliaries, repair shops and tents. It generated enough heat for three houses, and was a prime necessity with the air forces operating in freezing, particularly sub-zero, temperatures. It was made in two sizes, one developing 300,000 and the other 150,000 B.T.U. The larger unit weighed 390 lbs. The heater was equipped with retractable wheels and sled runners, so it could be pulled over rough ground or snow. It generated heat by burning



#### THE HARVEY-WHIPPLE PREHEATER

The 18-ft. hot air ducts can be folded up like an accordion into a 2-ft. space.

either gasoline or No. 2 fuel oil in a stainless steel combustion chamber, and the heat was non-toxic, so it could be used anywhere safely. Harvey-Whipple developed new type ducts which were accordion style, and could be extended to a length of 18 ft. or compressed to a length of only two ft. Other notable improvements included complete winterization, with all moving parts enclosed inside an insulated jacket. The engine ran inside its own heated compartment and thus was protected from frost, sleet and wind. In the past, exposed heaters, when operated at temperatures as low as 40 degrees below zero, had their carburetors freeze and their crankcase oil stiffen. Harvey-Whipple cured this; first by enclosing the engine and second, by running small heat ducts to both carburetor and crankcase. To solve the problem of servicing the tiny engines or other parts of the fuel unit in bad weather out-of-doors, the makers developed a quickly demountable power plant which could be removed in 30 seconds without tools. Also, the engine could be taken indoors and kept overnight so it would be warm when installed in the heater next day. Still another improvement was the automatic ignition by means of an electric spark, eliminating the former need for lighting the flame by hand torch. The heater would run continuously for eight hours and supply 250 degrees above outside temperature.

Hayes Industries, Jackson, Mich., designed and built wheels and brakes for aircraft of all weights and landing speeds. The 4-engine bombers were equipped with Hayes wheels and expander tube brakes.

Hayes Manufacturing Corporation, Grand Rapids, Mich., producer of aircraft subassemblies, parachutes, ordnance and dies and stampings, also manufactured outer wing panels and various control surfaces for aircraft. Hayes continued to be a large producer of life saving parachutes; and added to this division the manufacture of frag-

mentation bomb parachutes. Output of afterbody torpedo shell assemblies was increased materially. Hayes continued the fabrication of tools, jigs and metal stampings and completed its preparations for the production in large quantity of a complete truck cab of prime military and postwar importance.

Heath Company, Benton Harbor, Mich., developed important plastics parts for aircraft, including a plastic bonded plywood float.

The Hilliard Corporation, Elmira, N. Y., had a staff of engineers prepared to survey the oil-purifying problems of the industry, and supplied a line of Hilco units for engine oil reclaiming, run-in oil purifying, portable units for purifying oil in the field and filters attached to engines.

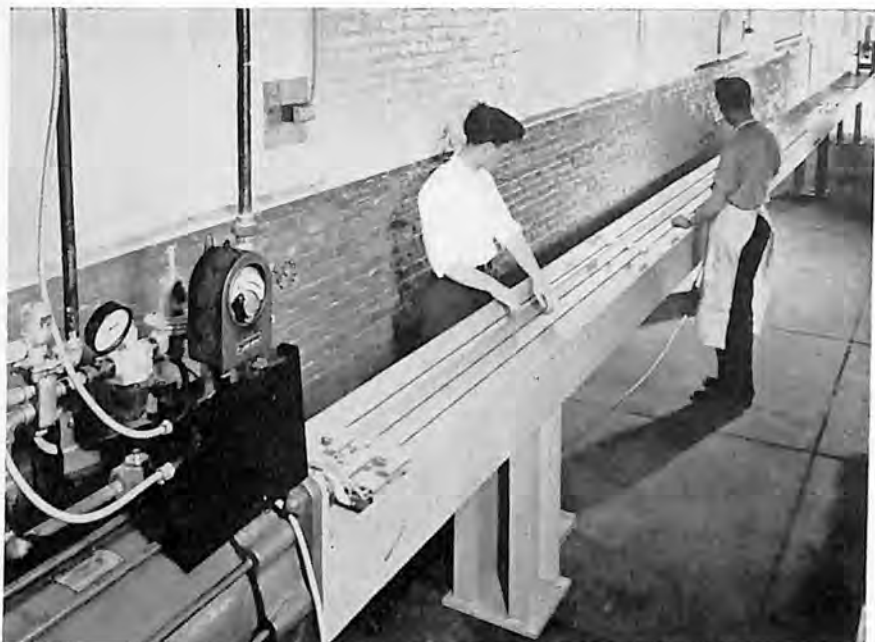
Hub Industries, Inc., Long Island City, N. Y., centered its peak war production on piston and gear type pumps for hydraulic actuation of gun turrets, control surfaces and different types of landing gears for aircraft. A combination electrically driven power package was developed for remote actuation of hydraulic units where use of a centralized hydraulic system was prohibitive. New engineering activities included development work on high pressure, high volume fuel pumps for new power plants, an automatic gyro control pilot involving a new principle of electrical control, and also the design of aircraft instrument movable repair shops which doubled the floor area of an automotive trailer shop when it was expanded for operation.

Hyland Machine Company, Dayton, O., was in production on parts for the aircraft industry, including special clips and clamps, various types of manual control assemblies, fork end, rod ends forged and milled from bar, screw machine and turret lathe products and small stampings. Hyland's fully-equipped tool room, machine and drill departments were available to the Services and the aircraft manufacturers.

Industrial Sound Control, Hartford, Conn., engineers and contractors for heat, cold and sound insulation, utilized Soundstone acoustical stone cast in blocks or slabs in treating test cells at the plants of numerous aircraft engine manufacturers. Because of the noises developed during full throttle test of powerful engines and propellers, the noise level in an untreated structure goes as high as 165 decibels. By treating the stacks or flues in the test houses, the firm was able to reduce this noise level to below 100 decibels. The company completed installations at the Pratt & Whitney, Wright Aeronautical, Ranger, Jacobs and Lycoming plants. A low cost standard type test house was in process of development; and the company also was planning to produce a compact, portable unit available to aircraft service stations throughout the country.

Interstate Aircraft and Engineering Corporation, Los Angeles, Calif., with an aircraft precision units plant in El Segundo, Calif., and a plant in De Kalb, Ill., accelerated the production of precision units





#### JACOEL TENSION TESTING MACHINE

It tests four 52-ft. rows of cable at one time.

such as bomb shackles, machine gun and cannon chargers, hydraulic actuating cylinders, accumulators and hydraulic valves. These units were manufactured to Interstate's own designs or were produced according to the designs of individual companies.

Jack & Heintz, Cleveland, O., was in peak war production on a number of instruments and parts used in fighter planes, bombers, transports, patrol boats, trainers, gliders and blimps. Jack & Heintz engineering was concentrated on reducing weight, increasing service life and developing greater output of aviation accessories of vital importance to our war effort.

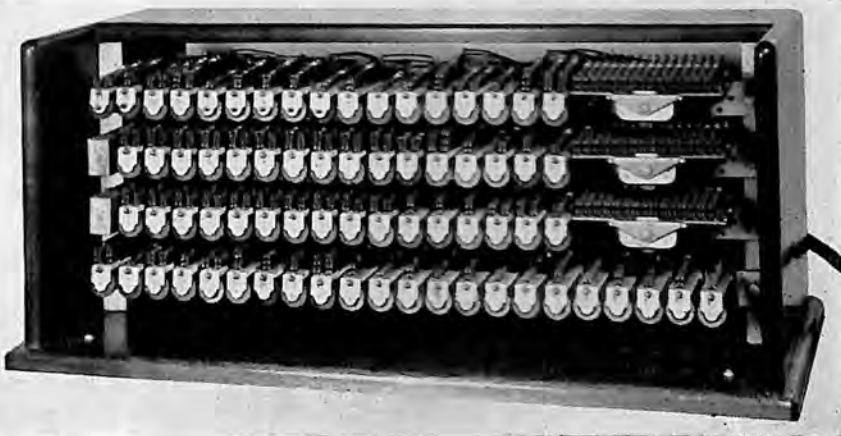
Jacoel Cable Splicing Equipment Company, Buffalo, N. Y., increased production of aircraft cable splicing to five times that of the previous year, using expanded plant facilities and improved techniques that produced 50 per cent more work per employee. The new Jacoel No. 9 machine for one-half to one inch diameter cables was popular with the manufacturers of hoisting slings. Jacoel also developed a precision cable stretching machine for accurate testing of load, which had many advantageous applications. It greatly reduced testing time. It could test four rows of cables at once, each row up to 52 ft. long. Thus it could proof load from four 52-ft. cables to 200 one-ft. cables at one time. A permanent test table connected the air cylinder piston to the scale, which was set at the required poundage. Operation of the

machine was automatic. It saved costs through its ease of operation, and met Army Air Forces specifications.

Joyce Aviation, Inc., Chicago, Ill., through its Airchox division, produced a line of precision aeronautical equipment, including parachute hardware, collapsible wheel chocks, exact airspeed computers, mooring anchor kits, tow targets, shoulder safety belts, and aircraft spinner and propeller blades.

The Keeney Manufacturing Company, Newington, Conn., developed design and production methods for exacting precision tube bending to the closest possible tolerances. The company produced ranges from  $\frac{1}{8}$  to 3 in. in brass, copper, mild and stainless steel and aluminum.

Kellogg Switchboard and Supply Company, Chicago, Ill., was at peak production on communications equipment for the armed forces. Much of that equipment was specifically designed for aviation communications, including small capacitors for aircraft radio receivers and transmitters to complete telephone crash alarm systems for installation at airports and ground stations. Throat, hand, desk and palm-type microphones were made in large quantities; also head and chest sets (transmitter and receiver units) for connecting into radio and telephone systems; special aviation headphone receivers with soft rubber ear muffs to keep out extraneous noises; jack boxes and volume control boxes for use with aircraft interphone equipment and other purposes; radio noise filters; rubber covered cords with attached jacks and plugs; multicontact plugs and sockets used in aircraft electrical wiring systems; band switches; expanding and retracting rub-



AN AIRPORT SYSTEM SWITCHBOARD

A 20-line Kellogg PAX all-relay switchboard unit with front cover removed. This product of the Kellogg Switchboard and Supply Company affords an ideal communication set-up for use in connection with airport protection equipment. Versatility and economy of operation make it a key item in many airport systems.

ber-covered coiled cords for cockpit lamps; capacitors and other component parts for use in aircraft radio receivers and transmitters. Communication equipment for aviation units included manual and relay operated crash alarm telephone systems for use at airports, which made it possible to report accidents from stations located at various points within any given area to a master central station and to service groups. Emergency fire reporting switchboards also were supplied.

Kennametal Inc., Latrobe, Pa., continued to supply single point tools of conventional type and newer designs having mechanically held tips, but the current progressive trend was in the field of carbide milling cutters. The step Kennamill, available in a range of sizes, was used extensively in airplane factories. It was a simple design of multiple fly cutter with Kennametal tipped replaceable blades, having negative rake cutting angles, and set at different depths to permit heavy cuts to be taken in a series of steps where available power was insufficient to remove the required amount of metal in a single cut. It brought advantages of high speed carbide milling to any shop having milling machines of reasonably recent manufacture. The step Kennamill greatly simplified cutter maintenance; blades were the same for all sizes; could be ground free hand to a template on an ordinary carbide tool grinder with silicon carbide or diamond wheels; and could be set at the required depth with a scale. They were notably successful in milling deep cuts on such airplane parts as terminal plates and landing gear forks. Under development, and soon to be offered to metalworking industries, was a line of face Kennamills, as well as other types, having radially-set, wedged-in solid Kennametal blades with double rake cutting angles. These were evolved so that the increased power of recently-developed milling machines could be utilized fully in large-volume chip removal at high cutting speeds. Kennametal Lathe Files, developed to permit machine filing of hard steel parts revolving at the same speed as they were machined with Kennametal tools, were used extensively with outstandingly increased production results. A supplementary advancement in this field was a rotating disc file comprising sectors of solid Kennametal having filing serrations. They were particularly suitable for rapid de-burring or smoothing aluminum castings and drop steel forgings.

Walter Kidde & Company, New York, had a long list of new developments, or products which had been released from the secrecy category. They included pneumatic gun chargers, both manual and automatic models, for clearing jammed aircraft guns during combat; cargo plane carbon dioxide fire extinguishing systems; a methyl bromide fire-extinguishing system for the Martin Mars, shells and noses for the projectile fired from aerial rocket guns.

The Kilgen Aircraft Division of The Kilgen Organ Company, St. Louis, Mo., was devoting its long experience to plywood fabrication

bonded with plastic, and its personnel of skilled woodworkers, toward producing a large quantity of precision wood assemblies for the Army Air Forces. Principal work was fabrication of the empennage, interior fittings, lower nose section of the fuselage, and other parts for the Army CG-4A glider; wing fairings and berths for the Boeing B-29; a considerable number of subassemblies for the AT-21; and a large quantity of plywood aircraft seats and turret gunner seats, including a Kilgen developed new type combination plastic plywood seat for the nose turret gunners on bombers. Kilgen also produced a large quantity of glider floor assemblies and navigator tables for the Curtiss C-46 Commando.

The Koehler Aircraft Products Company, Dayton, O., manufacturers of the new poppet type oil drain valves, known as the "Koehler Type" developed a new fuel drain valve for draining moisture from fuel tank strainers and fuel systems. This new valve incorporated the Koehler principle of "two positions only—open and closed." No safety wiring was necessary, thus eliminating service hours. Production was on an accelerated basis to meet increased demands. In addition to this new valve, a new light weight solenoid valve was being developed for oil dilution and priming purpose and for cabin heaters. A new fuel selector valve also was in the process of development, and it promised great possibilities.

Kollsman Instrument Division of Square D Company, Elmhurst, N. Y., developed two new instruments indicating the airplane's relationship to the speed of sound to aid the industry's activity in the investigation of supersonic speeds and shock-wave pattern effect. The first, a Machmeter, was designed as a test instrument for use by aircraft manufacturers in determining the Mach Number at which the airplane encountered the shock-wave effect for structural and airflow analysis. According to the theory of Mach, an Austrian scientist of the 1800's, developed as a result of his work on projectiles, at the speed of sound (or Mach Number 1) the normal airflow of air no longer continued and a "compressibility burble" or "shock-waves" interrupt the airflow. As the speed of sound varies with altitude, the speed at which an aircraft encounters the shock-wave pattern varies accordingly, and varies also with the cleanness of the design of the aircraft. Graduated in Mach Numbers from .3 to 1 the Machmeter gives a constant indication of the airplane's relationship to the speed of sound, a factor normally requiring involved computations. A second Kollsman development was an instrument to give the high speed fighter pilot warning of the point at which he would exceed the operating speed of his plane and enter this dangerous shock-wave pattern—a point at which freezing of controls and dangerous vibration frequently occurred. The result was the Kollsman Maximum Allowable Airspeed Indicator, an airspeed indicator with a red maximum pointer which, instead of remaining fixed, continuously moved over the dial with

changes in altitude indicating the maximum safe airspeed for the pilot under all conditions. It had a setting for the critical Machnumber of the airplane and also for the maximum airspeed regardless of Machnumber.

Even more accurate bombing and navigation for Army Air Forces planes was insured by completion of development work and early production on the new Kollsman True Airspeed Indicator—an instrument combining for the first time the functions of airspeed, altimeter and air temperature gage to give continuous indications of true airspeed. The new indicator not only gave the bombardier and navigator the necessary factor of true airspeed without the involved computations formerly necessary, eliminating many possibilities of error, but did so more accurately than it could be computed. Compressibility effect on the thermometer bulb and pitot-static tube were important factors compensated for in the new instrument that were not normally considered in computations of true airspeed. Development work also was continued on motors for electronic control applications such as phase shifting devices and rotatable transformers and, at the optical plant in Flushing, N. Y., on several new designs of binoculars, drift sights and other optical devices.

Krembs and Company, Chicago, Ill., produced 89 different Fluxine Fluxes, one for every metal-joining operation, each with individual properties suited to the specific operation, such as gas welding, gas brazing, silver soldering, soft soldering, spelter brazing, and arc, metallic or spot welding. Krembs Fluxine Fluxes were in powder, paste or liquid form. For the aviation industry the company had developed No. 7 for welding all types of aluminum, No. 18 for gas and atomic hydrogen welding of stainless steels and inconel, No. 41 used with high-melting silver solders on copper and its alloys and on steel, and No. 43, non-glaring, used when low-melting silver solders are specified.

Kropp Forge Aviation Division of Kropp Forge Company, Chicago, Ill., was in production of airframe drop forgings exclusively. A complete new plant, urgently essential because of the enormous drop forging requirements of the aircraft program, was built on the company's property and equipped with a large battery of drop forging hammers ranging from 6,000 to 20,000 lbs., with dual furnace equipment for each hammer, trimming presses and straightening or coining presses. Modern heat treating facilities also were available. The plant's design provided for flo-line production, with crane and conveyor systems handling bars and billets to cutting rooms, to heating furnaces, to hammers, to machine shop, sand blast, pickling, heat treating, inspection and on to cars or trucks for out-shipping. The production tonnage of this division was approximately four times that of the company's previous drop forging capacity, yet with the broad use of labor-saving equipment, the manpower requirements

were only about two and one-half times that of other operations. All heating and heat treating were under complete laboratory control. A modern laboratory for making chemical and metallurgical determinations and photomicrograph studies of test bars was equipped and manned by experts. The latest types of inspection equipment were available for making surface determinations, and a new luminous Magnaflux department was added. The division produced vast quantities of drop forgings for outstanding planes, including the Black Widow, Catalina, Constellation, Flying Fortress, Hellcat, Liberator, Lightning, Mustang, Skymaster, Superfortress, Thunderbolt and the new jet-propulsion planes.

Lawrance Aeronautical Corporation, Linden, N. J., founded by Charles L. Lawrance to develop a Diesel engine for aircraft, was in production of auxiliary power plants for the Army Air Forces. In addition to producing auxiliary power plants, Lawrence Aeronautical also was engaged in experimental work for the United States and other Allied Governments. Experience gained in designing and producing the auxiliary power plants used by both Army and Navy Air Forces indicated a new line of small engines for postwar civil aircraft.

Leach Relay Company, Los Angeles, Calif., was at peak war production of relays suitable for the electrical facilities on military and air line planes, as well as similar equipment for all other branches of the service.

The Leece-Neville Company, Cleveland, O., continued to produce generators, voltage regulators, and generator current relays for use on aircraft for the Army Air Forces and the U. S. Navy. In addition, D.C. electric motors from  $\frac{1}{2}$  to  $3\frac{1}{2}$  h.p. were supplied for aircraft use, such as hydraulic system motors, turret motors, propeller feathering pump motors and others. The generators and allied control equipment were built for voltages of 15 and 30 volts, with capacities of 25, 50 and 100 amperes for the 15 volt systems; and 25, 50, 100 and 200 amperes capacity for the 30 volt systems. Improvements were made in the carbon pile type of voltage regulators used on the 30 volt systems, which made it one of the most stable and dependable regulators available. Considerable work was done on development of generator brushes to provide much longer life than previously encountered. Results indicated that well over 1,000 hours brush life could be expected from several different generator types. Many major improvements also were made in the design of cranking and battery charging equipment manufactured by Leece-Neville for all types of heavy-duty diesel and gasoline engines used by all branches of the armed forces.

The Leland Electric Company, Dayton, O., increased production on its line of power inverter units designed to convert 12 or 24-volt direct current aircraft power to 400 or 800 cycle alternating current for operation of automatic pilots, radio compasses, radar equipment and other special aircraft instruments. Leland also produced carbon pile

type voltage regulators for use in inverters and other power type generators.

Liberty Aircraft Products Corporation, Farmingdale, N. Y., manufactured aircraft accessories, precision machine parts, tools, production machine parts to order, screw machine products, milling and gear cutting work, engine cylinders, pistons and crankcases, heat treating and carbonizing in electric furnaces with atmospheric control, cadmium plating and anodizing alloy parts, aircraft sheet metal work, wing assemblies, tail surfaces, pontoons, bomb racks and complete aircraft doping and finishing work. The corporation expanded plant facilities extensively.

Lights, Incorporated, Alhambra, Calif., achieved specialization by employing subcontracting associates in five divisions. They included aircraft and marine fittings, aircraft and airport lighting, ordnance material, design and fabrication of Latisteel structures and specialized export packaging and processing.

Link Aviation Devices, Binghamton, N. Y., which produced the Link trainer generally used in instrument flight instruction, developed a new Link instrument flying trainer. Designed to fit smoothly into modern methods of teaching instrument flying, the new model contained an air loaded control system, trim tab, flaps and undercarriage controls, engine instruments and their controls and built-in longitudinal, lateral and directional stability. The new trainer had flight characteristics which closely resembled those of actual aircraft, much like an Army AT-6 or Navy SNJ. Power effect on longitudinal stability was added, and a complete change in design of the airspeed system made it possible for pilots to practise climbs and descents exactly as in a modern plane. Likewise, a propeller pitch control not only changed the tachometer indication but had the correct effect on the whole trainer. Link cylinder head temperature gauge with cowl flap control, oil temperature gauge with oil cooler shutter control, carburetor air temperature gauge with carburetor heater control, oil pressure and fuel pressure gauges were included. The engine instruments were affected by power setting, altitude and "outside air temperature" and were controlled in the same way as similar instruments were controlled in an airplane. Flaps and undercarriage were available for low approaches. When they were lowered, power and attitude had to be handled accordingly. Aural null and/or automatic direction finding practice was made possible by inclusion of a new unit, and any desired instrument landing system using a glide path and localizer beam was available. Optional equipment included a unit to record all conversation between student and instructor. This afforded the student a chance to hear his own mistakes, correct his voice technique and learn proper handling of microphone and radio telephone procedures. The records also provided a chief instructor with a check not only on the students but on the instructor as well.

Other Link devices were an aviation-marine sextant, a test colimator—which was an optical device for producing an artificial star for students and for testing sextants after repair; the Link celestial navigation class trainer which let students practise without leaving the ground; and also a map reading and dead reckoning trainer.

The Liquidometer Corporation, Long Island City, N. Y., continued manufacture of remote indicating aircraft tank quantity gauges, and in 1944 produced the largest volume in its history. Liquidometer gauges which were purchased by practically all principal aircraft manufacturers for installation on trainers, fighters, bombers, cargo, transport and utility airplanes, were used to indicate the quantity of fuel, oil, de-icer fluid, windshield alcohol, water and other liquids contained in tanks. As a result of the company's continuous experimental program many design and manufacturing improvements were made. In addition, the company's special research department made considerable exploration of new operating principles.

Lord Manufacturing Company, Erie, Pa., had a new product program consistent with its reputation as a manufacturer of specialized functional rubber devices. In addition to anti-vibration engine suspensions for all the better known production models of radial and in-line engines, Lord offered protective mountings for instrument panels, radio equipment and other delicate components. An important activity was the adaptation of Lord vibration control techniques to helicopter installations. With its extensive machine tool and metal working facilities, Lord Manufacturing Company was prepared to render a comprehensive manufacturing service.

Luscombe Airplane Corporation, Trenton, N. J., peacetime manufacturer of the Silvaire line of all metal aircraft and other precision all metal products, was in production on all metal elements for combat and other military aircraft. A total of 21 different products were manufactured at the Trenton plants, ranging from bomb bay doors for the Grumman Avenger and rudders for the Hellcat, to ammunition boxes and air scoops. The company was particularly busy early in 1945 on orders for large fuel tanks for the Curtiss Commando military transport. Production during the final quarter of 1944 was 34.2 per cent above that for the third quarter.

Because of the increased demand by the armed forces for Luscombe-built equipment, the company leased a small factory at Dallas, Tex., to supplement the Trenton facilities, and soon after January 1, 1945, took over another factory building in Trenton, making three Luscombe factories in Trenton alone. An addition to the main factory at Mercer Airport was completed in 1944. Frederick J. Knack, who designed the original Silvaire models, rejoined the company as vice president in charge of engineering.

Macwhyte Company, Kenosha, Wisc., expanded military production of its "Hi-Fatigue" cable assemblies for aircraft, used on primary



controls for operating ailerons, rudders, elevators, motor controls, bomb release controls and retractable undercarriages. These cable assemblies were made from Macwhyte "Hi-Fatigue" aircraft cable and "Safe-Lock" swaged cable terminals. The cable with permanently attached terminals was made in lengths according to specifications. The cables were made from galvanized and stainless steel, fabricated to reduce constructional stretch and fatigue. The "Safe-Lock" terminals were made in eye ends, fork ends, stud ends, turnbuckle ends and numerous special types, supplied both loose and attached. Macwhyte wire rope slings were produced for use with the plane itself or for shipping. The plane slings were made light and flexible, and were built into the plane by the manufacturer to facilitate its being lifted aboard ship or elsewhere. The company also produced a line of tie rods for internal and external aircraft bracing and a general line of wire ropes for other industries.

Mercury Aircraft Inc., Hammondsport, N. Y., completed a quarter century of aeronautical manufacturing and six years of war work, both as a prime contractor to the Army and Navy and as subcontractor for various builders of aircraft. Two plants were in operation. One was producing fins, ailerons, stabilizers and other surfaces and spars. The other was devoted entirely to manufacture of aluminum tanks of various sizes and services, oil separators for use in connection with vacuum pumps in both Army and Navy types, and other aircraft accessories.

The Merz Engineering Company, Indianapolis, Ind., developed special gages, tools and machines for military aircraft and motor vehicles. One of its outstanding accomplishments was tooling for the M-22 Locust airborne tank manufactured by the parent concern, the Marmon-Herrington Company.

Micro Switch Division of First Industrial Corporation, Freeport, Ill., continued to be a major supplier of compact, light weight, snap acting electric switches of the precision type, used on all airplanes except the simplest trainers, in tanks, submarines, every type of surface fighting ship, military radio, radar, fire control equipment, and instruments, as well as being widely used on machine tools, packaging equipment, fire alarms, temperature controls and safety devices. The company set up its own extensive gage making department to provide the precision gages required for maintenance of the high degree of precision built into the Micro Switch. A double pole, double throw switch designed to give positive, simultaneous action of the two poles was supplied for use on aircraft. An entirely new type of switch built into the same physical dimensions as the Micro Switch of earlier design controlled a compressor supplying 1500 p.i.s. air pressure for use in operating bomb doors, turrets and other aircraft equipment. The switch was controlled by a diaphragm having an extremely small differential motion which kept the switch very close to the operating

point at all times. The switch was mounted directly on the compressor, was subject to severe vibration, and the inrush load was 75 amperes. Therefore satisfactory operation required that positive pressure between contacts be maintained up to the instant of snap. These difficult requirements were met by an entirely new design departing from previous practice. Development of a switch completely sealed against altitude, extreme humidity, explosive or corrosive atmospheres was completed. It was interchangeable with the widely used Micro Switch of the basic Type 31. Its operating and load interrupting characteristics were unaffected by change in pressure due to altitude. An ultra-small snap acting switch was also developed.

Moore-Eastwood & Company, Dayton, O., supplied the aircraft industry with tools, dies and special machinery, and produced bomb racks, bomb shackles, gun sights, gun mounting posts, gun mount adapters, filler valves, gun synchronizer generators, pistol mountings, tab controls and cable meters for tow-targets.

Norma-Hoffmann Bearings Corporation, Stamford, Conn., developed a number of new bearing designs to meet specialized problems in aircraft, such as roller bearings with crowned raceways, spring separators for low torque instrument bearings and new forms of built-in bearing seals. The research laboratory expanded its facilities to include running tests of high temperature bearing greases and corrosion resistant bearing protective materials.

The Northern Aircraft Products Division of The Aviation Corporation, Toledo, O., produced high-precision parts for aircraft engines and propellers. All production and inspection operations were performed by women, with male help being used only for supervision, set-up, maintenance and tool work.

Northwest Air Service, Inc., Seattle, Wash., was in expanded production on two of its original accessories. One was aircraft skis incorporating welded alloy steel pedestals equaling the shock absorbing capacity of replaced aircraft tires and permitting heavier loads. The board of the ski was of spruce and hardwood lamination, providing light weight and strength without warping or other distortion. The boards were equipped with easily replaceable steel sheathing thus preventing abrasion of the wood. The other development was a propeller pitch setter which required only one operator and reduced repair costs 50 per cent. The setter was simple in operation through a gear ratio of six to one in standard size and 12 to one in the heavy duty size. The operation started nearest the hub at the part where the blade was twisted and proceeded toward the tip, as each station was brought into alignment. Since there were six inches between racks, work was done in six-inch stations. Because the propeller was mounted on the pitch table and did not leave the original mounting until complete, there was eliminated any back-breaking work, removing and replacing the propeller and taking it in and out, back and forth from presses and

clamping tables. Each blade could be worked exactly to blueprints and to its mate. In construction, the pinions and gears were forged and machine milled. Racks and clamps were cast of 4130 chrome molybdenum steel and heat treated. All faces were machined and aligned accurately. The standard size handled blade widths up to  $9\frac{3}{4}$  in. and the heavy duty size blade widths up to  $12\frac{1}{2}$  in.

Numberall Stamp and Tool Co., Huguenot Park, Staten Island, N. Y., developed several new tools for making and numbering machine parts, gears, airplane parts and instruments, and sheet metal. One was Model 23H for hand stamping, the type holder having a security notch holding multiple, interchangeable type, and capable of being changed rapidly. Model 23P was similar in design but built for press stamping. Both could be changed rapidly.

Onsrud Machine Works, Chicago, Ill., provided special production milling machines to the aircraft industry to meet the two great trends in aircraft manufacture—design and building of aircraft of ever larger overall dimensions, and the planning of manufacturing operations on an ever greater mass production basis. Machine requirements resulted in delivery of Onsrud A-80 automatic contour milling machines for spar beam milling in overall bed lengths up to 60 ft. The second trend resulted in delivery to aircraft plants of fixtures and tooling for the A-80 milling machine of a type not required before. Complete work holding fixtures were designed and built, which incorporated all equipment for the control of cutter travel as well as the exact positioning and holding of work. Where this method was applied, a complete fixture was supplied for each step in the milling of a spar beam. Such fixtures served to reduce setup time and assure greater production accuracy. In addition to tools and fixtures, the mass production trend resulted in several new type milling machines of which the most important was the A-92 bevel mill. This machine was used to mill precision bevels on flat skin sheets, so that a perfect lap of sections could be obtained.

Pacific Engineering Corporation, Los Angeles, Calif., designers and producers of special equipment, was in accelerated production on its Model 10 and 20 Aerostands for the Services and aircraft manufacturers generally. The Aerostand was a specially designed and permanent platform so adapted that it replaced step-ladders, scaffolds and other makeshift arrangements for working on aircraft or loading or installation operations. It eliminated all need for special stands and had the widest range of uses, even for loading cargo crates up to 1,000 lbs.

The Parker Appliance Company, Cleveland, O., developed and produced an extensive line of patented tube couplings, valves and other accessories, including offset globe, ball check, needle, high pressure check, shuttle, relief, fuel selector, both manual and motor-driven, swing check, engine primer and special valves.

The Arthur D. Peterson Company, New York, developed a system of airport turf production which was made available on contract. The company also supplied machinery for airport drainage, tractors, and material handling equipment.

Pioneer Parachute Company, Manchester, Conn., developed a unique canopy tester, the first of its kind, as an important contribution in the never-ceasing search by Pioneer engineers for the advancement of aircraft safety through better parachutes. Like the notable Pioneer outdoor test tower which could record the performance of parachutes under conditions simulating actual use, the new indoor canopy tester made it possible to determine the strength of weakness of various fabrics used on the canopies. The machine was shaped like a giant mushroom to fit the contours of the standard human parachute. The canopy was placed over the radial form, and the chute suspension lines were anchored to the floor, instead of the body harness in actual use. A high pressure hydraulic jack forced the tester against the chute. The lifting force, increased by 500-lb. stages, was applied until some part of the parachute gave way. The machine exerted pressure up to 18,190 lbs. During the operation, observers could study all parts of the canopy at close range and detect the weaknesses as they developed. Pioneer experts determined that if the canopy could withstand a test



#### PACIFIC ENGINEERING TEST STANDS

Both Models 10 and 20 Aerostands are shown here in servicing operations on the Lockheed C-69 Constellation.



#### PIONEER PARACHUTE TESTER

The Pioneer canopy tester, showing application of hydraulic pressure to a standard chute. As the huge mushroom jack rises, the additional pressure exerted on the fabric, which is anchored to the floor, quickly shows up any weaknesses in weave or seams.

load of 5,000 lbs., it should be safe for use. This could be accomplished with the indoor canopy tester without injuring the parachute, as so often happened under the old drop testing method. Pioneer also improved the outdoor test tower, and made further progress in the development of new fabrics. This resulted in lighter weight yet stronger parachutes which were destined to play an important part in civilian postwar flying because they eliminated the objections to bulky cumbersome chutes.

The Republic Aircraft Products Division of The Aviation Corporation, Detroit, Mich., was manufacturing important parts for engines used in bombers and long-range pursuit planes.

Resistoflex Corporation, Belleville, N. J., was in war production on its compar flexible oil and solvent-proof tubing which carried high octane gasoline containing up to 40 per cent of aromatics without swelling or deteriorating. The same compar tubing was used to make conduits for hot dope aircraft finishes; and too, in making gaskets, seals and other special parts. It also was employed in clothing designed to protect the wearer from the skin poisoning effects of sulphur-base cutting oils and other solvents.

The Reynolds Metals Company, Aircraft Parts Division, Louisville, Ky., was part of a system of 38 plants strategically located throughout the country, with over 20,000 employees. The Company's Alabama aluminum reduction plant and rolling mills, a complete aluminum processing and fabricating unit, carried through all opera-

tions at a single location, starting from the domestic bauxite ore to finished aluminum alloy sheet, ready for aircraft construction.

The John A. Roebling's Sons Company, Aircord Division, Trenton, N. J., continued to supply aircord, terminals, slings, lock-clad control cord and control assemblies to the aircraft industry. The production of aircord and of aircraft and engine slings for prime aircraft manufacturers and for the Army and Navy, was maintained at a high level, while Lock-Clad Control Cord, developed by Roebling to provide less stretch and greater sensitivity of control, was supplied for certain airplanes. Roebling established itself as a producer of control cable assemblies at both the main plant at Trenton and the supplementary plant at Los Angeles, Calif. These assemblies were supplied in quantity to aircraft manufacturers as well as to manufacturers of assemblies for primary and secondary controls, to the extent that Roebling control cable assemblies were found in nearly all types of airplanes.

Rohr Aircraft Corporation, Chula Vista, Calif., was one of the largest suppliers of complete power plants and supercharger installations. The ever-increasing demand for completely interchangeable power units and other components was met through use of assembly line methods for manufacture of even the smallest part. Complete installations, quick engine changes and spare parts were being shipped to the armed forces in all parts of the world. For the first time in the history of the aviation industry a subcontractor was developing the power plant installations on a prototype ship for a major manufacturer. In addition to subcontracting, Rohr was a prime contractor in



THE NUMBERALL 25H TYPE HOLDER

For hand stamping metal parts.

the conversion of PB-2Y3 airplanes from military units to cargo planes, personnel transports and hospital and rescue ships. It constituted a major overhaul and rebuilding job. Rohr also developed a process to seal integral fuel tanks, and it was used successfully on Consolidated, Douglas and Lockheed planes.

Roseman Tractor Mower Company, Evanston, Ill., developed distinctively designed mowing machinery of especial value in airfield turf maintenance. Instead of side wheels for traction to drive the cutting reel, it was powered through greatly increased traction from light rear rollers. Units could be hooked up in gangs of from three to nine units. The constant, non-slip reel drive permitted cutting in dry or wet weather. The roller drive also permitted curb overhanging, thereby eliminating fringes.

Royal Engineering Company, East Hanover, N. J., developed a line of lubricants to simplify aircraft lubrication under all the different conditions incident to high speeds, the use of light metals and the widest variation of temperatures. The engineering problems in this field alone were legion; and Royal experts had to deal with every phase of aircraft operations. Their efforts finally resulted in reducing to three the number of greases required to lubricate a complete plane. They included Royal No. E-532 for high temperatures, No. 20 for intermediate and No. 100 for low temperatures.

SKF Industries, Philadelphia, Pa., devoted the facilities of a new plant to heavy production of ball and roller bearings for aircraft, including bearings for propeller thrust, crankshaft, control pulley, instrument bearings, and a variety of other bearings for auxiliary parts and accessories. Of especial importance were the SKF miniature bearings designed to overcome the slightest friction in vital flight instruments. A new type of bearing was developed by SKF and produced in huge quantities for aircraft engine rocker arms to take high radial and thrust loads at high temperatures. They were produced at a rate of 200,000 a month to a finish of three millionths of an inch and to a tolerance of one ten thousandths of an inch. SKF also developed super-precision bearings for gas turbine and compressor units in jet propulsion power plants.

Scintilla Magneto Division of Bendix Aviation Corporation, Sidney, N. Y., continued its research and production in the field of aircraft ignition, including magnetos, radio shielded harnesses, switches and spark plugs for use on all types of aircraft engines. In addition, Scintilla was in large-scale production of Diesel fuel injection equipment. In August 1944, it introduced the latest development in fuel injection—the new Bendix Scintilla unit injector, a fuel injection pump and nozzle assembly combined in a single unit. This unit completely eliminated all high-pressure tubing and any possibility of uneven timing. Since December 7, 1941, Scintilla and its subcontractors had supplied over 2,000,000 aircraft units for the armed forces plus

enormous quantities of service parts for these units. In May, 1944, Scintilla Magneto Division received the Army-Navy E award for its fine production records, six months later receiving the award for the second time.

The Henry L. Scott Company, Providence, R. I., produced a line of 67 different models of testers of wire, strip and rubber tensile strength, hysteresis, flexing, compression-cutting, twist, adhesion, plasticity and burst. The testers had capacities ranging from the finest filament to one ton tensile.

O. M. Scott & Sons Company, Marysville, O., supplied quantities of special seed for airfield purposes. The company had developed its airport program on the principle that good turf sod on landing fields offers many advantages; reducing dust and mud, absorbing heavy rainfall at an even rate thereby retarding erosion, knitting surface soil together to reduce ruts and keep down gravel, and adding beauty to airport surroundings.

Scott Aviation Corporation, Lancaster, N. Y., expanded plant facilities for required production on new designs of high altitude oxygen equipment for the armed forces. Scott high altitude oxygen equipment was standardized for one type of application, and other companies were licensed to manufacture in accordance with Scott designs and processes. Scott Cast 40-E aluminum alloy was used increasingly by aircraft companies for those parts where warpage or porosity gave difficulty in ordinary alloys.

The Seaman Paper Company, Chicago, Ill., developed and produced for the Services large quantities of insulating material to protect aircraft cabins against sound and temperatures. A number of combinations were produced with materials developed from a Kapok base; but early in 1944 wartime conditions made Kapok unavailable in sufficient quantities to meet insulation requirements. Seaman, meanwhile, had been experimenting with many different types of fibers, but before this research had been completed, a substitute for Kapok was found in Fiberglas, developed by the Owens-Corning Corporation. The Seaman Company was in heavy production on insulating material with a Fiberglas base early in 1945.

Shell Oil Co., Inc., New York, greatly increased its manufacture of aviation fuels and lubricants. Special high octane blending components were developed which enhanced the quality of aircraft fuels and increased the available quantities. Some of these components were made available to the petroleum industry as a whole.

Simmonds Aeroaccessories, Inc., New York, with plants in Long Island, California and Vermont, increased both its production and scope of application of Simmonds push-pull controls, automatic engine controls, hydraulic accumulators and fuses, spark plugs and other types of specialized aircraft and industrial equipment. An increase of installations of the Simmonds push-pull controls in all types of Allied





#### SIMMONDS WEATHER INSTRUMENT

A Simmonds Chronometric Radiosonde flight instrument is sent off a roof in New York.

aircraft brought the total number of installations near the three-quarters of a million mark. Early in 1944, Simmonds push-pull controls received the "yellow dot" from the A.A.F., after meeting all specifications for operation under conditions of extreme cold. New applications of these controls, which first were developed for aircraft use, were extended in the locomotive, automotive, industrial machinery and building construction fields.

The Simmonds automatic engine control program developed several exclusively American-designed units—the Type SA-5 and Type SA-9, built expressly for the American-built Rolls-Royce Merlin engine as installed in the P-51 Mustang. These controls automatically regulated manifold pressure, spark, and (Type SA-9) the operation of the emergency water injection system. Although other designs were primarily for military engines, the Simmonds Type SA-7 was intended for transports and private planes, having as its sole function the regulation of manifold pressure or "boost."

Simmonds precision aneroid capsules, the sensitive "bellows" used as the heart of the Simmonds automatic engine controls as well as in the Simmonds chronometric radiosonde meteorograph, were produced for use in Simmonds own products. Simmonds hydraulic equipment was expanded to include two new fuses of the quantity-measuring type. Large scale production of the Simmonds bottle-shaped hydraulic accumulator was continued for installation on Navy fighter planes. The Simmonds chronometric radiosonde system, combining the flight instrument, the receiver and the recorder, was developed further. The U. S. Weather Bureau conducted a series of operational tests on this radiosonde system, which collected high altitude weather data and transmitted it by a time-measuring principle, to the receiver and the recorder on the ground. Simmonds ceramic spark plugs also went into quantity production.

Sinclair Refining Company, New York, expanded facilities for production of aviation and all-purpose high octane gasoline for military purposes. Sinclair aviation gasolines were supplied in large quantities to our Army and Navy air forces and other Allied nations for maximum performance in all types of aircraft. These fuels and components were produced in nine Sinclair refineries. Critical laboratory analysis and engine testing controls were maintained to assure the highest standard of quality and uniformity. Sinclair also continued its research and development program on aircraft engine oils and lubricants suitable for the higher output engines on the larger type of airplanes in both military and commercial service. Particular attention was given to development of lubricants providing full protection under great extremes and variations of temperatures.

Skydyne, Inc., Port Jervis, N. Y., produced a line of laminated, sandwich construction plane parts, adaptable for wings, fuselage, tail and control surfaces and also interior equipment such as floors, partitions, doors and plane furniture. The material was form-molded to complex shapes and curvatures and was designed to provide minimum weight with maximum strength.

Socony-Vacuum Oil Company, New York, developed its "bead catalyst" designed to increase the potential power of high octane gasoline, increasing power from 23 to 35 per cent, and increasing yields of aviation gasoline from base stock from 13 to 30 per cent. Four of the company's refineries and several other oil companies were using the new method.

The Solar Aircraft Company, with plants in San Diego, Calif., and Des Moines, Ia., continued manufacture of airplane exhaust systems, cowlings, heat exchangers and allied products. Deliveries reached new peaks, and quantity production in 1945 was assured by substantial orders on hand for Solar equipment for military planes. Solar was manufacturing exhaust systems for the majority of B-29 Superfortresses to be built in 1945. In 1944, Solar made its initial entry into

the field of jet-propulsion, producing major parts of jet-propulsion engines for the General Electric Company and the Allison Division of General Motors. This extension of Solar's activities into a field of growing importance was a direct result of long experience gained in the fabricating and processing of heat resistant metals. This experience also led Solar to pioneer the development of other products which while diversified as to markets, were related through their common affiliation with heat and the fabrication of high temperature alloys. Outstanding among these products, as a major contribution to the war effort, was flame damping equipment to suppress exhaust flame and reduce visibility of aircraft in night operations. Solar designed and manufactured numerous flame damper installations used in great quantities on military aircraft.

Another Solar product was developed to meet a critical need in military plane production—a stainless steel self-locking nut plate, manufactured by Solar and sold under the trademark "Sol-A-Nut." Labor, time and materials were saved on every job by spotwelding "Sol-A-Nuts" instead of riveting. They were light in weight and did not corrode, and were made in one piece without critical areas to crystallize. "Sol-A-Nuts" were U. S. Army approved and interchangeable with all other nut plates classified under Army and Navy standard AN362. Further diversification of Solar products were to be attained by the final development of the Altiheater—a high altitude combustion type heater for warming airplane cabins, and for thermal anti-icing of wings and control surfaces. It was distinguished for its high heat output and light weight. Solar Welding Flux No. 16GH was a flux for welding high temperature alloys. In wide use it proved to be far superior to ordinary fluxes because it adhered to metal despite frequent handling, contained no carburizing agent such as shellac, prevented "burning," gave ductile welds, and was exceptionally easy to use with oxyacetylene, atomic hydrogen arc and metallic arc welding processes.

Southern Aircraft Corporation, Garland, Tex., increased plant area eight times in three years, and was in production on gun turrets for Liberators and tail surfaces and wing sections, pilot and co-pilot pedestals, bomb bay doors and anchor winches for other combat aircraft.

Spencer & Morris, Los Angeles and San Francisco, Calif., specialists in the application of overhead materials handling equipment for aircraft, introduced for the first time a fluid-like drive for under-driven cranes. Labeled the "Vari-Pressure Drive," the design was evolved following demands by the aircraft plants for a smooth start when moving overhead materials of a costly nature. The "Vari-Pressure" met this specification exactly, giving just the correct amount of driving function for each load. It proportioned the pressure on the driving member so that a constant ratio was maintained between the load and driving unit at all times. Also, applications of the Stabilized Crane

were perfected for anodic baths of aircraft parts, and for the purpose of stabilizing subassemblies on the production lines.

Working in cooperation with scientists of the University of Southern California, Spencer & Morris engineers developed stationery equipment for the air forces which determined the ability of pilots to withstand acceleration and check upon the effect of centrifugal force produced in the human body by fighter aircraft. This equipment simulated blackouts caused by dives and similar maneuvers.

Sperry Gyroscope Company, Brooklyn, N. Y., added to its vast lines of important aircraft instruments and other equipment by developing the Sperry Gyrosyn Compass, a directional gyro synchronized with the earth's magnetic fields. Sperry engineers succeeded in combining the functions of a directional gyro and a magnetic compass, and the result made not only for greater accuracy in navigation but also greatly lightened and simplified the duties of the plane's pilot. This was in part because the Gyrosyn Compass allowed for deadbeat indication and accurate magnetic headings without northerly turning error or the necessity of resetting. Further, in military aircraft, the usefulness of the standard magnetic compass in the cockpit was diminished because of disturbances in the earth's magnetic field due to proximity of electrical apparatus and armor plate. The new compass avoided the effect of these disturbances.

The Sperry Gyrosyn Compass was an electrically driven directional gyro precisely controlled by a Flux Valve. The latter was the "stand in" for a magnetic compass because it detected the direction of the earth's magnetic field. Small, hermetically sealed and with no rotating parts, the Flux Valve could be mounted rigidly in a wing tip safely removed from the disturbing influences of the cockpit. The Gyrosyn Compass was installed on the pilot's instrument panel or at the navigator's station. Up to six repeaters for remote indications could be used with the new Sperry Compass, which with two repeaters weighed less than 12 lbs. Provision was made for furnishing azimuth stabilization as required by any other equipment. When rough air momentarily swung the Flux Valve out of the horizontal, the resultant fluctuating signals might be expected to register as error on the Gyrosyn indicator. That this did not occur was due to the fact that the directional gyro effectively integrated all short period disturbances and oscillations, and the deadbeat accurate indication for the pilot continued. In a prolonged turn, erroneous signals might show in part on the indicator but they disappeared without oscillation and without any corrective measures on the part of the pilot as soon as the plane had been returned to straight flight. Employment of a split arrow course setting device made the faces of both the Gyrosyn Compass and the repeaters exceptionally easy to read.

Another Sperry development was the Attitude Gyro Indicator, an instrument capable of providing the pilot with precise attitude indica-

tions throughout 360 degrees of roll and pitch. For the first time in the history of aviation the pilot, by means of Sperry's Attitude Gyro, was provided with a visual indication of the position of his aircraft with reference to the earth's surface throughout all possible attitudes through which his airplane could be maneuvered. The Sperry Attitude Gyro was adaptable to all types of airplanes and was particularly valuable to those aircraft whose mission required extensive and complicated aerobatics. In the past, it was impractical to perform all aerobatic maneuvers without visual reference to the earth's surface. Using the new Sperry instrument, however, it became possible to accomplish under instrument conditions all possible aerobatic maneuvers with precision and a high degree of safety. The pattern type of picturization of airplane motion which this instrument presented was so simple to interpret that during recent tests pilots were performing perfectly executed loops and slow rolls under the hood with less than an hour's instruction in its use. As in other gyro flight instruments, a gyroscope was the heart of the new Sperry Attitude Gyro Indicator. Electrically propelled around a vertical axis, the gyro employed the familiar gyroscopic properties of rigidity and precession to provide a fixed reference pattern around which the plane could be maneuvered in any direction. This entirely new feature was made possible by a method of suspension. The reference pattern was marked on the surface of this stabilized sphere with luminescent paint and was visible to the pilot through a masked opening in the front of the instrument case. The indicating sphere was divided into hemispheres by painting the upper half white luminescent and the lower half black. In order to increase the concept of a spherical surface, as well as to indicate pitch angle, latitude lines in contrasting color, (white on black, black on white) were inscribed with short 10 degree marks between. A vertical meridian line, also in contrasting color, gave roll angle indication with reference to a fixed index on the mask around the sphere. A lateral lubber line, marked in alternate black and white sections, stretched across the center of the mask opening and provided the basic pitch index for reference to the pattern of the sphere. The only operating knob or adjustment required by the pilot was that for the "target," a small circle which adjusted up and down to compensate for change in trim of the airplane for level flight.

Sperry Products, Inc., Hoboken, N. J., produced an exactor hydraulic control which was a simple one pipe hydraulic control system reproducing identical motion without backlash or time lag. It made possible the application of force from a remote station to move or position accurately devices such as carburetors, valves and governors.

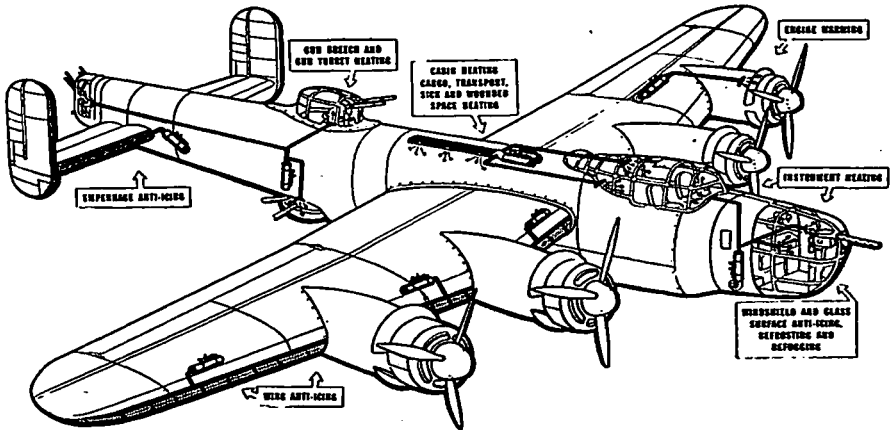
The Spool Cotton Company, Crown Fastener Division, New York, developed zipper equipment for protection of the vital parts of combat aircraft. Some of the latest designs of power operated turrets on our

bombers introduced new mechanical problems in closing the slots in the path of travel of the guns. Crown Fastener solved the problem for the Army and Navy by developing a double-acting zipper. This small thing was a most important contribution to our successful bombing operations over Germany. The closure consisted of a carrier shield fitted around the gun barrel. This carrier mounted two zipper sliders on universal joints and facing in opposite directions. As the power actuated gun traversed its path, the zipper opened automatically ahead of the gun and closed behind it. Careful research and design reduced friction loads to a point where only slight power was required to operate the zipper even when it was required to clear itself of ice at low temperatures. Smooth operation in either direction was also a most important factor so that there would be no interruption or roughness in the operation and sighting of the guns in action. The Crown gun slot closure was adapted to a variety of installations. Among the new features was construction of the zippers in predetermined curves so that they could be attached to the contour surface of the turret, thus preserving the aerodynamic efficiency of the turret design. The zipper closure also represented a saving in weight over other known designs of gun slot closures. Crown Fastener also developed a number of other unique zipper designs for aircraft use, including zippers for engine covers, maintenance shelters and other functional applications on combat airplanes.

The V. E. Sprouse Company, Columbus, Ind., pioneered in a light compact-type muffler and heater which had the advantage of complete freedom from contamination of the heated air with carbon monoxide gas from the exhaust system. Sprouse worked out designs for both single and multiple tail pipe exhaust heating systems, with decided advantages for the type using individual units for each side of the engine. Sprouse found a very distinct advantage in muffling the light airplane engine rather than sound proofing the cabin. This advantage appeared to be most prominent in four place planes or smaller. Sprouse mufflers were designed to reduce the exhaust noise level to a point somewhat below the propeller noise level. The Sprouse mufflers and heaters met Government requirements and withstood exacting endurance tests.

Standard Oil Company of California, San Francisco, devoted practically all its resources to military production and at the same time kept pace with demands for improved fuels and lubricants, all of which were to be made available for civil aviation after the war. Among Standard's new products was a new fuel for jet propulsion power units. Standard also had developed its own system for improved service at airports.

Stratos Corporation, an affiliate of Fairchild Engine and Airplane Corporation, of Babylon, N. Y., was engaged in research activity on high-altitude supercharging.



### AIRCRAFT HEATING SYSTEMS

Diagram showing installation of Surface Combustion "Janitrol" heaters in the different parts of bombers or transports.

Stump & Walter Company, New York, developed a program for supplying grass seed for airports based on a study of the peculiar requirements of landing fields in connection with dust and erosion control. The company found that grass offered the least costly and generally most effective means of control, that an airport vegetated with a good stand of sod-forming grasses permitted 25 per cent more flying time than where dust and erosion were prevalent. The company also reported that where dust was controlled by sod-forming grasses to the extent that it could not exert its abrasive effect on the precision assembly of motors, engine changes were decreased by about 30 per cent.

Superior Tube Company, Norristown, Pa., with plants seven miles northwest, near Collegeville, Pa., continued to produce tubing in a great variety of metals, specialized in alloy steel, from which aircraft valve push rods were manufactured by the company; output of instrument tubing, tubing for spark plug manufacture, for oil lines, as well as for airframe use. Its trademarked product, "Weldrawn" continued to gain in a number of applications for which it was well adapted. This type of tubing grew in popularity because of its lower price, as well as suitability in a number of fields. One of the plants was equipped solely for production of tubing used in the electronics field. Superior Tube Company was sponsor for reorganization for production of tubing at its associate plant, the Pacific Tube Company in Los Angeles, Calif.

Surface Combustion, Toledo, O., developed an aircraft heater, under the model name of Janitrol, for heating various sections of planes in flight. It employed the "whirling flame" principle which made combustion-type heaters practical for high-altitude flying. Constant improvements were made after the heater was introduced, and

several thousand planes were equipped with the unit to anti-ice and defrost glass surfaces, prevent freezing of gun turrets, bombsights, cameras and other instruments, to anti-ice wings, and for cabin warmth. Models included units with heat outputs of 15,000, 50,000, 100,000 and 125,000 Btu per hour. Both vaporizing and spray-type models were made. All units took their fuel supply from the airplane's regular fuel tanks, and introduced the liquid fuel directly into the combustion chamber. The heaters were ram operated, and some were equipped with fan and motor for ground operation.

The same principles were adapted to a new portable ground heater, designed for preheating airplane engines and cabins, to give warmth to ground crews working under conditions such as are found at Arctic air bases, for warming hangars, drying out instruments and parts in tropical climates or wherever moisture is excessive, and for heating purposes. It had a heat output of 250,000 Btu per hour; a temperature rise of 230 degrees; burned any grade of gasoline, kerosene, diesel oil or other light fuel oils; and could be equipped with either a gasoline engine or an electric motor for driving the fan.

Early in 1945, the portable aircraft heater was introduced, designed to warm the unheated cargo space of planes converted to hospital ships at a maximum 15,000-ft. ceiling. It was completely self-contained except for motive power, weighed less than 38 lbs. and could be installed and removed at will. It required no ram air for operation. A 3½ gal. fuel tank was built into the unit, to make it independent of the plane's fuel supply, and this was sufficient for eight hours continuous operation. The heater's own fuel pump was driven by a small motor and its circulating air fan was driven by a ½ h.p. 24-volt motor. To put the heater in operation simply required plugging to an electric connection and flicking the switch. High, medium and low operation was obtained with a fuel control switch. The fully automatic control system could be operated by a room thermostat if desired. Its heat output of 40,000 Btu per hour was equal in actual performance to a 125,000 Btu ram heater because air was taken from the cabin rather than having to raise the temperature of the much colder outside air.

Switlik Parachute Company, Trenton, N. J., was at peak production on seven different types of parachutes for the air forces, besides supplying parts so that riggers could keep the chutes in repair during operations in all theaters. The Switlik safety chute had many decided advantages, including simplicity of operation, low costs of maintenance, compactness, light weight, quick and positive opening and low rate of descent. It was designed to withstand a drop test load of 800 pounds. All materials used in its construction exceeded the requirements established for parachutes by the Government. The nylon used in the canopy was especially woven for parachutes, having a high tensile and tear strength. Suspension lines were made of pure silk, having an outer casing and an inner core, which provided a soft, kinkless cord



with a tensile strength in excess of 450 pounds. The harness webbing was made of pure purged linen, and had a tensile strength exceeding 3,000 pounds, yet it was soft and pliable. All forged hardware was of chrome nickel steel, heavily plated with cadmium. The cotton duck used was of high strength and was water repellent. Realizing years before the start of the war that this country should not be entirely dependent upon Japan for parachute silk, Stanley Switlik started collaborating with silk processors impressing upon them the necessity for a substitute for silk in parachutes. He was largely instrumental in having those processors produce nylon fabric of a texture and weave that was highly efficient and comparable to all tests formerly attained by natural silk, with the result that all parachutes were being made of nylon fabric in 1944.

The Texas Company, New York, devoted most of its research and production facilities to the war effort. Most of the 100 octane aviation gasoline used by the Allied air forces was made by the alkylation process, and Texaco played an important part in its development. Additional methods of making aviation gasoline, including catalytic cracking, were used to meet the tremendous demands of war. New types of fuels were continually being developed for future engines.

The Thompson Grinder Company, Springfield, O., was in production on hydraulic surface grinders capable of maintaining heavy production schedules without sacrificing precision. Many improvements were made on the standard line of machines, such as improved spindle construction, automatic down feed with spark out control which permitted one operator to produce repetitive parts from more than one machine at a time. A special machine was developed to grind channel sections in master rods and articulated rods, removing the tool marks produced by previous milling operations, thus reducing time required for polishing to an absolute minimum. The travel of the grinding wheel head was confined in such a way that it was only necessary to gauge the rod at one point and the entire shape was to the desired dimension well within required tolerances.

Thompson Products, Inc., Cleveland, O., signed contracts late in 1945 to produce huge quantities of important jet propulsion components, while continuing to turn out sodium cooled exhaust valves, a leading product among some one thousand different hardened and ground parts, and a heavy volume of fuel and fuel booster pumps, fuel selector cocks, "quick-disconnect" hydraulic couplings, oil filters and turbosuperchargers. The company set up a new Jet Propulsion and Turbine Division at Thompson Aircraft Products Co., Euclid, O., its \$30,000,000 Defense Plant Corporation subsidiary. The new division started production in December 1944. Thompson Products continued to be the largest employer in the Cleveland industrial area.

W. Harris Thurston, Inc., New York, manufactured a complete line of aircraft tapes and fabrics, including balloon and glider fabrics,

utility cloths, lightweight cloths and other cloths to Army and Navy specifications.

The Timken Roller Bearing Company, Canton, O., long specialists in tapered roller bearings, was in production on light duty bearings for landing gears, tailwheels, tail and nose wheel swivels, engine mounts, wing slot rollers, engine rocker arms, propeller blade thrust bearings and carburetor butterfly valves on planes, and in gear boxes and rotor-blade swivels of helicopters. Timken engineers designed a complete new line of some 30 new sizes of modern, light weight, light-duty bearings. Twelve of these designs were in production, and several were to be used in gear boxes and other moving parts of the helicopters being made in ever-increasing numbers for the Services. Another type was the propeller blade thrust bearing, which had seen extensive service on British aircraft. It was a double-row bearing, utilizing two cages and two sets of rollers, and required extreme precision in workmanship to achieve the smoothness of operation needed to hold torque to a minimum and allow complete and easy feathering while in flight. Experimental production was under way to adapt the bearing to American propeller specifications and for widespread use on helicopters. Improvements also were being made in design and construction of rocker arm bearings.

Tomkins-Johnson Company, Jackson, Mich., produced air-powered "Rivitors" for flush riveting in airframe manufacturing and assembly. This machine, with its automatic feed and setting mechanism, was designed to handle exclusively aircraft requirements for aluminum alloy riveting, with capacity for rivets  $\frac{1}{4}$  in. diameter by  $\frac{3}{4}$  in. long. It was operated by a foot pedal. The rate of setting was limited only by the ability of the operator to move the work from hole to hole. There was no manual rivet handling. It was available in throat depths ranging from 9 to 36 in. The company also manufactured air and hydraulic cylinders, with capacities for power movement ranging from 100 to 50,000 lbs., which were adapted to many jobs of pushing, pulling, lifting, clamping, pressing and controlling in aircraft plants. Another T-J product, the "Clinchor", set clinch nuts automatically and at high speed with minimum spoilage.

The Topflight Tool Company, Towson, Md., was in production of a new dimpling tool developed by Hermann Veit, of The Glenn L. Martin Company, which solved one of the problems of working the new aluminum alloys. The tools which had been adequate for ordinary aluminum had proved unsatisfactory. In forming dimples by a punching action, they caused minute cracks in the new metal because it was much harder and therefore more brittle. The new dimpling tool spun, rather than pounded the surface, to create a dimple. It was marketed by York Tool Sales Company, York, Pa.

Tube Turns, Inc., Louisville, Ky., continued to specialize in design, engineering and manufacturing of aluminum and steel forgings,

concentrating upon products that often required the development of exclusive or unusual techniques. The firm's large and well-equipped tool and die shop, was expanded further, and the facilities of its two modern plants were augmented. Tube Turns had the nation's largest battery of 8-in. and 9-in. upset forges; and huge hydraulic presses up to 2,500-ton capacity were available. A mechanical press unit in excess of 4,000-ton capacity was installed early in 1945. Tube Turns normalizing and annealing furnaces, quenching baths and rough finishing equipment were grouped for utmost efficiency and streamlined for volume production. For aircooled aircraft engines, Tube Turns products included cylinder barrels, heads, fins, pistons; housings, and impellers and inducers for superchargers. For liquid-cooled aircraft engines, Tube Turns forged couplings, gears, shafts, spindles and bearing cages. In addition, the company was a large-scale producer of airframe parts.

United Aircraft Products, Inc., Dayton, O., produced an increasing number of their diffusion oil coolers noted for non-congealing, maximum cooling and quick warm-up qualities. They also developed a jacketless oil cooler saving weight and space and having inherent surge protection. An improved oil dilution solenoid valve, consisting of a resilient composition seal on the valve face which assured a perfect seal at all times, became standard Air Forces equipment. The company also produced oil temperature regulators, fuel pumps and units, oil dilution solenoids, fuel strainers, Y drain valves, fuel cocks, dial and handles and miscellaneous other parts for aircraft and combat vehicle fuel and oil systems, also hydraulic landing gear struts, tail shocks, accumulators, hydraulic control valves and complete hydraulic equipment.

United States Plywood Corporation, New York, supplied its plywood products which were used extensively in the aircraft and marine fields, with large quantities also going into products for the Services. Flat waterproof weldwood plywood was in strong demand but metal-covered plywood, such as used for the Army's smokeless powder box, molded plywood, used for 18-foot auxiliary pontoon boats and for airplane parts, were likewise supplied in large quantities. Molded tubular weldwood, for Signal Corps masts, was manufactured in steadily increasing amounts and reached the record figure of six miles of tubing a week. Low pressure molding of plastic parts for use on aircraft was started on a large scale. The engineering and research laboratories of the corporation were active in the field of low pressure plastic moulding, and several interesting war products were developed.

United States Rubber Company, New York, investigated the use of new materials to replace the extremely critical things from which aircraft tires had been made, and as a result, the company introduced new synthetic compounds and new fabric constructions. As loads and weight were increased, the United States Rubber Company pioneered

the use of nylon tire fabrics, and improved bead construction to meet the need for lighter, stronger tires. This was accomplished despite requirements for lower quality rubber substitutes. The company reached the point in bead construction, which formerly required crude rubber, where guayule was used satisfactorily in bead wrapping. In the use of nylon for tire fabrics it was necessary to develop a solution which would permit adhesion of rubber and synthetics to the nylon. The company produced a latex solutioning process which accomplished the purpose. Latex is crude rubber in solution, however, and development was being continued to ascertain if the substitute could be used in solutioning to replace even that small amount of crude rubber. To increase production capacity because of military demands, the company perfected a technique of applying plies in multiples instead of individually, thereby saving much labor in the actual building of tires.

To help relieve the critical manpower shortage, yet maintain peak production without reduction in quality, the United States Rubber Company developed the use of 2200 denier rayon for airplane tires. This new principle in rayon tire construction provided stronger synthetic rubber tires and assured greater tire production. The 2200 denier rayon tire had twice the number of filaments twisted together as the 1100 denier which had been the standard type. Due to the greater strength of the heavier rayon, tires built of 2200 denier were stronger.

Utica Drop Forge & Tool Corporation, Utica, N. Y., developed and manufactured a complete line of pliers and adjustable wrenches for use in aircraft manufacturing.

Vickers, Incorporated, Detroit, Mich., produced hydraulic motors with a high horsepower-weight ratio for pressures up to 3,000 psi. One Vickers aircraft hydraulic motor, piston type constant displacement, weighed only 6.4 lbs., yet had a normal output rating of 16 h.p. at 3,000 psi and 3,750 r.p.m.

Waldes Koh-I-Noor, Long Island City, N. Y., developed a new type retaining ring, "Truarc" in sizes of four to 10 inches. It was tapered from the middle section to the free ends to assure absolute circularity and had lugs for easy application. The company manufactured four new types, bowed, beveled, recessed and crescent—each for different purposes. Waldes also produced an internal grooving tool to overcome difficulties in cutting precision grooves in bores and housings.

The Weatherhead Company, Cleveland, O., produced as many as a million aircraft fittings a week, including dural tubes and pipe fittings, flexible hose assemblies, hydraulic check valves and hydraulic actuating cylinders. It also developed a new hose and fitting for servicing hydraulic flexible hose assemblies in the field. Weatherhead in 60 days prepared for production of air compressors for the B-29 and other large bombers. This was a complicated piece of mechanism

weighing nine lbs. and containing 298 parts. It contained a tiny, powerful motor and stored up 1,500 lbs. of air pressure in a few minutes. Located at nine vital points in a bomber, it provided power for opening and closing the bomb bay doors and moving the guns and turrets of the Boeing Superfortress.

The Weems System of Navigation, Annapolis, Md., developed many of the shorter and up-to-date methods and navigation instruments in use, including The Line of Position Book, The Star Altitude Curves, The Line of Position Tables, the Gold Medal Text Book "Air Navigation", the Mark II Plotter, aircraft computers of several types, skeleton navigation charts so designed as to shorten and make easier the navigator's work, and classroom models of navigation instruments designed to expedite class instruction. The Weems Star Altitude Curves for the Polar regions introduced a new method of dead reckoning, commonly referred to as the "G" system. This new system was considered essential in the Arctic regions.

The Wellman Bronze and Aluminum Company, Cleveland, O., operated at full capacity two large plants devoted to the production of castings. In the older plant were produced castings of heat-treated aluminum, bronze and brass alloys and numerous types of bronzes. In the newer plant operations were confined to patterns and magnesium castings. Among the firm's products were cast magnesium generator housings and aircraft landing wheels, cast aluminum pneumatic tool housing and Dowmetal pneumatic tool handles.

Western Electric Company, New York, as the largest manufacturer of communications and electronic equipment for the armed forces, continued to produce "ears, eyes and voices" for the war planes of the United Nations. They included "command sets," specialized radio telephones for communication between plane and plane and plane and ground; runway localizer receivers, enabling big bombers and transports to land safely through overcast, fog and darkness; special navigation equipment, bombing devices, fire control apparatus; microphones of many types, including throat, lip and oxygen mask; headsets, ground transmitters and interphones for communication among plane crew members, and radar. Scientists of Bell Laboratories and the technicians of Western Electric were in the forefront of radar development and production.

A partial list of war material supplied to the Government since the start of the war included 584,000 airplane radio receivers, 415,000 airplane radio transmitters, 33,000 combination airplane receivers and transmitters, 1,250,000 headsets for aviators and tank crews, 1,370,000 microphones, 22,000 switchboard positions of 22 varieties, 5,000,000 military telephones, 300,000 sound powered telephones, 55,000 miles of Spiral four cable, 14,000,000,000 conductor feet of exchange cable, 4,475,000,000 conductor feet of toll cable, large quantities of various types of radar, thousands of teletypewriters, including many adapted

to radio, and package "C" carrier equipments. The value of the equipment supplied to the Services was about three fourths of a billion dollars.

Acclaimed by the Army as one of the outstanding developments of this war, the electrical gun director, designed by Bell Telephone Laboratories and manufactured by the Western Electric Company, aided materially in England's fight against Nazi planes and robot bombs. It was a direct outgrowth of experience gained in acoustic and transmission testing and research. Called an "electrical brain," it included a tracker, height finder, altitude converter and computer. The latter made split-second mathematical computations that would take a mathematician more than five hours to solve, permitting hitherto unknown accuracy in fire control against targets moving at terrific speeds. As the target approached the range of the anti-aircraft battery, the operators of the "tracker" unit of the electrical gun director immediately spotted it in the two telescopes and followed its course. As this was done, a mechanism was set in motion which transmitted the alti-



#### NEW ANTI-AIRCRAFT WEAPON

The Army's latest anti-aircraft gun—4.7 in.—equipped with the M-10 electrical director designed by Bell Telephone Laboratories and built by Western Electric Company.

tude angle and the azimuth angle to a computer unit. At the same time another instrument called a "height finder" fed the computer information concerning the actual height of the approaching target. Then the computer swiftly plotted its distance, course and speed, aimed the anti-aircraft gun and even set the fuse of the shell so that it would burst at the proper moment for a hit. In making these calculations, the computer also took into consideration such important items as the muzzle velocity of the gun, shell drift due to spin, air density, time of shell's flight, the pull of gravity on the shell, direction and velocity of the wind, and the distances from the tracker to the gun itself.

With the coming of peace, the scientific and technical knowledge it had gained in radio, electronics, telecommunications and aeronautics research during the war years, assured that the Western Electric Company could contribute heavily to the safety, convenience and comfort of world-wide commercial air travel and air-cargo deliveries.

Westinghouse Electric and Manufacturing Company, Pittsburgh, Pa., increased its output of aircraft accessories, such as aircraft generators, voltage regulators, relay switches, ammeters, voltmeters, voltammeters, lighting apparatus, Rectox engine starters, Micarta pulleys, molded and laminated Micarta parts, radio receivers and transmitters, and other equipment for planes and plane plants.

The Worthington Mower Company, Stroudsburg, Pa., developed a fast, rugged, high-cutting capacity gang mower for airport turf, and named it airfield "grass blitzer." Its mowing units were arranged in 3, 5, 7 or 9-gang teams, and it could be hauled by any truck or tractor. The 9-gang mower cut a 21-ft. swath at speeds up to 20 m.p.h. The company also made available a transport trailer to carry the units from field to field at highway speeds. The mower had no casters or rollers. The height of cut was regulated by suspension from the frame level, and nothing touched the ground except the drive wheels.

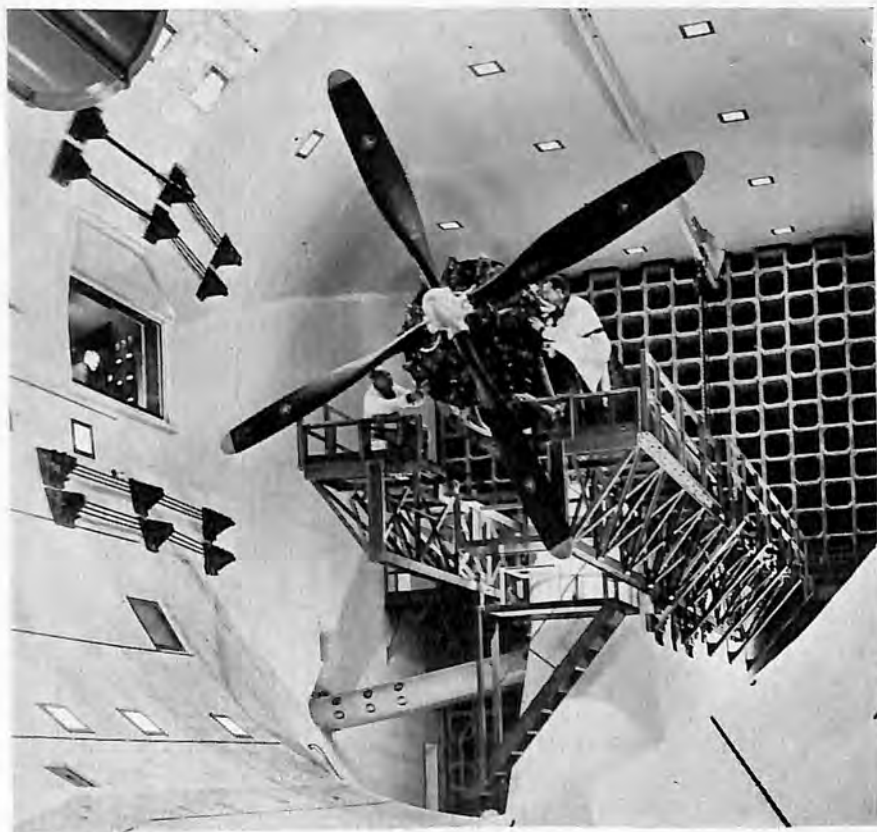
Wyman-Gordon Company, Worcester, Mass., producers of forgings, steel, aluminum and magnesium, already one of the largest producers of aircraft forgings in the world, was completing extensive expansion programs at both its Worcester and Harvey plants while supplying forgings to the builders of the higher powered aircraft engines and propellers and a large number of the airframe manufacturers. One of the most interesting forging developments was the successful forging by Wyman-Gordon of single-piece propeller hubs having pierced arms. Wyman-Gordon had developed this process three years previously, and with the mounting aircraft program, it developed a substantial saving in critical alloy steel. Previously all of these one-piece propeller hub forgings were supplied solid, resulting in a tremendous waste of material, as well as machining time. Both three-way and four-way hubs were produced in quantities by the new method. In two years it resulted in a saving of more than 4,000,000 lbs. of alloy steel.

A Wyman-Gordon subsidiary, the Wyman-Gordon Products Cor-

poration, was constructing a new plant to house the largest press ever designed or constructed. It was to be a hydraulic forging press of 18,000 tons capacity. The assembled weight was to be 5,000,000 lbs.

The York Electric Tool Company, York, Pa., was in production on a number of new tools and other devices for use in the aircraft industry. One was a wire printer which had been developed by The Glenn L. Martin Company to facilitate repairs of engine or instrument board wiring. In order to assure accuracy and greater speed of identification, the Services required that the wires should be marked each with its own special code number. Ordinary wire printing was not good enough, because it could be obliterated easily by gasoline or oil. The new printer "hot stamped" the ink pigment into the wire covering so that it could not be affected.

Zimmer-Thomson Corporation, Long Island City, N. Y., developed its Iso-Rev constant speed propeller designed to provide full horsepower at take-off and maintain efficiency under all conditions of flight.



CURTISS-WRIGHT PROPELLER TEST



## Flying Facts and Figures

SUBJECT	INDEX
Combat Record of U. S. Army Air Forces . . . . .	385
Combat Sorties by U. S. Army Air Forces . . . . .	386
Bombs Dropped by U. S. Army Air Forces . . . . .	388
U. S. A. Eighth Air Force Heavy Bomber Operations	392
Air Combat Record of U. S. Navy . . . . .	390
Combat Sorties by U. S. Navy . . . . .	390
Bombs Dropped by U. S. Navy Aviation . . . . .	390
Air Force Equipment of the United States . . . . .	392
Aircraft of the U. S. Army Air Forces . . . . .	392
Aircraft of the U. S. Navy . . . . .	392
Army Air Transport Command Operations . . . . .	394
Naval Air Transport Operations . . . . .	394
Total Personnel in U. S. Army Air Forces . . . . .	396
Aviation Personnel of U. S. Navy . . . . .	398
Officer Personnel in U. S. Army Air Forces . . . . .	396
Army Air Forces Flying Training Graduates . . . . .	396
Naval Aviation Service School . . . . .	398
Aviation Training Services of the Civil Aeronautics Administration . . . . .	398
Aircraft Production in the United States . . . . .	400
Production of Aircraft Engines in the United States . . . . .	400
Military Aircraft Production in the United States, by numbers . . . . .	402
Military Aircraft Production in the United States, by types and weights . . . . .	404
Production of Aircraft Propellers in the United States . . . . .	406
American Airplanes in War Service . . . . .	408-410
Value of Airframe, Engine and Propeller Production in the United States . . . . .	412
Civil Aeronautics Administration Funds . . . . .	412
Summary of Air Carrier Operations . . . . .	414
Status of Air Carrier Operations . . . . .	414
Monthly Air Carrier Operations . . . . .	416
United States Air Transport Routes . . . . .	418-424
Licensed Pilots in the United States . . . . .	426
Licensed Ground Instructors in the United States . . . . .	428
Civil Airports and Landing Fields . . . . .	430
Progress of Civil Aeronautics . . . . .	432-436
U. S. Domestic Air Carrier Operations . . . . .	436
Employees in the Aircraft Industry . . . . .	438
Wages and Hours in the Aircraft Industry . . . . .	440

COMBAT RECORD OF U. S. ARMY AIR FORCES

All Theaters

Year	Enemy Airplane Losses						U. S. Army Air Forces Airplane Losses	
	In Aerial Combat			On the Ground			Destroyed in Aerial Combat	Destroyed on the Ground
	Destroyed	Probably Destroyed	Damaged	Destroyed	Probably Destroyed	Damaged		
1941								
Dec. 7-31...	—	—	—	—	—	—	—	103
1942								
January....	—	—	—	—	—	—	2	4
February....	31	2	7	—	—	—	45	23
March.....	19	5	2	15	2	—	12	61 <sup>1</sup>
April.....	17	11	13	10	—	19	3	—
May.....	29	15	23	7	—	20	48	8
June.....	51	7	25	4	—	4	50	—
July.....	38	14	13	—	3	—	26	2
August.....	73	20	20	70	5	5	39	3
September..	65	34	37	30	—	1	33	1
October....	147	95	74	20	3	17	30	—
November..	197	51	42	83	16	25	73	4
December..	255	76	87	30	11	14	65	1
Total.....	922	330	352	284	40	105	426	107
1943								
January....	410	181	140	37	13	10	139	13
February....	301	110	104	35	4	—	102	5
March.....	438	144	181	25	24	—	102	8
April.....	677	169	204	125	2	66	213	10
May.....	756	227	317	104	60	51	205	5
June.....	661	193	248	36	8	—	208	—
July.....	1,019	326	463	80	28	—	354	6
August.....	1,329	326	368	238	8	91	320	2
September..	946	224	306	252	16	87	218	2
October....	1,518	285	290	390	40	194	308	—
November..	636	246	194	142	18	35	256	4
December..	934	336	320	45	1	44	283	5
Total.....	9,625	2,767	3,135	1,509	222	578	2,717	60
1944								
January....	1,333	400	427	36	5	28	380	8
February....	1,185	306	428	155	15	57	444	2
March.....	1,278	316	457	351	21	203	370	4
April.....	1,574	425	610	992	41	652	686	2
May.....	1,530	364	547	394	34	248	528	23
June.....	1,235	295	472	254	1	147	479	47
July.....	1,366	295	577	323	44	191	456	—
August.....	945	147	306	818	72	432	540	—
September..	770	113	285	712	82	364	460	10
October....	497	122	231	444	46	180	242	4
November..	799	199	206	369	48	112	279	49
December..	1,354	215	446	512	59	222	278	27
Total.....	13,846	3,197	5,082	5,360	468	2,836	5,142	176
Grand Total..	24,393	6,294	8,569	7,153	730	3,519	8,285	446

<sup>1</sup> Includes 59 P-40's lost or captured by Japs enroute Australia to Java by boat.

## COMBAT SORTIES BY U. S. ARMY AIR FORCES

All Theaters

	<i>Pacific Ocean Areas<sup>1</sup></i>	<i>Far East</i>	<i>China and India- Burma</i>	<i>Mediterranean Theater</i>	<i>European Theater</i>	<i>Total</i>
1941						
December 7-31...	—	212	—	—	—	212
1942						
January.....	12	341	—	—	—	353
February.....	14	742	5	—	—	761
March.....	17	979	23	—	—	1,019
April.....	18	1,181	30	—	—	1,229
May.....	31	1,223	52	—	—	1,306
June.....	153	1,180	158	70	—	1,561
July.....	130	1,172	111	166	—	1,579
August.....	150	1,197	115	255	324	2,041
September.....	157	1,352	171	576	423	2,679
October.....	172	1,604	191	1,519	534	4,020
November.....	183	1,663	199	2,544	629	5,218
December.....	250	1,677	286	2,166	543	4,922
Total.....	1,287	14,311	1,341	7,296	2,453	26,688
1943						
January.....	252	4,315	485	4,330	767	10,149
February.....	321	2,816	797	3,362	976	8,272
March.....	635	4,257	1,237	6,478	1,564	14,171
April.....	1,167	5,023	1,522	12,963	989	21,664
May.....	805	5,517	1,760	12,724	3,915	24,721
June.....	424	5,874	955	13,248	4,104	24,605
July.....	537	8,827	1,454	24,339	5,531	40,688
August.....	653	11,472	1,304	21,532	5,826	49,787
September.....	69	12,777	1,798	20,659	9,294	44,597
October.....	32	12,149	2,818	14,124	7,403	36,586
November.....	368	13,073	3,969	15,856	9,624	42,890
December.....	856	17,048	5,052	18,948	13,876	55,780
Total.....	6,119	103,148	23,151	168,563	63,929	364,910
1944						
January.....	1,402	17,064	2,962	28,992	15,183	65,603
February.....	1,114	15,233	3,589	20,568	24,425	64,929
March.....	1,246	15,185	5,171	24,798	31,950	78,350
April.....	1,424	13,653	4,971	30,645	43,434	94,127
May.....	1,115	16,005	6,750	42,539	67,079	134,388
June.....	1,047	14,410	6,281	33,947	96,035	151,720
July.....	4,179	10,400	7,375	33,987	74,878	130,819
August.....	3,398	9,644	7,584	37,968	77,976	136,570
September.....	2,510	12,476	7,365	26,359	57,384	106,094
October.....	2,241	11,537	8,883	22,607	52,596	97,864
November.....	3,232 <sup>2</sup>	9,200 <sup>2</sup>	8,829 <sup>2</sup>	26,051	49,289	96,601
December <sup>2</sup> .....	5,084	10,300	10,228	29,157	59,950	114,719
Total.....	27,992	155,107	79,988	357,618	651,079	1,271,784

<sup>1</sup> Includes Alaska.<sup>2</sup> Tentative.

***We make planes***



***that are speeding***



***the Victory on***



***every war-front***

**North American Aviation**  
*Sets the Pace!*

## BOMBS DROPPED BY U. S. ARMY AIR FORCES

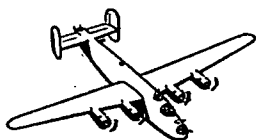
## All Theaters

	<i>Pacific Ocean Areas<sup>1</sup></i>	<i>Far East</i>	<i>China and India- Burma</i>	<i>Mediterranean Theater</i>	<i>European Theater</i>	<i>Total</i>
1941						
Dec. 7-31.....	—	36	—	—	—	36
1942						
January.....	2	40	—	—	—	42
February.....	2	63	9	—	—	74
March.....	3	69	19	—	—	91
April.....	3	110	24	—	—	146
May.....	7	158	54	—	—	219
June.....	75	176	94	115	—	460
July.....	82	214	67	356	—	719
August.....	102	274	50	430	135	991
September.....	105	307	64	482	215	1,173
October.....	112	352	69	771	334	1,638
November.....	109	404	100	1,195	612	2,420
December.....	148	421	147	1,061	417	2,194
Total*.....	750	2,633	697	4,410	1,713	10,203
1943						
January.....	7	825	197	1,083	739	3,751
February.....	135	663	421	1,773	705	3,697
March.....	318	732	682	2,773	1,530	6,035
April.....	693	564	800	5,042	1,130	8,229
May.....	464	806	1,170	7,436	2,688	12,564
June.....	288	1,014	541	8,409	2,468	12,720
July.....	453	2,709	881	13,850	4,366	22,259
August.....	572	2,910	851	12,460	5,071	21,864
September.....	81	3,024	1,098	13,941	8,520	26,664
October.....	—	3,269	1,678	8,915	6,014	19,876
November.....	337	4,354	1,230	7,258	8,312	21,491
December.....	788	9,184	1,332	10,183	14,118	35,605
Total.....	4,136	30,054	10,881	94,023	55,661	194,755
1944						
January.....	1,041	6,073	777	19,097	14,015	41,003
February.....	1,127	7,802	983	11,595	22,566	44,073
March.....	1,163	9,444	1,648	17,440	26,539	56,234
April.....	1,940	9,633	2,002	29,856	38,540	81,971
May.....	1,606	10,612	2,506	46,075	56,874	117,673
June.....	915	7,692	1,896	36,286	85,648	132,437
July.....	1,686	5,951	2,398	41,769	63,062	114,866
August.....	1,773	5,025	2,660	40,280	67,766	117,504
September.....	1,456	8,203	3,190	29,285	52,175	94,309
October.....	1,166	6,202 <sup>2</sup>	4,867	22,107	52,860	87,202
November.....	2,357	5,050 <sup>3</sup>	5,396 <sup>2</sup>	26,694	51,755	91,252
December <sup>2</sup> .....	4,499	8,400 <sup>3</sup>	5,981	26,534	58,880	104,294
Total.....	20,729	90,087	34,304	347,018	590,680	1,082,818

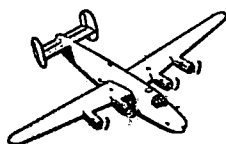
<sup>1</sup> Includes Alaska.<sup>2</sup> Tentative.<sup>3</sup> Estimated.

\* Includes 1941 Tonnage.

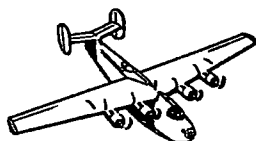
# From Flying Jeeps to Leviathans of the Air



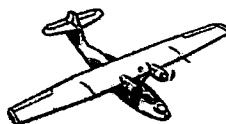
**LIBERATOR** . . . 4-engine bomber



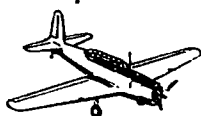
**LIBERATOR EXPRESS** . . . transport



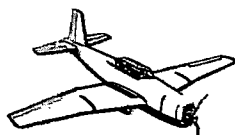
**CORONADO** . . . patrol bomber



**CATALINA** . . . patrol bomber



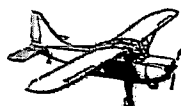
**VALIANT** . . . basic trainer



**VENGEANCE** . . . dive bomber



**RELIANT** . . . navigation trainer



**SENTINEL** . . . "Flying Jeep"

**WHEN VICTORY** has been won, Consolidated Vultee Aircraft Corporation will be in a position to

provide the postwar equivalent of these planes, from small "air flivvers" to trans-oceanic cargo and passenger planes.

## CONSOLIDATED VULTEE

San Diego, Calif.  
Vultee Field, Calif.  
Tucson, Ariz.

Fort Worth, Texas  
New Orleans, La.  
Nashville, Tenn.

Louisville, Ky.  
Wynne, Mich.  
Dearborn, Mich.

Allentown, Pa.  
Elizabeth City, N. C.  
Miami, Fla.

Member, Aircraft War Production Council

## AIR COMBAT RECORD OF U. S. NAVY

Including U. S. Marine Corps

All Theaters

Calendar Year	Japanese Planes Destroyed <sup>1</sup>	U. S. Navy Planes Destroyed	Ratio	U. S. Navy Combat Sorties <sup>2</sup>	Tons of Bombs Dropped by U. S. N.
1942.....	1,134	384	3-1	N.A.	3,000
1943.....	2,212	351	6.3-1	N.A.	12,000
1944.....	6,473	1,147	5.7-1	144,865 <sup>3</sup>	49,925 <sup>3</sup>

<sup>1</sup> Includes planes destroyed in air and on ground, but does not include U. S. Navy or Japanese plane losses by anti-aircraft fire.

<sup>2</sup> A sortie is one flight by one plane.

<sup>3</sup> Preliminary estimates.

N.A.—Not available.

## COMBAT SORTIES BY U. S. NAVY

Including U. S. Marine Corps

	Sorties
1944	
January.....	6,086
February.....	8,758
March.....	8,544
April.....	10,727
May.....	6,537
June.....	12,357
July.....	17,892
August.....	8,064
September.....	18,000 <sup>1</sup>
October, November and December.....	47,000 <sup>2</sup>
Total.....	144,865

<sup>1</sup> Preliminary.

<sup>2</sup> Estimated for 3 months.

## BOMBS DROPPED BY U. S. NAVY AVIATION

Including U. S. Marine Corps

Calendar Year	Tons of Bombs
1942.....	3,000
1943.....	2,546
1944	
January.....	1,723
February.....	2,546
March.....	3,318
April.....	4,186
May.....	2,692
June.....	3,454
July.....	6,218
August.....	3,288
September.....	6,000 <sup>1</sup>
October, November, December.....	16,500 <sup>2</sup>
1944 total.....	49,925

<sup>1</sup> Preliminary.

<sup>2</sup> Estimates for 3 months.



**U. S. Carrier Launches Navy's Grumman Hellcats**

*Grumman*

AIRCRAFT ENGINEERING CORPORATION. Bethpage, L. I., N. Y.



## FLYING FACTS AND FIGURES

## AIR FORCE EQUIPMENT OF THE UNITED STATES

Army and Navy Aircraft on Hand

	<i>U. S. Army Air Forces</i>		<i>U. S. Navy and Marine Corps</i>		<i>Total</i>
	<i>Combat</i>	<i>Other</i>	<i>Combat</i>	<i>Other</i>	
Dec. 1, 1941....	2,810	7,517	2,021	2,794	16,042
Dec. 31, 1944...	40,157	32,569	26,464	10,888	110,078

## AIRCRAFT OF THE U. S. ARMY AIR FORCES

	<i>Tactical</i>	<i>Training</i>	<i>Transport</i>	<i>Other Non-Tactical</i>	<i>Total</i>
Dec. 31, 1941.....	4,477	7,340	254	226	12,297
Dec. 31, 1942.....	11,607	17,044	1,857	2,796	33,304
Dec. 31, 1943.....	27,448	26,051	6,466	4,267	64,232
Dec. 31, 1944.....	41,961	17,060	10,456	3,249	72,726

## AIRCRAFT OF THE U. S. NAVY

Including U. S. Marine Corps

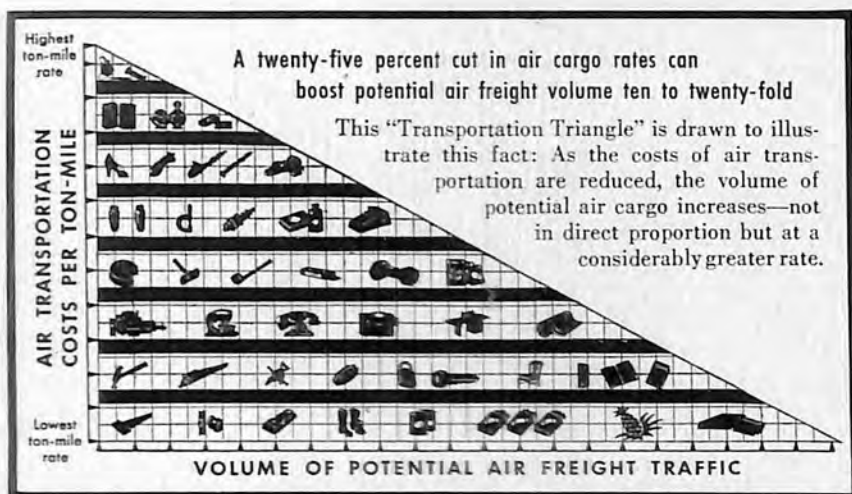
<i>On Hand</i>	<i>Combat</i>	<i>Other</i>	<i>Total</i>
Dec. 31, 1941.....	2,823	2,794	5,715
Dec. 31, 1942.....	5,879	6,355	12,234
Dec. 31, 1943.....	10,092	11,050	27,142
Dec. 31, 1944.....	26,464	10,888	37,352

AAF EIGHTH AIR FORCE HEAVY BOMBER OPERATIONS  
IN 1944

Based in England

	<i>Tons of Bombs Dropped</i>
Aircraft Plants.....	36,726
Oil Installations.....	52,622
Other Industries.....	39,630
City Areas, Industry Unspecified.....	42,603
Airfields and Airdromes.....	57,810
Railway Marshaling Yards and Other Communications.....	129,149
Military Installations.....	71,526
<b>Total.....</b>	<b>430,066<sup>1</sup></b>

<sup>1</sup> Of the total, the Eighth Air Force dropped 229,391 tons on strategic missions and 200,675 tons on tactical missions.



## PREDICTION: Postwar freight will fly at less than 15 cents a ton-mile

• Out of America's war-accelerated research will come new and different airplanes for a world at peace.

Planes of new, unorthodox design—capable of carrying larger loads longer distances with greater economy in operating costs.

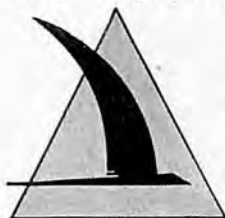
Giant land and seaplanes. "Shuttle" craft for short hauls. Express planes of incredible speed. Airplanes to travel America's postwar products and American technicians fast and far to markets anywhere on earth.

Knowledge U. S. aircraft designers already possess is enough to guarantee this prophecy. Aircraft now

on drawing boards can be operated profitable at rates below 15 cents per ton-mile. The rates for air freight before the war were from 80 to 90 cents per ton-mile.

After victory, Northrop accomplishments, with those of other U. S. leaders, will contribute to a new world of peace and opportunity.

*Meanwhile all the resources of Northrop in airplane design and airplane construction are devoted solely to producing the deadly airplanes of war. Airplanes that help bring closer the day of complete victory for the Allies.*



### **NORTHROP Aircraft, Inc.**

NORTHROP FIELD, HAWTHORNE, CALIFORNIA  
MEMBER AIRCRAFT WAR PRODUCTION COUNCIL, INC.

## AIR TRANSPORT COMMAND OPERATIONS

U. S. Army Air Forces

	<i>Average Number of Transports Assigned</i>	<i>Ton Miles Flown</i>	<i>Passengers Carried</i>	<i>Tons of Cargo Carried</i>
1943				
Total.....		320,340,000	51,128 <sup>1</sup>	54,683 <sup>1</sup>
1944				
January.....	787	39,630,000	55,633	22,482
February.....	832	42,920,000	51,697	21,919
March.....	886	47,990,000	54,682	22,086
April.....	869	48,650,000	84,037	25,092
May.....	1,014	56,070,000	78,252	25,559
June.....	1,167	61,770,000	90,091	32,467
July.....	1,258	74,250,009	102,197	36,844
August.....	1,446	88,470,000	125,675	47,422
September.....	1,524	88,390,000	145,627	44,141
October.....	1,608	100,740,000	152,971	50,254
November.....	1,825	104,200,000	153,482	57,761
December.....	1,900	105,300,000	162,526	53,181
Total.....		858,380,000	1,256,870	439,208

<sup>1</sup> Domestic only.

## NAVAL AIR TRANSPORT SERVICE

U. S. Navy<sup>1</sup>

<i>Month</i>	<i>No. <sup>2</sup> Planes</i>	<i>Plane Miles Flown</i>	<i>Passengers Loaded</i>	<i>Cargo and Mail Loaded (tons)</i>	<i>Total Ton Miles Flown</i>
1943					
July.....	140	2,783,499	17,736	2,980.4	6,107,966
August.....	145	2,991,847	18,163	3,315.0	6,962,022
September.....	153	3,125,857	18,487	3,276.8	7,167,495
October.....	159	3,258,347	20,204	3,571.7	7,761,677
November.....	173	3,426,678	21,640	3,944.9	8,514,185
December.....	179	3,611,329	22,363	4,128.8	9,286,471
Total for 6 months.		19,197,557	118,593	21,217.6	45,799,816
1944					
January.....	201	4,205,644	25,385	4,533.8	10,848,443
February.....	209	4,135,070	24,610	4,263.0	10,549,839
March.....	220	5,095,248	30,918	5,033.6	12,283,441
April.....	245	5,643,252	38,152	5,271.6	14,171,198
May.....	270	6,632,495	44,409	6,047.0	16,454,734
June.....	288	6,937,388	49,044	6,667.1	18,157,466
July.....	307	7,346,459	54,877	7,178.5	19,705,756
August.....	324	7,597,892	57,864	7,950.3	21,527,121
September.....	327	7,443,278	56,166	7,520.8	22,120,609
October.....	349	6,960,937	56,357	6,846.4	19,254,540
November.....	352	7,497,465	56,275	7,496.2	21,063,500
December.....	351	7,933,204	55,336	7,847.3	23,336,444
Total 1944.....		77,428,341	549,393	76,664.6	209,473,181

<sup>1</sup> Including contract operators.<sup>2</sup> Including transport planes used for training.



Wounded Soldiers, Sailors, Marines "Go Douglas." To date, over 200,000 Allied casualties have been brought back to safety by air. Evacuation of wounded from battle zones is a 100% Douglas responsibility.



Very Important People "Go Douglas." Army, Navy, Government and Industry Leaders travel in Douglas planes on our domestic airlines to speed the nation's mighty war effort.



7 out of 10 transports flown by the Air Transport Command are Douglas. If it's a mission to Moscow or a trip around the world, United Nations leaders "Go Douglas."



***They all GO DOUGLAS***



***Douglas***  
AIRCRAFT

## TOTAL PERSONNEL IN U. S. ARMY AIR FORCES

Year	Officers		Enlisted Personnel			Total		Grand Total
	Air Corps	Assigned from Other Army Services	Aviation Cadets	Air Corps	Assigned from Other Army Services	Air Corps	Assigned from Other Army Services	
Dec. 31, 1939	3,006		1,328	38,784		43,118		43,118
Dec. 31, 1940	6,437		4,792	89,998		101,227		101,227
Dec. 31, 1941	20,293	4,228	17,614	237,259	74,767	275,166	78,995	354,161
Dec. 31, 1942	98,835	28,432	94,003	1,083,319	292,460	1,276,157	320,892	1,597,049
Dec. 31, 1943	219,415	54,932	114,336	1,479,818	505,381	1,813,569	560,313	2,373,882
Dec. 31, 1944*	327,000	49,000	39,000	1,536,250	408,250	1,902,250	457,250	2,359,500

\* Approximate.

## OFFICER PERSONNEL OF U. S. ARMY AIR FORCES

Year	Pilots	Other Air Corps	Total Air Corps	Assigned from Other Army Services	Grand Total
Dec. 31, 1939	2,930	76	3,006		
Dec. 31, 1940	4,831	1,606	6,437		
Dec. 31, 1941	11,603	8,690	20,293	4,228	24,521
Dec. 31, 1942	34,505	64,330	98,835	28,432	127,267
Dec. 31, 1943	86,644	132,771	219,415	54,932	274,347
Dec. 31, 1944 <sup>1</sup>	159,000	168,000	327,000	49,000	376,000

<sup>1</sup> Approximate.

## AAF FLYING TRAINING GRADUATES

U. S. Army Air Forces

(Students Entered Since July 1, 1939)

Year	Basic Courses <sup>1</sup>							Flexible Gunners
	Pilots		Glider Pilots	Bombardiers	Navigators	Observers	Total	
	Advanced	Other <sup>2</sup>						
July 1939-Dec. 1941	9,030	—	—	328	647	198	10,203	—
1942	24,948	—	384	5,013	4,446	581	35,372	25,721
1943	61,904	3,913	3,344	15,601	14,392	376	99,530	91,587
1944	81,024	5,603	2,209	17,966	21,919	—	128,721	146,202

<sup>1</sup> Excludes transition and advanced specialization courses.<sup>2</sup> Includes FA liaison, advanced liaison, liaison instrument, advanced Stewart Field, observation, women, ATC pilots, and helicopter pilots.

**A DISTINGUISHED NEW NAME FOR A DISTINGUISHED OLD SCHOOL**



MAJOR C. C. MOSELEY, PRESIDENT SINCE 1929

**HAS CHANGED ITS NAME TO**

# **CAL-AERO**

## **TECHNICAL INSTITUTE**

*Specializing in*  
**AERONAUTICAL ENGINEERING**  
*and*  
**MASTER AVIATION MECHANICS**  
*Since 1929*

A change in name only—same school—same management—same personnel—same fine training. "Cal-Aero" is one of the most famous, substantial and highly honored names in the history of flight training. With an unparalleled record of efficiency and safety in training more than 20,000 pilots and 7,500 crew members for the A.A.F., and at the same time graduating thousands of civilians for the production front, it is but natural that the associated schools under personal supervision of Major C. C. Moseley should come under the single name—"Cal-Aero."

In planning for the post-war period, the technical phase of training will come under the name Cal-Aero Technical Institute. To this end "Cal-Aero" has purchased the famous Grand Central Air Terminal outright for a bigger and better future in Aviation.

. . . Flight Training is restricted to Army Air Force cadets for the duration.



MAJOR C. C. MOSELEY

PRES. SINCE 1929

**FORMERLY CURTISS-WRIGHT TECHNICAL INSTITUTE**

ON ITS OWN AIRPORT

GRAND CENTRAL AIRPORT, GLENDALE 1, CALIFORNIA

**IN THE HEART OF SOUTHERN CALIFORNIA'S AIRCRAFT INDUSTRY**

## AVIATION PERSONNEL OF U. S. NAVY

Including U. S. Marine Corps

<i>Cal. Yr. Dec. 31</i>	<i>Pilots</i>	<i>Ground Officers</i>	<i>Total Officers</i>	<i>Enlisted Av. Rates</i>	<i>Total Personnel</i>
1941.....	6,300	3,000	8,300	14,848	23,148
1944.....	47,276	24,336	71,612	228,356	299,968

## NAVAL AVIATION SERVICE SCHOOL

Enlisted Personnel Trained

	1942	1943	1944
January.....	1,713	4,143	6,197
February.....	1,699	5,451	5,276
March.....	1,707	6,009	5,411
April.....	1,148	6,634	6,441
May.....	1,152	7,268	5,820
June.....	2,623	5,311	5,631
July.....	2,033	7,464	6,875
August.....	2,548	6,209	5,998
September.....	2,658	5,861	7,364
October.....	3,514	6,734	5,406
November.....	3,231	4,854	5,860
December.....	3,489	4,710	6,656
Totals.....	27,515	70,648	72,944

AVIATION TRAINING SERVICES  
OF THE  
CIVIL AERONAUTICS ADMINISTRATION

[Civil Pilot Training—War Training Service]

	1940	1941	1942	1943	1944	Total
Hours flown.....	371,000	2,168,725	1,857,860	3,648,950	3,818,434	11,864,960
Number of trainees....	10,281	57,972	40,006	111,140	178,323	397,812
Courses.....	10,281	65,991	49,490	142,193 <sup>1</sup>	235,111 <sup>2</sup>	503,066
Elementary.....	10,197	47,276	26,845	46,626	29,232	160,176
Secondary.....	84	8,019	9,394	15,765	2,337	35,599
Cross Country.....	0	0	7,288	6,501	3,079	16,868
Link Instrument....	0	0	0	2,335	3,108	5,443
Instructor.....	0	7,131	5,903	5,447	2,582	21,123
Flight Officer.....	0	0	0	1,815	104	1,919
Army Air Crew In- doctrination.....	0	0	0	49,491	168,631	218,122
Navy Intermediate..	0	0	0	5,703	26,038	31,741
All others.....	0	3,565	0	8,510	0	12,075

<sup>1</sup> Includes 93,825 Army, 47,917 Navy and 451 Marine courses.<sup>2</sup> Includes 179,645 Army and 55,466 Navy courses.

# LINK

**Oldest and largest manufacturer  
of training devices to promote  
the safety of flight.**



**INSTRUMENT FLYING TRAINER  
PRE-FLIGHT TRAINER • COLLIMATOR  
MAP READING TRAINER • STAR GLOBE  
CREW NAVIGATION TRAINER  
CELESTIAL NAVIGATION CLASS TRAINER  
AVIATION-MARINE SEXTANT**



**LINK AVIATION DEVICES, INC.**

**BINGHAMTON, N. Y.**

**Link Manufacturing Co., Ltd., Gananoque, Ont.**

**J. V. W. & CO., INTERNATIONAL DISTRIBUTORS**

**1100 RAYMOND BOULEVARD, NEWARK 5, N. J.**

---

---



## PRODUCTION OF AIRCRAFT IN THE UNITED STATES

From Statistical Service, Aeronautical Chamber of Commerce of America

Year	Civil	Military	Total
1938.....	1,823	1,800	3,623
1939.....	3,715	2,141	5,856
1940.....	6,785	6,086	12,871
1941.....	6,844	19,290	26,134
1942.....	985	47,873	48,858
1943.....	—	85,946	85,946
1944.....	—	96,369	96,369

Source: 1938-1941—(Civil) U. S. Department of Commerce, "Civil Aeronautics Journal," Vol. 5, No. 1 (figures indicate registrations). 1938-1939—(Military) U. S. War Department, Bureau of Public Relations. 1942—(Civil) Civil Aeronautics Administration, Information Division. 1940-1944—(Military) Aircraft Resources Control Office, Report 15, Monthly & Summary.

## PRODUCTION OF AIRCRAFT ENGINES IN THE UNITED STATES

From Statistical Service, Aeronautical Chamber of Commerce of America

	1941		1942		1943		1944	
	Number of Engines	Horse- power in Thou- sands (incl. spares)	Number of Engines	Horse- power in Thou- sands (incl. spares)	Number of Engines	Horse- power in Thou- sands (incl. spares)	Number of Engines	Horse- power in Thou- sands (incl. spares)
January (est.)..	3,373	2,537	7,128	7,464	16,011	21,682	22,627	36,098
February.....	3,339	2,890	7,348	8,018	15,328	21,682	21,067	35,079
March.....	3,304	3,269	8,080	9,754	16,030	23,921	23,923	39,235
April.....	3,552	3,607	10,093	11,081	16,838	24,273	22,681	37,403
May.....	3,515	3,652	10,795	12,114	17,869	25,903	22,819	38,126
June.....	3,873	3,703	11,748	13,637	17,735	26,632	23,072	38,502
July.....	4,817	4,578	11,869	15,012	18,753	28,644	22,603	36,570
August.....	5,268	4,761	12,890	17,262	19,688	30,900	24,102	39,879
September.....	4,858	4,778	13,210	18,396	20,585	32,110	20,881	35,293
October.....	4,957	4,902	13,683	18,297	21,856	33,671	19,268	30,668
November.....	5,685	5,953	14,181	20,149	22,680	35,433	17,235	31,716
December.....	6,093	6,117	14,926	21,382	22,288	35,761	16,293	30,037
Total.....	52,633 <sup>1</sup>	50,747	136,851 <sup>2</sup>	172,566	226,561 <sup>3</sup>	339,538	256,571 <sup>4</sup>	428,666

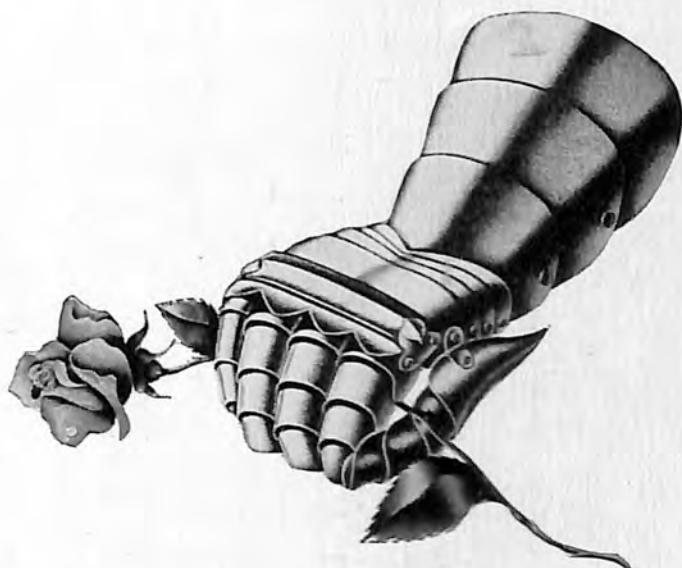
<sup>1</sup> Plus 4,467 engines for ordnance and additional spare parts.

<sup>2</sup> Plus 10,597 engines for ordnance and an additional engine equivalent of 22,667 of spare parts.

<sup>3</sup> Plus 8,479 ordnance and an additional engine equivalent of 77,257 of spare parts.

<sup>4</sup> Plus 5,800 engines for ordnance and an additional engine equivalent of 58,897 spare parts.

Source: Aircraft Resources Control Office, Report 15 (monthly summary).



*"A rose . . . by any other name . . ."*

As one William Shakespeare so aptly limned . . .

Is still the same sweet flower . . .

And while we concede that it's a far cry  
from the immortal bard to modern aerial combat,  
our point is just the same . . .

For the P-47\* is the same sweet ship by any other name.

Thunderbolt . . . Superbolt . . . Thunderbomber . . . Black Death . . .

and from one enthusiastic pilot,

the significant appellation, "Frank Buck", serves

to emphasize the fact that here is a plane

which not only performs its varied operational demands,

but has established, as well,

A most enviable reputation for "Bringing 'em back alive."

\*Combat pilots who have flown all types of Fighter Planes  
are unstinting in their praise of Thunderbolt versatility.



**REPUBLIC**



**AVIATION**

CORPORATION

Farmingdale, L. I., N. Y.

*Makers of the Mighty Thunderbolt*

Evansville, Ind.

## MILITARY AIRCRAFT PRODUCTION IN THE UNITED STATES NUMBERS AND WEIGHT\* BY MONTHS

From Statistical Service, Aeronautical Chamber of Commerce of America

[Weight in 000's of Pounds]

	1940		1941		1942		1943		1944	
	Units	Weight	Units	Weight	Units	Weight	Units	Weight	Units	Weight
January.....	267	1,600	1,016	3,920	2,980	14,389	5,013	35,869	8,789	89,989
February.....	266	1,500	962	4,390	3,099	15,844	5,453	41,420	8,760	94,574
March.....	298	1,400	1,135	4,581	3,497	18,848	6,264	47,273	9,117	101,363
April.....	376	1,500	1,388	6,212	3,501	18,048	6,472	52,661	8,343	96,437
May.....	480	2,200	1,331	5,847	3,989	21,597	7,114	57,348	8,902	102,418
June.....	602	2,400	1,477	6,143	3,734	23,065	7,094	62,149	8,049	97,804
July.....	561	2,300	1,461	5,830	4,109	25,545	7,373	63,724	8,000	93,857
August.....	528	2,000	1,853	7,760	4,281	27,292	7,612	69,134	7,939	93,944
September.....	515	1,700	1,914	8,652	4,307	30,065	7,598	71,152	7,597	90,000
October.....	617	2,200	2,273	10,255	4,063	28,030	8,362	76,098	7,429	87,834
November.....	737	2,400	2,051	9,344	4,812	31,434	8,789	80,453	6,747	81,719
December.....	839	3,400	2,429	12,802	5,501	37,908	8,802	85,701	6,697	80,777
Total.....	6,086	24,600	19,290	85,736	47,873	292,665	85,946	742,982	96,369	1,110,716

\* Includes spare parts.

Source: Aircraft Resources Control Office, Report 15 (monthly & summary).

## CARRYING THE LOAD



The Douglas A-26 Invaders are helping to carry the fight to the enemy. ¶ Beechcrafters are building complete wing assemblies, including engine nacelles and flaps, for the deadly A-26; in addition to the production of Beechcrafts for our Armed Services and those of our Allies. ¶ Beechcrafters are carrying a greater War Production load than ever before, but are proud to make this worthwhile extra contribution to early Victory. ¶ They ask the indulgence of prospective peacetime Beechcraft customers for their complete preoccupation with production for Victory. ¶ To the thousands of Beechcrafters in the Armed Services, and to all other service men and women everywhere, they send greetings and repledge themselves to do everything and anything within their power to bring Victory at the earliest possible moment.

# Beech Aircraft

CORPORATION

BEECHCRAFTS ARE DOING THEIR PART



WICHITA, KANSAS, U. S. A.

**MILITARY AIRCRAFT PRODUCTION IN THE UNITED STATES  
NUMBERS BY TYPES AND WEIGHT\***

From Statistical Service, Aeronautical Chamber of Commerce of America

[Weight in 000's of Pounds]

	July-Dec., 1940		1941		1942		1943		1944		Total July 1940-Dec., 1944	
	Units	Weight	Units	Weight	Units	Weight	Units	Weight	Units	Weight	Units	Weight
Bombers.....	626	5,669	4,119	40,573	12,637	163,050	29,362	425,151	35,008	611,122	81,752	1,245,565
Fighters & Naval Recon- naissance.....	1,162	3,756	4,940	17,776	12,240	54,100	24,739	126,254	39,133	217,766	82,214	419,652
Transports.....	164	1,160	533	3,776	1,984	18,257	7,013	55,496	9,854	113,673	19,548	192,362
Trainers.....	1,808	3,201	9,366	18,089	17,632	39,158	19,942	47,053	7,578	19,068	56,326	126,569
Communication & Special Purpose.....	10	13	501	930	3,367	2,000	4,874	3,407	4,783	3,952	13,535	10,302
<b>Total All Planes.....</b>	<b>3,770</b>	<b>13,799</b>	<b>19,459</b>	<b>81,144</b>	<b>47,860</b>	<b>276,565</b>	<b>85,930</b>	<b>657,361</b>	<b>96,356</b>	<b>965,581</b>	<b>253,375</b>	<b>1,994,450</b>

\* Airframe weight excludes spare parts.

Source: "Facts for Industry," War Production Board, Military Div., Nov. 18, 1944, Series 51-2-1, War Production Board, Military Div., Jan. 27, 1945.



The first American jet propelled airplane...one of the many contributions of the Bell Aircraft Corporation to the advancement of aviation.

MEMBER AIRCRAFT WAR PRODUCTION COUNCIL...EAST COAST, INC.

# BELL *Aircraft*

**PACEMAKER OF AVIATION PROGRESS**

**NIAGARA FRONTIER DIVISION, Buffalo and Niagara Falls, N. Y.**

*Airacobra (P-39) and Kingcobra (P-63) — Fighters*  
*Airacomet—America's First Jet Propelled Plane*  
*The Bell Helicopter*

**ORDNANCE DIVISION, Burlington, Vt.**

*Flexible Gun Mounts and other ordnance materials*

**GEORGIA DIVISION, Marietta, Ga.**

*B-29 Boeing Superfortress*

★ ★ BUY WAR BONDS AND SPEED VICTORY ★ ★

## PRODUCTION OF AIRCRAFT PROPELLERS IN THE UNITED STATES

From Statistical Service, Aeronautical Chamber of Commerce of America

	1941			1942			1943			1944		
	Steel Blade	Dural Blade	Total Blade	Steel Blade	Dural Blade	Total Blade	Steel Blade	Dural Blade	Total Blade	Steel Blade	Dural Blade	Total Blade
January.....	N.A.*	N.A.	2,111	762	5,826	6,588	2,079	10,130	12,209	1,636	20,957	22,593
February.....	N.A.	N.A.	1,012	667	4,578	5,245	2,149	10,554	12,703	1,541	20,822	22,363
March.....	N.A.	N.A.	2,524	2,456	4,621	7,077	2,797	11,616	14,413	1,697	20,445	22,142
April.....	N.A.	N.A.	2,419	1,154	7,220	8,374	2,938	12,779	15,717	2,058	19,375	21,433
May.....	N.A.	N.A.	2,612	1,503	7,221	8,724	2,668	13,279	15,947	2,099	19,873	21,972
June.....	N.A.	N.A.	2,829	1,395	8,231	9,626	2,272	14,603	16,875	2,792	18,088	21,780
July.....	N.A.	N.A.	2,987	1,079	8,543	9,622	2,526	16,784	19,310	2,725	16,475	19,200
August.....	N.A.	N.A.	3,434	1,254	8,337	9,591	2,494	17,772	20,266	2,905	18,035	21,000
September.....	N.A.	N.A.	4,171	1,213	8,697	9,910	2,234	18,179	20,413	2,544	17,102	19,646
October.....	N.A.	N.A.	4,449	2,176	8,787	10,963	2,004	20,270	22,274	2,987	14,503	17,490
November.....	N.A.	N.A.	4,411	1,586	8,419	10,005	1,797	19,548	21,345	2,807	14,477	17,344
December.....	N.A.	N.A.	5,142	1,602	9,952	11,554	1,554	20,911	22,465	2,869	13,908	16,777
Total.....	N.A.	N.A.	39,001	16,847	90,432	107,279	27,512	186,425	213,937	28,780	214,960	243,740

\* N.A. Not available.

Source: Aircraft Resources Control Office, Report 15 (monthly & summary).

VERSATILE \* RELIABLE

# Every Feature Proved in Service

MULTI-ENGINE SYNCHRONIZATION



UNIT INTERCHANGEABILITY



AERODYNAMIC BRAKING



LIGHT WEIGHT  
STEEL BLADES



# CURTISS

ELECTRIC PROPELLERS

CURTISS WRIGHT CORPORATION PROPPELLER DIVISION





**AMERICAN AIRPLANES IN SERVICE WITH OR IN AN-  
NOUNCED PRODUCTION FOR THE UNITED STATES  
AND BRITISH AIR FORCES**

January 1, 1945

Original Designer	Model		Approved Name
	U. S. Army	U. S. Navy	
<b>Bombers</b>			
Boeing.....	B-17	.....	Fortress
Douglas.....	B-18	.....	Bolo
Douglas.....	B-23	.....	Dragon
Consolidated Vultee....	B-24	PB4Y	Liberator
North American.....	B-25	PBJ	Mitchell
Martin.....	B-26	JM	Marauder
Boeing.....	B-29	.....	Superfortress
Consolidated Vultee....	B-32	.....	Dominator
Vega.....	B-34	PV	Ventura
Douglas.....	A-20 (P-70)	BD	Havoc (Boston)*
Douglas.....	A-24	SBD	Dauntless
Curtiss.....	A-25	SB2C, SBW, and SBF	Helldiver
Douglas.....	A-26	.....	Invader
Lockheed.....	A-29	PBO	Hudson
Martin.....	A-30	.....	Baltimore
Consolidated Vultee....	A-31, A-35	.....	Vengeance
Brewster.....	A-34	SB2A	Bermuda
North American.....	A-36 (P-51)	.....	Mustang
Grumman.....	.....	TBF, TBM	Avenger
Consolidated Vultee....	OA-10	PBY, PB2B, and PBN	Catalina
Consolidated Vultee....	.....	PB2Y	Coronado
Martin.....	.....	PBM	Mariner
<b>Fighters</b>			
Lockheed.....	P-38	.....	Lightning
Lockheed.....	P-80	.....	Shooting Star
Bell.....	P-39	.....	Airacobra
Curtiss.....	P-40	.....	Warhawk (Kittyhawk)*
Republic.....	P-43	.....	Lancer
Republic.....	P-47	.....	Thunderbolt
North American.....	P-51 (A-36)	.....	Mustang
Bell.....	P-59A	.....	Airacomet
Northrop.....	P-61	.....	Black Widow
Bell.....	P-63	.....	King Cobra (King Cobra I)*
Douglas.....	P-70 (A-20)	.....	Havoc (Boston)*
Vought.....	.....	F4U, FG, and F2G, F3A	Corsair
Grumman.....	.....	F6F	Hellcat
Grumman.....	.....	F4F, FM	Wildcat
<b>Observation</b>			
Consolidated Vultee....	O-49	.....	Vigilant
Curtiss.....	O-52	.....	Owl
Lockheed.....	O-56 (B-34)	.....	Ventura
Taylorcraft.....	O-57 (L-2)	.....	Grasshopper
Aeronca.....	O-58 (L-3)	.....	Grasshopper
Piper.....	O-59 (L-4)	.....	Grasshopper
Vultee.....	O-62 (L-5)	.....	Sentinel
Curtiss.....	.....	SO3C	Seamew
Vought.....	.....	OS2U, OS2N	Kingfisher

## OVER 450 LOCKHEEDS A MONTH FOR UNCLE SAM



**P-38 LIGHTNING FIGHTER**



**C-69 CONSTELLATION TRANSPORT**

**PV VENTURA PATROL BOMBER**



**B-17 BOEING FLYING FORTRESS**



One-hundred percent of Lockheed's production is for war! The swift P-38 Lightning fighter, the Navy's PV Ventura bomber, the Boeing Flying Fortress and the majestic Lockheed Constellation. Fighters, bombers, transports. Fast, dependable weapons of war—backed by the Lockheed tradition of leadership. ☆ This is Lockheed's record today and for as long as the need is for warplanes. Then, and only then, will Lockheed return to its original purpose—building planes for commerce and you.

**LOOK TO LOCKHEED FOR LEADERSHIP**

*Lockheed Aircraft Corporation, Burbank, California*

**AMERICAN AIRPLANES IN SERVICE WITH OR IN AN-  
NOUNCED PRODUCTION FOR THE UNITED STATES  
AND BRITISH AIR FORCES—Continued**

Original Designer	Model		Approved Name
	U. S. Army	U. S. Navy	
<i>Liaison</i>			
Consolidated Vultee....	L-1	.....	Vigilant (Vigilant I)*
Taylorcraft.....	L-2 (O-57)	.....	Grasshopper
Aeronca.....	L-3 (O-58)	.....	Grasshopper
Piper.....	L-4 (O-59)	NE	Grasshopper
Consolidated Vultee....	L-5 (O-62)	OY	Sentinel
<i>Trainers</i>			
North American.....	AT-6	SNJ	Texan (Harvard)*
Beech.....	AT-7	SNB	Navigator
Beech.....	AT-10	.....	Wichita
Beech.....	AT-11	SNB	Kansan
Boeing.....	AT-15	.....	Crewmaker
North American.....	AT-16	.....	Harvard
Cessna.....	AT-17 (UC-78)	PBO	Bobcat (Crane)*
Lockheed.....	AT-18 (A-29)	PBO	Hudson
Consolidated Vultee....	AT-19	.....	Reliant
Fairchild.....	AT-21	.....	Gunner
North American.....	BT-9, BT-14	.....	Yale
Fleetwings.....	BT-12	.....	Sophomore
Consolidated Vultee....	BT-13	.....	Valiant
Boeing.....	PT-13, PT-17, PT-18, PT-27	N2S	Kaydet
Fairchild.....	PT-19, PT-23, PT-26	.....	Cornell
Ryan.....	PT-21, PT-22	NR	Recruit
Timm.....	.....	N2T	Tutor
Curtiss.....	.....	SNC	Falcon
<i>Transports</i>			
Beech.....	C-43	GB	Traveller
Beech.....	C-45	JRB	Expeditor
Curtiss.....	C-46	R5C	Commando
Douglas.....	C-47	R4D	Skytrain (Dakota)*
Douglas.....	C-49, C-53	R4D	Skytrooper (Dakota)*
Douglas.....	C-54	R5D	Skymaster
Lockheed.....	C-56, C-60	R5O	Lodestar
Fairchild.....	UC-61	GK	Forwarder (Argus)*
Howard.....	.....	GH	Nightingale
Lockheed.....	C-63 (AT-18)	.....	Hudson
Lockheed.....	C-69	.....	Constellation
Curtiss.....	C-76	.....	Caravan
Cessna.....	UC-78 (AT-17)	JRC	Bobcat
Fairchild.....	C-82	.....	Packet
Consolidated Vultee....	C-87	RY	Liberator
Sikorsky.....	.....	JR2S	Excalibur
Grumman.....	OA-9	JRF	Goose
Grumman.....	OA-12	J2F-5	Duck
Grumman.....	.....	J4F	Widgeon
Martin.....	.....	JRM-1	Mars

\* British name for this model.



MANY research projects and experiments have been originated by Beech engineers since 1932. The results of their willingness to explore new fields are notable. The unique negative stagger Beechcraft biplane, long outstanding in its power class, is one. Another is the Model 18 all-metal twin-engine Beechcraft feeder airline and executive transport, an airplane which since 1936 has made such a record that thousands of these planes serve the armed forces as advanced trainers and personnel transports all over the world.

Since 1941, research at Beech Aircraft has had as its purpose the creation of improvements in aircraft designed for military use. Most of this research cannot be described, for obvious reasons. Something can be told, however, about the experi-

ment pictured above—an AT-10 Beechcraft advanced trainer equipped with a unique two-element empennage which replaces the conventional tail group. Its successful flight tests have shown interesting possibilities.

Whether or not this particular experiment proves practically useful is unimportant. What does matter is the spirit behind such research—an aggressive exploratory spirit that is not confined by tradition and convention but is free to operate anywhere within the boundary of sound engineering principles. The Beechcrafts of the future undoubtedly will reflect the gains attained through such a program, and will offer to their owners, whether military or commercial, an extra degree of performance and value.

# Beech Aircraft

CORPORATION

BEECHCRAFTS ARE DOING THEIR PART



WICHITA, KANSAS, U. S. A.

### VALUE OF AIRFRAME, ENGINE & PROPELLER PRODUCTION IN THE UNITED STATES

(in millions of dollars at 1943 prices)

Compiled by Statistical Service, Aeronautical Chamber of Commerce of America

Year	Airframes (Millions)	Engines (Millions)	Propellers (Millions)	Spare Parts (Millions)	Total Aircraft and Spare Parts* (Millions)
1940—2nd half.....	\$ 144	\$ 111	\$ 21	\$ 58	\$ 334
1941—1st half.....	295	188	36	110	629
2nd half.....	525	308	63	198	1,094
Total.....	820	496	99	308	1,723
1942—1st quarter....	456	260	53	220	989
2nd quarter....	507	371	76	300	1,344
3rd quarter....	768	461	81	279	1,689
4th quarter....	948	526	97	451	2,022
Total.....	2,769	1,618	307	1,350	6,044
1943—1st quarter....	1,148	584	117	560	2,409
2nd quarter....	1,594	628	145	695	3,062
3rd quarter....	1,871	733	176	811	3,591
4th quarter....	2,243	873	188	918	4,222
Total.....	6,856	2,818	626	2,984	13,284
1944—1st quarter....	2,671	955	195	1,044	4,865
2nd quarter....	2,660	1,030	207	975	4,872
3rd quarter....	2,477	1,064	203	952	4,696
4th quarter....	2,271	890	191	830	4,182
Total.....	10,079	3,939	796	3,801	18,615

\* Does not include production of gliders, airborne equipment and lighter-than-aircraft.  
Source: WPB, Bureau of Program & Statistics, Military Division, Aircraft Branch.

### CIVIL AERONAUTICS ADMINISTRATION FUNDS

Fiscal Years	1943	1944	1945 <sup>1</sup>
General Administration.....	\$ 1,664,000	\$ 1,945,000	\$ 2,666,718
Maintenance of Air Navigation Facilities.....	22,688,900	23,387,700	24,475,163
Technical Development.....	950,000	612,000	680,000
Enforcement of Safety Regulations.....	2,590,000	2,743,200	3,332,737
Establishment of Air Navigation Facilities 1942-44.....	10,533,375	4,797,000	4,067,860
Civilian Pilot Training.....	72,677,450	29,400,000	
Maintenance and Operation, Washington Na- tional Airport.....	521,500	558,000	559,000
Development of Landing Areas 1941-44.....	199,740,000	( <sup>2</sup> )	( <sup>2</sup> )
Development of Civil Landing Areas.....		9,907,890	( <sup>2</sup> )
War Training Service.....	3,500,000		
Total.....	\$314,865,225	\$ 73,350,790	\$ 35,781,478

<sup>1</sup> Does not include funds allotted by the military services and supplementary appropriations that may be made subsequent to December 31, 1944.

<sup>2</sup> Total appropriations of \$399,333,050 for the fiscal years 1941, 1942, and 1943 have been consolidated into one fund and unexpended funds are carried over until June 30, 1945.

<sup>3</sup> Unexpended funds for the fiscal year 1944 are carried over indefinitely to subsequent fiscal years.

*More than*

**300,000 PRATT & WHITNEY  
ENGINES**

**500,000 HAMILTON STANDARD  
PROPELLERS**

**10,000 CHANCE VOUGHT  
AIRPLANES**

**150 SIKORSKY HELICOPTERS**

*have already gone to war . . .*

These were built by a great war-time industrial team, with eleven other manufacturers adding their output to United Aircraft's own. They have played a major part in carrying the war in the air to the enemy.

Great as that achievement is, it was possible only because those engines, propellers and airframes had been designed by United Aircraft long before Pearl Harbor—and then refined, developed and *thoroughly proven* until they were ready for war-time quantity production when the need came.

**UNITED AIRCRAFT  
CORPORATION**

**East Hartford, Connecticut**

Pratt & Whitney Aircraft  
Sikorsky Aircraft

Hamilton Standard Propellers  
Chance Vought Aircraft

## SUMMARY OF AIR CARRIER OPERATIONS

## Air Lines in the United States

Compiled by Information and Statistics Service, Civil Aeronautics Administration

Calendar Years

Year	Operators	Planes in Service	Miles Flown	Total Passengers Carried	Total Passenger Miles Flown	Express Carried (pounds)	Mail Pound Miles Flown <sup>1</sup>
1926	11	( <sup>2</sup> )	4,258,771	5,782	( <sup>2</sup> )	3,555	( <sup>2</sup> )
1927	16	128	5,779,863	8,661	( <sup>2</sup> )	45,859	( <sup>2</sup> )
1928	31	268	10,400,239	47,840	( <sup>2</sup> )	210,404	( <sup>2</sup> )
1929	34	442	22,380,020	159,751	( <sup>2</sup> )	240,634	( <sup>2</sup> )
1930	38	497	31,992,634	374,935	84,014,572	350,523	( <sup>2</sup> )
1931	35	490	42,755,417	469,981	100,442,375	788,059	6,280,409,884
1932	29	456	45,606,354	474,279	127,038,798	1,033,970	5,402,249,740
1933	24	408	48,771,553	493,141	173,492,119	1,510,215	5,135,897,406
1934	22	417	40,955,396	461,743	187,858,620	2,133,191	4,922,822,780
1935	23	356	55,380,353	746,946	313,905,508	3,822,397	8,265,416,188
1936	21	272	63,777,226	1,020,931	427,740,253	6,958,777	11,482,872,622
1937	17	282	66,071,507	1,102,707	476,603,165	7,127,369	13,396,460,117
1938	18	253	69,668,827	1,343,427	557,719,268	7,335,967	14,845,719,671
1939	17	265	82,571,523	1,876,051	749,787,096	9,514,299	17,170,021,595
1940	16	358	108,800,436	2,959,480	1,147,444,948	12,506,176	20,071,275,685
1941	17	359	133,022,679	4,060,545	1,491,734,671	19,209,671	25,800,809,091
1942	16	179	110,102,860	3,551,833	1,481,976,329	40,101,657	42,133,253,820
1943	16	194	103,601,443	3,454,040	1,642,596,640	57,543,591	71,854,086,916
1944	16	279	142,234,837	4,668,330	2,264,282,443	65,916,837	101,650,403,775 <sup>4</sup>

<sup>1</sup> Mail pound miles flown are for domestic services and Hawaiian Airlines, Ltd., which company holds a domestic air mail contract.

<sup>2</sup> Not available prior to 1930.

<sup>3</sup> Air mail pound miles have been computed by the Post Office Department commencing with January, 1931, and are not available prior to that date.

<sup>4</sup> Estimated.

## STATUS OF AIR CARRIER OPERATIONS

Compiled by Information and Statistics Service, Civil Aeronautics Administration

January 1, 1945

Miles of Airways Operated.....		40,392
With U. S. Mail.....		40,392
With Passengers.....		39,251
With Express.....		40,392
Airplane Miles Scheduled Daily (Average).....		484,610
With U. S. Mail.....	484,610	
With Passengers.....	439,767	
With Express.....	484,610	
Number of Services in Operation.....		175
With U. S. Mail.....	175	
With Passengers.....	159	
With Express.....	175	
Number of Domestic Air Carriers.....		16



COUNT ON  
**Curtiss Commandos**  
 FOR TWIN-ENGINE ECONOMY

Lower the cost of air transportation and, at once, you raise the number of people and the kinds of cargo that will fly.

Coupled with such favorable features as its speed, capacity and dependability, the twin-engine economy of the Curtiss Commando will go a long way toward stimulating increased air commerce and consequent revenue for the airlines that operate it.

Ninety percent of domestic air travel is on flights of medium range. Over this range on a basis of block time, payload and direct flying cost, the Curtiss Commando is the most economical aircraft of its type. Curtiss-Wright Corporation, Airplane Division, Buffalo, New York.





## MONTHLY AIR CARRIER OPERATIONS

Domestic Air Lines in the United States

Compiled by Information and Statistics Service, Civil Aeronautics Administration

1942	Miles Flown	Passengers <sup>1</sup>	Passenger Miles <sup>1</sup>	Mail Pound Miles <sup>2</sup>	Express Pounds
January.....	11,126,776	300,900	113,134,990	2,593,528,302	2,531,162
February.....	9,978,889	286,435	104,219,667	2,552,948,641	2,169,543
March.....	11,352,252	371,398	139,060,782	3,018,933,335	2,560,255
April.....	11,339,905	428,153	158,217,575	2,995,738,918	2,883,801
May.....	10,846,781	373,363	146,234,958	3,156,110,855	3,075,985
June.....	7,353,270	243,819	110,301,132	3,129,665,458	3,096,877
July.....	8,079,138	265,369	117,216,147	3,442,923,698	3,533,980
August.....	8,451,428	285,824	128,429,975	3,661,421,999	3,926,901
September.....	8,098,555	275,277	126,151,759	3,870,283,599	4,374,884
October.....	8,407,566	275,063	129,182,369	4,334,959,342	4,340,553
November.....	7,776,768	242,284	113,048,028	4,337,909,595	3,973,689
December.....	7,291,532	203,948	96,778,947	5,038,830,078	3,633,847
Total.....	110,102,860	3,551,833	1,481,976,329	42,133,253,820	40,101,657
<i>1943</i>					
January.....	7,508,260	208,380	101,410,602	4,657,982,679	3,621,635
February.....	7,585,465	233,049	110,982,551	4,927,007,419	3,647,269
March.....	8,126,495	265,175	124,256,467	5,397,639,893	4,320,107
April.....	8,288,177	280,913	132,984,531	5,728,670,986	4,816,449
May.....	8,314,154	282,103	133,266,615	5,509,952,668	4,549,436
June.....	8,410,461	297,760	140,745,710	5,551,083,875	4,834,148
July.....	8,880,864	320,096	150,013,387	6,029,169,683	5,261,076
August.....	9,303,103	338,059	156,873,457	6,392,995,618	5,335,317
September.....	9,214,834	321,616	153,980,314	6,354,450,961	5,384,732
October.....	9,510,543	322,099	155,855,938	6,841,798,005	5,171,289
November.....	9,307,585	301,253	145,104,815	6,975,606,787	5,109,677
December.....	9,151,502	283,537	137,122,253	7,487,728,342	5,492,456
Total.....	103,601,443	3,454,040	1,642,596,640	71,854,086,916	57,543,591
<i>1944</i>					
January.....	9,343,024	285,283	141,474,106	7,044,645,117	4,918,235
February.....	8,507,500	260,754	125,088,611	6,586,724,636	4,078,753
March.....	9,595,470	293,523	142,834,165	7,338,756,981	4,776,197
April.....	9,902,237	318,560	155,159,351	7,009,248,123	4,322,557
May.....	11,219,214	369,649	181,038,023	8,078,053,989	4,536,242
June.....	11,674,188	389,123	193,288,705	8,379,074,825	5,331,033
July.....	12,769,587	441,712	211,703,804	8,671,416,609	5,755,702
August.....	13,555,054	476,808	227,350,700	9,639,206,212 <sup>3</sup>	6,730,270
September.....	13,599,602	464,536	225,471,943	9,220,424,956 <sup>3</sup>	6,149,351
October.....	14,595,700	497,664	239,022,033	9,865,087,054 <sup>3</sup>	6,762,571
November.....	13,942,022	455,726	217,338,262	9,667,893,279 <sup>3</sup>	6,201,876
December.....	13,651,239	414,992	204,512,740	10,000,000,000 <sup>4</sup>	6,354,050
Total.....	142,234,837	4,668,330	2,264,282,443	101,650,403,775	65,916,837

<sup>1</sup> Revenue and non-revenue.<sup>2</sup> Includes Hawaiian Airlines, Ltd. Source: Post Office Dept.<sup>3</sup> Source: CAB Form 2780.<sup>4</sup> Estimated.



*Finish the Fight — with War Bonds*

### **Coast-to-coast record: 6 hrs., 3 min., 50 sec.**

On January 9, 1945, a Boeing C-97 Army transport flew from Seattle to Washington, D. C., in *six hours—3 minutes—50 seconds* . . . 2323 miles at an average of 383 miles an hour with a 45-mile tail wind . . . a coast-to-coast non-stop record!

The C-97 is the military forerunner of the great post-war luxury airliner—the Boeing Stratocruiser. With the advent of this new super-transport, you'll travel in luxurious comfort, and at surprisingly low cost.

Carrying 100 persons, the Boeing Stratocruiser will have operating ranges up to 3500 miles with ample fuel reserves. When flying at over-

weather altitudes, atmospheric conditions inside the pressurized cabin will be equivalent to comfortable low-level flight.

The Boeing Stratocruiser is the newest member of a famous family of four-engine champions—the Boeing B-29 Superfortress, the Flying Fortress, Stratoliner and Clipper.

*When victory is won, the same skill in design, engineering and manufacture which has established Boeing leadership in the big bomber field will bring you the Stratocruiser and other advancements in air transport. You can be sure . . . if it's "Built by Boeing" it's out in front.*

**Designers of the B-29 Superfortress • The Flying Fortress • The new Stratocruiser  
The Kaydet Trainer • The Stratoliner • Pan American Clippers**

# **BOEING**

## UNITED STATES AIR TRANSPORT ROUTES

January 1, 1945

Compiled by Information and Statistics Service, Civil Aeronautics Administration

Domestic Routes	Airway miles	Daily Schedule (round trips)	Daily mileage	Operator
Pittsburgh-Huntington via Elkins and Charleston . . . . .	333	2	1,332	All American Aviation, Inc.
Pittsburgh-Huntington via Parkersburg . . . . .	338	2	1,352	"
Pittsburgh-Washington via Harrisburg . . . . .	506	1	1,012	"
Pittsburgh-Williamsport . . . . .	202	2	808	"
Pittsburgh-Jamestown . . . . .	178	2	712	"
New York-Washington . . . . .	215	3	1,290	American Airlines, Inc.
New York-Los Angeles via Washington, Nashville, Memphis, Dallas or Fort Worth . . . . .	2,744	7	38,386	"
New York-Los Angeles via Washington and Little Rock . . . . .	2,792	2	11,168	"
New York-Los Angeles via Washington, Nashville, Dallas or Fort Worth . . . . .	2,734	1	5,468	"
Dallas or Fort Worth-Los Angeles . . . . .	1,358	2	5,432	"
El Paso-Los Angeles . . . . .	843	1	1,686	"
Nashville-Los Angeles . . . . .	1,879	2	7,516	"
New York-Chicago via Detroit . . . . .	733	1	1,466	"
New York-Chicago via Buffalo and Detroit . . . . .	762	8	12,188	"
New York-Chicago via Buffalo, Detroit and South Bend . . . . .	764	1	1,528	"
Detroit-Chicago (direct) . . . . .	247	1	494	"
Detroit-Chicago via South Bend . . . . .	251	1	502	"
Windsor-Chicago . . . . .	257	1	514	"
New York-Buffalo (direct) . . . . .	292	1	584	"
New York-Buffalo via Syracuse . . . . .	328	1	656	"
New York-Cleveland via Syracuse and Buffalo . . . . .	521	1	1,042	"
Washington-Chicago via Cincinnati . . . . .	667	3	4,002	"
Washington-Chicago via Huntington and Cincinnati . . . . .	682	1	1,364	"
Boston-New York (direct) . . . . .	184	9 $\frac{1}{2}$	3,496	"
Boston-New York via Hartford . . . . .	186	38 $\frac{1}{2}$ weekly	2,045	"
Boston-New York via Providence . . . . .	192	5	1,920	"
Boston-New York via Hartford and Providence . . . . .	204	1	408	"
Chicago-Fort Worth via St. Louis and Oklahoma City . . . . .	924	2	3,696	"
Chicago-Fort Worth via St. Louis, Joplin and Oklahoma City . . . . .	926	1	1,852	"
Cleveland-Nashville via Columbus . . . . .	488	2	1,952	"
Cleveland-Nashville . . . . .	488	1	976	"
Nashville-Memphis . . . . .	200	1	400	"
Dallas or Fort Worth-Laredo . . . . .	394	2	1,576	"
Chicago-Brownsville via Kansas City, Dallas and San Antonio . . . . .	1,400	1	2,800	Braniff Airways, Inc.
Chicago-San Antonio . . . . .	1,209	2	4,836	"
Chicago-Nuevo Laredo . . . . .	1,270	1	2,540	"
Chicago-Dallas . . . . .	930	2	3,612	"
Denver-Dallas via Amarillo . . . . .	706	1	1,412	"



THE FAIRCHILD  
**PACKET**  
 CARRIER FOR THE SKY ROADS

**F**AIRCHILD has built the Packet—a swift carrier for the new age of flight; a “flying boxcar” that can carry great loads and has a range of over 3,500 miles.

The Packet can carry 42 fully equipped paratroops and deliver them through two rear end jump doors. Military cargo is loaded with ease through a huge split door in the stern. The fuselage floor is parallel to the ground at truck floor level—no need for hoisting devices.

The Packet is another example of “the touch of tomorrow in the planes of today” achieved by Fairchild engineering.

BUY U. S. WAR BONDS AND STAMPS

**PRODUCTS  
 FOR THE NEW AGE**

**The Ranger Twelve**—lightweight, compact, smooth power for single and multiple engine aircraft.

**Airplanes**—The Packet, the Gunner, the Forwarder, the Cornell—planes built to perform specific jobs well.

**Al-Fin**—a process that chemically bonds aluminum to steel. Used in making the famous AL-FIN cylinders for more efficient cooling.

**Duramold**—A process which lends strength and stiffness to low density materials. Used in making plastic-bonded parts of complex curvatures for aircraft.

 **FAIRCHILD** ENGINE AND AIRPLANE CORPORATION

30 ROCKEFELLER PLAZA, NEW YORK 20, N. Y.

Ranger Aircraft Engines Division, Farmingdale, L. I.

Duramold Division, Jamestown, N. Y.

Subsidiary: Al-Fin Corp., New York, N. Y.

Affiliate: Stratof Corp., New York, N. Y.

Fairchild Aircraft Division, Hagerstown, Md.

United States Air Transport Routes (January 1, 1945)—Continued

Domestic Routes	Airway miles	Daily Schedule (round trips)	Daily mileage	Operator
Dallas-Houston .....	241	2	964	Braniff Airways, Inc.
Dallas-Corpus Christi via Houston .....	426	1	852	"
Dallas-Corpus Christi via Houston and San Antonio .....	600	1	1,200	"
Dallas-San Antonio .....	250	1	500	"
Chicago-New Orleans via St. Louis .....	857	4	6,856	Chicago & Southern Airlines
Chicago-Memphis .....	508	3	3,048	"
Memphis-Houston .....	526	2	2,104	"
Denver-Kansas City (direct) .....	553	1	1,106	Continental Air Lines, Inc.
Denver-Kansas City via Topeka .....	553	1	1,106	"
Denver-Tulsa .....	638	1	1,276	"
Denver-San Antonio via Hobbs .....	1,023	1	2,046	"
Denver-San Antonio via El Paso .....	1,102	1	2,204	"
El Paso-Hobbs .....	198	1	396	"
Wichita-Tulsa .....	126	1	252	"
Atlanta-Cincinnati .....	380	3	2,280	Delta Air Corporation
Atlanta-Savannah .....	251	1	502	"
Atlanta-Charleston .....	301	2	1,204	"
Atlanta-Fort Worth via Jackson .....	768	1	1,536	"
Atlanta-Fort Worth via Jackson and Shreveport .....	778	2	3,112	"
Atlanta-Fort Worth via Jackson and Monroe .....	778	2	3,112	"
New Orleans-Fort Worth .....	497	1	994	"
Boston-New York .....	184	5	1,840	Eastern Air Lines, Inc.
New York-Miami via Orlando .....	1,227	1	2,454	"
New York-Miami via Washington, Charleston and Jacksonville .....	1,187	3	7,122	"
New York-Miami via Washington, Columbia, and Jacksonville .....	1,197	1	2,394	"
New York-Miami via Washington, Raleigh and Jacksonville .....	1,189	2	4,756	"
New York-Miami via Washington and Jacksonville .....	1,185	1	2,370	"
New York-Brownsville via Atlanta and New Orleans .....	1,815	2	7,260	"
New York-San Antonio via Atlanta and New Orleans .....	1,802	1	3,604	"
New York-Houston via Atlanta and New Orleans .....	1,570	1	3,140	"
New York-New Orleans via Atlanta .....	1,242	1	2,484	"
New York-Atlanta .....	800	1	1,600	"
New York-St. Louis via Washington and Evansville .....	950	2	3,800	"
Evansville-St. Louis .....	162	1	324	"
Chicago-Atlanta via Evansville .....	652	3	3,912	"
Chicago-Atlanta via Louisville .....	642	3	3,852	"
Evansville-Atlanta .....	354	1	708	"
Atlanta-Miami via Tampa .....	630	4	5,040	"
Atlanta-Miami via Macon and Jacksonville .....	615	2	2,460	"
Atlanta-Miami via Jacksonville .....	614	1	1,228	"
Cheyenne-Denver .....	96	4	768	Inland Air Lines, Inc.
Cheyenne-Great Falls .....	562	2	2,248	"
Cheyenne-Huron .....	486	1	972	"
Rapid City-Spearfish .....	40	2	160	"
Minneapolis-Kansas City via Omaha .....	526	3	3,156	Mid-Continent Airlines, Inc.
Minneapolis-Kansas City via Watertown and Omaha .....	678	1	1,356	"



## LIGHTER, STRONGER TIRES FOR HEAVIER LOADS!

To make landings and take-offs safer under the heavier loads and tougher operating schedules of wartime, "U.S." pioneered the lighter, stronger rayon and nylon cord constructions now used in airplane tires throughout our Armed Forces. On the air routes of the world, on airliners, bombers, fighters and giant transports, U.S. Royal Airplane tires are setting new safety records day by day.

**U. S. ROYAL Airplane Tires**  
**UNITED STATES RUBBER COMPANY**

1230 Sixth Avenue • Rockefeller Center • New York 20, N. Y.

SERVING THROUGH SCIENCE



TO SPEED THE VICTORY

## United States Air Transport Routes (January 1, 1945)—Continued

Domestic Routes	Airway miles	Daily Schedule (round trips)	Daily mileage	Operator
Minneapolis-St. Louis via Des Moines...	512	1	1,024	Mid-Continent Airlines, Inc.
Des Moines-Tulsa via Kansas City.....	389	1	778	"
Kansas City-Tulsa via Joplin.....	238	1	476	"
New Orleans-Jacksonville via Mobile....	511	3	3,066	National Air Lines, Inc.
New Orleans-Jacksonville.....	503	2	2,012	"
New York-Jacksonville.....	839	2	3,356	"
Jacksonville-Miami via Orlando.....	489	1	978	"
Jacksonville-Miami via Tampa.....	378	3	2,268	"
Tampa-Miami.....	198	1	396	"
Miami-Key West.....	127	2	508	"
Boston-Bangor.....	208	2	832	Northeast Airlines, Inc.
Boston-Presque Isle.....	353	2	1,412	"
Bangor-Moncton.....	221	2	884	"
Boston-Montreal.....	259	2	1,036	"
Chicago-Seattle via Helena and Spokane..	1,820	1	3,640	Northwest Airlines, Inc.
Chicago-Seattle via Great Falls.....	1,844	2	7,376	"
Chicago-Seattle via Billings, Butte and Spokane.....	1,804	2	7,216	"
Spokane-Portland.....	290	3	1,740	"
Chicago-Minneapolis (direct).....	350	2	1,400	"
Chicago-Minneapolis via Milwaukee, Madison and Rochester.....	395	1	790	"
Chicago-Minneapolis via Milwaukee and Rochester.....	395	1	790	"
Chicago-Minneapolis via Rochester.....	357	1/2	357	"
Chicago-Minneapolis via Milwaukee and Madison.....	384	1/2	384	"
Chicago-Fargo.....	596	1	1,192	"
Minneapolis-Duluth.....	144	1	288	"
Norfolk-Washington.....	143	14	2,002	Pennsylvania-Central Airlines Corp.
Cleveland-Detroit.....	91	11	1,001	"
Washington-Cleveland via Pittsburgh....	322	5	3,220	"
Washington-Cleveland via Youngstown..	347	2	1,388	"
Washington-Cleveland (direct).....	310	2	1,240	"
Washington-Detroit.....	400	3	2,400	"
Washington-Pittsburgh.....	186	1	372	"
Detroit-Milwaukee (direct).....	252	1	504	"
Detroit-Milwaukee via Muskegon.....	259	1	518	"
Detroit-Milwaukee via Grand Rapids....	268	2	1,072	"
Chicago-Detroit via Grand Rapids.....	272	1	544	"
Chicago-Detroit via Muskegon.....	298	2	1,192	"
Chicago-Grand Rapids.....	132	2	528	"
Pittsburgh-Birmingham.....	640	2	2,560	"
Pittsburgh-Buffalo (direct).....	189	1	378	"
Pittsburgh-Buffalo via Erie.....	215	1	430	"
New York-Los Angeles via Pittsburgh, Chicago, Kansas City and Winslow....	2,632	1	5,264	Transcontinental & Western Air, Inc.
New York-Los Angeles via Pittsburgh, Chicago, Kansas City and Phoenix....	2,616	3	15,696	"
New York-Los Angeles via Pittsburgh, Chicago, Kansas City and Albuquerque	2,600	3	15,558	"
New York-Los Angeles via Kansas City	2,565	2	10,260	"
New York-Kansas City via Pittsburgh and Chicago.....	1,185	2	4,740	"
New York-Kansas City via Pittsburgh and Indianapolis.....	1,124	1	2,248	"
New York-Chicago via Pittsburgh.....	758	1	1,516	"
Washington-Los Angeles via Kansas City	2,438	2	9,752	"
Washington-Chicago via Columbus and Dayton.....	630	1	1,260	"

## Overocean Airlines Can't Overlook these Facts *about the Martin Mars!*

**Range:** Mars has flown 4,227 miles non-stop, carrying 13,000 lbs. of cargo.

**Capacity:** Has carried useful loads of over 35,000 lbs.

**Costs:** Operates at 15c per ton-mile. Twenty new sisterships will operate at less than 10c.

**Availability:** Made 14 flights between Hawaii and California in one month.

**Speed:** Can transport 20 tons of cargo to any spot on earth in 3 days or less.

**Postwar:** Three commercial versions have been designed. THE GLENN L. MARTIN COMPANY, BALTIMORE 3, MARYLAND.



**Martin**  
AIRCRAFT

Builders of "Dependable"



Aircraft Since 1909

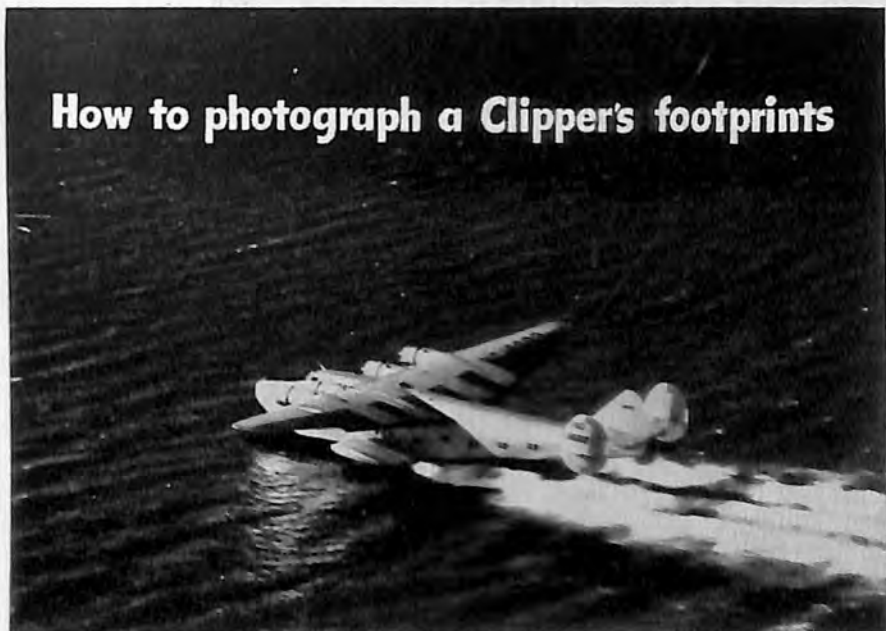


## United States Air Transport Routes (January 1, 1945)—Continued

Domestic Routes	Airway miles	Daily Schedule (round trips)	Daily mileage	Operator
Washington-Dayton.....	393	1	786	Transcontinental & Western Air, Inc.
Washington-Pittsburgh.....	186	1	372	"
Detroit-Cincinnati.....	242	3	1,452	"
Los Angeles-San Francisco (direct).....	327	3½	2,289	"
Los Angeles-San Francisco via Oakland..	338	½	338	"
Los Angeles-San Francisco via Fresno and Oakland.....	354	x	708	"
New York-Chicago via Cleveland.....	725	8½	12,325	United Air Lines, Inc.
New York-Chicago via Akron.....	738	x	1,476	"
New York-Chicago via Allentown and South Bend.....	728	1	1,456	"
New York-Chicago via South Bend.....	737	½	737	"
Washington-Chicago via Toledo.....	610	3	3,660	"
Chicago-San Francisco via Omaha, Denver and Salt Lake City.....	1,904	3	11,364	"
Chicago-San Francisco via Omaha and Denver.....	1,865	2	7,460	"
Chicago-San Francisco via Omaha, Cheyenne and Salt Lake City.....	1,892	2	7,568	"
Chicago-San Francisco via Omaha and Denver.....	1,903	1	3,806	"
Chicago-San Francisco via Des Moines and Cheyenne.....	1,869	1	3,738	"
Chicago-San Francisco via Omaha and Cheyenne.....	1,870	1	3,740	"
Chicago-Seattle via Des Moines and Boise.....	2,055	1½	6,165	"
Chicago-Seattle via Omaha and Boise.....	2,056	1½	6,168	"
Chicago-Salt Lake City via Denver.....	1,302	3	7,812	"
Chicago-Salt Lake City via Cheyenne.....	1,263	1	2,526	"
Seattle-Los Angeles via Sacramento and San Francisco.....	1,042	1½	3,126	"
Seattle-Los Angeles via Medford and San Francisco.....	1,033	3½	7,231	"
Seattle-Los Angeles via Eugene and San Francisco.....	1,025	1	2,050	"
Los Angeles-San Francisco (direct).....	327	2	1,308	"
Los Angeles-San Francisco via Santa Barbara and Monterey.....	352	1	704	"
Oakland-Los Angeles.....	338	1	676	"
Sacramento-San Francisco.....	79	2	316	"
San Diego-Los Angeles.....	123	2	492	"
Seattle-Portland.....	135	3	810	"
Los Angeles-San Francisco.....	327	6	3,924	Western Air Lines, Inc.
San Diego-Los Angeles via Long Beach..	123	2	492	"
Los Angeles-Salt Lake City via Las Vegas.	590	5	5,900	"
Salt Lake City-Lethbridge via Great Falls	740	1	1,480	"
Salt Lake City-Butte.....	366	1	732	"
Total.....	40,392*		484,610	

\* Adjusted to eliminate the mileage for services operating over the same route.

## How to photograph a Clipper's footprints



In studying the effects of water pressure on Clipper hulls, Pan American World Airways engineers asked our help. They thought Standard of California's "pressure-sensitive unit," a petroelectronic instrument (electronics, applied to petroleum research), might help them measure stresses accurately.

Standard engineers went to work with two units, an oscillograph and a recording camera. Their photographic record showed that water pressure on the forward hull area was neg-

ligible. But greater pressures battered the hull farther aft during take-offs. These findings gave Pan American World Airways the information they needed.

We tell this story to emphasize that Standard research leadership rests upon familiarity with all phases of aircraft operation. This thorough understanding of aviation's needs enables us to consistently improve Standard Aviation Gasolines and Lubricants for Pan American — and flyers everywhere.



## STANDARD OF CALIFORNIA

225 BUSH STREET

SAN FRANCISCO 20, CALIFORNIA

## LICENSED PILOTS IN THE UNITED STATES

January 1, 1945

Compiled by Information and Statistics Service, Civil Aeronautics Administration

<i>State</i>	<i>Airline</i>	<i>Commercial</i>	<i>Private</i>	<i>Total</i>
Alabama.....	2	244	1,072	1,318
Arizona.....	1	238	830	1,069
Arkansas.....	3	295	1,434	1,732
California.....	363	3,050	12,017	15,439
Colorado.....	79	282	1,690	2,051
Connecticut.....	8	108	1,009	1,215
Delaware.....	2	59	279	340
District of Columbia.....	41	199	821	1,061
Florida.....	384	923	2,269	3,576
Georgia.....	113	502	1,563	2,178
Idaho.....	—	106	907	1,013
Illinois.....	295	1,026	5,055	6,376
Indiana.....	8	405	2,339	2,752
Iowa.....	7	358	2,647	3,012
Kansas.....	30	425	2,815	3,270
Kentucky.....	1	114	822	937
Louisiana.....	26	286	1,635	1,947
Maine.....	5	127	503	695
Maryland.....	9	220	1,282	1,511
Massachusetts.....	53	489	2,782	3,324
Michigan.....	42	664	4,221	4,927
Minnesota.....	117	477	2,344	2,838
Mississippi.....	3	160	927	1,090
Missouri.....	164	712	3,292	4,168
Montana.....	11	169	935	1,115
Nebraska.....	3	178	1,609	1,790
Nevada.....	4	35	266	305
New Hampshire.....	—	62	452	514
New Jersey.....	37	475	2,778	3,290
New Mexico.....	4	105	670	779
New York.....	424	1,758	7,618	9,800
North Carolina.....	4	258	1,610	1,872
North Dakota.....	—	76	666	742
Ohio.....	30	777	4,704	5,511
Oklahoma.....	4	751	2,677	3,432
Oregon.....	31	237	1,782	2,050
Pennsylvania.....	46	964	5,922	6,932
Rhode Island.....	1	60	413	474
South Carolina.....	3	231	1,173	1,407
South Dakota.....	—	70	841	911
Tennessee.....	65	332	1,726	2,123
Texas.....	306	1,879	6,991	9,176
Utah.....	31	138	1,077	1,246
Vermont.....	1	57	333	391
Virginia.....	66	278	1,580	1,924
Washington.....	110	561	2,690	3,361
West Virginia.....	2	146	1,262	1,410
Wisconsin.....	7	327	1,879	2,213
Wyoming.....	19	74	452	545
For., Terr., Misc.....	81	493	706	1,280
Totals.....	3,046	22,059	107,327	132,432



*The Piper Cub L-4 "Grasshopper" in action*

*The light plane that is  
making history in the War!*

*The light plane that will  
continue to lead in Peace!*

***PIPER CUB***

PIPER AIRCRAFT CORPORATION • LOCK HAVEN, PENNA.

## LICENSED GROUND INSTRUCTORS IN THE UNITED STATES

January 1, 1945

Compiled by Information and Statistics Service, Civil Aeronautics Administration

<i>State</i>	<i>Men</i>	<i>Women</i>	<i>Total</i>
Alabama.....	130	9	139
Arizona.....	133	10	143
Arkansas.....	160	7	167
California.....	1,329	89	1,418
Colorado.....	219	37	256
Connecticut.....	122	7	129
Delaware.....	17	2	19
District of Columbia.....	82	8	90
Florida.....	466	46	512
Georgia.....	259	5	264
Idaho.....	58	7	65
Illinois.....	619	39	658
Indiana.....	236	14	250
Iowa.....	308	20	328
Kansas.....	330	18	348
Kentucky.....	74	8	82
Louisiana.....	155	10	165
Maine.....	92	6	98
Maryland.....	149	12	161
Massachusetts.....	421	24	445
Michigan.....	325	20	345
Minnesota.....	208	10	218
Mississippi.....	80	7	87
Missouri.....	588	27	615
Montana.....	139	5	144
Nebraska.....	194	10	204
Nevada.....	46	8	54
New Hampshire.....	66	6	72
New Jersey.....	469	29	498
New Mexico.....	86	6	92
New York.....	1,512	75	1,587
North Carolina.....	113	12	125
North Dakota.....	61	3	64
Ohio.....	525	38	563
Oklahoma.....	513	41	554
Oregon.....	87	3	90
Pennsylvania.....	847	47	894
Rhode Island.....	76	4	80
South Carolina.....	121	9	130
South Dakota.....	86	8	94
Tennessee.....	205	14	219
Texas.....	940	92	1,032
Utah.....	126	6	132
Vermont.....	66	3	69
Virginia.....	159	8	167
Washington.....	295	13	308
West Virginia.....	120	10	130
Wisconsin.....	170	21	191
Wyoming.....	50	2	52
Alaska.....	8	0	8
Canada.....	16	0	16
Canal Zone.....	2	0	2
Hawaiian Islands.....	10	0	10
Mexico.....	8	0	8
Foreign, Misc.....	56	0	56
<b>Totals.....</b>	<b>13,732</b>	<b>915</b>	<b>14,647</b>



# Mobilgas AIRCRAFT with "FLYING HORSEPOWER"

Means more power for America's  
wings now and after Victory.

SOCONY-VACUUM OIL CO., INC.  
26 Broadway, New York City



## War and Peace

Tributes to ground crews on the fighting fronts show how America has depended on its trained aircraftmen in waging modern war. When peace comes, they will be needed to help maintain our flag in first place on the world's airways.

ACADEMY OF AERONAUTICS

LaGuardia Field, N. Y.

CASEY JONES SCHOOL OF AERONAUTICS

Newark, N. J.

Manufacturers of  
"NORTHWEST" AIRCRAFT SKIIS  
and  
"NORTHWEST" PROPELLER PITCH SETTERS  
A real contribution to the war effort



Approved repair stations, air line overhaul bases, military repair depots and propeller manufacturers throughout the world have had these machines in operation during past eight years and will attest to their efficiency  
**PROPELLER REPAIR COSTS  
CAN BE DECREASED 50%**

Stocks of engine parts, accessories, and aircraft supplies  
Approved Repair Station 90 Magnaflex License 188



BOEING FIELD  
Branch Office and Shops  
FAIRBANKS, ALASKA

## CIVIL AIRPORTS AND LANDING FIELDS

January 1, 1945

Compiled by Information and Statistics Service, Civil Aeronautics Administration

State	Municipal	Commercial	Miscellaneous Government	Private	Total	Intermediate	Lighted*
Alabama	13	8	0	0	21	3	18
Arizona	23	17	4	2	46	10	29
Arkansas	13	19	0	2	34	3	10
California	66	60	3	6	135	12	86
Colorado	25	12	0	1	38	3	12
Connecticut	6	10	0	1	17	1	6
Delaware	2	4	0	0	6	0	2
District of Columbia	0	0	1	0	1	0	3
Florida	32	17	1	1	51	4	54
Georgia	14	11	0	1	26	9	37
Idaho	31	6	6	1	44	5	14
Illinois	16	58	0	5	79	6	22
Indiana	16	29	0	1	46	5	20
Iowa	19	24	0	1	44	4	14
Kansas	35	20	0	2	57	5	19
Kentucky	8	8	0	0	16	3	10
Louisiana	13	17	0	1	31	4	21
Maine	16	9	0	0	25	0	18
Maryland	2	15	0	0	17	0	5
Massachusetts	10	32	0	1	43	1	12
Michigan	90	33	2	4	129	2	21
Minnesota	26	15	0	2	43	2	8
Mississippi	19	9	0	0	28	6	17
Missouri	15	26	0	1	42	9	18
Montana	47	4	12	2	65	14	25
Nebraska	24	10	0	5	39	5	15
Nevada	13	10	1	0	24	9	17
New Hampshire	10	4	0	0	14	0	5
New Jersey	5	28	0	1	34	0	11
New Mexico	23	11	2	8	44	10	23
New York	42	75	0	3	120	2	34
North Carolina	16	28	0	0	44	1	14
North Dakota	24	3	0	0	27	8	11
Ohio	30	61	0	3	94	8	27
Oklahoma	31	34	0	2	67	4	22
Oregon	17	11	0	0	28	4	24
Pennsylvania	35	88	0	2	125	3	28
Rhode Island	0	2	0	0	2	0	2
South Carolina	14	8	0	1	23	2	15
South Dakota	14	7	0	0	21	1	7
Tennessee	12	9	0	0	21	7	18
Texas	77	95	0	9	181	25	94
Utah	18	2	0	1	21	7	18
Vermont	9	3	0	0	12	0	3
Virginia	15	26	0	1	42	5	19
Washington	29	8	2	1	40	3	27
West Virginia	9	15	0	0	24	2	4
Wisconsin	24	25	1	1	51	3	10
Wyoming	19	1	4	2	26	9	15
Total	1,067	1,027	39	75	2,208	229	964

\* Includes Military Airports.



NOW AVAILABLE FOR YOUR  
**AIRFIELD**

## The WORTHINGTON AIRFIELD "GRASS BLITZER"

Frequent mowing by high speed gang mowers is, in the opinion of military and civilian airfield maintenance experts, the secret of keeping airfield turf in the best condition.

Since the early part of the war the Worthington Organization has been manufacturing its famous "Grass Blitzer" — a rugged, fast gang mower — 100 per cent for the military branches of our government and for the air forces of some of our Allies. Today many thousands of these machines are in use all over the world.

### Some Facts about the WORTHINGTON AIRFIELD "GRASS BLITZER"

- Built in 3, 5, 7 and 9-gang mowing units for airfields of all classes and sizes.
- Mowing units can be readily attached to and easily hauled by any make of tractor or truck you have available.
- Can be operated at speeds up to 20 MPH. Cutting capacity at this speed — 368 acres per 8-hour day.
- Wide application — can be used for mowing roadway approaches, administration building and hangar lawns in addition to airfield turf. You avoid cost of special machinery for these purposes.

### Start the solution of your Airfield Mowing Problems in 1945

The Worthington Airfield "Grass Blitzer" is now being produced for other than military requirements.

#### WRITE TODAY FOR DETAILS

THE ARMY-NAVY "E" PENNANT (with two stars) flies over our plant as a tribute from the Armed Forces to our employees for their loyal war production record.



*Distributors in All Principal Cities*



**WORTHINGTON  
MOWER COMPANY**

STROUDSBURG, PENNSYLVANIA  
Established 1914



## PROGRESS OF CIVIL AERONAUTICS IN THE UNITED STATES

(All statistics are as of Dec. 31 each year)

Compiled by Information and Statistics Service, U. S. Civil Aeronautics Administration

	1942	1943	1944
<b>DOMESTIC AIR-CARRIER OPERATIONS</b>			
Operators (number of).....	16	16	16
Airplanes (in service and reserve).....	179	194	279
Air-carrier route mileage (unduplicated).....	36,442	36,982	40,392
Express service.....	36,442	36,982	40,392
Mail service.....	35,641	36,982	40,392
Passenger service.....	35,168	34,893	39,251
Miles flown:			
Daily average.....	301,652	283,840	484,610
Revenue miles.....	110,102,860	103,601,443	142,234,837
Passenger traffic:			
Passengers carried.....	3,551,833	3,454,040	4,668,330
Revenue <sup>2</sup> .....	3,349,134	3,351,537	4,575,716
Nonrevenue.....	202,699	102,503	92,614
Passenger miles flown (1 passenger carried 1 mile):.....	1,481,976,329	1,642,596,640	2,264,282,443
Revenue.....	1,398,042,146	1,606,119,468	2,229,571,113
Nonrevenue.....	83,934,183	36,477,172	34,711,330
Passenger seat miles flown.....	1,937,672,755	1,824,849,802	2,492,893,507
Passenger load factor (per cent):			
Revenue.....	72.15	88.01	89.40
Revenue and nonrevenue.....	76.11	90.01	90.83
Passenger fare per mile.....	\$0.0527	\$0.0535	.....
Mail:			
Ton miles <sup>3</sup> .....	21,066,627	35,927,042	50,825,202
Express and freight:			
Ton miles.....	11,691,208	15,117,925	17,094,029
Pounds <sup>4</sup> .....	39,968,785	57,543,591	65,916,837
Accidents:			
Number of accidents.....	31	24	30
Miles flown per accident.....	3,551,705	4,316,727	4,741,161
Number of fatal accidents.....	5	2	5 <sup>5</sup>
Miles flown per fatal accident.....	22,020,572	51,800,722	28,446,967
Fatal accidents per 1,000,000 miles flown.....	0.05	0.02	0.04
Pilot fatalities.....	5	2	5
Miles flown per pilot fatality.....	22,020,572	51,800,722	28,446,967
Copilot fatalities.....	5	2	3
Crew fatalities (other than pilot and copilot).....	6	4	2
Passenger fatalities.....	55	22	48
Passenger miles flown per passenger fatality.....	26,945,024	74,663,484	47,172,551
Passenger fatalities per 100,000,000 passenger miles flown.....	3.71	1.34	2.12
Ground crew and third party fatalities.....	0	0	0
Total fatalities.....	71	30	58
Fatalities per 1,000,000 miles flown.....	0.64	0.29	0.41
<b>PRIVATE FLYING OPERATIONS</b> (All domestic)			
Airplanes in operation.....	22,329	22,323 <sup>1</sup>	21,212
<b>AIRPORTS AND LANDING FIELDS</b>			
Airports and landing fields:			
Total airports in operation.....	2,809	2,769	3,427

# AMERICA ANSWERS \*\*\*

## THE BELLANCA

### AIRCRAFT QUIZ

A TABULATION of Bellanca Aircraft Quiz returns indicates the peacetime plane desired. The majority want a single engine three or four place landplane with 140 m. p. h. top speed, 125 m. p. h. cruising speed and a 500-mile cruising range. They prefer a fixed low-wing monoplane. Retractable landing gear was the favorite and this was divided between tri-cycle and two-wheeled types. Over a third of the Quiz participants were in the Armed Forces when they filled in the Quiz.

These returns closely approximate the specification of the well-known Bellanca Cruisair. The design of this easy-to-fly cabin plane incorporated such advanced features as retractable landing gear, full-cantilever plastic-bonded wing construction, 120 h.p. 6-cylinder aircooled engine. The Cruisair had a cruising speed of 120 miles per hour with fuel consumption of 22 miles to the gallon. This economical, airworthy plane was built on the keynote of safety and efficiency...Bellanca Aircraft Corporation, New Castle, Delaware.

#### FIRST CHOICE CHARACTERISTICS

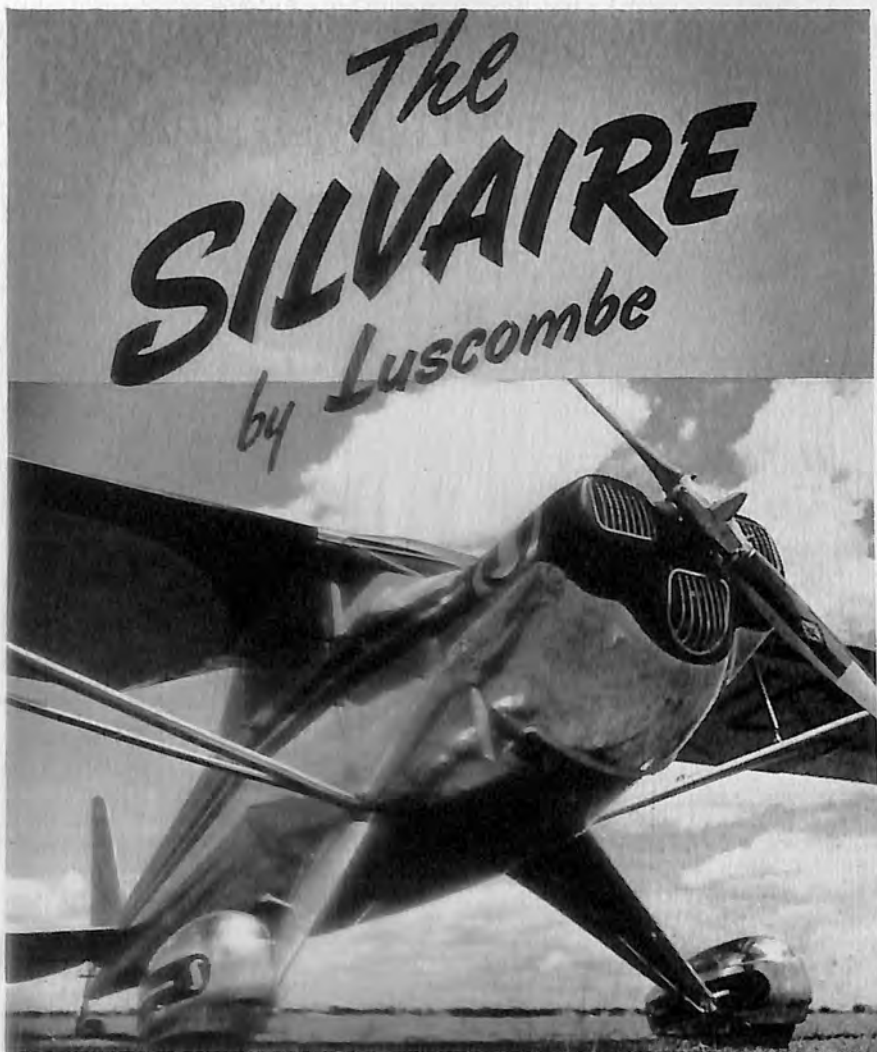
- 1—Three and four places (82% combined vote)
- 2—One engine (58%)
- 3—500 mi. range (44%)
- 4—125 mph cruising speed (40%)  
140 mph top speed (39%)
- 5—120 hp engine (27%)
- 6—Aircooled engine (32%)
- 7—All-metal and Plastic construction (72% combined vote)
- 8—Low wing (61%)
- 9—Fixed wing (58%)
- 10—Retractable gear (72% combining tri-cycle and two-wheel votes)
- 11—Dual-wheel control (60%)
- 12—Controllable-pitch prop (32%)
- 13—Luggage, 50 lbs. per person (average vote)
- 14—Landplane (64%)
- 15—Uses: personal-and-business (84%)
- 16—Price, \$2,500 to \$3,500 (42% combining three price brackets)

# BELLANCA

## PROGRESS OF CIVIL AERONAUTICS IN THE UNITED STATES

(Continued)

	1942	1943	1944
<b>AIRPORTS AND LANDING FIELDS (Continued)</b>			
Commercial.....	1,060	801	1,027
Municipal.....	1,129	914	1,067
Intermediate CAA—lighted.....	273	239 <sup>4</sup>	228
Intermediate CAA—unlighted.....	0	1	1
Army, Navy, Marine Corps, National Guard, reserve, private and miscellaneous airports	338	814	1,104
Lighted, total.....	700	859	964
<b>FEDERAL AIRWAYS SYSTEM AND AIDS TO AIR NAVIGATION</b>			
Federal airways:			
Mileage.....	33,407	33,403	34,424
Mileage under construction at close of year..	1,363	1,493	275
Communications:			
Total Radio range stations.....	280	291	297
Radio range stations with scheduled broad- casts.....	105	108	285
Radio range stations with nonscheduled broadcasts.....	159	166	2
Radio range stations without voice.....	16	17	10
Radio marker beacons.....	40	63	84
Weather reporting airway and airport stations:			
Weather Bureau and CAA operated long- line teletypewriter equipped.....	442	365	535
Traffic control stations teletypewriter equipped.....	26	36	371
Miles of weather reporting teletypewriter service.....	52,618	52,800	62,545
Miles of traffic control teletypewriter service	9,008	10,372	36,755
Weather Bureau—first order stations (does not include airport stations).....	135	120	118
Airway lighting:			
Beacons:			
Revolving.....	2,080	2,035	2,037
Flashing.....	141	143	123
Beacons—privately owned and certified.....	1,041	1,201	1,347
Intermediate landing fields, lighted.....	267	236	228
<b>CERTIFICATES</b>			
Certificated aircraft:			
Airplanes.....	22,904	22,927 <sup>1</sup>	21,893
Glider.....	104	124	144
Certificated airmen:			
Pilots, airplane, total.....	110,510	122,884	132,432
Airline transport.....	2,177	2,315	3,046
Commercial.....	18,808	20,587	22,059
Private.....	89,525	99,982	107,327
Pilots, glider.....	211	1,435	2,412
Mechanics.....	18,097	20,805	23,157
Parachute technicians.....	...	473	939
Ground instructors.....	7,604	12,739	14,647



# The SILVAIRE by Luscombe

**YOUR "PRIVATE CAR" IN THE AGE OF FLIGHT** » » » Before the war, The Silvaire was the only all-metal airplane to sell at a popular price. When the war is won, Luscombe will again be bringing you an all-metal, all-purpose plane at a figure inviting personal ownership.....Presenting the important features by which Luscombe has proved its dependability—improved by all that Luscombe has learned through busy years of high precision all-metal war work—the new Silvaire of 194-? will be a plane to win your confidence and stimulate your pride and you will find you can afford it! Additional information may be obtained by writing Department C.

**LUSCOMBE AIRPLANE CORPORATION, TRENTON 7, NEW JERSEY**

---

**PROGRESS OF CIVIL AERONAUTICS IN THE UNITED STATES**  
(Continued)

	1942	1943	1944
<b>CERTIFICATES (Continued)</b>			
Student pilot certificates issued (yearly):			
Airplane.....	93,777	36,802	51,618
Glider.....	486	1,137	1,211

<sup>1</sup> Includes DPC aircraft assigned by CAA to WTS operators.

<sup>2</sup> Totals shown for passengers and express carried are not unduplicated figures, as the same passengers and express may be counted for more than one route.

<sup>3</sup> The mail pound miles flown by Hawaiian Airlines, Ltd., are included with the domestic mail pound miles as this company holds a domestic air mail contract. All other operations statistics for this carrier are included with foreign and territorial statistics.

<sup>4</sup> Includes 3 fields which were constructed but not commissioned on Jan. 1, 1944.

<sup>5</sup> Includes 2 non-passenger, single engine flights that carried mail and cargo only.

**U. S. DOMESTIC AIR CARRIER OPERATIONS**

And Accident Statistics for the Calendar Years 1942, 1943 and 1944

Compiled by Information and Statistics Service, Civil Aeronautics Administration

	1942	1943	1944
Miles Flown.....	110,102,860	103,601,443	142,234,837
Total Passengers Carried.....	3,551,833	3,454,040	4,668,330
Total Passenger Miles.....	1,481,970,329	1,642,590,640	2,264,282,443
Fatal Accidents.....	5	2	5 <sup>1</sup>
Passenger Fatalities.....	55	22	48
Crew Fatalities.....	16	8	10
Miles Flown per Fatal Accident.....	22,020,572	51,800,722	28,446,067
Passenger Miles Flown per Passenger Fatality..	26,814,248	74,663,484	47,172,551
Miles Flown per Crew Fatality.....	6,881,429	12,950,180	14,223,484

<sup>1</sup> Includes two non-passenger, single engine flights that carried mail and cargo only.

MINIMUM WEIGHT with MAXIMUM STRENGTH

# *Skydyne* SANDWICH CONSTRUCTION

for AIRCRAFT SURFACES • INTERIOR EQUIPMENT

Wings • Fuselage • Tail  
Control Surfaces

Floors • Partitions  
Doors • Furniture

Plane parts form-molded by Skydyne combine greater strength with less weight than is possible by any other process. Adaptable to complex shapes and curvatures, the laminated Skydyne Sandwich Construction gives a smooth, streamlined, rivet-free surface . . . cuts costs . . . simplifies design, production, assembly, maintenance. Highly resistant to sound, heat, vibration.

Skydyne aeronautical engineers have pioneered the use of Sandwich Construction for airplanes and airborne equipment. They can help you to BUILD LIGHTER PLANES . . . FOR LARGER PAYLOADS . . . WITH SKYDYNE! Write for literature.

## *Skydyne Inc*

Manufacturers—Engineering Consultants—Designers  
River Road, Port Jervis, New York

DESIGNERS ENGINEERS  
MANUFACTURERS

RUBBER PRODUCTS  
FOR THE  
AIRCRAFT INDUSTRY  
WRITE FOR CATALOG

COMPLETE LINE  
A. N. GROMMETS

BUMPERS - RINGS  
BUSHINGS - MOLDS  
EXTRUSIONS - SLAB  
GASKETS - SHEET  
WASHERS - SPRING  
TUBING - SPONGE  
SPECIAL PARTS

THOUSANDS OF PARTS  
AVAILABLE FROM  
STOCK OR FROM  
OUR STOCK MOLDS  
SEND US YOUR  
INQUIRIES

All Phones  
HAYMARKET 7093



ATLANTIC INDIA RUBBER WORKS, INC.  
1291 WEST WASHINGTON STREET • CHICAGO, ILLINOIS

PARKS AIR COLLEGE  
PARKS AIRPARK EAST ST. LOUIS, ILL.

18th YEAR

Offers YOU COLLEGE and PROFESSIONAL  
TRAINING Majoring in AVIATION

Accredited by the Illinois Superintendent of Public Instruction. Included since 1938 in Directory of Higher Institutions of Learning, issued by the U. S. Office of Education. U. S. approved since 1929 as a Flight and Ground School.

"G. I. Bill of Rights" educational benefits are sufficient to pay most of, though not all of, direct school expenses for eligible Veterans.

Open to high school graduates with a ranking in the upper two-thirds of their classes.

Three engineering courses majoring in Aviation Operations, Aviation Maintenance, and Aeronautical Design Engineering lead to the Bachelor of Science degree, the Airplane and Airplane Engine Mechanics ratings, and the Private Pilot rating on the two-control personal plane.

Professional Flight Training, leading to the Commercial Pilot rating and the Instrument Pilot rating, is selective for all enrolled engineering students who are physically qualified.

Each course provides 120 weeks, ten terms, of personalized instruction and is completed in 2 1/2 calendar years. Enrollment limited to 400 students.

Airpark, 21 buildings devoted to school purposes exclusively. Dormitories and dining hall are on the campus.

Winter term, January 8, Spring term, April 2.

Send post card for new 64-page catalog. Address:

**PARKS AIR COLLEGE**  
East St. Louis, Ill.

## EMPLOYEES IN THE AIRCRAFT INDUSTRY

Compiled by Statistical Service, Aeronautical Chamber of Commerce of America

<i>At End of Month</i>	<i>Total Employees of All Prime Contractors</i>	<i>Airframes</i>	<i>Engines</i>	<i>Propellers</i>
<b>1941</b>				
January.....	194,135	146,197	41,329	6,609
February.....	204,902	153,554	44,143	7,265
March.....	216,156	161,231	47,205	7,720
April.....	231,102	172,240	50,461	8,401
May.....	246,006	183,134	53,060	8,912
June.....	269,059	200,260	59,381	9,418
July.....	293,661	218,925	64,813	9,923
August.....	319,125	238,549	70,213	10,363
September.....	341,450	255,796	74,710	10,944
October.....	371,247	276,810	82,907	11,530
November.....	391,453	291,574	87,544	12,335
December.....	423,027	313,297	96,746	12,984
<b>1942</b>				
January.....	460,356	341,603	104,156	14,597
February.....	501,753	368,669	116,804	16,280
March.....	538,060	390,278	129,387	18,305
April.....	572,616	412,927	138,974	20,715
May.....	611,272	439,188	148,738	23,340
June.....	653,033	470,705	156,964	25,304
July.....	695,359	505,274	162,893	27,192
August.....	753,425	553,240	170,680	29,505
September.....	796,954	580,593	176,597	30,854
October.....	852,862	635,056	185,387	32,419
November.....	910,932	680,535	195,860	34,528
December.....	970,359	729,995	204,177	36,187
<b>1943<sup>1</sup></b>				
January.....	1,027,914	770,471	219,084	38,359
February.....	1,072,573	800,055	232,186	40,332
March.....	1,106,664	810,848	244,434	42,382
April.....	1,139,018	839,349	255,547	44,122
May.....	1,166,555	856,244	263,684	46,627
June.....	1,203,479	881,139	273,798	48,542
July.....	1,233,385	900,584	282,944	49,857
August.....	1,257,427	907,098	297,329	53,000
September.....	1,290,181	924,872	310,573	54,736
October.....	1,311,765	931,109	325,916	54,740
November.....	1,326,345	936,466	336,128	53,751
December.....	1,310,799	922,859	333,303	54,637
<b>1944</b>				
January.....	1,307,953	913,091	337,698	57,164
February.....	1,295,701	898,865	339,833	57,093
March.....	1,267,657	875,423	335,614	56,620
April.....	1,247,182	856,325	334,458	56,399
May.....	1,227,724	840,351	332,149	55,224
June.....	1,197,974	811,623	331,667	54,684
July.....	1,180,866	796,976	329,620	54,270
August.....	1,139,919	769,282	317,346	53,291
September.....	1,095,198	741,129	300,451	53,618
October.....	1,062,900	721,449	289,563	51,888
November.....	1,050,320	715,421	284,356	50,543
December <sup>2</sup> .....	1,045,600	713,100	283,500	49,000

<sup>1</sup> Beginning with January 1943 and thereafter figures differ generally from those previously released due to a shift in reporting from a net to a gross basis. The effect of this change is an increase of approximately 9,500 over the total and airframe employment previously reported for January 1943. The engine and propeller figures were not affected until later in 1943 and the change is of insufficient magnitude to impair the employment trend.

<sup>2</sup> Preliminary.

Source: U. S. Department of Labor, Bureau of Labor Statistics, Division of Construction and Public Employment.

# IF YOU

**Can't get drawings!**

**Can't get planning sheets!**

**Can't get tools!**

**Can't meet schedules!**

**Can't get results!**

**CARNEY can do it for you!**

Carney has the "know-how." Because we've done it before in aircraft, radar, automotive, business machines, instruments, radio, hydraulics and in many other fields.



**C A R N E Y**  
**ENGINEERING COMPANY**  
*Consultants . . . Industrial Engineers*  
1819 BROADWAY, NEW YORK 23, N. Y.



## WAGES AND HOURS IN THE AIRCRAFT INDUSTRY

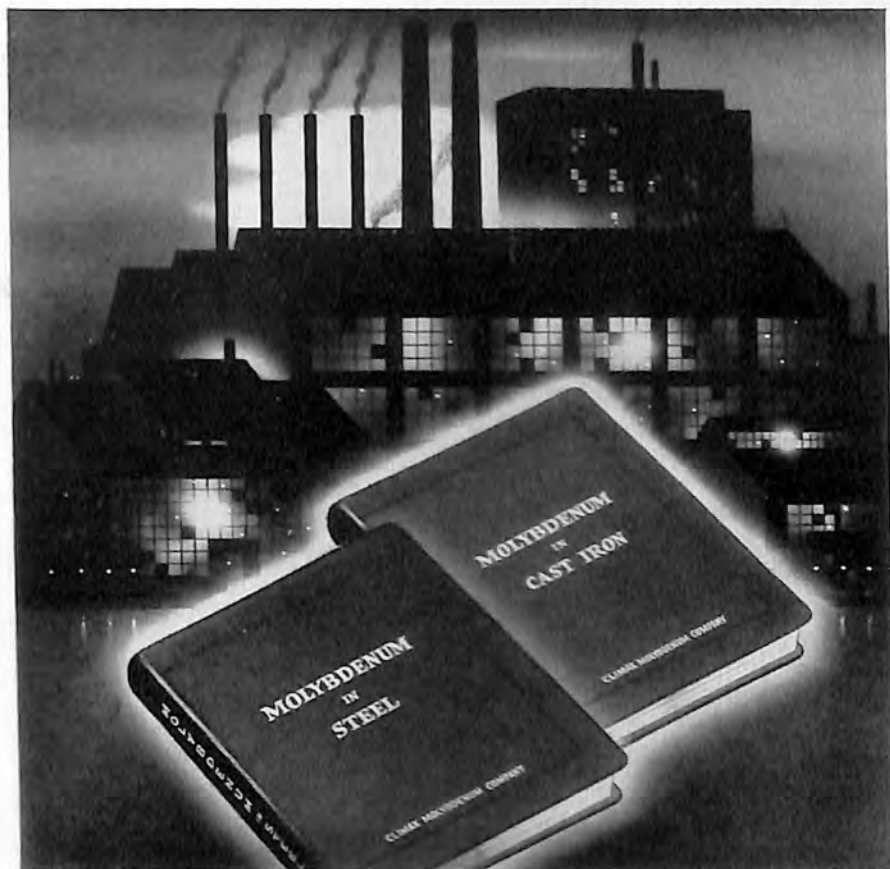
From Statistical Service, Aeronautical Chamber of Commerce of America

## AVERAGE HOURS AND EARNINGS OF WAGE EARNERS IN AIRFRAME, ENGINE AND PROPELLER PLANTS

	Airframe Plants			Engine Plants			Propeller Plants		
	Weekly Hours	Average Weekly Earnings	Hourly Earnings	Weekly Hours	Average Weekly Earnings	Hourly Earnings	Weekly Hours	Average Weekly Earnings	Hourly Earnings
1941									
Jan.....	44.7	\$34.08	\$ .76	46.3	\$41.22	\$ .89	45.1	\$37.26	\$ .83
Feb.....	45.3	34.85	.77	45.5	39.57	.87	47.4	39.28	.83
Mar.....	44.9	34.50	.77	45.8	40.79	.89	47.7	41.15	.86
Apr.....	45.2	35.11	.78	41.9	38.96	.92	37.9	31.30	.83
May.....	45.2	35.21	.78	47.0	45.07	.96	47.4	43.30	.91
June.....	44.6	34.80	.78	47.0	46.49	.99	48.5	44.40	.92
July.....	44.5	35.32	.79	47.0	47.36	1.01	49.6	46.33	.93
Aug.....	45.5	37.85	.83	47.0	48.71	1.04	42.1	46.26	1.10
Sept.....	45.4	37.81	.83	48.1	50.82	1.06	45.7	46.50	1.02
Oct.....	44.9	38.03	.86	47.2	52.04	1.10	48.6	49.26	1.01
Nov.....	44.0	39.34	.89	47.7	55.28	1.16	44.8	51.37	1.15
Dec.....	45.8	41.53	.91	48.3	55.63	1.15	53.2	63.95	1.20
1942									
Jan.....	48.9	46.12	.94	50.6	62.09	1.23	52.0	59.10	1.14
Feb.....	47.5	44.35	.93	49.7	59.34	1.19	49.7	54.15	1.09
Mar.....	47.6	44.33	.93	49.3	60.93	1.23	50.1	56.42	1.13
Apr.....	47.4	44.62	.94	48.5	58.90	1.21	50.9	58.04	1.14
May.....	46.7	44.52	.95	48.3	58.43	1.21	51.5	59.51	1.16
June.....	46.1	44.65	.97	48.2	58.07	1.21	51.0	59.58	1.17
July.....	45.6	44.40	.97	48.0	59.61	1.24	52.1	59.01	1.13
Aug.....	46.0	44.78	.97	48.3	60.21	1.25	48.9	57.47	1.18
Sept.....	45.8	45.34	.99	47.6	61.00	1.28	47.7	59.44	1.25
Oct.....	45.7	44.35	.97	48.8	61.14	1.25	48.3	60.18	1.24
Nov.....	46.1	44.91	.97	47.3	59.25	1.25	46.2	56.38	1.22
Dec.....	46.4	45.59	.98	47.1	58.92	1.25	48.9	59.89	1.22
1943									
Jan.....	46.3	45.82	.99	47.2	59.84	1.27	49.0	59.62	1.22
Feb.....	45.0	45.89	1.00	47.8	60.21	1.26	47.4	58.05	1.23
Mar.....	46.1	46.48	1.01	48.5	61.33	1.26	47.7	58.18	1.22
Apr.....	47.1	48.90	1.04	48.0	60.40	1.26	48.2	60.14	1.25
May.....	46.7	49.21	1.05	48.8	62.10	1.27	48.2	60.27	1.25
June.....	46.4	49.47	1.07	46.7	59.03	1.26	48.3	60.56	1.25
July.....	45.4	48.31	1.06	46.7	59.40	1.27	48.3	60.94	1.26
Aug.....	45.6	48.97	1.07	47.1	59.70	1.27	49.0	61.27	1.25
Sept.....	46.5	51.58	1.11	47.7	62.25	1.30	49.0	64.11	1.31
Oct.....	46.6	51.50	1.10	47.7	61.14	1.28	47.0	58.89	1.25
Nov.....	46.6	51.84	1.11	47.4	61.14	1.29	47.6	59.75	1.26
Dec.....	45.6	51.12	1.12	46.2	58.47	1.26	47.2	59.89	1.27
1944									
Jan.....	47.7	54.03	1.13	47.7	61.69	1.29	48.7	61.71	1.27
Feb.....	47.3	53.65	1.13	46.9	60.66	1.29	47.4	59.52	1.26
Mar.....	46.8	53.52	1.14	47.1	60.97	1.29	46.5	58.26	1.26
Apr.....	46.4	53.32	1.15	47.1	61.15	1.30	46.7	59.10	1.26
May.....	46.8	54.30	1.16	46.0	59.49	1.29	46.4	58.16	1.25
June.....	46.9	54.37	1.16	46.7	61.00	1.31	47.3	60.61	1.28
July.....	46.5	53.00	1.16	42.2	55.23	1.31	44.3	57.00	1.29
Aug.....	46.8	54.36	1.16	45.4	59.19	1.30	48.2	62.70	1.30
Sept.....	45.7	53.99	1.18	44.3	58.44	1.32	45.0	59.30	1.32
Oct.....	46.5	54.51	1.17	45.9	59.75	1.30	47.5	62.62	1.32
Nov.....	47.0	55.28	1.18	44.9	59.05	1.31	46.2	61.07	1.32
Dec.1.....	47.3	55.66	1.18	46.3	61.14	1.32	45.8	61.21	1.34

Source: U. S. Dept. of Labor, Bureau of Labor Statistics.

1 Preliminary.



## PRACTICAL DATA FOR PRESENT PROBLEMS

Here are two books designed to help users of Molybdenum steels and irons to conserve all alloying elements, and possibly steel and iron, by getting the most in the way of strength, toughness and wear resistance with the lowest alloy content.

"MOLYBDENUM IN STEEL" covers the fundamental metallurgy of Molybdenum steels. Heat treatment

—physical properties—applications —of a number of these steels are treated at length.

"MOLYBDENUM IN CAST IRON" covers the effect of Molybdenum in gray iron, giving suggested analyses for practical applications and detailed discussion of high strength (60,000 p.s.i. and up) irons.

Both books will gladly be sent without charge on request.

CLIMAX FURNISHES AUTHORITATIVE ENGINEERING DATA ON MOLYBDENUM APPLICATIONS.



MOLYBDIC OXIDE, BRIQUETTED OR CANNED • FERROMOLYBDENUM • "CALCIUM MOLYBDATE"

**Climax Molybdenum Company**  
500 Fifth Avenue • New York City

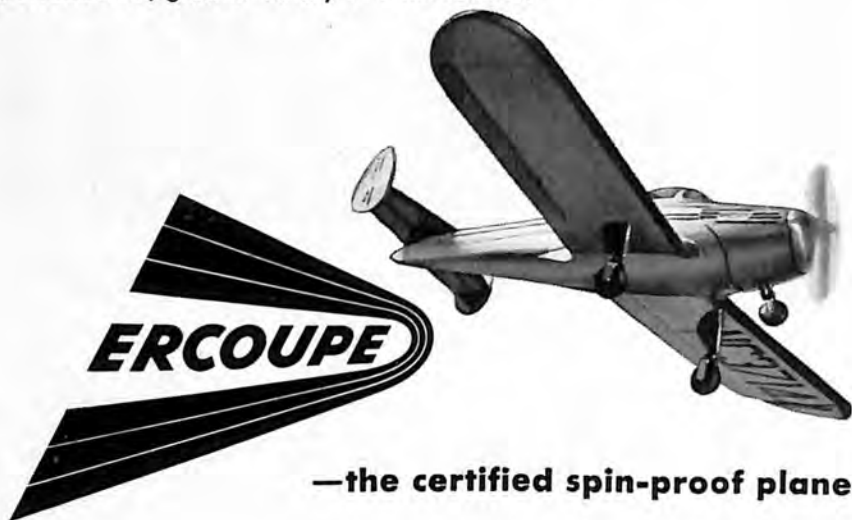
## Today

making gun turrets for Navy bombers, radar and other military equipment . . . plus machines to speed plane production, including propeller-profilers, automatic punches and riveters, stretch-presses, metal shrinkers and sheet metal formers.



## Tomorrow

applying its engineering prowess again to the making of the personal plane of easier operation, better performance, greater safety . . . the famous



—the certified spin-proof plane

Winner of four "E" pennants



**ENGINEERING AND RESEARCH CORPORATION**  
Riverdale, Maryland

# Directory

SUBJECT	PAGE
Aeronautical Chamber of Commerce of America, Inc. . . . .	458
Aeronautical Periodicals of the United States . . . . .	480
Air Transport Association of America . . . . .	476
Aircraft Owners and Pilots Association . . . . .	476
Aircraft War Production Council, Inc. . . . .	462-464
Aircraft War Production Council, East Coast, Inc. . . . .	466-472
American Society of Mechanical Engineers . . . . .	458
Aviation Writers Association . . . . .	460
Civil Aeronautics Administration, U. S. Department of Commerce . . . . .	446
Civil Aeronautics Board . . . . .	448
Congressional Committees Interested in Aviation . . . . .	452-456
Federal Communications Commission . . . . .	456
Institute of the Aeronautical Sciences . . . . .	472
Manufacturers Aircraft Association, Inc. . . . .	460
National Advisory Committee for Aeronautics . . . . .	448
National Aeronautic Association of U. S. A., Inc. . . . .	478
National Association of State Aviation Officials . . . . .	474-476
Post Office Department, Air Mail Service . . . . .	450
Scheduled Air Carriers . . . . .	482-484
Society of Automotive Engineers, Inc. . . . .	478
U. S. Army Air Forces, War Department . . . . .	444-445
U. S. Department of Commerce, Weather Bureau . . . . .	450
U. S. Forest Service, Department of Agriculture . . . . .	456
U. S. Naval Aviation . . . . .	446
Directory of Aircraft and Aircraft Engine Manu- facturers . . . . .	488-500
Classified Directory of Equipment Manufacturers . . . . .	502-596
Alphabetical Directory of Equipment Manufacturers . . . . .	598-672

# DIRECTORY

## U. S. ARMY AIR FORCES,

Washington, D. C.

February 1, 1945

Henry L. Stimson, Secretary of War  
Robert W. Patterson, Under Secretary of War  
Robert A. Lovett, Asst. Secretary of War for Air

Commanding General, Army Air Forces.....	Gen. Henry H. Arnold
Deputy Commander, AAF, and Chief of Air Staff.....	Lt. Gen. Barney M. Giles
Deputy Chief of Air Staff.....	Brig. Gen. Patrick W. Timberlake
Deputy Chief of Air Staff.....	Brig. Gen. Ray L. Owens
Deputy Chief of Air Staff.....	Brig. Gen. F. H. Smith, Jr.
Deputy Chief of Air Staff and Chief of Staff 20th Air Force.....	Brig. Gen. L. Norstad
Management Control.....	Brig. Gen. B. E. Gates
Assistant Chief of Air Staff, Personnel (Acting).....	Brig. Gen. J. H. McCormick
Assistant Chief of Air Staff, Intelligence.....	Major Gen. J. P. Hodges
Assistant Chief of Air Staff, Training.....	Brig. Gen. W. W. Welsh
Assistant Chief of Air Staff, Materiel and Services.....	Major Gen. O. P. Echols
Assistant Chief of Air Staff, Operations, Commitments and Requirements.....	Brig. Gen. Donald Wilson
Assistant Chief of Air Staff, Plans.....	Major Gen. L. S. Kuter
AAF Personnel Distribution Command.....	Major Gen. H. R. Harmon
AAF Training Command.....	Lt. Gen. B. K. Yount
I Troop Carrier Command.....	Brig. Gen. W. D. Old
Air Transport Command.....	Major Gen. H. L. George
Air Technical Service Command.....	Lt. Gen. Wm. S. Knudsen
AAF Tactical Center.....	Major Gen. Edwin J. House
AAF Proving Ground Command.....	Brig. Gen. G. Gardner
First Air Force.....	Major Gen. F. O'D. Hunter
Second Air Force.....	Major Gen. R. B. Williams
Third Air Force.....	Major Gen. W. T. Larson
Fourth Air Force.....	Major Gen. J. E. Parker
Fifth Air Force.....	Major Gen. E. C. Whitehead
Sixth Air Force.....	Major Gen. W. O. Butler
Seventh Air Force.....	Major Gen. R. W. Douglass
Eighth Air Force.....	Lt. Gen. J. H. Doolittle
Ninth Air Force.....	Major Gen. H. S. Vandenberg
Tenth Air Force.....	Major Gen. H. C. Davidson
Eleventh Air Force.....	Major Gen. D. Johnson
Twelfth Air Force.....	Major Gen. J. K. Cannon
Thirteenth Air Force.....	Major Gen. St. C. Streett
Fourteenth Air Force.....	Major Gen. Claire Chennault
Fifteenth Air Force.....	Major Gen. N. F. Twining
Twentieth Air Force.....	Gen. H. H. Arnold
Office of Flying Safety.....	Col. George C. Price
Air Inspector.....	Brig. Gen. J. W. Jones
Air Surgeon.....	Major Gen. D. N. W. Grant
Budget and Fiscal.....	Brig. Gen. L. W. Miller
Air Judge Advocate.....	Brig. Gen. L. H. Hedrick
Air Communications Office.....	Brig. Gen. H. H. McClelland
Special Assistant for Anti-Aircraft.....	Major Gen. H. R. Oldfield

Against Germany

ALLIED AIR FORCES IN EUROPEAN THEATER

- U. S. Strategic Air Forces, RAF Bomber Command  
 Ninth Air Force (Tactical), RAF Tactical Air Force
- U. S. Strategic Air Forces.....Commander-in-Chief, Lt. Gen. Carl A. Spaatz  
 Chief of Staff, Brig. Gen. Edward Curtis  
 Operational Deputy, Major Gen. Frederick Anderson  
 Administrative Deputy, Major Gen. Hugh J. Knerr
- Eighth Air Force.....Lt. Gen. James H. Doolittle  
 Fifteenth Air Force.....Major Gen. Nathan F. Twining  
 (Operational Control)
- Allied Expeditionary Air Forces
- RAF 2nd Tactical Air Force.....Air Marshal Sir Arthur Coningham  
 Ninth Air Force (Tactical).....Major Gen. Hoyt S. Vandenburg
- 9th Tactical Air Command.....Brig. Gen. E. R. Quesada  
 (with 1st Army)
- 10th Tactical Air Command.....Brig. Gen. O. P. Weyland  
 (with 3rd Army)
- 20th Tactical Air Command.....Brig. Gen. R. E. Nugent  
 (with 9th Army)

ALLIED AIR FORCES IN MEDITERRANEAN THEATER

- Mediterranean Allied Air Forces.....Commander-in-Chief, Lt. Gen. Ira C. Eaker  
 Deputy Commander-in-Chief, Air Marshal Sir J. C. Slessor
- Fifteenth Air Force.....Major Gen. Nathan F. Twining  
 (Administrative Control)
- Twelfth Air Force.....Major Gen. John K. Cannon  
 RAF Mediterranean and Middle East.....Air Marshal F. J. Linnell

Against Japan

PACIFIC OCEAN AREA

- Twentieth Air Force; U. S. Army Strategic Air Forces, Pacific Ocean Area;  
 Naval and Marine Air Forces; Pacific Fleets Carrier Task Forces and Air Wings
- Twentieth Air Force.....Commander-in-Chief, Gen. Henry H. Arnold  
 Deputy Commander, Lt. Gen. Millard F. Harmon  
 Chief of Staff, Brig. Gen. Lauris R. Norstad
- 20th Bomber Command.....Major Gen. Roger Ramey  
 (India-China)
- 21st Bomber Command.....Major Gen. Curtis Le May  
 (Saipan)
- U. S. Strategic Air Forces, POA.....Commander-in-Chief, Lt. Gen. Millard F. Harmon  
 Deputy Commander for Operations, Major Gen. Willis Hale
- 21st Bomber Command.....Major Gen. Curtis Le May  
 Seventh Air Force.....Major Gen. Robert L. Douglass, Jr.  
 Fourth Marine Aircraft Wing (U. S. M. C.).....Major Gen. Louis E. Woods

SOUTHWEST PACIFIC THEATER

- Far East Air Forces, U. S. Fifth Air Force, U. S. Thirteenth Air Force, First Marine  
 Aircraft Wing, Australian, New Zealand, Netherlands East Indies Air Units
- Far East Air Forces.....Commander-in-Chief, Lt. Gen. George C. Kenney  
 Fifth Air Force.....Major Gen. Ennis C. Whitehead  
 (includes Air Task Forces)
- Thirteenth Air Force.....Major Gen. W. St. Clair Streett  
 First Marine Aircraft Wing (U. S. M. C.).....Major Gen. Ralph D. Mitchell

CHINA THEATER

- U. S. Army Air Forces and Chinese Air Forces
- Fourteenth Air Force.....Major Gen. Claire Chennault  
 Chinese-American Composite Wing

SOUTHEAST ASIA

- Eastern Air Command, U. S. Tenth Air Force, 3rd Tactical Air Force
- Eastern Air Command.....Major Gen. George E. Stratemeyer  
 Tenth Air Force.....Major Gen. H. C. Davidson

# DIRECTORY

## U. S. NAVAL AVIATION

Washington, D. C.

February 1, 1945

James Forrestal, Secretary of the Navy  
 Ralph A. Bard, Under Secretary of the Navy  
 Artemus L. Gates, Assistant Secretary of the Navy for Air  
 H. Struve Hensel, Assistant Secretary of the Navy

Fleet Admiral E. J. King.....	Commander in Chief U. S. Fleet and Chief of Naval Operations
Vice Admiral A. W. Fitch.....	Deputy Chief of Naval Operations (Air)
Vice Admiral G. D. Murray.....	Commander, Air Force Pacific Fleet
Vice Admiral P. N. L. Bellinger.....	Commander, Air Force Atlantic Fleet
Maj. Gen. Field Harris.....	Director, Marine Aviation
Rear Admiral J. W. Reeves.....	Director, Naval Air Transport Service
Rear Admiral J. H. Cassady.....	Asst. Deputy Chief of Naval Operations (Air)
Capt. J. P. Vest.....	Director, Aviation Training
Capt. C. W. Oexle.....	Director, Air Combat Intelligence
Capt. H. F. Fick.....	Director, Aviation Planning
Capt. H. L. Meadow.....	Director, Aviation Personnel
Capt. J. R. Dudley.....	Director, Flight

### Bureau of Aeronautics\*

Rear Admiral D. C. Ramsey.....	Chief, Bureau of Aeronautics
Rear Adm. L. B. Richardson.....	Asst. Chief, Bureau of Aeronautics
Comdr. R. E. Dixon.....	Director, Military Requirements
Comdr. R. S. Quackenbush, Jr.....	Director, Photographic
Capt. L. DeFlorez.....	Director, Special Devices
Capt. G. S. Smith.....	Director, Procurement
Capt. T. C. Lonquest.....	Director, Engineering
Capt. L. D. Webb.....	Director, Production

\* The Bureau of Aeronautics is responsible for the design and procurement of Naval aircraft. The aircraft then are turned over to the Office of the Deputy Chief of Naval Operations (Air).

## CIVIL AERONAUTICS ADMINISTRATION

### U. S. DEPARTMENT OF COMMERCE

Washington, D. C.

Henry A. Wallace, Secretary of Commerce  
 William A. M. Burden, Assistant Secretary of Commerce

Administrator of Civil Aeronautics.....	T. P. Wright
Deputy Administrator.....	Charles I. Stanton
Assistant Administrator.....	John E. Sommers
Assistant Administrator—Foreign Operations.....	A. S. Koch
Executive Officer.....	A. E. Stockburger
General Counsel (Acting).....	Glen D. Woodmansee
Director of Information and Statistics.....	Ben Stern
Director of Federal Airways.....	T. B. Bourne
Director of Safety Regulation.....	Fred Lanter
Director of Airports.....	C. B. Donaldson
Director of Manpower and Training.....	Bruce Uthus

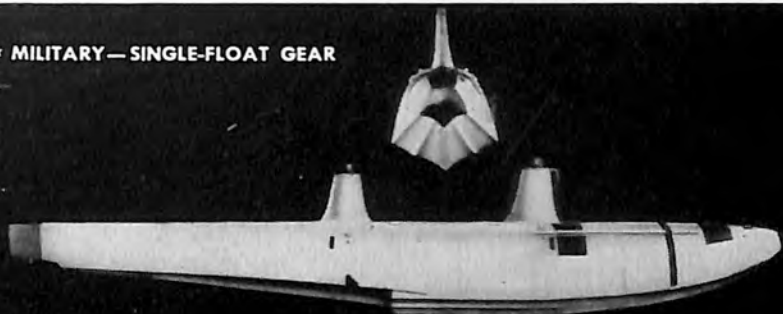
### Regional Managers

Region I	New York, N. Y.....	Oren Harwood
Region II	Atlanta, Ga.....	W. M. Robertson
Region III	Chicago, Ill.....	H. R. Neely
Region IV	Fort Worth, Tex.....	L. C. Elliott
Region V	Kansas City, Mo.....	W. E. Kline
Region VI	Santa Monica, Calif.....	H. A. Hook
Region VII	Seattle, Wash.....	Paul Morris
Region VIII	Anchorage, Alaska.....	M. C. Hoppin
Region IX	Honolulu, T. H.....	John M. Beardslee

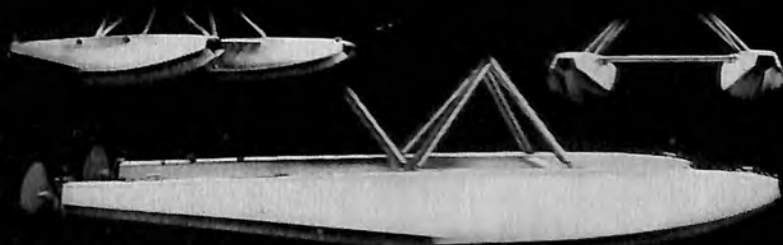
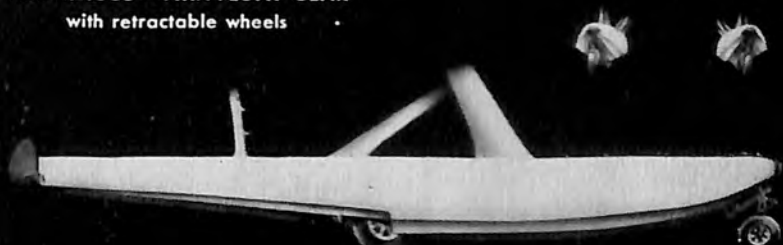
# ***EDO FLOAT GEAR***

*All-metal seaplane floats for every type of aircraft*

**\* MILITARY — SINGLE-FLOAT GEAR**



**\* AMPHIBIOUS — TWIN-FLOAT GEAR**  
with retractable wheels



**\* COMMERCIAL — TWIN-FLOAT GEAR**

## ***Edo Aircraft Corporation***

Contractors to the U.S. Navy and U.S. Army Air Forces and Allied Governments

418 SECOND STREET, COLLEGE POINT, N.Y., U.S.A.



### NATIONAL ADVISORY COMMITTEE FOR AERONAUTICS

1500 New Hampshire Avenue, N. W.

Washington, D. C.

Laboratories, Langley Field, Va.; Moffett Field, Calif.; Cleveland, O.

Created by act of Congress, approved March 3, 1915, for the supervision and direction of the scientific study of the problems of flight. Its membership was increased to 15 by act approved March 2, 1939. The members are appointed by the President, and serve as such without compensation.

- Jerome C. Hunsaker, Sc.D., (Chairman), Massachusetts Institute of Technology, Cambridge, Massachusetts.
- Lyman J. Briggs, Ph.D., (Vice Chairman), Director, National Bureau of Standards.
- Henry H. Arnold, General of the Army, Commanding General, Army Air Forces.
- William A. M. Burden, Assistant Secretary of Commerce.
- Vannevar Bush, Sc.D., Director, Office of Scientific Research and Development.
- William F. Durand, Ph.D., Stanford University.
- Oliver P. Echols, Major General, Assistant Chief of Air Staff, Army Air Forces.
- Aubrey W. Fitch, Vice Admiral, Deputy Chief of Naval Operations (Air), Navy Department.
- William Littlewood, Vice President—Engineering, American Airlines, New York.
- Francis W. Reichelderfer, Sc.D., Chief, U. S. Weather Bureau.
- Lawrence B. Richardson, Rear Admiral, Assistant Chief of the Bureau of Aeronautics, Navy Department.
- Edward Warner, Sc.D., Vice Chairman, Civil Aeronautics Board.
- Alexander Wetmore, Ph.D., Secretary, Smithsonian Institution.
- Orville Wright, Sc.D., Dayton, Ohio.
- Theodore P. Wright, Sc.D., Administrator of Civil Aeronautics.

George W. Lewis, Sc.D., Director of Aeronautical Research

John F. Victory, LL.M., Secretary

Edward H. Chamberlin, Assistant Secretary

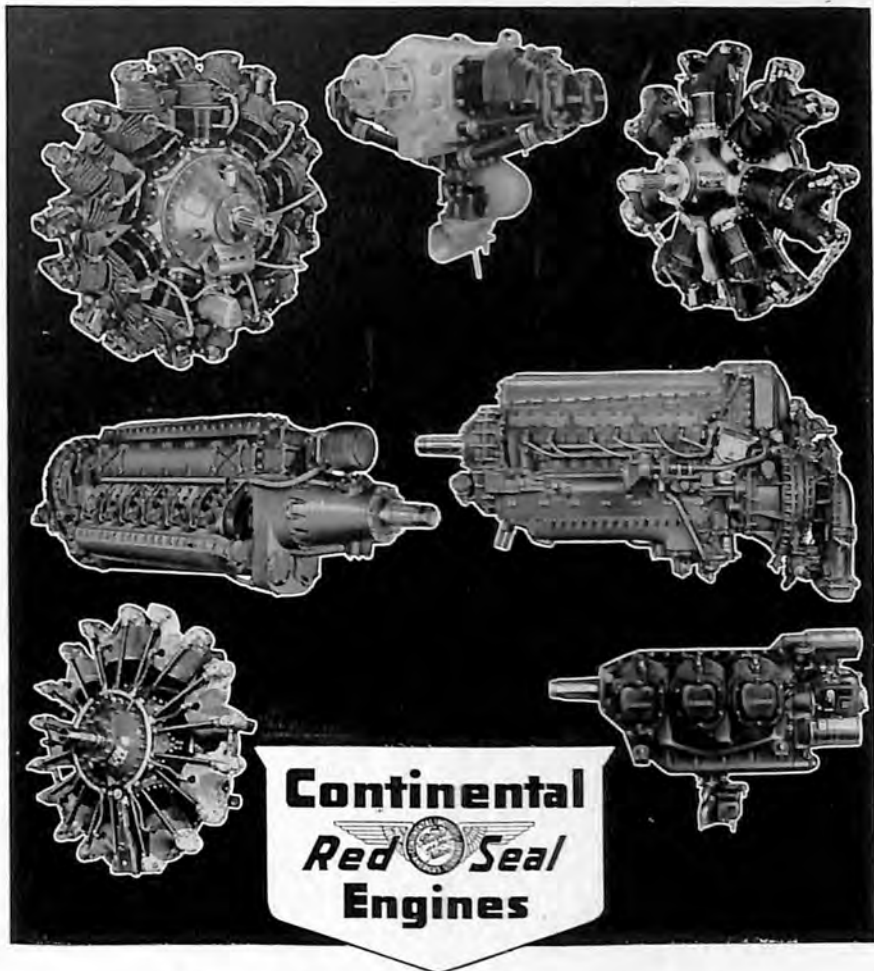
Charles H. Helms, Chief of Military Research

Russell G. Robinson, Chief of Research Coordination

- Henry J. E. Reid, Engineer-in-Charge, Langley Memorial Aeronautical Laboratory, Langley Field, Virginia.
- Smith J. DeFrance, Engineer-in-Charge, Ames Aeronautical Laboratory, Moffett Field, California.
- Edward R. Sharp, Manager, Aircraft Engine Research Laboratory, Cleveland, Ohio.
- Carlton Kemper, Executive Engineer, Aircraft Engine Research Laboratory, Cleveland, Ohio.

### CIVIL AERONAUTICS BOARD

- L. Welch Pogue..... Chairman
- Edward P. Warner..... Vice Chairman
- Harliee Branch..... Member
- Oswald Ryan..... Member
- Josh Lee..... Member
- Fred A. Toombs..... Secretary
- George A. Neal..... General Counsel
- C. Edward Leasure..... Chief Examiner
- Irston R. Barnes..... Director, Economic Bureau
- Jesse W. Lankford..... Director, Safety Bureau



**P O W E R T O W I N**

The complexity of these aircraft engines built by Continental shows an extraordinary ability to produce.

Each model of engine enjoys the advantages of the most modern and efficient equipment for the development of operating characteristics and to prove endurance qualities.

All parts are coordinated to insure the utmost in power, economy, smooth operation and dependability. The final result is called Continental Red Seal Power — the Power to Win.

Your Dollars Are Power, Too!  
Buy War Bonds and Keep Them!



Awarded to the  
Detroit and Muskegon Plants of  
Continental Motors Corporation  
for High Achievement

***Continental Motors Corporation***  
*Aircraft Engine Division*  
MUSKEGON, MICHIGAN



# DIRECTORY

## U. S. DEPARTMENT OF COMMERCE WEATHER BUREAU

Washington, D. C.

Chief of Bureau .....	F. W. Reichelderfer
Assistant Chief for General Administration .....	W. F. McDonald
Executive Assistant for Scientific Services .....	C. F. Sarle
Special Assistant for Technical Services .....	D. M. Little
Chief, Instrument Division .....	Wm. R. Thickett
Chief, Synoptic Reports and Forecasts Division .....	I. R. Tannehill
Acting Chief, Station Operations Division .....	R. E. Spencer

### Regional Directors

Region I	Flushing, N. Y. ....	Walter J. Mozom
Region II	Atlanta, Ga. ....	T. R. Reed
Region III	Chicago, Ill. ....	Vincent E. Jakl
Region IV	Fort Worth, Tex. ....	Erle L. Hardy
Region V	Kansas City, Mo. ....	John A. Riley
Region VI	Los Angeles, Calif. ....	Floyd D. Young
Region VII	Seattle, Wash. (Boeing Field) .....	J. C. Smith
Region VIII	Anchorage, Alaska. ....	Glen Jefferson

### Forecast Centers

#### *Airway Forecasts*

Albuquerque, N. M.	Minneapolis, Minn.
Brownsville, Tex.	New York, N. Y.
Cincinnati, Ohio	St. Louis, Mo.
Dayton, Ohio	Seattle, Wash.
Fort Worth, Tex.	Waco, Tex.
Madison, Wisc.	

#### *Airway and General Weather Forecasts*

Anchorage, Alaska	Honolulu, T. H.
Atlanta, Ga.	Juneau, Alaska
Billings, Mont.	Kansas City, Mo.
Boston, Mass.	Miami, Fla.
Burbank, Calif.	New Orleans, La.
Chicago, Ill.	Salt Lake City, Utah
Denver, Colo.	San Francisco, Calif.
Fairbanks, Alaska	Washington, D. C.

#### *Hurricane Forecasts*

Boston, Mass.	San Juan, P. R.
Miami, Fla.	Washington, D. C.
New Orleans, La.	

## POST OFFICE DEPARTMENT AIR MAIL SERVICE

Washington, D. C.

Postmaster General .....	Frank C. Walker
Second Assistant Postmaster General .....	Smith W. Purdum
Deputy Second Assistant Postmaster General .....	Roy M. Martin

### Domestic Air Mail Service:

Superintendent .....	Vacant
Assistant Superintendent .....	R. S. Burgess
Regional Superintendent, New York, N. Y. ....	W. H. Nichols
Regional Superintendent, Chicago, Ill. ....	R. E. Pollard
Regional Superintendent, Atlanta, Ga. ....	J. L. Fulghum
Regional Superintendent, Fort Worth, Tex. ....	A. C. Hodges
Regional Superintendent, San Francisco, Calif. ....	A. O. Willoughby

Director of International Postal Service .....	S. M. Weber
Assistant Director of International Postal Service .....	V. B. Waters
Assistant Director of International Postal Service .....	E. J. Mahoney

**10** PIONEER IN FACT AS IN NAME

**Every Instrument Needed by Pilot,  
Navigator and Flight Engineer**

Since the early days of aviation, Pioneer has been the recognized center for the development and manufacture of precision flight instruments.

This long concentration on one objective has had two important results: Pioneer has contributed to flight security such basic advancements as the Turn and Bank Indicator, the Rate of Climb Indicator, and the Gyro Flux Gate Compass. And the Pioneer line has been expanded until it now includes every flight instrument required by navigator, pilot and flight engineer.

New developments of far-reaching importance await only the lifting of war restrictions to be generally available. Watch Pioneer—First in Creative Engineering of precision flight instruments.

**PIONEER INSTRUMENTS**

Bendix and Pioneer are trademarks of Bendix Aviation Corporation

ECLIPSE-PIONEER DIVISION  
Teterboro, N.J.

**Bendix**  
AVIATION CORPORATION

## CONGRESSIONAL COMMITTEES INTERESTED IN AVIATION

Standing Committees of the 79th Congress

## Senate

## Appropriations

Carter Glass	(D)	James M. Mead	(D)
Kenneth McKellar	(D)	Burnet R. Maybank	(D)
Carl Hayden	(D)	Styles Bridges	(R)
Elmer Thomas	(D)	Wallace H. White	(R)
Millard E. Tydings	(D)	Chan Gurney	(R)
Richard B. Russell	(D)	C. Wayland Brooks	(R)
Pat McCarran	(D)	Clyde M. Reed	(R)
John H. Overton	(D)	Harold H. Burton	(R)
John H. Bankhead	(D)	Joseph H. Ball	(R)
Joseph C. O'Mahoney	(D)	Raymond E. Willis	(R)
Theodore Francis Green	(D)	Homer Ferguson	(R)
Dennis Chavez	(D)	Kenneth S. Wherry	(R)

## Interstate Commerce

Burton K. Wheeler	(D)	Frank P. Briggs	(D)
Alben W. Barkley	(D)	Wallace H. White, Jr.	(R)
Edwin C. Johnson	(D)	Warren R. Austin	(R)
Tom Stewart	(D)	Henrik Shipstead	(R)
James M. Tunnell	(D)	Charles W. Tobey	(R)
Ernest W. McFarland	(D)	Clyde M. Reed	(R)
Clyde R. Hoey	(D)	Chan Gurney	(R)
Olin D. Johnston	(D)	Albert W. Hawkes	(R)
Francis J. Myers	(D)	E. H. Moore	(R)
Brien McMahon	(D)	Homer E. Capehart	(R)
Hugh B. Mitchell	(D)		

## Military Affairs

Elbert D. Thomas	(D)	Tom Stewart	(D)
Edwin C. Johnson	(D)	Burnet R. Maybank	(D)
Lister Hill	(D)	Warren R. Austin	(R)
Sheridan Downey	(D)	Styles Bridges	(R)
Albert B. Chandler	(D)	Chan Gurney	(R)
Harley M. Kilgore	(D)	Chapman Revercomb	(R)
James E. Murray	(D)	George A. Wilson	(R)
Joseph C. O'Mahoney	(D)	John Thomas	(R)
Robert F. Wagner	(D)	Harold H. Burton	(R)

## Naval Affairs

David I. Walsh	(D)	Warren G. Magnuson	(D)
Millard E. Tydings	(D)	Francis J. Myers	(D)
Richard B. Russell	(D)	Hiram W. Johnson	(R)
Harry Flood Byrd	(D)	Charles W. Tobey	(R)
Peter G. Gerry	(D)	Raymond E. Willis	(R)
Charles O. Andrews	(D)	C. Wayland Brooks	(R)
Allen J. Ellender	(D)	Owen Brewster	(R)
John L. McClellan	(D)	Edward V. Robertson	(R)
James O. Eastland	(D)	Leverett Saltonstall	(R)

## Post Offices and Post Roads

Kenneth McKellar	(D)	Glen H. Taylor	(D)
Carl Hayden	(D)	Clyde M. Reed	(R)
Josiah W. Bailey	(D)	William Langer	(R)
Dennis Chavez	(D)	C. Douglass Buck	(R)
Allen J. Ellender	(D)	Bourke B. Hickenlooper	(R)
James M. Mead	(D)	Homer E. Capehart	(R)
W. Lee O'Daniel	(D)	Wayne Morse	(R)
James G. Scrugham	(D)	Leverett Saltonstall	(R)
James O. Eastland	(D)	Forrest C. Donnell	(R)
John L. McClellan	(D)		

# AERO *of Corry*

PRECISION AIRCRAFT PARTS SINCE 1916



**A N BOLTS**



**FUEL VALVES**



**FUEL PUMPS**



**ENGINE CONTROLS**



**FUEL STRAINERS**

● Designers and fabricators of high alloy, precision made A N hardware and accessories, including A N Bolts, Fuel Valves, Fuel Pumps, Fuel Strainers, Engine Controls and related units. Now supplying parts for all American and Canadian designed military airplanes.

● Complete engineering, development and production facilities available for present or projected requirements.



**AERO SUPPLY MFG. CO. INC., 19 WAYNE ST., CORRY, PA.**

## TO HELP YOU DO BETTER WORK *Faster*

HOLE CHECKERS :: THREAD CHECKERS :: AMPLIFYING GAGES  
BENCH CENTERS :: RADIUS DRESSERS :: LAPPING PLATES

American precision products are used in tool rooms, on production lines and in inspection departments of leading manufacturers everywhere. They are built for extreme accuracy. Each has important exclusive features. Get complete details of the American line of Gages and Tool Room Accessories. Send for Bulletin 43-YB.



(Above)  
Air Operated  
Hole Checker  
for gaging  
internal  
diameters.

(Below)  
Thread  
Checker  
for gaging  
threads  
on pitch  
diameters.



**THE AMERICAN GAUGE CO.**  
*125 Bayard St.* DAYTON 1, OHIO

CONGRESSIONAL COMMITTEES INTERESTED IN AVIATION  
(Continued)

## House of Representatives

## Appropriations

Clarence Cannon	(D)	George W. Andrews	(D)
Clifton A. Woodrum	(D)	John J. Rooney	(D)
Louis Ludlow	(D)	Herman P. Kopplemann	(D)
Malcolm C. Tarver	(D)	John Taber	(R)
Jed Johnson	(D)	Richard B. Wigglesworth	(R)
J. Buell Snyder	(D)	D. Lane Powers	(R)
Emmet O'Neal	(D)	Charles A. Plumley	(R)
Louis C. Rabaut	(D)	Everett M. Dirksen	(R)
John H. Kerr	(D)	Albert J. Engel	(R)
George H. Mahon	(D)	Karl Stefan	(R)
Harry R. Sheppard	(D)	Francis Case	(R)
Butler B. Hare	(D)	Frank B. Keefe	(R)
Albert Thomas	(D)	Noble J. Johnson	(R)
Joe Hendricks	(D)	Robert F. Jones	(R)
Michael J. Kirwan	(D)	Ben F. Jensen	(R)
John M. Coffee	(D)	H. Carl Andersen	(R)
W. F. Norrell	(D)	Henry C. Dworshak	(R)
Albert Gore	(D)	Walter C. Ploeser	(R)
Jamie L. Whitten	(D)	Harve Tibbott	(R)
Thomas J. O'Brien	(D)	Walt Horan	(R)
James M. Curley	(D)	Dean M. Gillespie	(R)
Thomas D'Alesandro, Jr.	(D)		

## Interstate and Foreign Commerce

Clarence F. Lea	(D)	Dwight L. Rogers	(D)
Robert Crosser	(D)	Benjamin J. Rabin	(D)
Alfred L. Bulwinkle	(D)	Vito Marcantonio	(A.L.)
Virgil Chapman	(D)	Charles A. Wolverton	(R)
Lyle H. Boren	(D)	Pehr G. Holmes	(R)
Lindley Beckworth	(D)	B. Carroll Reece	(R)
J. Percy Priest	(D)	Charles A. Halleck	(R)
Oren Harris	(D)	Carl Hinshaw	(R)
George G. Sadowski	(D)	Clarence J. Brown	(R)
Richard F. Harless	(D)	Evan Howell	(R)
John W. Murphy	(D)	Leonard W. Hall	(R)
Edward A. Kelly	(D)	Thomas D. Winter	(R)
Luther Patrick	(D)	Joseph P. O'Hara	(R)
John B. Sullivan	(D)	Wilson D. Gillette	(R)

## Military Affairs

Andrew J. May	(D)	Melvin Price	(D)
R. Ewing Thomason	(D)	Walter G. Andrews	(R)
Overton Brooks	(D)	Dewey Short	(R)
John J. Sparkman	(D)	Leslie C. Arends	(R)
Paul J. Kilday	(D)	Charles R. Clason	(R)
Carl T. Durham	(D)	J. Parnell Thomas	(R)
Clifford Davis	(D)	Paul W. Shafer	(R)
John Edward Sheridan	(D)	Thomas E. Martin	(R)
Robert Sikes	(D)	Charles H. Elston	(R)
Philip J. Philbin	(D)	Forest A. Harness	(R)
Paul Stewart	(D)	Ivor D. Fenton	(R)
Arthur Winstead	(D)	J. Leroy Johnson	(R)
Chet Holifield	(D)	Clare Boothe Luce	(R)
James A. Roe	(D)		

## Naval Affairs

Carl Vinson	(D)	Ed. V. Izac	(D)
Patrick H. Drewry	(D)	Lansdale G. Sasser	(D)
Lyndon B. Johnson	(D)	James J. Heffernan	(D)
Michael J. Bradley	(D)	L. Mendel Rivers	(D)

# LEACH RELAYS

In the early days of commercial aviation, the Leach Relay Company pioneered in the design and production of *relays* suitable for aircraft applications, and *Leach relays* have since been universally used by all the leading airlines.

Today we are working 100% on War Production supplying *relays* suitable for military aircraft and for all branches of the service. In this field we again pioneered, designing and producing many *relays* for these applications. We are constantly developing new and special items.

You are invited to consult with us on your *relay* problems.

## LEACH RELAY CO.

5915 Avalon Blvd., Los Angeles, Calif.

*Relays Exclusively*



## AIRCRAFT OIL DRAINCOCKS —VALVES and SOLENOIDS

(For Fuel—Oil—Coolants)

Specified as standard equipment on America's most renowned fighters and bombers . . . the highest tribute that could be paid to the outstanding superiority of Koehler Aircraft valves and solenoids. The culmination of 13 years experience in building similar products, Koehler oil valves are proving their worth where results count most.

← Koehler K1700B Drain Valve. A fool-proof drain valve developed to save service hours. Available in all sizes. Replaces AN 771



KOEHLER AIRCRAFT PRODUCTS COMPANY  
814 Vermont Ave., Dayton 4, Ohio

Producers of Aircraft (Oil and Fuel) Valves since 1931



→ Koehler's Oil Draincocks—operate freely in all temperatures.

K1610B OIL DRAIN VALVE  
Poppet Principle Weighs Only 6 Oz.





**CONGRESSIONAL COMMITTEES INTERESTED IN AVIATION**  
(Continued)

**Naval Affairs (Continued)**

F. Edward Hébert	(D)	George J. Bates	(R)
John E. Fogarty	(D)	William E. Hess	(R)
Emory H. Price	(D)	Jack Z. Anderson	(R)
William A. Rowan	(D)	James Wolfenden	(R)
Ray J. Madden	(D)	William W. Blackney	(R)
Franck R. Havenner	(D)	Robert A. Grant	(R)
Hugh De Lacy	(D)	Margaret Chase Smith	(R)
Andrew J. Biemiller	(D)	James V. Heidinger	(R)
James W. Mott	(R)	Harry L. Towe	(R)
W. Sterling Cole	(R)		

**Post Offices and Post Roads**

Thomas G. Burch	(D)	Frank L. Chelf	(D)
George D. O'Brien	(D)	Fred A. Hartley, Jr.	(R)
Samuel A. Weiss	(D)	Noah M. Mason	(R)
Charles E. McKenzie	(D)	John C. Butler	(R)
Tom Murray	(D)	William C. Cole	(R)
James H. Torrens	(D)	Harold C. Hagen	(R)
Matthew M. Neely	(D)	William H. Stevenson	(R)
Philip A. Traynor	(D)	Walter E. Brehm	(R)
Edward J. Gardner	(D)	Robert J. Corbett	(R)
Frank T. Starkey	(D)	John W. Heselton	(R)
Ned R. Healy	(D)	Edward J. Elsaesser	(R)
John E. Lyle	(D)	James I. Dolliver	(R)
Dudley G. Roe	(D)		

**U. S. FOREST SERVICE**

**DEPARTMENT OF AGRICULTURE**

Washington, D. C.

Claude R. Wickard, Secretary of Agriculture

Chief of the Forest Service: Lyle F. Watts

Northern Region.....	Headquarters, Missoula, Mont. P. D. Hanson, Regional Forester
Rocky Mountain Region.....	Headquarters, Denver, Colo. John W. Spencer, Regional Forester
Southwestern Region.....	Headquarters, Albuquerque, N. Mex. Frank C. W. Pooler, Regional Forester
Intermountain Region.....	Headquarters, Ogden, Utah Wm. B. Rice, Regional Forester
California Region.....	Headquarters, San Francisco, Calif. S. B. Show, Regional Forester
North Pacific Region.....	Headquarters, Portland, Ore. Horace J. Andrews, Regional Forester
Eastern Region.....	Headquarters, Philadelphia, Pa. R. M. Evans, Regional Forester
Southern Region.....	Headquarters, Atlanta, Ga. Joseph C. Kircher, Regional Forester
North Central Region.....	Headquarters, Milwaukee, Wisc. Jay H. Price, Regional Forester
Alaska Region.....	Headquarters, Juneau, Alaska B. Frank Heintzleman, Regional Forester

**FEDERAL COMMUNICATIONS COMMISSION**

Washington, D. C.

**Commissioners**

Paul A. Porter, Chairman

Paul A. Walker	E. K. Jett
Norman S. Case	Ray C. Wakefield
C. J. Durr	Vacancy

**TODAY IN WARTIME . . .**

**TOMORROW IN PEACETIME**

*Keep an Eye on Eagle Parachute!*

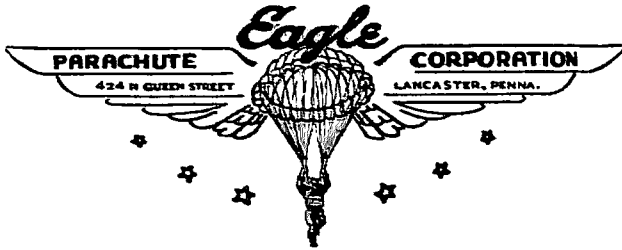
Tens of thousands of Eagle Parachutes have been time-tested by America's armed forces in every theatre of war, under many conditions of stress and strain.

Every Eagle Parachute must be perfect. Our expert craftsmen meet that challenge today. And, perfection is our pledge for

peacetime products tomorrow.

Eagle's "know-how" and precision sewing facilities are now available for the cooperative development of postwar products. Your inquiries are invited.

Watch for the Eagle Wings . . . on related aviation textile products when Victory is won!



# AIRCRAFT RADIO CORPORATION

**DESIGNERS AND MANUFACTURERS  
OF RADIO EQUIPMENT FOR ARMY  
AND NAVY AIRPLANES**

**BOONTON, N. J. » » U. S. A.**

## AERONAUTICAL CHAMBER OF COMMERCE OF AMERICA, INC.

Shoreham Building, Washington 5, D. C.

### Officers

Chairman of the Board, Donald W. Douglas.....	President, Douglas Aircraft Co.
President, E. E. Wilson.....	Vice Chairman, United Aircraft Corp.
Vice President, Lawrence D. Bell.....	President, Bell Aircraft Corp.
Vice President, LaMotte T. Cohu.....	Chairman, Northrop Aircraft
Secretary-Treasurer, Harrison Brand, Jr.....	Aeronautical Chamber of Commerce of America

### Governors

Lawrence D. Bell.....	Bell Aircraft Corp.
E. R. Breech*.....	Bendix Aviation Corp.
Clayton J. Brukner.....	The Waco Aircraft Co.
LaMotte T. Cohu.....	Northrop Aircraft
Donald W. Douglas*.....	Douglas Aircraft Co.
C. L. Egtvedt*.....	Boeing Aircraft Co.
Victor Emanuel.....	The Aviation Corp.
R. E. Gillmor.....	Sperry Gyroscope Co.
Robert E. Gross.....	Lockheed Aircraft Corp.
J. H. Kindelberger.....	North American Aviation
Alfred Marchey*.....	Republic Aviation Corp.
Glenn L. Martin.....	The Glenn L. Martin Co.
T. Claude Ryan.....	Ryan Aeronautical Co.
Guy W. Vaughan.....	Curtiss-Wright Corp.
J. Carlton Ward, Jr.....	Fairchild Engine & Airplane Corp.
E. E. Wilson*.....	United Aircraft Corp.
Harry Woodhead.....	Consolidated Vultee Aircraft Corp.

\* Executive Committee.

### Staff of the Chamber

Chairman, Management Committee and Manager, Personal Aircraft Council.....	John E. P. Morgan
Acting Manager, Personal Aircraft Council.....	Joseph T. Geuting, Jr.
Director, Industrial Relations Research Service.....	R. Randall Irwin
Director, Public Relations Service.....	Bert C. Goss
Director, Readjustment Service.....	John K. Boyle
Director, Research, Statistics & Information Services.....	Rudolf Modley
Director, Technical Service.....	Eugene W. Norris
Director, Traffic Service.....	Harry R. Brashear
Manager, Aircraft Manufacturers Council, West Coast.....	James L. Straight
Manager, Aircraft Manufacturers Council, East Coast.....	Ken Ellington

## THE AMERICAN SOCIETY OF MECHANICAL ENGINEERS

29 West 39th Street, New York 18, N. Y.

President..... Alex. D. Bailey

### Aviation Division

#### Executive Committee:

A. R. Stevenson.....	Chairman
J. E. Younger.....	Secretary
F. K. Teichman.....	Fred Weick
E. S. Thompson.....	

#### Junior Advisors:

Bruce E. DelMar	F. H. Fowler	Martin Goland
-----------------	--------------	---------------

#### General Committee:

L. M. K. Boelter	F. R. Shanley
Timothy E. Colvin	Thomas A. Watson

**"which we are proud to serve"**

At Kropp Forge we are indeed proud of our contribution to the history-making planes named here — super-tough drop forgings for the parts which must withstand the terrific tensional, torsional and compression stresses of flight and combat. In these planes, the strength, toughness and durability of Kropp Forgings have been transformed into greater speeds, longer ranges, heavier loads, higher altitudes and greater maneuverability.

When the number of planes on order necessitated the rapid delivery of "aircraft quality" drop forgings in unprecedented quantities, our large new plant was built for the exclusive production of aviation drop forgings, of which we have furnished "plenty and on time" for America's triumphant air effort.

In the aircraft of the peacetime era, Kropp forgings will help furnish greater staunchness and safety.

Avenger  
 Black Widow  
 Catalina  
 Commando  
 Constellation  
 Coronado  
 Corsair  
 Dauntless  
 Flying Fortress  
 Havoc  
 Hellcat  
 Helldiver  
 Invader  
 Liberator  
 Lightning  
 Marauder  
 Mitchell  
 Mustang  
 Skymaster  
 Skytrain  
 Superfortress  
 Thunderbolt  
 Ventura  
 Warhawk

Member of the A.C.C.A.



Engineering Representatives in Principal Cities

**Kropp Forge Aviation Co.**

*Division of The Kropp Forge Company*  
 5301 W. ROOSEVELT ROAD, CHICAGO (50)

## MANUFACTURERS AIRCRAFT ASSOCIATION, INC.

30 Rockefeller Plaza, New York

### Officers

1945

S. S. Bradley.....	Chairman of the Board
F. H. Russell.....	President
Clayton J. Brukner.....	Vice President
Robert E. Gross.....	Vice President
Joseph T. Hartson.....	Vice President
J. H. Kindelberger.....	Vice President
Raymond S. Pruitt.....	Vice President
John M. Rogers.....	Vice President
Raycroft Walsh.....	Vice President
James P. Murray.....	Secretary
William E. Valk.....	Treasurer
John A. Sanborn.....	Asst. Treas., Asst. Secy., and General Manager

### Directors

S. S. Bradley.....	Chairman of the Board
A. T. Burton.....	North American Aviation, Inc.
Charles H. Chatfield.....	United Aircraft Corporation
Frank N. Fleming.....	Douglas Aircraft Company, Inc.
M. G. Cleary.....	Lockheed Aircraft Corporation
D. W. Farrington.....	The Glenn L. Martin Company
Charles Kingsley.....	Grumman Aircraft Engineering Corporation
James P. Murray.....	Boeing Aircraft Company
R. S. Pruitt.....	Consolidated Vultee Aircraft Corporation
Frank H. Russell.....	President
William E. Valk.....	Curtiss-Wright Corporation
Ray P. Whitman.....	Bell Aircraft Corporation

## AVIATION WRITERS ASSOCIATION

P. O. Box 856, Grand Central Annex, New York 17, N. Y.

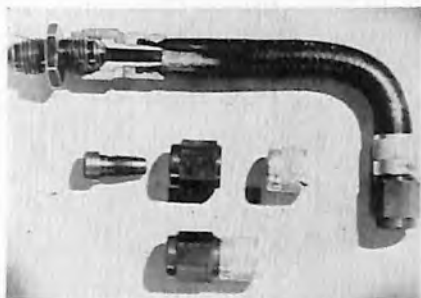
### Officers

President.....	George E. Haddaway
First Vice President.....	Maurice Roddy
Second Vice President.....	Phillip Andrews
Secretary.....	Devon Francis
Treasurer.....	Leslie V. Spencer

### Governors

Lt. Leon W. Shloss, U.S.N.R.—Military
Robert B. Sibley
Area 1: Maine, Vermont, New Hampshire, Massachusetts, Connecticut and Rhode Island.
Russell Newcomb
Area 2: New York State.
Don Rose
Area 3: Pennsylvania, New Jersey and Delaware.
Wayne W. Parrish, Chairman
Area 4: District of Columbia, Maryland, West Virginia and Virginia.
John A. Daly
Area 5: N. Carolina, S. Carolina, Tennessee, Mississippi, Alabama, Georgia and Florida.
Tom Ashley
Area 6: Louisiana, Arkansas, Oklahoma, Texas and New Mexico.
Michael H. Froelich
Area 7: Minnesota, Wisconsin, Iowa and Illinois.
Justin D. Bowersock
Area 8: Missouri, Kansas, Colorado, Nebraska, S. Dakota, N. Dakota and Wyoming.
Lawrence Black
Area 9: California, Arizona, Utah, Nevada, Idaho, Montana, Oregon and Washington.
Arthur H. Rice
Area 10: Michigan, Ohio, Indiana and Kentucky.

# AEROQUIP



## HOSE LINES

—with detachable and reusable fittings (3 pieces—each replaceable) simplify supply problems and save time. Assembly without special tools. Fittings can be removed and reused over 100 times.

## SELF-SEALING COUPLINGS

—allow disconnection of liquid-carrying lines without loss of fluid and reconnection without inclusion of air.



AEROQUIP CORPORATION  
JACKSON, MICHIGAN



A complete line of quality fuels and lubricants for aircraft, automotive, and industrial use.

**GULF OIL CORPORATION**  
General Offices • Pittsburgh, Pa.



## AIRCRAFT WAR PRODUCTION COUNCIL, INC.

7046 Hollywood Blvd., Los Angeles 28, Calif.

## Board of Directors

C. L. Egtvedt*	Boeing Aircraft Company
Harry Woodhead	Consolidated Vultee Aircraft Corporation
Donald W. Douglas	Douglas Aircraft Company, Inc.
Robert E. Gross	Lockheed Aircraft Corporation
J. H. Kindelberger	North American Aviation, Inc.
La Motte T. Cohu	Northrop Aircraft, Inc.
T. Claude Ryan	Ryan Aeronautical Company

William F. Peters.....Manager

\* Succeeded Philip G. Johnson, who died Sept. 14, 1944.

## Committees

## Accounting Committee

H. E. Bowman	Boeing Aircraft Company
L. K. Grant	Consolidated Vultee Aircraft Corporation
R. V. Hunt	Douglas Aircraft Company, Inc.
Dudley E. Browne	Lockheed Aircraft Corporation
R. A. Lambeth	North American Aviation, Inc.
Claude N. Monson	Northrop Aircraft, Inc.
James C. Noakes	Ryan Aeronautical Company

## Engineering Committee

W. E. Beall	Boeing Aircraft Company
Bruce Smith	Consolidated Vultee Aircraft Corporation
A. E. Raymond	Douglas Aircraft Company, Inc.
J. B. Wassall	Lockheed Aircraft Corporation
Gordon Throne	North American Aviation, Inc.
R. A. Dutton	Northrop Aircraft, Inc.
B. T. Salmon	Ryan Aeronautical Company

## Industrial Relations Committee

C. E. French	Boeing Aircraft Company
W. Gerard Tuttle	Consolidated Vultee Aircraft Corporation
D. C. Wilkins, Jr.	Consolidated Vultee Aircraft Corporation
A. C. Galbraith	Douglas Aircraft Company, Inc.
William W. Aulepp	Lockheed Aircraft Corporation
E. D. Starkweather	North American Aviation, Inc.
Graham L. Sterling, Jr.	Northrop Aircraft, Inc.
W. Frank Persons	Ryan Aeronautical Company

## Production Expediting Committee

H. O. West	Boeing Aircraft Company
I. M. Laddon	Consolidated Vultee Aircraft Corporation
F. W. Conant	Douglas Aircraft Company, Inc.
H. E. Ryker	Lockheed Aircraft Corporation
J. S. Smithson	North American Aviation, Inc.
Gage H. Irving	Northrop Aircraft, Inc.
Eddie Molloy	Ryan Aeronautical Company

## Public Relations Committee

Harold Mansfield	Boeing Aircraft Company
Earl A. Hoose, Jr.	Consolidated Vultee Aircraft Corporation
Allen F. Simmons	Consolidated Vultee Aircraft Corporation
A. M. Rochlen	Douglas Aircraft Company, Inc.
Don Black	Douglas Aircraft Company, Inc.
John E. Canaday	Lockheed Aircraft Corporation
Bert Holloway	Lockheed Aircraft Corporation
Leland R. Taylor	North American Aviation, Inc.
P. K. Macker	North American Aviation, Inc.
Dale Armstrong	Northrop Aircraft, Inc.
William Wagner	Ryan Aeronautical Company



**NEW AND RECONDITIONED AIRCRAFT,  
 ENGINES, PROPELLERS, PARTS,  
 ACCESSORIES AND AERONAUTICAL  
 MATERIALS**

*SUPPLIERS AND TECHNICAL CONSULTANTS  
 INSPECTION, APPRAISAL, DOCUMENTATION,  
 FORWARDING AND SHIPPING OF AVIATION  
 EQUIPMENT*

**CHARLES H. BABB CO.**

Grand Central Airport  
 Glendale 1, Calif.

444 Madison Avenue  
 New York 22, N. Y.

*Cables: BABBCO, Los Angeles and New York*

U. S. EXPORT LICENSE NO. 124



**AIRCRAFT WAR PRODUCTION COUNCIL, INC.**  
Committees (Continued)

**Employee Services Section**

J. H. Chandler.....	Boeing Aircraft Company
L. D. Larimer.....	Consolidated Vultee Aircraft Corporation
A. R. Baish.....	Consolidated Vultee Aircraft Corporation
George S. Hunt.....	Douglas Aircraft Company, Inc.
Ray Baur.....	Lockheed Aircraft Corporation
John H. Fry.....	North American Aviation, Inc.
Walter T. Gage.....	Northrop Aircraft, Inc.
E. G. O'Bryan, Jr.....	Ryan Aeronautical Company

**Government Reports Section**

H. O. West.....	Boeing Aircraft Company
William A. Scheyli.....	Consolidated Vultee Aircraft Corporation
W. H. Robinson.....	Consolidated Vultee Aircraft Corporation
Robert A. Hall.....	Douglas Aircraft Company, Inc.
D. M. Leigh-Taylor.....	Douglas Aircraft Company, Inc.
I. A. Crawford.....	Lockheed Aircraft Corporation
M. E. Lanning.....	North American Aviation, Inc.
Gage H. Irving.....	Northrop Aircraft, Inc.
E. C. Harris.....	Northrop Aircraft, Inc.
Charles K. Bongard.....	Northrop Aircraft, Inc.
Felix J. Rossoll.....	Ryan Aeronautical Company

**Materiel Section**

H. O. West.....	Boeing Aircraft Company
E. H. Jones.....	Consolidated Vultee Aircraft Corporation
F. W. Conant.....	Douglas Aircraft Company, Inc.
B. W. deGuichard.....	Lockheed Aircraft Corporation
Rulon Nagely.....	North American Aviation, Inc.
P. I. Chase.....	Northrop Aircraft, Inc.
Walter O. Locke.....	Ryan Aeronautical Company

**Production Statistics (Manpower Utilization) Section**

H. O. West.....	Boeing Aircraft Company
George P. Tidmarsh.....	Consolidated Vultee Aircraft Corporation
Robert A. Hall.....	Douglas Aircraft Company, Inc.
James R. Crawford.....	Lockheed Aircraft Corporation
William F. Snelling.....	North American Aviation, Inc.
Gerald J. Voyer.....	Northrop Aircraft, Inc.
Felix J. Rossoll.....	Ryan Aeronautical Company

**Recruitment Section**

F. D. Weaver.....	Boeing Aircraft Company
H. E. Pasek.....	Consolidated Vultee Aircraft Corporation
C. S. Warner.....	Consolidated Vultee Aircraft Corporation
L. N. Fitts.....	Douglas Aircraft Company, Inc.
M. V. Mattson.....	Lockheed Aircraft Corporation
R. L. Sheward.....	North American Aviation, Inc.
C. D. Freshwater.....	Northrop Aircraft, Inc.
J. F. Saye.....	Ryan Aeronautical Company

**Training Section**

F. D. Weaver.....	Boeing Aircraft Company
T. P. Faulconer.....	Consolidated Vultee Aircraft Corporation
George C. Ford.....	Consolidated Vultee Aircraft Corporation
M. D. Faugh.....	Douglas Aircraft Company, Inc.
C. A. Pederson.....	Lockheed Aircraft Corporation
John A. Peart.....	North American Aviation, Inc.
L. J. Baker.....	Northrop Aircraft, Inc.
L. E. Plummer.....	Ryan Aeronautical Company



## Steel is Off. . . a millionth!

**N**O THIS ISN'T WALL STREET. And that isn't ticker tape the man is reading.

But if the finely finished surface of a Sodium-Cooled Aircraft Valve\* is "off" by only a millionth of an inch, this Surface Analyzer records it on the tape.

The entire Eaton organization is steeped in precision traditions through long association with the exacting requirements of both the aircraft and the automotive industries.

All of Eaton's resources in craftsmanship and engineering—all of Eaton's energies and will-to-produce are de-

voted now to war work in fourteen greatly expanded plants. But the experience gained in making scores of *new* war products—in finding and working with special *new* alloys—in manufacturing for *new* industries—in devising *new* time-saving production methods—will be invaluable when combined with Eaton's habitual standards of precision and applied to peacetime products later on.

# EATON

EATON MANUFACTURING COMPANY  
General Offices: Cleveland, Ohio

PLANTS: CLEVELAND • DETROIT • SAGINAW  
MARSHALL • BATTLE CREEK • VASSAR • MASSILLON

\*Developed by Eaton's Wilcox-Rich Division

**AIRCRAFT WAR PRODUCTION COUNCIL, EAST COAST, INC.**

Room 365, 630 Fifth Avenue, New York 20, New York

Telephone: Circle 6-5640

**Board of Directors**

Victor Emanuel.....	The Aviation Corporation
L. D. Bell.....	Bell Aircraft Corporation
Rex Beisel.....	Chance Vought Aircraft
G. W. Vaughan.....	Curtiss-Wright Corporation
L. C. Goad.....	Eastern Aircraft Div., General Motors Corporation
J. Carlton Ward, Jr.....	Fairchild Engine & Airplane Corporation
Glenn L. Martin.....	The Glenn L. Martin Company
Alfred Marchev.....	Republic Aviation Corporation
Clyde M. Vandeburg.....	General Manager
Harry A. Harter.....	Assistant Manager
Lloyd H. Smith.....	Treasurer
R. Stone.....	Assistant Secretary

**Committees****Advisory Committee on Conservation & Reclamation**

R. H. McKee.....	Bell Aircraft Corporation
A. C. Keiser, Jr.....	Bell Aircraft Corporation
W. Smethurst.....	Chance Vought Aircraft
D. Hamill.....	Curtiss-Wright Corporation
R. S. Sharp.....	Curtiss-Wright Corporation
Earl H. Streeter.....	Eastern Aircraft Div., General Motors Corporation
Harrison E. Rockhill.....	Eastern Aircraft Div., General Motors Corporation
J. W. Buffington.....	Fairchild Engine & Airplane Corporation
Ross B. Hooker.....	The Glenn L. Martin Company
Howell van Gerbig.....	Ranger Aircraft Engines Div., Fairchild Engine & Airplane Corporation
Frank Zinc.....	Republic Aviation Corporation

**Advisory Committee on Engineering**

S. K. Hoffman.....	The Aviation Corporation
Ralph Fawcett.....	Bell Aircraft Corporation
E. R. Ledbetter.....	Bell Aircraft Corporation
P. Baker.....	Chance Vought Aircraft
H. E. McDonald.....	Curtiss-Wright Corporation
Louis H. Enos.....	Curtiss-Wright Corporation—Propeller Div.
Walter F. Burke.....	Eastern Aircraft Div., General Motors Corporation
J. P. D. Garges.....	Eastern Aircraft Div., General Motors Corporation
George W. Lescher.....	Fairchild Engine & Airplane Corporation
Edwin L. Zivi.....	The Glenn L. Martin Company
A. T. Gregory.....	Ranger Aircraft Engines Div., Fairchild Engine & Airplane Corporation
R. L. Bortner.....	Republic Aviation Corporation

**Advisory Committee on Industrial Relations**

C. W. Bishop.....	The Aviation Corporation
Vaughn Bell.....	Bell Aircraft Corporation
J. Q. Dougherty.....	Bell Aircraft Corporation
B. H. Prentice, Jr.....	Bell Aircraft Corporation
G. Anderson.....	Chance Vought Aircraft
E. Lyons.....	Curtiss-Wright Corporation
J. M. Hetherton.....	Curtiss-Wright Corporation—Propeller Div.
R. E. Waldo.....	Eastern Aircraft Div., General Motors Corporation
Samuel A. Angotti.....	Fairchild Engine & Airplane Corporation
D. W. Siemon.....	The Glenn L. Martin Company
H. S. Hall.....	Ranger Aircraft Engines Div., Fairchild Engine & Airplane Corporation
C. J. Hodge.....	Republic Aviation Corporation

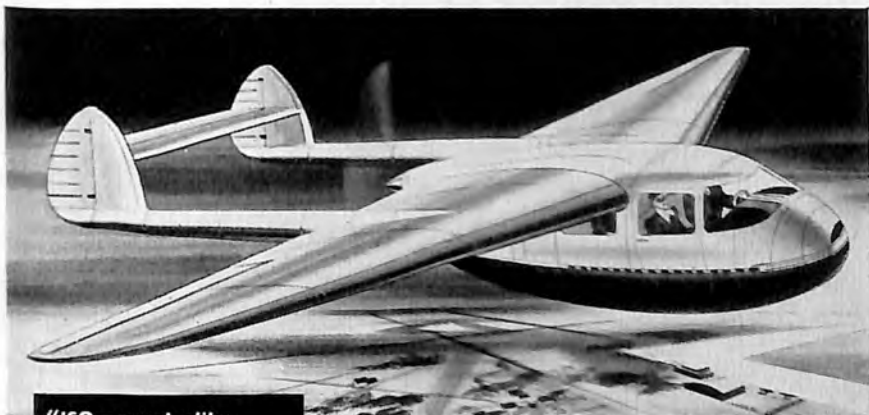


***ISO-REV Constant Speed* PROPELLERS**  
**FOR UNSURPASSED EFFICIENCY**

ISO-REV precision constant-speed governing at any RPM selected during flight, irrespective of power input or air speed, affords take-off at 100% of available horsepower plus optimum aerodynamic propeller efficiency and engine economy under all conditions of flight.

Today our entire energies and resources are devoted to the nation's war effort.

We feel fortunate that our contribution toward victory may also place added enjoyment and utility within reach of the plane owner of tomorrow.



**"ISO—equal, alike,  
 the same, uniform"  
 Webster**

***ISO-REV***

CONSTANT SPEED

*propellers*

AIRCRAFT SPECIALTIES DIVISION

**ZIMMER-THOMSON CORPORATION**

29-05 Review Avenue, Long Island City 1, New York

**AIRCRAFT WAR PRODUCTION COUNCIL, EAST COAST, INC.  
Committees (Continued)**

**Advisory Committee on Material**

D. T. Waltz .....	The Aviation Corporation
R. H. McKee .....	Bell Aircraft Corporation (Buffalo)
T. H. Mitchell .....	Bell Aircraft Corporation (Georgia)
F. W. Lauer .....	Chance Vought Aircraft
Frank A. Maley .....	Curtiss-Wright Corporation, Airplane Div.
W. W. Gleeson .....	Curtiss-Wright Corporation, Propeller Div.
H. I. Clark .....	Eastern Aircraft Div., General Motors Corporation
O. R. Perkins .....	Fairchild Engine & Airplane Corporation
John Thomas Welsh .....	The Glenn L. Martin Company
F. F. Elznic .....	Ranger Aircraft Engines Div., Fairchild Engine & Airplane Corporation
R. H. McMann .....	Republic Aviation Corporation

**Advisory Committee on Plant Defense**

D. H. Russ .....	The Aviation Corporation
John T. Madigan .....	Bell Aircraft Corporation (Buffalo)
B. H. Prentice, Jr. ....	Bell Aircraft Corporation (Georgia)
C. Mahan .....	Chance Vought Aircraft
I. F. LeGore .....	Curtiss-Wright Corporation, Airplane Div.
P. J. Quinn .....	Curtiss-Wright Corporation, Propeller Div.
E. T. Adams .....	Eastern Aircraft Div., General Motors Corporation
John A. White .....	Fairchild Engine & Airplane Corporation
E. A. Schurman .....	The Glenn L. Martin Company
C. M. Burke .....	Ranger Aircraft Engines Div., Fairchild Engine & Airplane Corporation
Arthur J. Kelly .....	Republic Aviation Corporation

**Advisory Committee on Production**

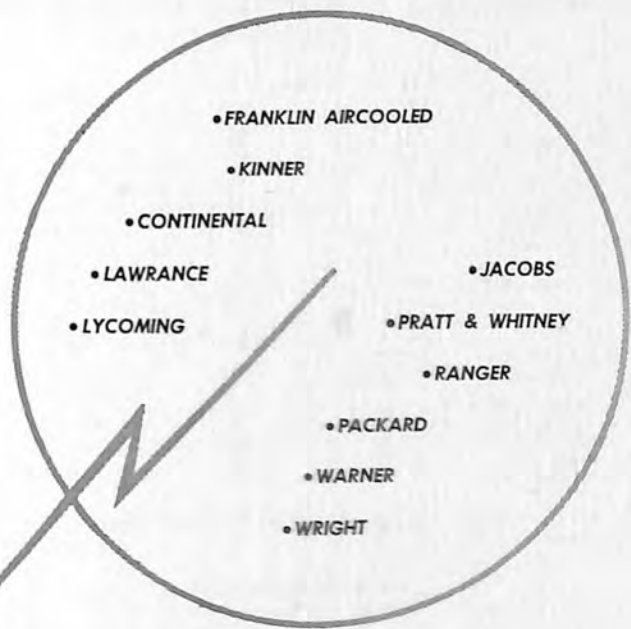
William Davey .....	Bell Aircraft Corporation (Buffalo)
E. J. Engelbert .....	Bell Aircraft Corporation (Georgia)
B. Taliaferro .....	Chance Vought Aircraft
Martin Barbe .....	Curtiss-Wright Corporation, Airplane Div.
George R. Auld .....	Eastern Aircraft Div., General Motors Corporation
J. W. Jones .....	Eastern Aircraft Div., General Motors Corporation
Louis Fahnestock .....	Fairchild Engine & Airplane Corporation
Robert Young .....	The Glenn L. Martin Company
Howell van Gerbig .....	Ranger Aircraft Engines Div., Fairchild Engine & Airplane Corporation
H. E. Lasker .....	Republic Aviation Corporation

**Advisory Committee on Property Accountability**

W. A. Mogensen .....	The Aviation Corporation
R. H. McKee .....	Bell Aircraft Corporation (Buffalo)
W. H. Espey .....	Chance Vought Aircraft
Charles W. Loos .....	Curtiss-Wright Corporation (New York)
W. G. Kileen .....	Eastern Aircraft Div., General Motors Corporation
W. H. Schwebel .....	Fairchild Engine & Airplane Corporation
R. A. Bath .....	The Glenn L. Martin Company
J. V. Miccio .....	Republic Aviation Corporation

**Advisory Committee on Public Relations**

Arthur Foristall .....	The Aviation Corporation
Stephen Fitzgerald .....	Bell Aircraft Corporation (Buffalo)
E. Richard Hawkins .....	Bell Aircraft Corporation (Georgia)
F. Delear .....	Chance Vought Aircraft
Jess W. Sweetser .....	Curtiss-Wright Corporation (New York)
Adrian W. Smith .....	Curtiss-Wright Corporation, Airplane Div.
J. H. O'Connell .....	Curtiss-Wright Corporation, Propeller Div.
J. N. Bird .....	Eastern Aircraft Div., General Motors Corporation
J. E. Lowes, Jr. ....	Fairchild Engine & Airplane Corporation
Avery McBee .....	The Glenn L. Martin Company
Gordon C. Sleeper .....	Republic Aviation Corporation



**SCINTILLA**



**SCINTILLA  
MAGNETO**

*“Sparks” the finest*

Ever since the early days of aviation, the name Scintilla has signified the finest in Aircraft Ignition Equipment.

Today Scintilla as always “sparks the finest” in war and commercial aircraft.

Scintilla Aircraft Magnetos—the leaders in the past—and in the future.



DIVISION OF

**Bendix** AVIATION CORPORATION  
SIDNEY, N. Y.

“BENDIX-SCINTILLA” AND “SCINTILLA” ARE TRADE-MARKS OF BENDIX AVIATION CORPORATION

**AIRCRAFT WAR PRODUCTION COUNCIL, EAST COAST, INC.**  
**Committees (Continued)**

**Advisory Committee on Quality**

A. Andrade	Bell Aircraft Corporation (Georgia)
G. Franko	Chance Vought Aircraft
Louis G. Raiche	Curtiss-Wright Corporation, Airplane Div.
F. C. Fake	Curtiss-Wright Corporation, Propeller Div.
C. C. Aurand	Eastern Aircraft Div., General Motors Corporation
R. H. Seaman	Eastern Aircraft Div., General Motors Corporation
W. A. Shuping	Fairchild Engine & Airplane Corporation
C. G. Stephens	The Glenn L. Martin Company
A. Dysart	Republic Aviation Corporation
Howell van Gerbig	Ranger Aircraft Engines Div., Fairchild Engine & Airplane Corporation

**Advisory Committee on Service**

Barney Cane	The Aviation Corporation
A. L. Fornoff	Bell Aircraft Corporation (Buffalo)
W. H. McCarthy	Chance Vought Aircraft
W. V. Andrews	Curtiss-Wright Corporation, Airplane Div.
F. Brychta	Curtiss-Wright Corporation, Propeller Div.
Allen Wescott	Eastern Aircraft Div., General Motors Corporation
Glen Evins	Fairchild Engine & Airplane Corporation
T. L. Taylor	The Glenn L. Martin Company
Howell van Gerbig	Ranger Aircraft Engines Div., Fairchild Engine & Airplane Corporation
G. J. Scranton	Republic Aviation Corporation

**Advisory Committee on Spare Parts**

Barney C. Cane	The Aviation Corporation
T. G. Haertel	Bell Aircraft Corporation (Buffalo)
E. B. Trout	Chance Vought Aircraft
C. W. Kraus	Curtiss-Wright Corporation, Airplane Div.
Robert B. Taft	Curtiss-Wright Corporation, Propeller Div.
Allen Wescott	Eastern Aircraft Div., General Motors Corporation
F. Kent Bradford	Fairchild Engine & Airplane Corporation
Frederick O. Muller	The Glenn L. Martin Company
Howell van Gerbig	Ranger Aircraft Engines Div., Fairchild Engine & Airplane Corporation
E. W. Kulesh	Republic Aviation Corporation

**The Advisory Committee on Surpluses**

Benjamin M. Smarr	The Aviation Corporation
R. H. McKee	Bell Aircraft Corporation
J. E. Dare	Chance Vought Aircraft
R. J. Lindquist	Curtiss-Wright Corporation
J. Neill	Curtiss-Wright Corporation
F. L. Heuer	Curtiss-Wright Corporation—Propeller Div.
H. L. Clark	Eastern Aircraft Div., General Motors Corporation
J. W. Buffington	Fairchild Engine & Airplane Corporation
W. H. Schwebel	Fairchild Engine & Airplane Corporation
S. S. Bishop	Fairchild Engine & Airplane Corporation
Ross B. Hooker	The Glenn L. Martin Company
Howell van Gerbig	Ranger Aircraft Engines Div., Fairchild Engine & Airplane Corporation
R. H. McMann	Republic Aviation Corporation

**Specialists Panel on Contractor Data**

L. R. Fuller	Bell Aircraft Corporation
Specialists rotating	Chance Vought
J. C. Columbus	Curtiss-Wright Corporation
Donald R. Watson	Eastern Aircraft Div., General Motors Corporation
George W. Lescher	Fairchild Engine & Airplane Corporation
Paul S. Carter	Fairchild Engine & Airplane Corporation
A. L. Varrieur	The Glenn L. Martin Company
W. H. Ehmann	Republic Aviation Corporation
N. T. Mastrangelo	Republic Aviation Corporation



## SURPLUS SALES and FINDING SERVICE

- We serve the aircraft industry as a qualified intermediary, finding materials for buyers, and arranging sales of surplus, either Government or contractor-owned (CPFF or fixed-price contract surpluses).
- Our Master Inventory of surpluses lists over 100,000 items, available for immediate shipment from contractors' overstocks in almost any quantities required.
- Buyers pay no fees for our services, and get quicker deliveries, often at substantial price savings. We are reimbursed by the seller for marketing what he cannot use.
- Sellers pay only a reasonable percentage fee on surplus actually moved through our service; no registration fees or other charges.
- Send your requirements to us.
- List your idle surplus with us.

*Division of*  
**BEECH AIRCRAFT CORP.**  
 701-725 East Central Ave.  
 Wichita 1, Kansas

**MATERIAL  
 DISTRIBUTORS  
 INCORPORATED**



## AIRCRAFT WAR PRODUCTION COUNCIL, EAST COAST, INC. Committees (Continued)

### Plastic Tooling Research Panel

G. W. Beiser.....	Bell Aircraft Corporation
Sherman S. Cross.....	Bell Aircraft Corporation
L. M. Harris.....	Chance Vought Aircraft
E. J. Machemer.....	Curtiss-Wright Corporation
Harold Clark.....	Curtiss-Wright Corporation
R. O. Runnerstrom.....	Curtiss-Wright Corporation
C. E. Rich.....	Curtiss-Wright Corporation
Robert J. Marble.....	Curtiss-Wright Corporation
James A. Massaro.....	Eastern Aircraft Div., General Motors Corporation
G. F. Berndroth.....	Eastern Aircraft Div., General Motors Corporation
H. B. Stowe.....	Eastern Aircraft Div., General Motors Corporation
G. F. Macfarlane.....	Edo Aircraft Corporation
J. F. Barnes.....	Kaiser Cargo, Incorporated
P. M. Wisberger.....	Goodyear Aircraft Corporation
Otto Heckscher.....	Kellett Aircraft Corporation
Melvin K. Young.....	The Glenn L. Martin Company
A. Stevens.....	Oneida, Limited
Hamilton Allen.....	Oneida, Limited
L. Wittman.....	Republic Aviation Corporation
L. Ewen.....	Republic Aviation Corporation

### Specialists Panel on Test and Research

J. S. Limage.....	Bell Aircraft Corporation
S. Smith.....	Bell Aircraft Corporation
A. D. Brown.....	Bell Aircraft Corporation
J. R. Carpenter.....	Bell Aircraft Corporation
E. J. Mailloux.....	Chance Vought Aircraft
E. E. Foster.....	Curtiss-Wright Corporation
A. F. Donovan.....	Curtiss-Wright Corporation
R. Guerke.....	Curtiss-Wright Corporation—Propeller Div.
J. P. D. Garges.....	Eastern Aircraft Div., General Motors Corporation
B. J. Kaganov.....	Eastern Aircraft Div., General Motors Corporation
M. J. Frank.....	Fairchild Engine & Airplane Corporation
G. L. Bryan, Jr.....	The Glenn L. Martin Company
R. C. Bergh.....	Republic Aviation Corporation

## INSTITUTE OF THE AERONAUTICAL SCIENCES

1505 RCA Building, West, 30 Rockefeller Plaza

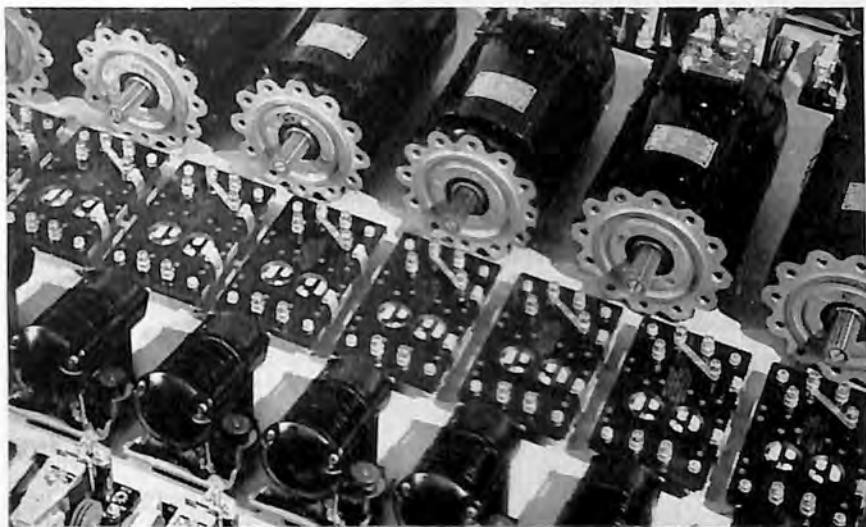
New York 20, New York

### Officers for 1945

President.....	Charles H. Colvin
Vice President.....	W. A. M. Burden
Vice President.....	Leroy R. Grumman
Vice President.....	I. M. Laddon
Executive Vice President.....	Bennett H. Horchler
Treasurer.....	Earl D. Osborn
Chairman of the Council.....	Lester D. Gardner
Assistant to the President.....	George R. Forman
Secretary.....	Robert R. Dexter
Controller.....	Joseph J. Maitan

### Council Members for 1945

P. R. Bassett	William K. Ebel	C. S. Jones
Rex B. Beisel	Sherman M. Fairchild	John C. Leslie
George W. Brady	Charles Froesch	Alfred Marchev
Ralph S. Damon	R. Paul Harrington	Elmer A. Sperry, Jr.



**THE LEECE-NEVILLE COMPANY**

5363 HAMILTON AVENUE • CLEVELAND 14, OHIO • U.S.A.

MANUFACTURERS OF

AIRCRAFT GENERATORS • REGULATORS • RELAYS • PUMP MOTORS



Let Hartzell engineers design the prop for your post-war plane which will add to its performance. Or, if it is wind-tunnel blades or engine test clubs you want send us your specifications.

**HARTZELL  
PROPELLER CO.  
PIQUA, OHIO, U. S. A.**

**Kodak  
Films, Papers,  
Chemicals, and  
Lenses for  
Aerial Photography**



**EASTMAN KODAK COMPANY  
ROCHESTER, N. Y.**

## NATIONAL ASSOCIATION OF STATE AVIATION OFFICIALS

## Officers

President.....	Sheldon B. Steers
First Vice President.....	L. L. Schroeder
Second Vice President.....	Joseph Bergin
Third Vice President.....	Arthur H. Tully, Jr.
Secretary-Treasurer.....	E. W. Stanford

## State Officials

ALABAMA:	E. W. Stanford, Director, Alabama Aviation Commission 711 High Street, Montgomery 5, Ala.
COLORADO:	Clarence L. Ireland, Chairman, State Aeronautical Commission 251 State Capitol, Denver 2, Colo.
CONNECTICUT:	Kenneth H. Ringrose, Acting Commissioner, Department of Aeronautics P. O. Box 537, Hartford, Conn.
GEORGIA:	Cody Laird, Chairman, Aeronautics Advisory Board of Georgia P. O. Box 4116, Atlanta 2, Ga.
IDAHO:	Max C. Sheridan, Assistant Director of Aeronautics, Department of Public Works P. O. Box 879, Room 907, State House, Boise, Idaho
ILLINOIS:	George C. Roberts, Secretary, Illinois Aeronautics Commission 500 E. Capitol Avenue, Springfield, Ill.
IOWA:	Lt. Col. Don C. Johnston, Secretary, Iowa Aeronautics Commission State House, Cedar Rapids, Iowa
KENTUCKY:	Roger E. Schupp, Secretary, Kentucky Aeronautics Commission Administrative Building, Bowman Field, Louisville, Ky.
LOUISIANA:	Robert R. Adams, Chief of Aeronautics, Department of Public Works Baton Rouge, La.
MAINE:	John E. Willey, Chairman, Maine Aeronautics Commission State Airport, Augusta, Me. Adrian A. Cote, Commissioner, Maine Aeronautics Commission State Airport, Augusta, Me.
MARYLAND:	Wm. McK. Reber, Jr., Director, State Aviation Commission 728 Muncey Building, Baltimore 2, Md.
MASSACHUSETTS:	Arthur H. Tully, Jr., Director, Massachusetts Aeronautics Commission Room 805, 100 Nashua Street, Boston 9, Mass.
MICHIGAN:	Sheldon B. Steers, Director, Michigan Board of Aeronautics Capital City Airport, Lansing 2, Mich.
MINNESOTA:	L. L. Schroeder, Commissioner, Department of Aeronautics 2429 University Avenue, St. Paul 4, Minn.
MISSOURI:	Eugene V. Fryhoff, Director, Aviation Division, State Department of Resources & Development State Office Building, Jefferson City, Mo.
NEBRASKA:	S. Paul Kitrell, Secretary, Nebraska Aeronautics Commission Lincoln, Neb.
NEW HAMPSHIRE:	James F. O'Neil, Chairman, New Hampshire Aeronautics Commission State House, Concord, N. H.
NEW JERSEY:	Gill Robb Wilson, Director, New Jersey Department of Aviation Trenton, N. J.
OHIO:	Roger A. Valentine, Secretary, Ohio State Bureau of Aeronautics 501 Wyandotte Building, Columbus, O.
OREGON:	Major Leo G. Devaney, Director, Oregon State Board of Aeronautics 507 Lumbermen's Building, Portland, Ore.
PENNSYLVANIA:	Wm. L. Anderson, Director, Pennsylvania Aeronautics Commission, Department of Commerce Harrisburg Airport, New Cumberland, Pa.
RHODE ISLAND:	Daniel J. Ryan, Director of Public Works, Division of Aeronautics Room 200, State Office Building, Providence 3, R. I.
SOUTH CAROLINA:	Dexter C. Martin, Director, South Carolina Aeronautics Commission Columbia, S. C.
SOUTH DAKOTA:	Major John Moody, Executive Secretary, South Dakota Aeronautics Commission Pierre, S. D.

# 250,000

*Life saving*

## PARACHUTES

... is a record of which we are proud. This leadership in producing 250,000 parachutes is the background for post-war commercial aviation needs.

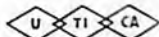
New educational air-safety film available for colleges—training schools—high schools.

ALSO write for the informative Switlik Parachute Chart and new manual. All free, of course.



**SWITLIK PARACHUTE COMPANY**  
DEPT. AY-5, TRENTON 7, NEW JERSEY

FOR MORE TOOL MILEAGE



## Utica Tools

The demands of the times for highest operating efficiency are met by UTICA Pliers and Adjustable Wrenches.

**UTICA DROP FORGE & TOOL CORPORATION**  
UTICA, NEW YORK

School of Aeronautics

## STEWART TECHNICAL SCHOOL

Stewart Bldg., 253-7 W. 64 St., N.Y. 23  
"A" AND "E" MECHANIC COURSES  
AERONAUTICAL DRAFTING COURSE

\* Approved by the  
CIVIL AERONAUTICS ADMINISTRATION  
as an  
AIRCRAFT and AIRCRAFT ENGINE MECHANIC SCHOOL  
also as an  
AIRCRAFT REPAIR STATION  
Chartered by  
THE REGENTS OF THE UNIVERSITY OF THE STATE OF NEW YORK

Founded 1909—In Aeronautics since 1929

Approved by the  
U. S. DEPT. OF LABOR

Foreign students may apply to an American Consul for admission into the United States for the purpose of attending this School as non-quota immigrants without regard to the quota of their country of birth.

Write for illustrated catalog—YB

**NATIONAL ASSOCIATION OF STATE AVIATION OFFICIALS  
(Continued)**

<b>TENNESSEE:</b>	Herbert Fox, Executive Director, Tennessee Bureau of Aeronautics Berry Field, Nashville, Tenn.
<b>UTAH:</b>	Joseph Bergin, Director, Utah State Aeronautics Commission 439 Capitol Building, Salt Lake City 3, Utah
<b>VERMONT:</b>	Edw. F. Kuapp, Aeronautics Inspector-Examiner, Vermont Aero- nautics Board State House, Montpelier, Vt.
<b>VIRGINIA:</b>	Lt. Col. Allen Perkinson, Director, Virginia State Corporation Com- mission 907 Travelers Building, Richmond 19, Va.
<b>WEST VIRGINIA:</b>	Hubert A. Stark, Administrative Officer, W. Va. Board of Aeronautics 201 Atlas Building, Charleston 1, W. Va. Ernest L. Bailey, Chairman, W. Va. Board of Aeronautics 257 Capitol Building, Charleston 5, W. Va.
<b>WYOMING:</b>	Wilfred O'Leary, Aeronautical Commissioner, Wyoming Department of Aviation Majestic Building, Cheyenne, Wyo.

**AIR TRANSPORT ASSOCIATION OF AMERICA**

1515 Massachusetts Ave., N. W.

Washington 5, D. C.

Phone: Executive 2920

**Officers**

President.....	Edgar S. Gorrell
Vice President.....	J. W. Miller
Secretary.....	M. F. Redfern
Treasurer.....	J. F. Hintersehr

**Directors**

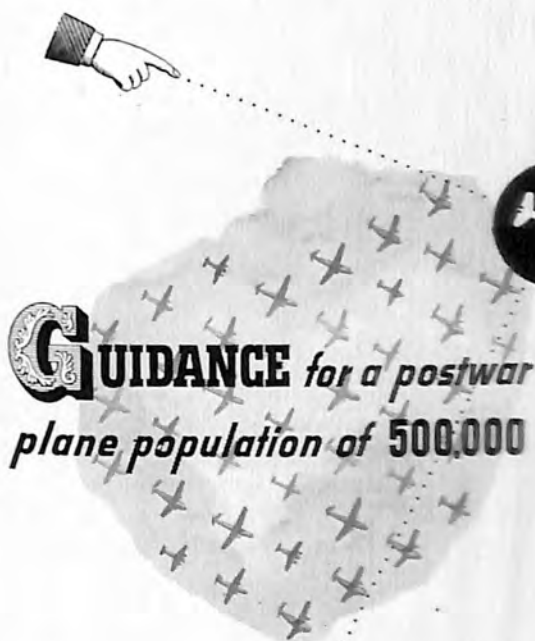
T. E. Braniff	Jack Frye	O. M. Mosier
Paul F. Collins	Croil Hunter	E. V. Rickenbacker
	C. Bedell Monro	

**Staff**

Executive Assistant to the President.....	S. G. Tipton
Executive Secretary, Air Traffic Conference of America.....	M. F. Redfern
Director of Tariff.....	C. C. Hubbard
Executive Secretary, Finance and Accounting Conference.....	E. F. Kelly
Legal Department.....	D. W. Markham
State Relations.....	Harold Meixell
Federal Relations.....	Mrs. Winifred Crosby
Information.....	W. T. Raymond
Military Priority Liaison.....	F. Macklin
Economic Research and Planning.....	Dr. L. C. Sorrell
Rate Bases and Related Matters.....	Dr. H. V. Hobbah
Engineering and Maintenance.....	A. W. Dallas
Operations, Meteorology, Airports.....	John Groves
Air Cargo, Express, Mail.....	Emory Johnson
Director of Press.....	Perley Boone
Library and Statistics.....	George McCann
Labor Relations.....	E. M. Fitch

**AIRCRAFT OWNERS AND PILOTS ASSOCIATION**

National Service Office.....	Carpenters Building, Washington, D. C.
President.....	C. Townsend Ludington
Vice President.....	Philip T. Sharples
Secretary.....	Alfred L. Wolf
Treasurer.....	Laurence P. Sharples



**G**UIDANCE for a postwar  
plane population of 500,000

Outstanding aviation authorities foresee the time—only five or six years away—when the United States will have a private plane population of approximately half a million! And these planes will be cruising through skies already crisscrossed by the airways of commercial fleets. Expanded or newly-devised methods of control will be an obvious necessity.

Whatever the method of control, it is apparent that radio and radar must serve as the basic tools for implementing this control. Belmont Radio will be ready and able to supply this vital need of private and commercial aviation in the postwar years. For it is the radio and radar equipment manufactured by Belmont upon which thousands of Army and Navy airmen now put their reliance.

Belmont means to devote its extensive laboratory facilities and its great skill in the engineering and manufacture of aircraft radio and radar equipment to the peacetime benefit of American aviation. *Keep your eyes on Belmont!* Belmont Radio Corp., 5947 W. Dickens Ave., Chicago 39, Ill.

**Belmont Radio**

RADAR \* TELEVISION \* FM \* ELECTRONICS

## SOCIETY OF AUTOMOTIVE ENGINEERS, INC.

29 West 39th St., New York 18, New York

### Officers for 1945

President.....	James M. Crawford
Vice President (Rep. Aircraft Engrg.).....	J. L. Atwood
Vice President (Rep. Aircraft-Engine Engrg.).....	R. W. Young
Vice President (Rep. Air Transport Engrg.).....	William Littlewood
Secretary and General Manager.....	John A. C. Warner
Manager of Aeronautical Department.....	J. D. Redding

### The Council

W. A. Parrish, Vice President	L. R. Buckendale, Councilor
M. O. Teetor, Vice President	R. F. Steeneck, Councilor
A. G. Herreshoff, Vice President	H. T. Youngren, Councilor
W. T. Fishleigh, Vice President	J. C. Armer, Councilor
L. V. Cram, Vice President	F. C. Patton, Councilor
W. F. Strehlow, Vice President	R. J. S. Pigott, Councilor
E. P. Gohn, Vice President	B. B. Bachman, Treasurer
H. A. Flogaus, Vice President	Mac Short, Past President (1943)
W. S. James, Past President (1944)	

### Aeronautic Committees

Aircraft Activity Committee.....	J. L. Atwood, Chairman
Aircraft-Engine Activity Committee.....	R. W. Young, Chairman
Air Transport Activity Committee.....	William Littlewood, Chairman
Standards Committee	
Aeronautics Division.....	Arthur Nutt, Chairman
Aircraft-Engine Subdivision.....	C. E. Mines, Chairman
Aircraft Access. & Equip. Subdivision.....	William Littlewood, Chairman
Aircraft Propeller Subdivision.....	Erle Martin, Chairman
Special Aircraft Projects Subdivision.....	Peter F. Rossmann, Chairman
Aircraft Materials & Processes Coordinating Subdivision.....	J. B. Johnson, Chairman
Aircraft-Engine Materials & Processes Committee.....	B. Clements, Chairman
Airframes Materials & Processes Committee.....	L. D. Bonham, Chairman
Aircraft Accessory Materials & Processes Committee.....	A. W. F. Green, Chairman

## NATIONAL AERONAUTIC ASSOCIATION OF U. S. A., INC.

(Founded 1922)

1025 Connecticut Avenue, Washington 6, D. C.

United States Representative of Federation Aeronautique Internationale  
Governing Body for Sporting Aviation in the United States

### Officers

President.....	William R. Enyart
Vice President.....	Harry K. Coffey
Vice President.....	Glenn B. Eastburn
Vice President.....	James R. Graham
Treasurer.....	William P. Redding
Secretary.....	Richard C. Palmer
General Counsel.....	William P. MacCracken, Jr.
Manager.....	Lowell H. Swenson

### Board of Directors

J. Lee Barrett	Roger Wolfe Kahn	C. C. Thompson
Harry A. Bruno	Wesley E. Keller	Roscoe Turner
Raymond E. Buck	George B. Logan	Stanley T. Wallbank
Dudley H. Dorr	W. Percy McDonald	O. S. Warden
Stanley C. Draper	Rudy C. Mueller	J. Howard Wilcox
Arthur S. Dudley	Wayne W. Parrish	Gill Robb Wilson
Carl Hinton	Sheldon B. Steers	
John H. Jouett	William B. Stout	



WHEN IN CLEVELAND

*Visit the* **Thompson Products**  
**AUTO ALBUM and**  
**AVIATION MUSEUM**

Chester & E. 30th St., Cleveland, O.



OPEN DAILY — ADMISSION FREE



Afternoons, including Saturday and Sunday, 1:00 to 5:00  
 Evenings, Mondays, Wednesdays, Fridays, 7:00 to 10:00



“SPEND AN HOUR IN YESTERDAY”

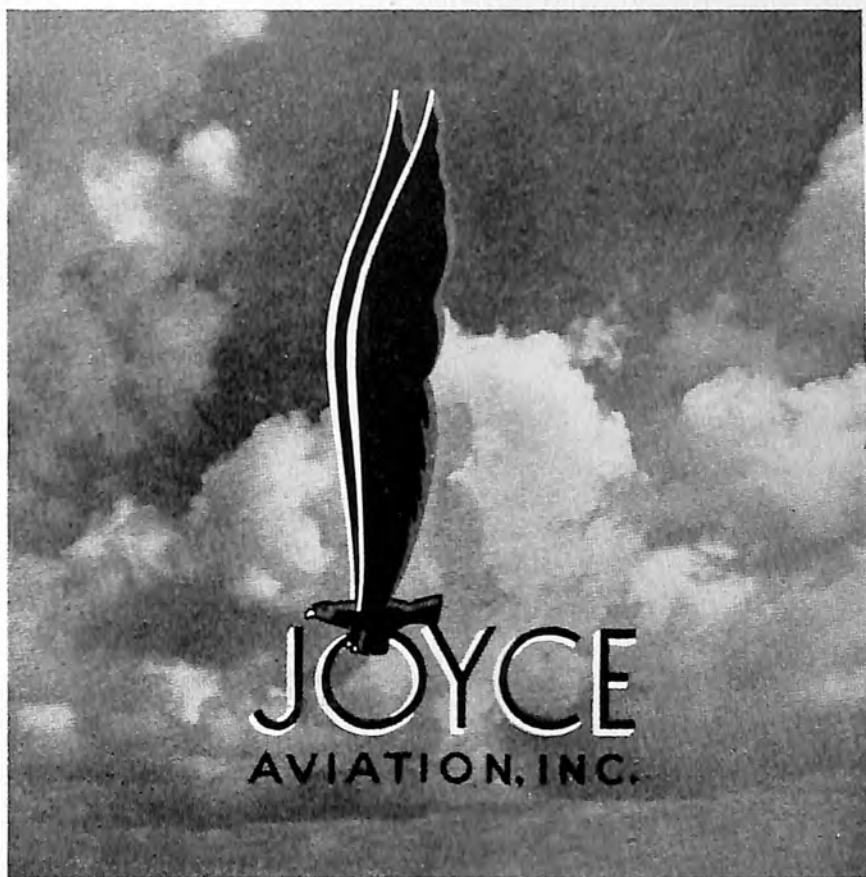
**Thompson Products, Inc.**  
 Cleveland, Ohio





## AERONAUTICAL PERIODICALS OF THE UNITED STATES

AERO DIGEST	515 Madison Avenue, New York, N. Y.
AERONAUTICAL REVIEW	30 Rockefeller Plaza, New York, N. Y.
AIR FACTS	30 Rockefeller Plaza, New York, N. Y.
AIR LAW REVIEW	Washington Square East, New York, N. Y.
AIR LINE MECHANIC	6240 S. Kedzie Avenue, Chicago, Ill.
AIR LINE PILOT	3145 W. 63rd Street, Chicago, Ill.
AIR NEWS	545 Fifth Avenue, New York, N. Y.
AIR TECH	545 Fifth Avenue, New York, N. Y.
AIR TRAILS	79 Seventh Avenue, New York, N. Y.
AIR TRANSPORT	330 W. 42nd Street, New York, N. Y.
AIRCRAFT YEAR BOOK (ANNUAL)	10 Rockefeller Plaza, New York, N. Y.
AIRLANES	304 West 57th Street, New York, N. Y.
AIRPORT REFERENCE	304 S. Broadway, Los Angeles, Calif.
AMERICAN AVIATION	1317 F Street N. W., Washington, D. C.
AMERICAN AVIATION DAILY	1317 F Street N. W., Washington, D. C.
AUTOMOTIVE AND AVIATION INDUSTRIES	Chestnut and 56th Street, Philadelphia, Pa.
AVIATION	330 W. 42nd Street, New York, N. Y.
AVIATION EQUIPMENT	1170 Broadway, New York, N. Y.
AVIATION NEWS	330 W. 42nd Street, New York, N. Y.
FLYING	540 N. Michigan Avenue, Chicago, Ill.
FLYING ACES	29 Worthington Street, Springfield, Mass.
JOURNAL OF AIR LAW	357 E. Chicago Avenue, Chicago, Ill.
JOURNAL OF THE AERONAUTICAL SCIENCES	30 Rockefeller Plaza, New York, N. Y.
MODEL AIRPLANE NEWS	551 Fifth Avenue, New York, N. Y.
NATIONAL AERONAUTICS	1025 Connecticut Avenue, Washington, D. C.
OFFICIAL AVIATION GUIDE	608 S. Dearborn Street, Chicago, Ill.
SKYWAYS	444 Madison Avenue, New York, N. Y.
SOUTHERN FLIGHT	1901 McKinney Avenue, Dallas, Tex.
SPORTSMAN PILOT	515 Madison Avenue, New York, N. Y.
U. S. AIR SERVICES	Transportation Building, Washington, D. C.
WESTERN FLYING	304 S. Broadway, Los Angeles, Calif.



AN ESTABLISHED NAME IN TODAY'S SKIES  
WITH A REPUTATION YEARS OLD

AIRCHOX COMPANY  
Division of

**JOYCE** *Aviation, INC.*

GENERAL OFFICES, 8 SO. MICHIGAN AVE., CHICAGO 3

Parachute Hardware, Release Mechanisms, Collapsible Wheel Chocks, Exact Airspeed Computers, Mooring Anchor Kits, Tow Targets for Aerial and Anti-aircraft Gunnery, Shoulder Safety Belts.

# SCHEDULED AIR CARRIERS OPERATING IN OR FROM CONTINENTAL UNITED STATES AND UNITED STATES TERRITORIES

**ALL AMERICAN AVIATION, INC.,**  
210 Greenhill Ave., Wilmington 99, Del.

**AMERICAN AIRLINES, INC.,**  
100 E. 42nd St., New York 17, N. Y.

**PERSONNEL:** A. N. Kemp, Pres.; R. S. Damon, V. Pres. & Gen. Mgr.; C. A. Rheinstrom, V. Pres.-Traffic; H. L. Smith, V. Pres.-Operations; W. Littlewood, V. Pres.-Engrg.; C. W. Jacob, Secy.; H. K. Rulison, Treas.; T. J. Deegan, Public Information Dir.; C. A. Stevens, Jr., Adv. Mgr.; O. H. Hamm, Pur. Agt.; V. Vernon, Pers. Dir.

**AMERICAN EXPORT AIRLINES, INC.,**  
25 Broadway, New York 4, N. Y.

**PERSONNEL:** W. H. Coverdale, Pres.; J. E. Slater, Exec. V. Pres.; T. Burke, J. M. Eaton, V. Pres.; D. G. Richardson, V. Pres.-Operations; H. M. Gillespie, Secy. & Treas.; A. S. Graham, Pub. Rel. Dir.; C. H. Case, Pur. Agt.; D. W. Holmes, Pers. Dir.; W. S. Green, Mgr., Passenger-Cargo Dept.; B. Bergesen, Flight Operations Supt.; J. Y. Craig, Chief Pilot; P. Mitchell, Maintenance Supt.; W. A. Schrader, Communications Supt.; L. Brown European Dir.; W. Muller, Mgr., Passenger Dept.; A. F. Cofod, Jr., Mgr., Cargo Dept.; C. D. Leslie, Auditor.

**BRANIFF AIRWAYS, INC.,**  
Love Field, Dallas, Tex.

**PERSONNEL:** T. E. Braniff, Pres.; S. J. Ingram, Asst. to Pres.; C. E. Beard, V. Pres.-Traffic; R. C. Shrader, V. Pres.-Operations; T. Walsh, Exec. Asst. to V. Pres.-Operations; C. G. Adams, Secy. & Treas.; H. C. Thurman, Gen. Counsel; W. M. Henshel, Public & Information Dir.; P. D. Niles, Traffic Exec.; H. McGee, Pur. Agt.; J. M. Harrison, Pers. Dir.; C. G. Johnson, Maintenance Supt.; R. V. Carlton, Chief Pilot; H. B. Moore, Research Dir.; J. E. Cook, Gen. Traffic Mgr.; J. Brough, Operations Supt.

**CHICAGO & SOUTHERN AIR LINES, INC.,**  
Municipal Airport, Memphis 2, Tenn.

**PERSONNEL:** C. Putnam, Pres.; F. W. Wildman, Asst. to Pres.; B. E. Braun, V. Pres.-Operations; H. R. Bolander, Jr., Secy. & Gen. Counsel; W. J. Byrne, Treas.; R. L. Heining, Gen. Traffic Mgr.; W. L. Scott, Supt. of Reservations & Procedures; E. Ostheimer, Mgr., Schedules, Tariffs & Statistics; J. A. Young, Asst. Mgr., Operations; R. Knight, Supt. of Flying; L. D. Anderson, Chief Pilot; T. D.

Brooks, Maintenance Supt.; R. R. Davalos, Coordinator of Maintenance; C. Petterson, Supt. Building & Ground Maintenance; W. G. Gabehart, Supt. of Stations; J. Russell, Supervisor of Stewardesses; R. L. Anderson, Engrg. Supt.; R. H. Moore, Chief Flight Supt.; F. J. Leone, Chief Meteorologist; R. H. Schwank, Pur. Dir.; G. L. Fox, Supt. of Stores; R. T. Crutchfield, Pers. Dir.; G. E. Bounds, Adv. & Pub. Dir.; P. Wadlington, Communications Dir.; T. M. Miller, Staff Statistician; R. S. Maurer, Asst. to Gen. Counsel; M. Williams, Dir., Printing & Procedures; H. F. Hershey, Supt. of Flight & Ground Training; W. C. Burks, Mgr., Mail & Cargo Traffic; J. H. Quinn, Chief Accountant.

**COLONIAL AIRLINES, INC.,**  
New York Municipal Airport, Jackson Heights, N. Y.

**CONTINENTAL AIR LINES, INC.,**  
Municipal Air Terminal, Denver 7, Colo.

**DELTA AIR LINES, Atlanta Municipal Airport, Atlanta, Ga.**

**PERSONNEL:** C. E. Faulk, Pres.; C. E. Woolman, V. Pres. & Gen. Mgr.; C. H. McHenry, Secy.; T. Oliver, Treas.; R. S. Webber, Traffic Mgr.; J. H. Cobb, Jr., Pub. Rel. Dir., Adv. Mgr. & Pers. Dir.; H. D. Wigley, Pur. Agt.; G. R. Cushing, Operations Mgr.; L. B. Judd, Compt.; G. J. Dye, Supt. of Maintenance; E. M. Johnson, Dir. of Planning & Research.

**EASTERN AIR LINES, INC.,**  
10 Rockefeller Plaza, New York, N. Y.

**PERSONNEL:** E. V. Rickenbacker, Pres. & Gen. Mgr.; P. H. Brattain, First V. Pres.; S. L. Shannon, V. Pres.; T. F. Armstrong, Secy. & Treas.; B. H. Griffith, Pub. Rel. Dir.; J. H. Brock, Pur. Agt.; W. C. Gilbert, Pers. Dir.; W. Sternberg, Gen. Traffic Mgr.; C. Froesch, Chief Engr.; H. Knowlton, Dir. of Research & Planning.

**HAWAIIAN AIRLINES, LTD.,**  
Honolulu, Hawaii, U.S.A.

**PERSONNEL:** S. C. Kennedy, Pres. & Gen. Mgr.; M. B. Carson, V. Pres.; A. Smith, Secy. & Pers. Dir.; H. S. Turner, Treas.; M. W. Mitchel, Traffic Mgr.; E. M. Welty, Pub. Rel. Dir. & Adv. Mgr.; W. B. Morrisson, Pur. Agt.; O. Hill, Communications Mgr.; R. Campbell, Maintenance Mgr.; B. Hogg, Chief Pilot; C. I. Elliott, Operations Mgr.; O. McCraw, Stations Mgr.

**INLAND AIR LINES, INC.,**  
P. O. Box 1811, Casper, Wyo.



*Yours* **FOR BETTER ENGINE PERFORMANCE**

The accurate measure of aircraft spark plugs is their ability to yield better performance, greater dependability and longer life. Champion-Ceramic Aircraft Spark Plugs have compiled an unequalled record and are continuing to fill an unremitting demand from our air forces, air line operators, and private pilots. All Champion-Ceramic Aircraft Spark Plugs are products of the same materials, design and workmanship and, accordingly, provide that extra measure of performance, dependability and long life *in every aircraft engine* that has made them first choice for military, commercial and private planes. Use Champions and fly with confidence. Champion Spark Plug Company, Toledo 1, Ohio.



C26—Unshielded



DEPENDABLE  
**CHAMPION** SPARK  
PLUGS  
FOR EVERY AIRCRAFT ENGINE



C34S—Shielded



**K.L.M. ROYAL DUTCH AIRLINES,**  
16 Old Bond St., London W. 1, England  
PERSONNEL: H. Nieuwenhuis, P.J.C. Vos,  
Managing Directors.  
521 Fifth Ave., New York 17, N. Y.  
L. F. Bowman, Representative.  
7046 Hollywood Blvd., Hollywood 28, Calif.  
J. P. de Bree, Technical Representative.  
Willemstad, Curacao, N.W.I.  
D. A. Ijsselstijn, Gen. Mgr.

**MID-CONTINENT AIRLINES, INC.,**  
102 E. Ninth St., Kansas City 6, Mo.  
PERSONNEL: J. W. Miller, Pres.; W. R. Moreland, Asst. to Pres.; J. C. Collins, V. Pres. & Secy.; J. A. Cunningham, V. Pres.-Operations; H. W. Coburn, Gen. Traffic Mgr.; C. A. Wicks, Treas. & Asst. Secy.; N. W. Barker, Pur. Agt.; C. H. Calhoun, Supt. of Maintenance; D. DeVault, Supt. of Communications; F. N. Buttimer, Dir. of Research.

**NATIONAL AIRLINES, INC.,**  
Municipal Airport, Jacksonville, Fla.  
PERSONNEL: G. T. Baker, Pres.; J. C. Brawner, Asst. to Pres.; H. S. Parker, Jr., V. Pres.; E. J. Kershaw, V. Pres.-Operations; R. Foreman, Secy.; A. MacDonald, Treas.; D. G. Bash, Dir. of Research & Development; M. Bryan, Dir. of Public Information & Adv. Mgr.; L. Daenba, Pur. Agt.

**NORTHEAST AIRLINES, INC.,**  
Commonwealth Airport, Boston 28,  
Mass.

**NORTHWEST AIRLINES, INC.,**  
1885 University Ave., St. Paul 4, Minn.  
PERSONNEL: C. Hunter, Pres. & Gen. Mgr.; W. F. Marshall, Exec. Asst. to Pres.; L. C. Glotzbach, Asst. to Pres.; R. O. Bullwinkel, Asst. to Pres.-Traffic; E. I. Whyatt, V. Pres. & Treas.; K. R. Ferguson, V. Pres.-Operations; A. E. Floan, Secy. & Gen. Counsel; L. S. Holstad, Asst. Treas.; C. L. Stein, Asst. Secy. & Dir. of Stewardesses; E. W. Yoris, Dir. of Internal Security; K. E. Gouedy, Mgr., Contract Termination; H. C. Timberlake, Economist; J. A. Ferris, Pub. Dir.; R. L. Smith, Operations Mgr.; R. E. Geror, Mgr., Mechanical Div.; C. E. Swanson, Mgr. of Engrg. & Communications; J. E. Ohrbeck, Supt. of Operations-Eastern Region; F. C. Judd, Supt. of Operations-Western Region; M. B. House, Controller; J. D. Vars, Pur. Agt.; J. M. Cook, Adv. Mgr.; S. Wyman, Chief Clerk Traffic; J. A. Urbanski, Asst. Pers. Dir.; M. E. Leadon, Gen. Supt. of Aircraft Maintenance; L. E. Koerner, Supt. of Overhaul; L. I. Belden, System Chief Pilot; D. C. Evans, Supt. of Stations-Eastern Region; A. T. Petersen, Supt. of Stations-Western Region; R. O. Daniel, Chief Pilot & Check Pilot-Western Region; F. R. Erickson, Mgr., Mail & Express; A. G. Kinsman, Western Traffic Mgr.; D. C. Vaile, Asst. to Western Traffic Mgr.; C. A. Boilod, Regional Traffic Mgr.-New York; K. Boddé, Asst. Dist. Traffic Mgr.-New York.

**PAN AMERICAN-GRACE AIRWAYS, INC.,**  
135 E. 42nd St., New York 17, N. Y.  
PERSONNEL: H. J. Roig, Pres.; G. Vidal, V. Pres. & Compt.; D. Campbell, R. H. Patchin, H. B. Dean, V. Pres.; J. S. Woodbridge, Treas.; W. F. Cogswell, Secy.; H. P. Morris, Asst. Secy.; C. de Groot, Gen. Traffic Mgr.; W. F. Lewis, Chief Accountant; T. M. Dunn, Technical Mgr.; D. J. Shea, Pers. Dir.

**Lima, Peru**  
PERSONNEL: T. J. Kirkland, J. T. Shannon, V. Pres.; R. W. Sylvester, Traffic Mgr.; H. A. Harris, Pub. Rel. & Adv. Mgr.; C. R. Disher, Operations Mgr.; B. H. Young, Maintenance Mgr.; V. M. LaPierre, Communications Mgr.;

R. Drake, Chief Accountant; F. E. Nelson, Chief Pilot; J. T. Scholtz, Chief Meteorologist; W. D. Peck, Dir. of Technical Planning & Projects; H. E. Benham, Dir. of Training Program; A. Hurtado, Medical Consultant; A. F. Surre, Chief Airport Engr.

**PAN AMERICAN WORLD AIRWAYS,**  
135 E. 42nd St., New York, N. Y.  
PERSONNEL: J. T. Trippe, Pres.; J. C. Cooper, S. F. Pryor, V. Pres. & Assts. to Pres.; J. C. Roop, V. Pres. & Treas.; F. Gledhill, V. Pres. & Pur. Agt.; A. A. Priester, V. Pres. & Chief Engr.; V. E. Chenea, V. Pres. & Traffic Mgr.; G. L. Rihl, E. E. Young, H. M. Bixby, H. B. Dean, V. Pres.; W. Morrison, V. Pres.-Latin American Div.; A. Archibald, Asst. V. Pres. & Asst. Secy.; J. H. Johnston, J. C. Cone, W. J. McEvoy, Asst. V. Pres.; H. P. Morris, Secy. & Gen. Atty.; W. Van Dusen, Pub. Rel. Dir.; K. Gunter, Adv. Dir.; H. C. Leuteritz, Chief Communications Engr.

**PENNSYLVANIA CENTRAL AIRLINES,**  
National Airport, Washington, D. C.  
PERSONNEL: C. B. Monro, Pres.; J. J. O'Donovan, J. H. Carmichael, R. Wilson, V. Pres.; H. Dever, Secy.; R. G. Lochiel, Treas.; E. Sullivan, Sales Mgr.; J. R. Bell, Pub. Rel. Dir. & Adv. Mgr.; J. Kurtz, Pur. Agt.; J. Rinker, Pers. Dir.; R. W. Manchester, Supt. of Operations; R. O. Smith, Maintenance Mgr.; L. G. Lederer, Medical Mgr.; B. J. Vierling, Chief Engr.; A. Brooks, Chief Pilot; T. Hardesty, Chief Ground Operations; K. Hartman, Chief Hostess.

**TRANSCONTINENTAL & WESTERN AIR,**  
INC.,  
101 W. 11th St., Kansas City, Mo.  
PERSONNEL: T. B. Wilson, Ch. of Board; J. Frye, Pres.; E. L. Talman, Exec. V. Pres.; J. A. Collings, V. Pres.-Transportation; J. C. Franklin, V. Pres.-Engrg. & Maintenance; O. F. Bryan, V. Pres.-War Projects; C. E. Fleming, J. Nichols, V. Pres.; A. M. Jens, Acting Secy.; J. B. Thurston, Acting Treas.; E. O. Cocke, Gen. Traffic Mgr.; C. S. Fullerton, Dir. Passenger Sales; R. E. Whitmer, Dir. Cargo Sales; L. Baron, Dir. News Bureau; J. C. DeLong, Adv. Dir.; F. B. Eisenberg, Dir. Pur. & Stores; R. C. Oberdahn, Ind. Rel. Dir.

**UNITED AIR LINES, INC.,**  
5959 S. Cicero Ave., Chicago 38, Ill.  
PERSONNEL: W. A. Patterson, Pres.; H. Cray, V. Pres.-Traffic; J. A. Herlighy, V. Pres.-Operations; C. C. Thompson, V. Pres.-Pub. Rel.; P. M. Wilcox, V. Pres.-Administrative; J. W. Newey, V. Pres.-Finance; S. V. Hall, R. L. Dobie, Regional V. Pres.-Operations; S. P. Martin, Secy.; N. B. Haley, Treas.; C. Barkes, Compt.; C. H. Blanchar, Auditor; B. B. Gragg, Sales Dir.; E. A. Raven, Asst. Dir. Adv.; R. M. Rummel, Asst. Pub. Dir.; R. K. Moore, Pur. Agt.; R. F. Ahrens, Pers. Dir.; W. Mentzer, Mgr., Engrg.; C. P. Graddick, Mgr., Air Cargo; D. F. Magarrell, Passenger Service; E. P. Lott, Mgr., Design, Bldgs. & Airports.

**WESTERN AIR LINES, INC.,**  
6331 Hollywood Blvd., Los Angeles 28,  
Calif.  
PERSONNEL: W. A. Coulter, Pres.; L. H. Dwerlkotte, Exec. V. Pres. & Gen. Mgr.; T. Wolfe, V. Pres.-Traffic; C. N. James, V. Pres.-Operations; P. Sullivan, Secy. & Treas.; M. Winters, Pub. Rel. Dir.; T. W. Cate, Adv. Mgr.; D. M. Pattison, Pur. Agt.; E. H. Brown, Pers. Dir.; E. N. Whitney, Mgr., Operations; R. J. Smith, Supt. of Passenger Service; R. A. Dick, Gen. Traffic Mgr.; R. Grant, Gen. Mgr., Cargo Traffic.



**KLM** THE outbreak of the war in 1939 completely paralyzed KLM's vast international network in Europe and resulted in the loss of all but a few of its large fleet of modern airliners. The fall of the Netherlands Indies in 1942 caused the disruption of the last portion of KLM's famous 9000 mile Amsterdam Batavia route, that still was being operated under great difficulties.

However, in the West Indies, where KLM started its operations on a modest scale in 1934, the Flying Dutchman now maintains 5180 miles of vital air-services and thus makes a substantial contribution to the United Nations' war effort.

And, in the meantime, KLM is carefully planning for the post-war era; it will again blaze new airtrails and expects to play an important role in the development of air commerce in a world of peace and prosperity.

## K.L.M. ROYAL DUTCH AIRLINES

521-5TH AVENUE, NEW YORK 17, N. Y. MU 2-7894



## DEOXIDINE Cleans and Conditions Steel and Aluminum for Durable Paint Finish . . . . .

DEOXIDINE removes rust, destroys or inhibits rust producers, removes light oil and scale and produces a chemically clean, paint receptive surface.

There are numerous types of DEOXI-

DINE suited to varying requirements in metal cleaning and for application by spray, dip or brush. Our Technical Laboratory will gladly advise you regarding the Deoxidine best suited to your needs. Write dept. R-45.

*Manufacturers of Inhibitors & Metal Working Chemicals*

## AMERICAN **ACP** PAINT CO.

Note — West Coast Plants may address inquiries and orders for prompt delivery to Leon Finch, Ltd., 728 East 59th St., Los Angeles, California.



**AIRLINE OIL PURIFIERS  
 HYFLOW OIL FILTERS  
 OIL RECLAIMERS  
 FLITE FILTERS**

*serving*

**The Aircraft Industry**

**HILCO UNITS AVAILABLE FOR**

- \* *Aircraft engine oil reclaiming.*
- \* *Aircraft engine run-in oil purifying.*
- \* *Portable for purifying in the field.*
- \* *Flite Filters — attached to engines.*

*and*

**For the Manufacturing Industry**

- \* *Hydraulic oil purifying.*
- \* *Quench oil filtering.*
- \* *Cutting oil purifying.*

Wherever oil is used HILCOS are needed to save equipment—oil—money. Let a HILCO field engineer survey your oil purifying problems.

**WRITE FOR FREE LITERATURE**

**THE HILLIARD CORPORATION**  
 85 W. FOURTH ST.                      ELMIRA, N. Y.



# CANNON CONNECTORS

★

## AIRCRAFT

TYPE  
AN3108



TYPE  
AN3106



TYPE  
AN3102



TYPE  
AN3100



TYPE  
AN3101



**TYPE AN Series** of cord connectors to Army-Navy specifications come in five basic shapes: (1) straight (2) 90° (3) wall mounting unit (4) box mounting unit (5) movable receptacle. More than 200 contact arrangements with capacities from 5 to 200 amperes.



TYPE K-23



TYPE K-21



TYPE K-325L



TYPE  
RK315L



TYPE  
RK-22



TYPE  
RK-24

**TYPE K and RK Connectors** for aircraft radio, instruments and electrical circuits come in three basic types: (1) 90° (2) straight (3) wall mounting unit. 8 diameters with 1 to 60 contacts. More than 185 contact arrangements. 10 to 250 amperes.

*Write for General Catalog*

# CANNON ELECTRIC

Cannon Electric Development Company  
3209 Humboldt Street • Los Angeles 31, California



# DIRECTORY OF AIRCRAFT AND AIRCRAFT ENGINE MANUFACTURERS

---



---

## MANUFACTURERS OF AIRCRAFT

---



---

### AIRPLANES

---

**AERONCA AIRCRAFT CORP.,**  
Municipal Airport, Middletown, O.  
350 Fifth Ave., New York, N. Y.

**PERSONNEL:** J. W. Friedlander, Pres.; E. S. Sutherland, Exec. V. Pres.; C. Friedlander, V. Pres.; E. H. Wideman, V. Pres. & Pur. Dir.; A. Helmers, Secy. & Treas.; A. B. Bennett, Sales Dir.; B. L. Hinds, Pub. Rel. Dir.; R. Davison, T. Noonan, C. Smith, Sales Mgrs.; R. Hermes, Chief Engr.; P. Altman, Consulting Engr.; V. Baltz, Factory Supt.; E. P. Kennedy, Prod. Mgr.; L. Nelson, Service Mgr.

**BEECH AIRCRAFT CORP.,**  
Wichita 1, Kans.

**PERSONNEL:** W. H. Beech, Pres.; R. K. Beech, V. Pres. & Pur. Dir.; T. A. Wells, V. Pres. & Chief Engr.; J. P. Gaty, V. Pres. & Gen. Mgr.; C. G. Yankey, V. Pres.; O. A. Beech, Secy. & Treas.; H. D. MacKinnon, Prod. Mgr.; C. B. Wooten, Sales Mgr.; W. E. Blazier, Pers. Dir.; W. H. McDaniel, Pub. Dir. & Adv. Mgr.; L. L. Pechin, Factory Supt.

**BELL AIRCRAFT CORP., 2050 Elmwood Ave.,**  
Buffalo, N. Y.

**PERSONNEL:** L. D. Bell, Pres. & Gen. Mgr.; R. P. Whitman, First V. Pres.; H. E. Collins, J. V. Carmichael, V. Pres.; C. L. Beard, V. Pres. & Secy.; L. F. Sperry, V. Pres. & Treas.; D. G. Forman, Exec. Asst. to Pres.; L. P. Faneuf, Asst. to Pres.; D. F. Devine, Compt.; H. Gaylord, Ind. Engrg. Mgr.; J. Meade, Labor Rel. Dir.; H. H. Munsey, Patent Atty.; S. E. Fitzgerald, Pub. Rel. Dir.

**Niagara Frontier Div.,**  
Buffalo and Niagara Falls, N. Y.

**PERSONNEL:** R. P. Whitman, Mgr.; L. L. Benson, Asst. to Mgr.; E. H. Conerton, Adm. Asst. to Mgr. & Planning & Coordination Dir.; R. M. Stanley, Engrg. Dir.; W. Davey, Mfg. Dir.; J. Snure, Jr., Pub. Rel. Dir.; G. B. Cleversley, Management Engrg. Dir.; H. C. Winch, Legal Counsel Dir.; A. L. Pernoft, Service Dir.; J. Woolams, Chief Test Pilot; V. Bell, Ind. Rel. Dir.; H. A. Holmberg, Procurement Dir.; G. L. Smith, Quality Dir.; D. C. Rowe, Experimental Dir.

**Georgia Div.,**  
Marietta, Ga.

**PERSONNEL:** J. V. Carmichael, Mgr.; E. J. Englehart, Prod. Mgr.; A. L. Leo-Wolf, Asst. Secy.; A. S. Kruzeck, Mgr. Ind. Planning; E. R. Hawkins, Pub. Rel. Mgr.; J. Q. Dougherty, Ind. Rel. Mgr.; M. R. Wilkins, Contracts Mgr.; A. D. Brown, Chief Engr.; R. H. Coleman, Service Mgr.; N. A. Lomas, Pur. Mgr.; H. A. Dow, Chief of Flight Test; A. A. Andrade, Quality Mgr.; W. A. Carrington, Mgr. Factory Operations; L. M. Blair, Legal Counsel; N. G. Gill, Mgr. Prod. Control.

**Ordnance Div.,**  
Burlington, Vt.

**PERSONNEL:** J. J. Domonkos, Mgr.; L. P. Evans, Jr., Mgr. Contracts & Sales; B. H. Prentice, Jr., Ind. Rel. Mgr.; H. Schmidt, Pur. Agt.; E. M. Harrison, Chief Accountant; F. Nolan, Quality Mgr.; J. J. Rush, Prod. Control Mgr.; L. F. Dow, Pub. Rel. Dir.; V. Moss, Factory Mgr.

**BELLANCA AIRCRAFT CORP.,**  
New Castle, Del.

**PERSONNEL:** G. M. Bellanca, Ch. of Bd.; N. F. Vanderlipp, Pres.; S. S. Arsht, V. Pres. & Treas.; I. I. Islamoff, V. Pres. & Acting Gen. Mgr.; A. F. Haiduck, V. Pres. & Factory Mgr.; H. L. Thompson, Secy.; R. F. Wright, Dir. of Purchases; A. J. MacRae, Per. Dir.

**BOEING AIRCRAFT CO., Seattle, Wash.**

**PERSONNEL:** C. L. Egtvedt, Ch.; H. O. West, Exec. V. Pres.; H. E. Bowman, Secy. & Treas.; J. P. Murray, V. Pres. & Eastern Rep.; W. E. Beall, V. Pres. Engrg.; O. W. Tupper, A. F. Logan, R. P. Holman, Assts. to Pres.; F. B. Collins, Sales Mgr.; C. E. French, Dir. Ind. Rel.; R. Gelzenlichter, Chief Contract Administrator; E. C. Wells, Chief Engr.; L. A. Wood, Asst. Chief Engr.; C. B. Gracey, Materiel Mgr.; H. Mansfield, Pub. Rel. Mgr.; C. M. Cleveland, Asst. Pub. Rel. Mgr. & Adv. Mgr.; R. A. Neale, Operations Mgr.; R. J. Early, Gen. Prod. Mgr.; T. J. Emmert, Asst. to Exec. V. Pres.; R. J. Higman, Plant Facilities Mgr.; C. S. Rankin, Quality Mgr.; L. N. Searle, Factory Gen. Supt.; J. H. Frederickson, Supt. of Installations; C. M. Weaver, Experimental Gen. Supt.; J. A. Duke, Chief Inspector; W. W. Rutledge, Asst. Gen. Prod. Mgr.; L. D. Spittler, Prod. Planning Mgr.; C. F. Udden, Prod. Controls Mgr.; F. Weaver, Pers. Mgr.; B. Bucey, Supt. of Tooling; R. W. Boise, Jr., Chief Ind. Engr.; G. V. Dierst, Plant Protection Mgr.; A. W. Jacobson, Branch Plants Supt.; J. Lipke, Supt. of Maintenance.

**Branch Plants**

**Aberdeen, Wash.**

W. Holbein, Mgr.

# SERVING THE SERVICES WITH PRODUCTS OF DESIGN SIMPLICITY



Solenoid Operated High Pressure Pneumatic Selector Valves



\*ISO hydraulic REMOTE CONTROL SYSTEMS

"MIGHTY MIDGET," 4-way hydraulic selector valve



\*STALOCK—the all around fastener. Many types, sizes

FLUID METERING PUMPS—Capacities from 0.5 to 30 GPH



ADEL CLIPS—Over 10,000 types, sizes. 250 million in service

Design Simplicity at ADEL means (1) reducing to simplest terms (2) standardizing (3) manufacturing with greatest precision. Add these up and you get smaller size, lighter weight, longer life and superior performance. \*Trade Mark

**ADEL**  
Trade Mark

**ADEL PRECISION PRODUCTS CORP.**  
Burbank, California • Huntington, W. Va.  
Offices: Seattle 1, Washington; Dayton 2, Ohio;  
Detroit 2, Michigan; Hagerstown, Maryland;  
Baltimore 1, Maryland; New York 20, New York

**FOR YOUR BEST INTEREST BUY WAR BONDS**

**Bellingham, Wash.**

E. J. Miller, Mgr.

**Everett, Wash.**

R. B. Duxbury, Mgr.

**S. Tacoma, Wash.**

W. E. Pratt, Mgr.

**Tacoma, Wash.**

T. Nelson, Mgr.

**Chehalis, Wash.**

F. Owens, Mgr.

**Renton Div.**

**PERSONNEL:** F. P. Laudan, V. Pres. & Div. Mgr.; W. F. Flanley, Asst. Div. Mgr.; J. L. Valentine, Asst. to Div. Mgr.; F. L. Dobbins, Materiel Mgr.; C. Williams, Gen. Supt.; C. H. Mahnken, Chief Inspector; H. Rydeen, Pers. Mgr.; F. M. Kingsbury, Plant Protection Mgr.; R. Teig, Div. Compt.; G. Walker, Plant Engr.; R. J. Loudon, Supt. of Maintenance.

**Wichita Div.,****Boeing Airplane Co.**

**PERSONNEL:** J. E. Schaefer, V. Pres. & Div. Mgr.; L. M. Divinia, Exec. Asst. to Div. Mgr.; H. W. Zipp, Chief Engr.; J. J. Clark, Asst. Chief Engr.; H. F. Brown, Works Mgr.; A. W. Schupp, Asst. Works Mgr.; G. Trombold, Pers. Mgr.; L. G. Sinning, Pur. Dir.; C. Barron, Asst. Secy. & Treas.; G. L. Findlay, Pub. Rel. Mgr.; W. W. McCutcheon, Chief Inspector.

**CESSNA AIRCRAFT CO., Wichita, Kans.**

**PERSONNEL:** D. L. Wallace, Pres. & Gen. Mgr.; D. S. Wallace, Exec. V. Pres. & Treas.; F. A. Boettger, Secy. & Controller; D. Flower, Sales Mgr.; T. Salter, Chief Engr.; D. Roskam, Prod. Mgr.; A. Sheldon, Factory Supt.; S. Graves, Chief Inspector; P. Elder, Pers. Dir.; A. E. Kangas, Service Mgr.; J. Rix, Plant Mfg. Engr.; W. S. Strobel, Plant Maintenance Engr.; C. P. Weisner, Pur. Dir.

**Hutchinson, Kans.**

**PERSONNEL:** C. R. Larkin, Factory Mgr.; W. W. Moore, Prod. Mgr.; E. E. Rippey, Chief Inspector; J. B. Lindner, Factory Supt.; L. O. Smith, Gen. Acct.; H. B. Houser, Pers. Dir.

**CONSOLIDATED VULTEE AIRCRAFT CORP., Lindbergh Field, San Diego, Calif.**

**PERSONNEL:** T. M. Girdler, Ch. of Bd.; H. Woodhead, Pres.; I. M. Laddon, Exec. V. Pres.; C. T. Leigh, V. Pres.; F. A. Callery, V. Pres. Finance; W. M. Shanahan, Secy. & Treas.; V. C. Schorlemmer, Controller; R. A. Bussey, Asst. Secy. & Asst. Treas.; R. S. Pruitt, General Counsel; F. A. Learman, Gen. Sales Mgr.; A. W. Larsen, Pur. Dir.; F. A. Lauerman, Ind. Rel. Dir.

**Divisions****Consairway Div., Fairfield, Calif.**

R. S. Mitchell, Mgr.

**Fort Worth Div., Fort Worth, Tex.**

R. G. Mayer, Mgr.

**Louisville Div., Louisville, Ky.**

W. L. Jones, Mgr.

**Miami Div., Miami, Fla.**

A. M. Hall, Mgr.

**Nashville Div., Nashville, Tenn.**

E. Wenigmann, Mgr.

**New Orleans Div., New Orleans, La.**

L. H. Cooper, Mgr.

**San Diego Div., San Diego, Calif.**

J. L. Kelley, Mgr.

**Stinson Div., Wayne, Mich.**

T. Y. Smith, Mgr.

**Stout Research Div., Dearborn, Mich.**

J. M. Gwinn, Jr., Mgr.

**Tucson Div., Tucson, Ariz.**

W. R. Lawrence, Mgr.

**Vultee Field Div., Downey, Calif.**

C. W. Coslow, Mgr.

**Elizabeth City Div., Elizabeth City, N. C.  
Allentown Div., Allentown, Pa.****CULVER AIRCRAFT CORP.,**

600 E. 35th St., Wichita, Kans.

**PERSONNEL:** C. G. Yankey, Pres.; T. B. Woodbury, V. Pres. & Gen. Mgr.; A. W. Mooney, V. Pres. & Chief Designer; V. M. Laing, Secy.; F. M. Farrell, Treas. & Pur. Dir.; M. J. Paxman, Prod. Mgr.; W. W. Taylor, Sales Mgr.; H. E. Swanson, Pers. Dir.; R. B. Short, Chief Engr.; R. H. Lehman, Factory Mgr.

**CURTISS-WRIGHT CORP., 30 Rockefeller Plaza, New York 20, N. Y.**

**PERSONNEL:** G. W. Vaughan, Pres.; G. M. Williams, Sr., V. Pres.; R. J. Lindquist, J. A. B. Smith, B. S. Wright, F. H. Harrison, E. J. Harrington, C. W. France, R. L. Earle, C. W. Loos, W. F. Goulding, S. D. Irwin, C. I. Morton, V. Pres.; E. S. Cramer, Secy. & Treas.; J. W. Sweetser, Pub. Rel. Dir.; R. W. Darrow, Asst. Pub. Rel. Dir.; I. L. Willis, Ind. Rel. Dir.; M. E. Nevils, Pub. Dir.

**CURTISS-WRIGHT CORP., DEVELOPMENT DIV., P. O. Box 30, Bloomfield, N. J.**

**PERSONNEL:** P. F. Rossmann, Gen. Mgr.; W. C. Walker, Asst. Gen. Mgr.; R. C. Dehmel, Chief Engr.; E. Ruckelshaus, Market Research Mgr.; W. V. C. Ausser, Pers. Dir.; J. W. Maloney, Pers. Mgr.; D. P. Jones, Pur. Agt.; G. D. Hedden, Controller; W. E. Timmerman, Plant Engr.

**CURTISS-WRIGHT CORP., AIRPLANE DIV., Buffalo, N. Y.**

**PERSONNEL:** B. S. Wright, V. Pres.; A. W. Smith, Exec. Asst. to V. Pres.; P. N. Jansen, Dir. of Prod.; G. M. Ebert, Dir. of Finance; W. J. Crosswell, Dir. of Contracts; G. A. Page, Dir. of Engrg.; L. G. Raiche, Dir. of Quality; A. D. Palmer, Jr., Dir. of Pub. & Internal Rel.; C. C. Furnas, Dir. of Research.

**Plant No. 1: Kenmore, N. Y.**

**PERSONNEL:** J. J. Lee, Gen. Mgr.; J. M. Martin, Asst. to Gen. Mgr.; L. Botts, Contracts Liaison Rep.; R. Diller, Quality Mgr.; J. D. Springer, Mgr. Pub. & Internal Rel.; E. Fabing, Mgr. Mfg. Control; E. Lenz, Mgr. Prod. Planning; A. G. Butler, Chief Engr.; J. Cooper, Ind. Rel. Mgr.; G. B. Chase, Pers. Mgr.

**Plant No. 2: Buffalo, N. Y.**

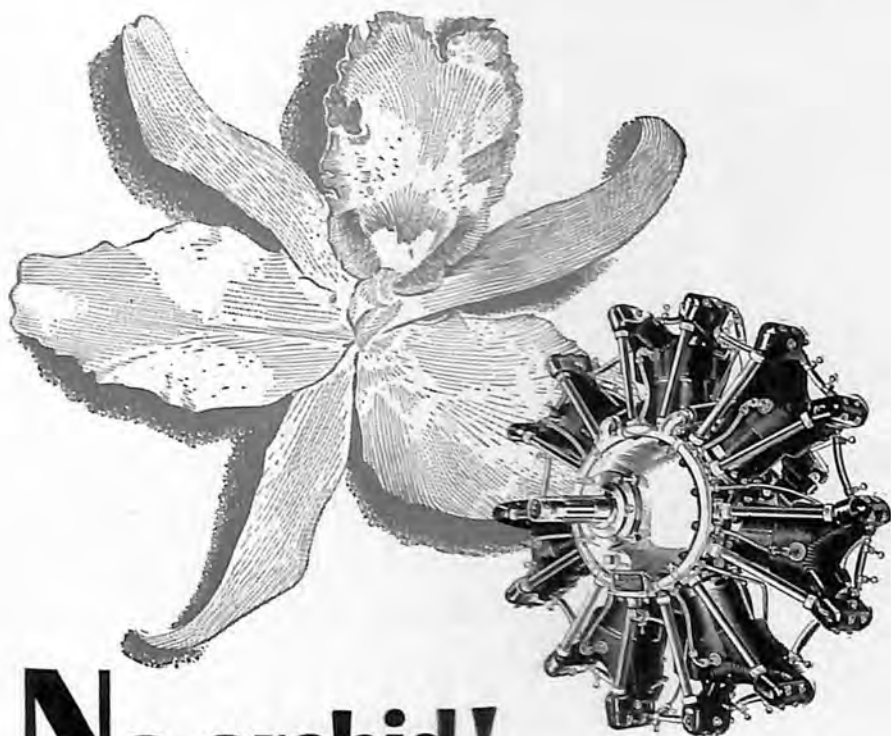
**PERSONNEL:** N. F. Vanderlipp, Gen. Mgr.; E. J. Ducayet, Contracts Mgr.; F. A. Maley, Materials Mgr.; R. H. Puffer, Mgr. Ind. Rel.; W. E. Lucas, Pers. Mgr.; G. A. Page, Chief Engr.; C. H. Augspurger, Mgr. Pub. & Internal Rel.; A. E. Smith, Factory Mgr.

**Plant No. 3: Columbus, O.**

**PERSONNEL:** J. P. Davey, Gen. Mgr.; G. A. Snodgrass, Asst. to Gen. Mgr.; R. C. Blaylock, Chief Engr.; O. A. Dworak, Materials Mgr.; W. J. Flood, Controller; G. F. Habestro, Contracts Mgr.; R. H. Stewart, Quality Mgr.; R. A. Fuhrer, Factory Mgr.; H. E. Glegg, Pers. Mgr.; W. A. Maharry, Pub. Rel. Mgr.

**Plant No. 4: St. Louis, Mo.**

**PERSONNEL:** C. W. France, V. Pres. & Gen. Mgr.; W. E. Nickey, Asst. Gen. Mgr.; J. N. Foster, Factory Mgr.; T. E. Killeen, Jr., Asst. to Gen. Mgr. for Pers. & Pub. Rel.; W. L. Wells, Chief Engr.; E. A. Warren, Contracts Mgr.; W. M. Reynolds, Controller; D. N. Donzelot, Quality Mgr.



# No orchid!

This Jacobs engine is no war baby, hot-house developed at high speed, with cost no object . . . no military matériel headed for future scrap heaps when the show is over!

The Jacobs was born in the twenties, built for pilots who paid for their own engines out of perilous prize money and hard-earned charter hours . . . developed through the Depression years when aviation was in the poorhouse . . . a bread and butter job for ships that had no spares . . . an orphan child on upkeep, but a hog for performance and payload.

When the war broke, the Jacobs was a sure thing in its power class, proven in performance, ripe for quantity production, and

ready for the tough job of toting twin-engine trainers that turn hot pilots into Big Operators.

Jacobs engines take more take-offs and more full throttle time than the big radials on combat ships, stand up under student handling, diverse terrain and varied climate . . . and today deliver more than a thousand hours of service between major overhauls—performance that is *three times* the original prescription!

**F**OR worry-free, dependable delivery of packaged power at low cost, Jacobs had a lot to offer the war effort . . . will have even more for peacetime aviation and industry. Proof on request . . . Jacobs Aircraft Engine Co., Pottstown, Pa.



**JACOBS** • Pottstown, Pa.

**Plant No. 5: Buffalo, N. Y.**

PERSONNEL: C. C. Furnas, Dir. of Research; P. E. Hovgard, Assoc. Dir.; J. C. Evans, Exec. Asst. to Dir.; W. R. Boocock, Asst. to Dir.; C. G. Trimbach, Head, Developments Armament; G. H. Cartledge, Head, Materials Dept.; C. L. Frederick, Head, Physics Dept.; A. F. Donovan, Head, Structures Dept.; I. G. Ross, Head, Flight Research; G. F. Goodyear, Patents Mgr.; W. E. Voisinot, Lab. Mgr.; A. E. Strasser, Controller; T. E. O'Brien, Pers. Mgr.

**Plant No. 6: Louisville, Ky.**

PERSONNEL: G. J. Brandewiede, Gen. Mgr.; W. L. Recker, Asst. to Gen. Mgr.; H. K. Moffitt, Contracts Mgr.; G. W. Wood, Materials Mgr.; W. G. Shilling, Pers. Mgr.; W. B. Tischendorf, Pub. Rel. Mgr.; H. A. Moles, Chief Engr.; H. A. McLaine, Factory Mgr.; W. H. MacLean, Controller; M. A. Rhoads, Quality Mgr.

**DEL-AIR CORP., De Land, Fla.**

PERSONNEL: W. A. Stone, Pres. & Gen. Mgr.; W. J. Deegan, Jr., V. Pres., Secy. & Prod. Mgr.; E. M. Porter, Treas.; J. G. Vilsack, Jr.; Pur. Dir.; J. A. Kelley, Pers. Dir.; C. H. Warner, Factory Mgr.

**DOUGLAS AIRCRAFT CO., INC., 3000 Ocean Park Blvd., Santa Monica, Calif.**

PERSONNEL: D. W. Douglas, Pres.; F. W. Conant, V. Pres.-Mfg.; A. E. Raymond, V. Pres.-Engrg.; J. M. Rogers, V. Pres.-Adm. Contract; R. V. Hunt, V. Pres.-Compt.; W. H. Ball, Exec. Asst. to Pres.; B. O. Howard, Asst. to Pres.; J. D. Weaver, Tech. Asst. to Pres.; H. P. Grube, Treas.; A. M. Rochlen, Dir. Ind. & Pub. Rel.; S. O. Porter, Dir. Pers.; D. J. Bosio, Dir. Materiel.

**Chicago Plant:**

J. C. Buckwalter, Plant Mgr.

**El Segundo Plant:**

T. E. Springer, Plant Mgr.; E. H. Heine-  
mann, Chief Engr.

**Long Beach Plant:**

G. A. Huggins, Plant Mgr.; F. W. Her-  
man, Chief Engr.

**Oklahoma City Plant:**

C. C. Pearson, Plant Mgr.; L. A. Car-  
ter, Chief Engr.

**Santa Monica Plant:**

H. E. Guerin, Plant Mgr.; E. F. Burton,  
Chief Engr.

**Tulsa Plant:**

W. G. Jerrems, III, Plant Mgr.; D.  
Dunlap, Chief Engr.

**EASTERN AIRCRAFT DIV., GENERAL MOTORS CORP., Linden, N. J.**

PERSONNEL: L. C. Goad, Gen. Mgr.; C. S. Swayze, Asst. Gen. Mgr.; H. L. Jennings, Asst. to Gen. Mgr.; W. G. Kileen, Div. Compt.; R. E. Waldo, Pers. Dir.; J. N. Bird, Dir. Employee Rel.; P. E. Baugh, Mgr., Linden Plant; E. J. Hanson, Mgr., Trenton Plant; A. L. Hopkins, Mgr., Bloomfield Plant; C. E. Hoehn, Mgr., Tarrytown Plant; M. J. Olson, Mgr., Baltimore Plant.

**ENGINEERING & RESEARCH CORP., Riverdale, Md.**

PERSONNEL: L. A. Wells, Pres.; M. W. King, V. Pres. & Secy.; W. G. Carroll, Treas.; J. N. Dean, Gen. Mgr.; E. P. Scully, Pur. Agt.; J. E. Richardson, Pers. Dir.; P. C. Wright, Pub. Dir.; F. E. Weick, Chief Engr.

**FAIRCHILD ENGINE & AIRPLANE CORP., 30 Rockefeller Plaza, New York 20, N.Y.**

PERSONNEL: S. M. Fairchild, Chairman; J. C. Ward, Jr., Pres.; M. B. Gordon, V. Pres.-Oper.; R. S. Boutelle, V. Pres., Fairchild Aircraft Div.; H. H. Budds, V. Pres., Ranger Aircraft Engine Div.; A. P. Adams, V. Pres., Duramold Div.; W. Wilson, Treas.; W. H. Schwebel, Secy. & Compt.; J. E. Lowes, Jr.; Dir. Pub. Rel.; A. R. Stocker, Dir. Foreign Rel.; D. C. Smith, Dir. Development.

**FAIRCHILD AIRCRAFT DIV. OF FAIRCHILD ENGINE & AIRPLANE CORP., Hagerstown, Md.**

PERSONNEL: R. S. Boutelle, V. Pres. & Gen. Mgr.; P. J. Frizzell, Asst. Gen. Mgr.; A. F. Flood, Div. Compt.; G. Evins, Mgr. Contracts & Service Dept.; A. J. Thieblot, Chief Engr.; G. W. Lescher, Exec. Engr.; J. M. Jacobson, Asst. Chief Engr.; R. H. Depew, Jr., Mgr. Special Projects; S. A. Angotti, Pers. Dir.; O. R. Perkins, Procurement Dir.; L. Fahnestock, Works Mgr.; C. P. Slick, Factory Mgr.; P. Harr, Quality Mgr.; J. E. Steinhauer, Gen. Service Mgr.; K. Bradford, Mgr. Service Div.; L. H. Smith, Mgr. Personal Aircraft Sales; L. J. Povey, Mgr. Military Aircraft Sales; J. A. Wales, Jr., Asst. Gen. Mgr., Pub. Rel.; J. M. Johnson, Dayton Rep.

**FUNK AIRCRAFT CO., Coffeyville, Kans.**

PERSONNEL: W. G. Jensen, K. R. Jensen, J. C. Funk, H. C. Funk, Partners; J. C. Funk, Gen. Mgr.; N. F. Howard, Sales Mgr. & Pur. Dir.; H. C. Funk, Chief Engr.; R. T. Gossard, Factory Mgr.

**GENERAL AIRCRAFT CORP., 43-02 Ditmars Blvd., Long Island City 5, N. Y.**

PERSONNEL: H. J. Maynard, Jr., Pres.; J. T. Geuting, Jr., L. E. Reinsner, H. Fahnestock, Jr., V. Pres.; K. I. Deane, Secy.; E. S. Gremse, Treas.; L. W. Mattson, Sr., Pers. Dir.; P. T. Nickson, Chief Engr.

**GLOBE AIRCRAFT CORP., Blue Mound Rd., Fort Worth 6, Tex.**

PERSONNEL: J. Kennedy, Pres.; V. Viner, V. Pres.; J. K. Rhodes, Secy.; N. N. Oille, Treas.; P. Andrews, Pur. Dir.; J. Moran, Pers. Dir.; K. H. Knox, Chief Engr.; W. G. Fuller, Factory Mgr.

**GLOBE CORP., AIRCRAFT DIV., Box 922, Joliet, Ill.**

PERSONNEL: G. F. Getz, Jr., Pres.; R. E. Gage, V. Pres. & Gen. Mgr.; R. N. Little, Secy.; B. C. Hightower, Treas.; E. F. Mangold, Pur. Dir.; A. Brennan, Pers. Dir.; J. C. Battaglia, Chief Engr.; C. C. Crosier, Factory Mgr.

**GOODYEAR AIRCRAFT CORP., 1210 Massillon Rd., Akron 15, O.**

PERSONNEL: P. W. Litchfield, Pres.; H. E. Blythe, V. Pres. & Gen. Mgr.; P. E. H. Leroy, V. Pres. & Treas.; R. DeYoung, V. Pres.-Prod.; T. A. Knowles, V. Pres.-Sales; K. Arnstein, V. Pres.-Engrg.; H. L. Hyde, Secy.; L. A. Murphy, Pur. Dir.; F. J. Carter, Pers. Dir.; L. E. Judd, Pub. Dir.; J. K. Hough, Adv. Mgr.

**GRUMMAN AIRCRAFT ENGINEERING CORP., Bethpage, N. Y.**

PERSONNEL: L. R. Grumman, Pres.; L. A. Swirbul, Exec. V. Pres.; W. T. Schwendler, E. C. Towl, V. Pres.; J. A. Stamm, Secy.; E. W. Poor, Treas.

**HARLOW AIRCRAFT CO., 620 E. Valley Blvd., Alhambra, Calif.**

PERSONNEL: H. F. Keenan, Pres.; F. Der Yuen, V. Pres. & Gen. Mgr.; J. E. Addicot, Jr., V. Pres., Secy. & Sales Mgr.; E. L. McCreary, Treas.; M. J. Hoffman, Prod. Mgr. & Factory Mgr.; R. E. Smith, Pur. Dir.; M. H. Gray, Pers. Dir.; D. C. Mendenhall, Chief Engr.

RYAN PRODUCTION ENGINEERING DEVELOPMENT NO. 28-30-18



**Faster, Lighter Aircraft, Greater Pay Loads  
through New Techniques in Processing  
Aluminum Alloys...**

How to develop airplanes capable of carrying greater pay loads at higher speeds by reducing structural weight? That's the aeronautical engineer's basic problem.

To accomplish this end could a metal be found which had the lightness of Aluminum and the strength of steel? Yes, Aluminum alloys could be post-aged to give them this much desired strength. But, the process so reduced the corrosion resistance of the metal that full advantage could not be taken of this development.

Ryan metallurgists tackled the problem and came up with a procedure which yields a light corrosion-resistant alloy with the strength of low carbon steel.

Ryan engineers have been *first* to make full use of this weight-saving development in the design and construction of aircraft. This advantage, which adds to the deadliness of American warplanes, will be equally valuable to the peacetime planes of the future.



**THE PROBLEM:** How to take advantage of the extra strength imparted to Alclad 24S by the post-aging process. The strength of this metal, composed of an Aluminum alloy covered with a thin deposit of pure Aluminum, may be increased by post-aging. However, this has always been accompanied by a loss in corrosion resistance which prevented aeronautical engineers from completely utilizing this advantage. The aging reduced the galvanic potential between the alloy and the clad Aluminum and removed the electrolytic protection it afforded.

**THE SOLUTION:** Ryan research found a way to obtain the strength increase and maintain high corrosion resistance: The Alclad is placed in an oven and held to a temperature of 365° F. for ten hours. This induces a copper precipitation and raises the tensile strength at least 20%. Then the corrosion resistance is restored by anodizing a thin layer of oxide on the surface and spraying it with a zinc chromate primer.

**THE ADVANTAGES:** By ordering specified stock, post-aging at carefully controlled temperatures and anodizing and priming, Ryan has created new possibilities for Aluminum alloys. The entire aircraft industry may now have the benefit which this metal, with Aluminum's lightness and steel's strength, goes to every designer and builder of airplanes.

RELY ON RYAN  
TO BUILD WELL

1922 1945



**RYAN** *Airplanes*

Ryan Aeronautical Company, San Diego — Member, Aircraft War Production Council, Inc.

DESIGNERS AND BUILDERS OF NAVY FIGHTING PLANES AND EXHAUST MANIFOLD SYSTEMS

**KAISER CARGO, INC., FLEETWINGS DIV.,**  
Bristol, Pa.

PERSONNEL: E. E. Trefethen, Jr., Pres.; S. D. Hackley, V. Pres. & Gen. Mgr.; S. H. Wilde, Asst. Secy. & Oper. Div. Mgr.; F. R. Browning, Asst. Treas. & Exec. Asst. to V. Pres.; W. E. Lucie, Controller; J. L. McClane, Contracts Mgr.; W. E. Strang, Ind. Rel. Dir.; L. J. Kelly, Prod. Budget Mgr.; J. E. Birdsall, Resident Counsel; G. G. Cudhea, Chief Engr.; C. de Ganahl, Res. Engr.; A. A. Shick, Procurement Mgr.; H. Boyd, Factory Mgr.

**LOCKHEED AIRCRAFT CORP.,**  
Burbank, Calif.

PERSONNEL: R. E. Gross, Pres.; K. H. Smith, J. T. Gray, Assts. to Pres.; L. K. Schwartz, Asst. to Pres. & Sales Mgr.; C. S. Gross, V. Pres. & Gen. Mgr.; C. A. Barker, Jr., V. Pres. & Treas.; M. Short, V. Pres.-Navy Spec. Proj.; C. Chappellet, V. Pres.-Adm.; C. B. Squier, V. Pres.-Sales & Serv.; H. L. Hibbard, V. Pres. & Chief Engr.; H. E. Ryker, V. Pres.-Material; L. M. Bach, Gen. Works Mgr.; L. W. Wulfekuhler, Secy.; L. V. Kerber, Contract Off.; J. L. Wells, Pur. Dir.; W. W. Aulepp, Ind. Rel. Dir.; E. A. Foster, Pub. Dir.; B. W. Holloway, Adv. Mgr.

**LUSCOMBE AIRPLANE CORP.,**

Trenton 7, N. J.

PERSONNEL: L. H. P. Klotz, Pres.; F. J. Knack, V. Pres.-Engrg.; C. L. Riegel, Secy. & Treas.; R. D. Clampett, Sales Mgr.; F. Peberdy, Pur. Dir.; L. P. Taylor, Pers. Dir.; H. H. Booth, Sales Prom. Mgr.; J. Cunningham, Factory Supt.

**MCDONNELL AIRCRAFT CORP.,**

St. Louis, Mo.

Memphis, Tenn.

PERSONNEL: J. S. McDonnell, Pres., Sales Mgr., Pub. Dir. & Adv. Mgr.; G. W. Carr, Exec. V. Pres.; L. A. Smith, V. Pres., Secy. & Treas.; N. L. Stetsen, Prod. Mgr.; J. M. Lipscomb, Pur. Dir.; F. H. Eyler, Pers. Dir.; G. C. Covington, Chief Engr.; C. W. Drake, Factory Mgr.

**THE GLENN L. MARTIN CO.,**

Baltimore 3, Md.

PERSONNEL: G. L. Martin, Pres.; J. T. Hartson, H. F. Vollmer, W. K. Ebel, H. T. Rowland, V. Pres.; T. H. Jones, Secy.; M. G. Shook, Treas.; W. C. Miles, Prod. Supt.; T. J. Dunnion, Procurement Dir.; D. W. Siemon, Pers. Dir.; A. McBee, Pub. Rel. Dir.; R. Young, Factory Mgr.

**THE GLENN L. MARTIN-NEBRASKA CO.,**  
Omaha 1, Neb.

PERSONNEL: J. T. Hartson, Pres.; G. T. Willey, V. Pres. & Gen. Mgr.; H. D. Boggs, Asst. to V. Pres.; W. K. Aiken, Outside Prod. Mgr.; G. L. Barnett, Asst. Gen. Mgr.; C. S. Miller, Treas.; R. L. Evans, Pers. Dir.; C. W. Miller, Chief Engr.; K. F. Wasmuth, Quality Mgr.; R. B. Hartman, Procurement Dir.; J. P. Bailey, Factory Mgr.; C. A. Blaney, Prod. Mgr.; J. V. Longley, Controller; R. L. Bell, Coordination Mgr.; G. R. DeVisser, Chief Ind. Engr.; F. M. Bryant, Flight Operations Mgr.; J. D. McCarthy, Spares & Shipping Mgr.; J. P. Murphy, Pub. Rel. Dir.

**MEYERS AIRCRAFT CO.,**

Tecumseh, Mich.

PERSONNEL: A. H. Meyers, Pres., Sales Mgr., Pub. Dir., Adv. Mgr. & Chief Engr.; C. F. Sage, V. Pres.; B. W. Hoffman, Secy. & Treas.; O. Meier, Gen. Mgr. & Prod. Mgr.; B. W. Hoffman, Pur. Dir.

**NORTH AMERICAN AVIATION, INC.,**  
5701 Imperial Highway, Inglewood, Calif.

PERSONNEL: J. H. Kindelberger, Pres. & Gen. Mgr.; L. R. Taylor, R. L. Burla, C. J. Gallant, Assts. to Pres.; J. L. Atwood, V. Pres.; R. H. Rice, V. Pres. & Chief Engr.; J. S. Smithson, V. Pres.-Mfg.; R. A. Lambeth, V. Pres. & Treas.; S. G. Anspach, Secy. & Asst. Treas.; N. Shropshire, Contract Administrator; M. E. Beaman, Ind. Rel. Dir.; E. Nagely, Material Dir.; A. R. Miller, Plant Protection Dir.; H. V. Schwalenberg, Quality Control Dir.; P. K. Macker, Pub. Rel. Dir.; N. S. Houston, Management Control Dir.; C. J. Hansen, Chief Project Engr.

California Div.,

Inglewood, Calif.

PERSONNEL: R. E. Dawe, Mgr.; R. H. Ruud, Asst. Mgr.; J. R. Baker, Contract Administrator; J. A. Prenderville, Chief Accountant; E. Starkweather, Ind. Rel. Dir.; H. Booth, Chief of Material; C. Aubrey, Chief Inspector; E. C. Bertram, Plant Engr.; E. H. Adkins, Plant Protection Dir.

Texas Div.,

Dallas, Tex.

PERSONNEL: R. McCulloch, Mgr.; J. J. Fluck, Asst. Mgr.; A. DeShong, Asst. to Mgr.; G. E. Moores, Contract Administrator; R. C. Bumb, Chief Engr.; H. L. Howard, Compt.; N. Molinaro, Ind. Rel. Dir.; P. T. Bee, Chief of Material; R. F. Martin, Quality Control Dir.; W. B. Acker, Plant Engr.; R. E. Smith, Plant Protection Dir.

**NORTH AMERICAN AVIATION, INC., OF**  
KANSAS, Kansas City, Kans.

PERSONNEL: H. R. Raynor, Plant Mgr.; C. Wolf, Asst. Plant Mgr.; R. P. Shanahan, Asst. to Plant Mgr.; F. P. Spalding, Contract Administrator; W. A. Spivak, Chief Engr.; E. P. Lundy, Chief Accountant, F. Branch, Ind. Rel. Dir.; D. L. Miller, Chief of Material; H. S. Rankin, Chief Inspector; J. McNamara, Plant Engr.; M. C. Spear, Plant Protection Dir.

**NORTHROP AIRCRAFT, INC.,**

1001 E. Broadway, Hawthorne, Calif.

PERSONNEL: L. T. Cohu, Ch. of Board & Gen. Mgr.; J. K. Northrop, Pres. & Chief Engr.; G. H. Irving, V. Pres. & Asst. Mgr.; C. N. Monson, V. Pres. & Treas.; G. L. Sterling, Jr., V. Pres. & Gen. Counsel; T. C. Coleman, V. Pres.; M. W. Stephens, Secy.; P. I. Chase, Pur. Agt.; W. T. Gage, Pers. Dir.; C. E. Apponyi, Pub. Dir.

**PHILLIPS AVIATION CO.,**

1525 Monterey Rd., S. Pasadena, Calif.

PERSONNEL: J. A. Phillips, Jr., Pres. & Gen. Mgr.; D. B. Morgan, V. Pres.; L. M. Phillips, Secy. & Treas.; O. A. Phillips, Prod. Mgr. & Chief Engr.; C. A. Mason, Pur. Dir. & Factory Mgr.; B. Swartz, Pers. Dir.

**PIPER AIRCRAFT CORP.,**

Lock Haven, Pa.

PERSONNEL: W. T. Piper, Pres. & Treas.; T. V. Weld, V. Pres., Gen. Mgr. & Adv. Mgr.; W. T. Piper, Jr., Secy.; H. Eckman, Prod. Mgr.; W. B. St. John, Sales Mgr.; R. C. McKissick, Pur. Dir.; H. H. Herritt, Pers. Dir.; G. Vincent, Pub. Dir.; W. C. Jamouneau, Chief Engr.; F. Estlick, Factory Mgr.



## Ten Minute Hop By Helicopter—*Postwar*

Among American cities of 100,000 population or more—few are less than forty minutes from downtown area to airport—by surface transportation.

But with *helicopter* shuttle-service, most city's major airports will be only *ten minutes* away—or *less*—from the rooftops of downtown hotels, garages, office buildings, bus and railroad stations.

And in the hands of professional pilots, such helicopter shuttle-service will be as safe as it is swift. For stoplights, street intersections, and heavy traffic will be eliminated—shav-

ing time schedules to save as much as a half-hour at each end of your trip.

For short-haul service, too, from smaller to larger cities, and for trips to remote and otherwise inaccessible locations with no landing facilities, the helicopter will prove practical and useful.

At McDonnell, we are actively working on the development of the helicopter for peacetime uses. After victory, we'll tell you more concerning our plans and products. Until then... we'll continue to do our utmost to turn out more planes, parts, and plastics for war... to speed victory and peace.

**McDONNELL** *Aircraft Corporation*  
*Manufacturers of* PLANES • PARTS • PLASTICS ★ SAINT LOUIS—MEMPHIS ★



**REPUBLIC AVIATION CORP.,**  
Farmingdale, N. Y.

PERSONNEL: A. Marchev, Pres.; H. W. Flickinger, V. Pres.; C. H. Miller, V. Pres. & Mgr., Farmingdale Div.; M. I. Peale, V. Pres. & Mgr., Indiana Div.; J. J. Ryan, V. Pres. & Counsel; A. Kartveli, V. Pres. & Chief Engr.; T. Davis, Secy. & Treas.; H. E. Lasker, Works Mgr.; C. J. Kucvyn, Prod. Mgr.; G. C. Sleeper, Pub. Rel. Dir. & Sales Mgr., Personal Plane Div.; D. M. Parker, Dir. Military Contracts; H. G. Larson, Procurement Dir.; C. J. Hodge, Ind. Rel. Dir.; C. H. Huff, Pub. Mgr.; F. VonRitter, Adv. Mgr.; I. J. Keough, Factory Mgr.

**ROBERTSON AIRCRAFT CORP.,**  
Lambert-St. Louis Municipal Airport,  
Robertson 21, Mo.

PERSONNEL: N. Schuyler, Pres.; J. C. Thompson, V. Pres.; W. B. Robertson, Secy.; P. L. McMahon, Treas.; R. N. Rioux, Gen. Mgr.; A. Overy, Prod. Mgr.; W. B. Russell, Sales Mgr. & Pub. Dir.; R. E. Laing, Pur. Dir.; J. M. Johannes, Pers. Dir.; V. W. Payne, Chief Engr.; J. E. Downing, Factory Mgr.

**RYAN AERONAUTICAL CO.,**  
Lindbergh Field, San Diego, Calif.

PERSONNEL: T. C. Ryan, Pres.; O. L. Woodson, V. Pres. & Gen. Mgr.; G. A. Stillwagon, Secy.; G. C. Woodard, Treas.; G. E. Barton, Works Mgr.; S. C. Breder, Sales Mgr.; O. F. Rigley, Pur. Dir.; W. F. Persons, Pers. Dir.; W. Wagner, Pub. Dir. & Adv. Mgr.; B. T. Salmon, Chief Engr.

**TAYLORCRAFT AVIATION CORP.,**  
Alliance, O.

PERSONNEL: J. C. Hart, Pres.; R. G. King, Asst. to Pres.; R. H. Wendt, V. Pres. & Chief Engr.; K. W. Tibbits, V. Pres.-Mfg.; M. W. Third, Secy. & Treas.; R. E. Iden, Asst. Sales Mgr.; O. M. Bell, Pur. Dir.; G. A. Bennett, Pers. Dir.; J. F. Masterson, Pub. Dir. & Adv. Mgr.

**UNITED AIRCRAFT CORP.,**  
400 S. Main St., East Hartford 8, Conn.

PERSONNEL: F. B. Rentschler, Ch.; E. E. Wilson, R. Walsh, V. Ch.; J. F. McCarthy, Controller; H. M. Horner, Pres.; L. S. Hobbs, V. Pres.-Engrg.; C. J. McCarthy, S. A. Stewart, V. Pres.; C. H. Chatfield, Secy.; C. L. Gault, Treas.; F. W. Caldwell, Dir. Research; J. M. Barr, Mgr., Export Dept.; R. E. Beach, Dir. Contract Termination; M. F. Burke, Pers. Dir.; N. V. Clements, Dir. Adv. & Pub.; T. E. Sullivan, H. E. Mooberry, Assts. to Pres.

**UNIVERSAL MOULDED PRODUCTS**  
CORP., Bristol, Va.

PERSONNEL: T. H. McKoy, Jr., Pres.; H. W. Page, V. Pres., Treas. & Gen. Mgr.; R. L. Reed, Secy.; R. E. Glavin, Prod. Mgr. & Factory Mgr.; D. C. Malcom, Sales Mgr.; G. S. Spinks, Pur. Dir.; G. Pfeeger, Pers. Dir.; R. J. Nebesar, Chief Engr.

**CHANCE VOUGHT AIRCRAFT, DIV. OF**  
**UNITED AIRCRAFT CORP.,**  
550 S. Main St., Stratford, Conn.

PERSONNEL: R. B. Beisel, Gen. Mgr.; H. L. Hartman, Exec. Asst.; J. J. Gaffney, Div. Acct.; R. W. Gleason, Asst. Treas. & Asst. Secy.; P. S. Baker, Engrg. Mgr.; J. M. Shoemaker, Chief Engr.; B. D. Taliaferro, Factory Mgr.; G. Franko, Chief Inspector; W. H. Espey, Plant Engr.; J. J. Hospers, Service Mgr.; F. W. Lauer, Procurement Mgr.; G. V. Anderson, Pers. Supervisor; J. E. Dare, Surplus Sales Supervisor; F. J. Delear, Pub. Rep.

**THE WACO AIRCRAFT CO.,** Troy, O.  
PERSONNEL: C. J. Brukner, Pres.; H. R. Perry, V. Pres., Acting Secy. & Gen. Mgr.; A. F. Arcier, V. Pres.-Engrg.; R. E. Hoefflin, Treas.; P. L. Hobbins, Pur. Agt.; M. G. Lowman, Pers. Dir.; C. J. Lake, Adv. Mgr.; R. Pearson, Factory Mgr.

**WHITE AIRCRAFT CORP.,** Palmer, Mass.  
PERSONNEL: D. G. White, Pres. & Treas.; R. Turner, V. Pres.; M. H. Lawrence, Secy.; S. E. Shaw, Pur. Dir.; R. M. Collat, Pers. Dir. & Pub. Dir.; C. Killmeyer, Factory Mgr.; R. W. Goodell, Compt.

---

**ROTOR AIRCRAFT**

---

**BELL AIRCRAFT CORP.,**  
2050 Elmwood Ave., Buffalo, N. Y.  
PERSONNEL: L. D. Bell, Pres. & Gen. Mgr.; R. P. Whitman, First V. Pres.; H. E. Collins, J. V. Carmichael, V. Pres.; C. L. Beard, V. Pres. & Secy.; L. F. Sperry, V. Pres. & Treas.; D. G. Forman, Exec. Asst. to Pres.; L. P. Faneuf, Asst. to Pres.; D. F. Devine, Compt.; H. Gaylord, Ind. Engrg. Mgr.; J. Meade, Labor Rel. Dir.; H. H. Munsey, Patent Atty.; S. E. Fitzgerald, Pub. Rel. Dir.

**G & A AIRCRAFT, INC.,**  
Pitcairn Field, Willow Grove, Pa.  
PERSONNEL: V. H. Frazier, Pres.; J. L. Cohill, R. H. Isbrandt, V. Pres.; C. A. Pauley, Treas.; H. S. Brainard, Secy.; L. J. Campbell, Asst. Secy. & Asst. Treas.

**KELLETT AIRCRAFT CORP.,**  
Lansdowne Ave. & State Rd., Upper  
Darby, Pa.

PERSONNEL: W. W. Kellett, Pres.; R. G. Kellett, Exec. V. Pres.; W. L. Wilson, V. Pres.; R. H. Prewitt, V. Pres.-Engrg.; W. R. Yarnall, Secy. & Treas.; S. W. Frick, Asst. Secy. & Gen. Counsel; T. S. Ryan, Asst. Treas.; W. V. Trelease, Factory Mgr.

**MCDONNELL AIRCRAFT CORP.,**  
St. Louis, Mo.

PERSONNEL: J. S. McDonnell, Pres., Sales Mgr., Pub. Dir. & Adv. Mgr.; G. W. Carr, Exec. V. Pres.; L. A. Smith, V. Pres., Secy. & Treas.; N. L. Stetsen, Prod. Mgr.; J. M. Lipscomb, Pur. Dir.; F. H. Eyer, Pers. Dir.; G. C. Covington, Chief Engr.; C. W. Drake, Factory Mgr.

**PLATT-LEPAGE AIRCRAFT CO.,**  
P. O. Box 59, Chester, Pa.

PERSONNEL: W. L. LePage, Pres.; H. H. Platt, V. Pres.; H. F. A. Sessions, Secy., Pers. Dir. & Pub. Dir.; L. M. Burroughs, Treas.; D. C. Beatty, Gen. Mgr.; G. H. Miller, Sales Mgr.; F. K. Herding, Pur. Dir.; M. C. Smith, Chief Engr.; N. Sanderson, Factory Mgr.

**SIKORSKY AIRCRAFT, DIV. OF UNITED**  
**AIRCRAFT CORP.,** South Ave., Bridge-  
port 1, Conn.

PERSONNEL: B. L. Whelan, Gen. Mgr.; F. G. Dawson, Exec. Asst.; I. I. Sikorsky, Engrg. Mgr.; J. H. Spade, Div. Acct.; R. A. Aspinwall, Asst. Treas.; J. L. Brown, Jr., Factory Mgr.; C. L. Beers, Pur. Agt.; N. V. Clements, Dir. Adv. & Pub.; M. E. Gluhareff, Chief Engr.

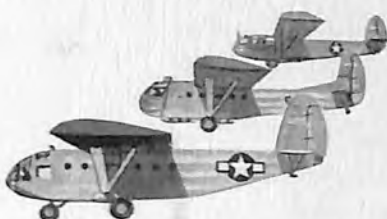
*Contractors to the U. S. Army Air Corps.*



DESIGNERS OF ALL ARMY  
CARGO-TRANSPORT GLIDERS

AIRCRAFT BUILDERS SINCE 1921

Designed by WACO and manufactured under WACO's engineering supervision are the gliders illustrated. Top to bottom: CG-3A, CG-4A, CG-13A and CG-15A.



THE WACO AIRCRAFT COMPANY • TROY, OHIO • U.S.A.

WORLD'S PREMIER AIRPLANE FABRIC

LIGHTER

STRONGER

SMOOTHER

FLIGHTEX

FLIGHTEX FABRICS, INC. • 93 WORTH ST. • NEW YORK 13, N. Y.

Leading Manufacturers of  
Fabric and Tapes for the  
Aircraft Industry.



Export Representative  
AVIQUIPO, Inc.  
25 Beaver Street, N. Y.  
Cable Add.: 'Aviquipo'

---

**GLIDERS**


---

**ALLIED AVIATION CORP.**, Baltimore, Md.  
**PERSONNEL:** R. E. Breed, III, Pres.; C. J. MacGarvey, Exec. V. Pres. & Treas.; J. C. Gaffin, V. Pres. & Sales Mgr.; E. V. Chartrand, Secy.; J. C. Richardson, Factory Mgr.; A. Arendt, Pur. Dir.; R. R. Scott, Pers. Dir.; L. L. Collins, Chief Engr.

**DEL-AIR CORP.**, De Land Fla.  
**PERSONNEL:** W. A. Stone, Pres. & Gen. Mgr.; W. J. Deegan, Jr., V. Pres., Secy. & Prod. Mgr.; E. M. Porter, Treas.; J. G. Vilsack, Jr., Pur. Dir.; J. A. Kelley, Pers. Dir.; C. H. Warner, Factory Mgr.

**G & A AIRCRAFT, INC.**,  
 Pitcairn Field, Willow Grove, Pa.  
**PERSONNEL:** V. H. Frazier, Pres.; J. L. Cohill, R. H. Ibrandt, V. Pres.; C. A. Pauley, Treas.; H. S. Brainard, Secy.; L. J. Campbell, Asst. Secy. & Asst. Treas.

**GENERAL AIRCRAFT CORP.**,  
 43-02 Ditmars Blvd., Astoria, N. Y.  
**PERSONNEL:** E. S. Gremse, Pres. & Treas.; L. W. Mattson, V. Pres. & Gen. Mgr.; K. I. Deane, Secy.; T. A. Martin, Prod. Mgr.; W. D. Byrne, Pur. Dir.; P. J. Collins, Pers. Dir.; E. C. Bedwell, Chief Engr.; A. Forward, Factory Mgr.

**KIRSCH CO.**, Sturgis, Mich.  
**PERSONNEL:** G. W. Kirsch, Pres. & Gen. Mgr.; J. N. Kirsch, V. Pres.; A. W. Evers, Secy., Pub. Dir. & Adv. Mgr.; D. W. Hoxie, Treas. & Factory Mgr.; L. Barnell, Prod. Mgr.; P. B. Stratton, Sales Mgr.; H. E. Davis, Pur. Dir.; J. A. McCormick, Pers. Dir.; F. Stutz, Chief Engr.

**McFARLAND AIRCRAFT CO.**,  
 Greenville, O.  
 Sailplane Div., R.F.D. Box 388M, Spring Valley, Calif.  
**PERSONNEL:** W. D. McFarland, Pres. & Treas.; J. B. Neiswonger, V. Pres.; L. R. McFarland, Secy.; C. L. Ofenstein, Chief Engr.

**NORTHWESTERN AERONAUTICAL CORP.**, 1902 W. Minnehaha Ave., St. Paul 4, Minn.  
**PERSONNEL:** J. E. Parker, Pres. & Gen. Mgr.; G. H. Plufka, V. Pres. & Treas.; R. W. Whittingham, Secy. & Prod. Mgr.; T. W. Pallister, Compt.; A. Molde, Pur. Dir.; D. H. Whitmore, Pers. Dir.; W. Stern, Pub. Dir.; B. H. T. Lindquist, Chief Engr.

**ROBERTSON AIRCRAFT CORP.**,  
 Lambert-St. Louis Municipal Airport,  
 Robertson 21, Mo.  
**PERSONNEL:** N. Schuyler, Pres.; J. C. Thompson, V. Pres.; W. B. Robertson, Secy.; P. L. McMahon, Treas.; R. N. Rioux, Gen. Mgr.; A. Overy, Prod. Mgr.; W. B. Russell, Sales Mgr. & Pub. Dir.; R. E. Laing, Pur. Dir.; J. M. Johannes, Pers. Dir.; V. W. Payne, Chief Engr.; J. E. Downing, Factory Mgr.

**SCHWEIZER AIRCRAFT CORP.**,  
 County Airport, Elmira, N. Y.  
**PERSONNEL:** E. Schweizer, Pres. & Chief Engr.; P. A. Schweizer, V. Pres., Treas., Gen. Mgr. & Sales Mgr.; B. P. McDowell, Secy.; W. Schweizer, Prod. Mgr. & Factory Mgr.; W. J. Brown, Pur. Dir.; E. S. Bardwell, Pers. Dir. & Pub. Dir.; F. Hurtt, Adv. Mgr.

---

**TAYLORCRAFT AVIATION CORP.**,  
 Alliance, O.

**PERSONNEL:** J. C. Hart, Pres.; R. G. King, Asst. to Pres.; R. H. Wendt, V. Pres.-Engrg.; K. W. Tibbitts, V. Pres.-Mfg.; M. W. Third; Secy. & Treas.; R. E. Iden, Asst. Sales Mgr.; O. M. Bell, Pur. Dir.; G. A. Bennett, Pers. Dir.; J. F. Masterson, Pub. Dir. & Adv. Mgr.

**THE WACO AIRCRAFT CO.**, TROY, O  
**PERSONNEL:** C. J. Brukner, Pres.; H. R. Perry, V. Pres., Acting Secy. & Gen. Mgr.; A. F. Arcier, V. Pres.-Engrg.; R. E. Hoefflin, Treas.; P. L. Hobbins, Pur. Agt.; M. G. Lowman, Pers. Dir.; C. J. Lake, Adv. Mgr.; R. Pearson, Factory Mgr.

---

**MANUFACTURERS OF  
 AIRCRAFT ENGINES**


---

**AIRCOOLED MOTORS CORP.**,  
 Liverpool Rd., Syracuse 8, N. Y.  
**PERSONNEL:** L. E. Pierson, Jr., Pres.; C. T. Doman, V. Pres. & Chief Engr.; C. F. B. Roth, V. Pres., Gen. Sales Mgr. & Pub. Dir.; C. F. Carr, Secy. & Treas.; J. E. Babcock, Factory Mgr.; C. H. Bennum, Sales Mgr.; A. K. Stevens, Pur. Dir.; H. H. Severson, Pers. Dir.

**ALLISON DIV., GENERAL MOTORS CORP.**,  
 Indianapolis, Ind.  
**PERSONNEL:** E. B. Newill, Gen. Mgr.; W. G. Guthrie, Prod. Mgr.; R. C. Golt, Sales Mgr.; R. E. Settle, Pur. Dir.; K. H. Hoffman, Pers. Dir.; R. C. Fleming, Pub. Dir. & Adv. Mgr.; R. M. Hazen, Chief Engr.

**CONTINENTAL MOTORS CORP.**,  
 205 Market St., Muskegon, Mich.  
**PERSONNEL:** C. J. Reese, Pres. & Gen. Mgr.; B. F. Tobin, Jr., Exec. V. Pres.; L. P. Kalb, Exec. V. Pres.-Oper.; A. Wild, V. Pres. & Mgr., Aircraft Div.; G. E. Winters, V. Pres.-Prod.; G. J. Harinton, V. Pres. & Factory Mgr.; D. H. Hollowell, V. Pres.-Sales & Service, Aircraft Div.; B. F. Tobin, Jr., V. Pres. & Secy.; H. W. Vandeven, Treas.; R. D. Hicks, Service Mgr., Aircraft Div.; J. L. Wierengo, Adv. & Pub. Rel. Mgr.; T. Jackson, Chief Engr., Aircraft Div.; J. Baker, Pers. Dir.; M. R. Ramsey, Dir. Pur.; F. French, Prod. Supt., Aircraft Div.

**GENERAL ELECTRIC CO.**,  
 1 River Rd., Schenectady 5, N. Y.

**THE GUIBERSON CORP.**,  
 1000 Forest Ave., Dallas, Tex.  
**PERSONNEL:** A. Guiberson, Pres.; W. W. Finlay, V. Pres. & Gen. Mgr.; R. D. Wallis, Secy. & Treas.; J. B. Story, Sales Mgr.; W. Rathbun, Pur. Dir.; M. B. Bogarte, Pers. Dir.; H. W. Strong, Pub. Dir. & Adv. Mgr.; R. Taylor & B. Lind, Chief Engrs.; C. Adams, E. Von Reyn, P. F. LaRoche, Factory Mgrs.

**JACOBS AIRCRAFT ENGINE CO.**,  
 750 Queen St., Pottstown, Pa.  
**PERSONNEL:** J. A. Harris, III, Ch. & Pres.; H. B. Knerr, V. Pres., Treas. & Gen. Mgr.; J. S. Smith, V. Pres. & Secy.; A. R. Jacobs, V. Pres. & Engrg. Dir.; G. F. Brece, Asst. Treas.; K. N. Thompson, Asst. Secy.; A. R. Thomas, Asst. Gen. Mgr.; G. S. Garrard, Acting Chief Engr.; C. E. Stetler, Gen. Supt.; D. C. Frederick, Service Mgr.; R. J. Thomas, Metallurgist; I. Swede, Chief Inspector; W. A. Hurlman, Asst. Chief Engr.; J. S. Lucas, Sales & Service; H. E. Rader, Maintenance Supt.; G. H. Lamore, Traffic Mgr.; L. M. Basler, Pers. Mgr.; R. I. Yocom, Pur. Agt.

## DISTINGUISHED SERVICE

They've blasted Germans and Japs, and have served the Russians and British. ★ Everywhere they have performed distinguished service. ★ Because of their dependability, these engines are always ready to go. Because of their smoothness, there is less pilot fatigue. Because of their economy with fuel, their range is wide. ★ These are engine qualities that will be important to you in the days of far-flung air transport to come.



**POWERED BY ALLISON**

- P-38 - Lightning*
- P-39 - Airacobra*
- P-40 - Warhawk*
- A-36 and P-51 - Mustang*
- P-63 - Kingcobra*

*Allison has already furnished more than 75,000,000 H.P. for use in these planes.*

**LIQUID-COOLED AIRCRAFT ENGINES**

*Allison*  
 DIVISION OF  
 Indianapolis, Indiana



**KEEP AMERICA STRONG  
 BUY MORE WAR BONDS**

*Every Sunday Afternoon*  
 GENERAL MOTORS SYMPHONY OF THE AIR - NBC Network

**KINNER MOTORS, INC.,**

635 W. Colorado Blvd., Glendale 4, Calif.  
 PERSONNEL: E. Herring, Pres.; G. Edenquist, V. Pres., Sales Mgr. & Adv. Mgr.; V. E. Semrau, Secy. & Treas.; J. N. Gladden, Gen. Mgr.; V. J. Wagoner, Prod. Mgr.; P. Coleson, Pur. Dir.; R. E. Hannum, Pers. Dir.; J. G. Kuhn, Chief Engr.

**LYCOMING DIV., THE AVIATION CORP.,**  
Williamsport, Pa.

PERSONNEL: V. Emanuel, Ch. of Board; I. Babcock, Pres.; W. F. Wise, L. I. Hartmeyer, B. Conway, I. J. Snader, V. Pres.; R. S. Pruitt, V. Pres. & Secy.; W. A. Mogensen, V. Pres. & Treas.; G. G. Johnson, Plant Mgr.; H. J. Glasby, Factory Mgr.; E. L. Wilkinson, Prod. Mgr.; R. E. Posthauer, Sales Mgr.; J. J. Elliott, Pur. Dir.; C. Bishop, Pers. Dir.; A. W. Gratop, Pub. Dir.; S. K. Hoffman, Chief Engr.

**PHILLIPS AVIATION CO.,**

1525 Monterey Rd., S. Pasadena, Calif.  
 PERSONNEL: J. A. Phillips, Jr., Pres. & Gen. Mgr.; D. B. Morgan, V. Pres.; L. M. Phillips, Secy. & Treas.; O. A. Phillips, Prod. Mgr. & Chief Engr.; C. A. Mason, Pur. Dir. & Factory Mgr.; B. Swartz, Pers. Dir.

**PRATT & WHITNEY AIRCRAFT DIV.,**  
**UNITED AIRCRAFT CORP.,**

400 S. Main St., East Hartford 8, Conn.  
 PERSONNEL: W. P. Gwinn, Gen. Mgr.; L. S. Johnson, Exec. Asst. to Gen. Mgr.; C. L. Burns, Asst. to Gen. Mgr.; W. A. Parkins, Engrg. Mgr.; A. V. D. Willgoos, Chief Engr.; V. Cronstedt, Exec. Engr.; T. E. Tillinghast, Sales Mgr.; F. T. Hawes, Adm. Asst. to Sales Mgr.; L. H. Gitzinger, Chief Installation Engr.; H. E. Carlson, Supvr.-Engine Orders; E. S. McLellan, Contact Administration; L. L. Snow, Airport Mgr.; F. H. Flynn, Service Mgr.; A. Dewing, Acting Mgr.-Spare Parts Sales; R. T. Horner, Div. Accountant; J. R. Seaman, Asst. Treas.; G. H. D. Miller, Factory Mgr.; D. Jack, Asst. Factory Mgr.-Mech. Methods; J. S. Robertson, Asst. Factory Mgr.-Administration; E. S. Marks, Asst. Quality Mgr.; A. A. Merry, Chief Tool Engr.; W. F. Eddy, Jr., Materials Engr.; J. J. Borrup, Prod. Mgr.; J. W. Dunnell, Pur. Mgr.; R. W. Pinkham, Pur. Agt.; C. H. Crook, Traffic Mgr.; T. R. Downs, Pers. Supvr.; G. E. Slye, Pub. Rep.

**PRATT & WHITNEY AIRCRAFT CORP. OF**  
**MISSOURI, Bannister Rd. & Troost**  
**Ave., Kansas City, Mo.**

PERSONNEL: H. M. Horner, Pres.; L. C. Mallet, V. Pres. & Gen. Mgr.; R. T. Riley, V. Pres. & Asst. Gen. Mgr.; C. L. Gault, Treas.; C. H. Chatfield, Secy.; F. Detweiler, Div. Acct. & Asst. Secy.; V. I. Moncrieff, Factory Mgr.; H. R. Barre, Pur. Agt.; J. L. Bunce, Chief Engr.; C. F. Toren, Chief Inspector; L. Doty, Assembly & Test Supt.

**RANGER AIRCRAFT ENGINES DIV., OF**  
**FAIRCHILD ENGINE & AIRPLANE**  
**CORP., Farmingdale, N. Y.**

PERSONNEL: H. H. Budds, V. Pres. & Gen. Mgr.; E. M. Lester, Asst. Gen. Mgr. & Dir. Contracts; H. van Gerbig, Asst. Gen. Mgr.; M. G. Demougeot, Mfg. Mgr.; C. E. Smith, Mgr. Plant No. 1; F. D. Hubbard, Dir. Pur.; C. O. Samuelson, Contracts Mgr.; A. T. Gregory, Chief Engr.; C. P. Sander, Asst. Chief Engr.; P. Wellenkamp, Mgr. Engrg. Oper.; W. E. Myott, Chief Plant Engr.; T. Hammen, Jr., Field & Installation Engr.; W. H. Seymour, Compt.; C. E. Carrigan, Chief Metallurgist; J. B. Tallman, Sr., Quality Mgr.; J. F. Stengel, Dir. Ind. Rel.; H. A. Hershfield, Jr., Dir. Pub. Rel.

**THE WARNER AIRCRAFT CORP.,**

20263 Hoover Ave., Detroit 5, Mich.  
 PERSONNEL: W. O. Warner, Pres. & Gen. Mgr.; L. A. Faunce, V. Pres., Sales Mgr. & Adv. Mgr.; L. A. Majneri, V. Pres. & Chief Engr.; W. J. Jarvie, Secy. & Treas.; G. A. Dahlquist, Prod. Mgr. & Factory Mgr.; G. Whetter, Pur. Dir.; K. Symington, Pers. Dir.

**WRIGHT AERONAUTICAL CORP., DIV.**  
**OF CURTISS-WRIGHT CORP.,**

132 Beckwith Ave., Paterson, N. J.  
 PERSONNEL: G. W. Vaughan, Ch. of Bd. & Pres.; G. M. Williams, Exec. V. Pres.; P. B. Taylor, V. Pres. & Acting Gen. Mgr.; W. D. Kennedy, V. Pres. & Mgr.-Cincinnati Plant; C. C. King, Treas.; E. S. Cramer, Secy.; J. H. Darragh, Jr., Asst. Secy. & Asst. Treas.; J. M. Scanlan, Asst. Secy.; R. F. Gagg, Asst. to Gen. Mgr.; A. A. Tumser, Inspection Dir.; P. W. Brown, Mfg. Dir.; W. J. Ehlers, Ind. Rel. Dir.; R. E. Johnson, Marketing Dir.; W. B. Birren, Sales & Service Mgr.; M. J. Storz, Pub. Rel. Mgr.; R. W. Young, Chief Engr.; J. G. Stock, Gen. Controller; C. C. Shellberg, Pur. Mgr.; J. T. Wetzel, Service Mgr.; T. M. Lucas, Contract Mgr.; A. Sunday, Mgr.-License Div.; J. M. Demarest, Mgr.-Paterson Plant; G. P. Terwilliger, Mgr. of Pers. & Employee Rel. Div.-Paterson Plants; D. Wallace, Plant Engr.-Paterson Plants; K. E. Sutton, Mgr.-Wood Ridge Plant.

---

Simmonds-Hobson

**AUTOMATIC ENGINE CONTROLS****PUSH-PULL CONTROLS****HYDRAULIC ACCUMULATORS****HYDRAULIC FUSE****CHRONOMETRIC RADIOSONDES****SPARK PLUGS****EQUIPMENT AND COMPONENTS FOR**  
**HYDRAULIC SYSTEMS****COWLING AND PANEL CLIPS**  
**AND FASTENERS**


**SIMMONDS**  
AEROCESSORIES INC.

**30 ROCKEFELLER PLAZA, N. Y. 20, N. Y.**

# POWER ALOFT

With the smoothness of sail and  
the might of a storm, Wright engines  
supply pre-eminent power aloft  
in the boundless ocean of the air.



CYCLONES AND WHIRLWINDS PAY THEIR WAY

# CLASSIFIED DIRECTORY OF EQUIPMENT MANUFACTURERS

## ABRASIVES

Avondale Chemical Co.  
Bay State Abrasive Products Co.  
Continental Machines, Inc.  
General Abrasive Co., Inc.  
General Aircraft Supply Corp.  
Hanson-Van Winkle-Munning Co.  
R. M. Hollingshead Corp.  
Ideal Commutator Dresser Co.  
Lasalco, Inc.  
The Lea Manufacturing Co.  
Mead Specialties Co.  
Mid-West Abrasive Co.  
Peiger, McCaw & Co.  
The Udylite Corp.  
Weldon Roberts Rubber Co., Bright-  
boy Industrial Div.

## AIR COMPRESSORS

Aerco Corp.  
Allis-Chalmers Manufacturing Co.  
Brunner Manufacturing Co.  
Champion Pneumatic Machinery Co.  
Curtis Pneumatic Machinery Div.,  
Curtis Mfg. Co.  
Durham Aircraft Service, Inc.  
The Electric Sprayit Co.  
Hartwell Aviation Supply Co.  
Lynch Manufacturing Corp.  
The Marquette Metal Products Co.  
Paasche Airbrush Co.  
Pesco Products Co.  
Ritter Co., Inc.  
K. R. Wilson  
Worthington Pump & Machinery Corp.

## AIRCRAFT ARMAMENT & EQUIPMENT

Adel Precision Products Corp.  
Aerojet Engineering Corp.  
Air-Parts, Inc.  
Air Transport Mfg. Co.  
All American Aircraft Products, Inc.  
Bendix Products Div., Bendix Aviation  
Corp.  
Booth Manufacturing Corp.

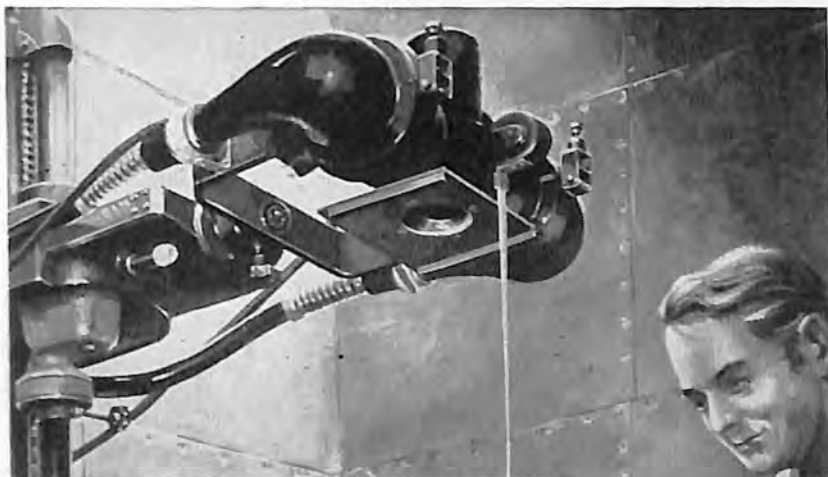
Breeze Corporations, Inc.  
Burklyn Co.  
Capac Manufacturing Co.  
Chandler Evans Corp.  
Consolidated Vultee Aircraft Corp.  
Curtiss-Wright Corp.  
Del-Air Corp.  
The Electric Sprayit Co.  
Fairchild Camera & Instrument Corp.  
General Aviation Equipment Co., Inc.  
General Electric Co.  
Harvey-Whipple Inc.  
Heyer Products Co. Inc.  
Interstate Aircraft & Engrg. Corp.  
Kaiser Cargo, Inc., Fleetwings Div.  
Walter Kidde & Co., Inc.  
King Plastics Corp.  
The Laister-Kauffmann Aircraft Corp.  
P. R. Mallory & Co., Inc.  
Glenn L. Martin Co.  
Micro Switch Div., First Industrial  
Corp.  
National Machine Products  
Pollak Manufacturing Co.  
Preco Inc.  
Southern Aircraft Corp.  
Spartan Aircraft Co.  
Specialties, Inc.  
Sperry Gyroscope Co., Inc.  
The Steel Products Engineering Co.  
Tennessee Aircraft, Inc.  
United States Radium Corp.  
Variety Aircraft Corp.  
Wallace Engineering Co.  
N. A. Woodworth Co.

## AIRCRAFT PARTS

Jack & Heintz, Inc.  
Rohr Aircraft Corp.

## Aluminum

Acme Aluminum Alloys Inc.  
Advance Aluminum Castings Corp.  
Aero Supply Mfg. Co. Inc.  
Aero Trades Co.  
Aeronautical Manufacturing Corp.  
Agawam Aircraft Products, Inc.



## QUALITY CONTROL...

Assures Easier Machining and Better Performance of Acme Aluminum Castings

THE aluminum alloy castings that come to you from the Acme foundry are tested castings—put through every form of inspection and examination known to modern metallurgical technique.

X-ray inspection gives a clear and accurate picture of the casting's internal structure.\* To measure strength, bars from every melt are pulled to the breaking point on a tensile machine. And the completion of our spectographic laboratory has put at our disposal—and yours—the newest advancements in the scientific analysis of alloy metals.

Because of their accuracy and in-



herent quality, you will find Acme Aluminum Alloy Castings require less machining time, reduce your cost per finished part.

Acme engineers will be glad to submit recommendations, without obligation.

# ACME

*Aluminum Alloys, Inc.*

Formerly Acme Pattern & Tool Co., Inc.

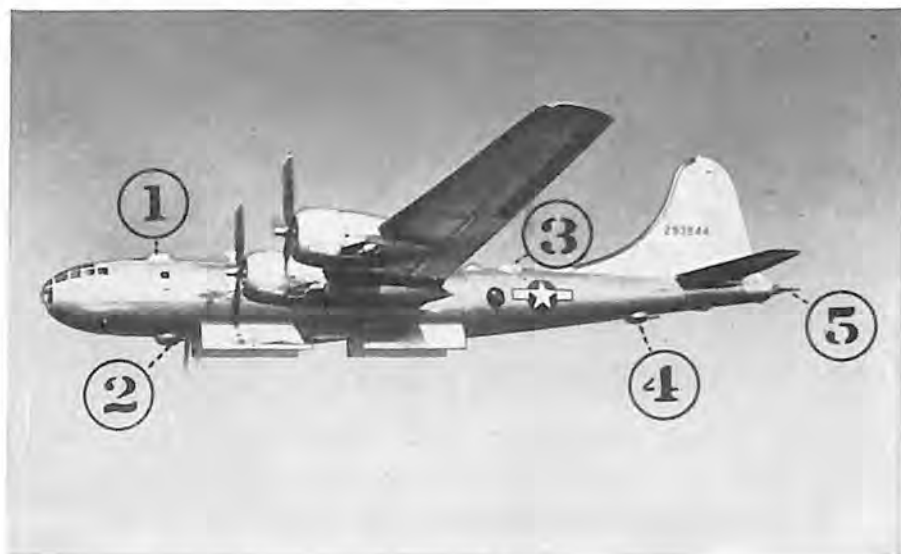
DAYTON 3, OHIO

PATTERNS • TOOLS • ALUMINUM CASTINGS • ENGINEERING



## G-E ARMAMENT SYSTEMS

for greater protection from fewer guns



●The five G-E turrets on the B-29 are so located that several guns can be concentrated in any direction.

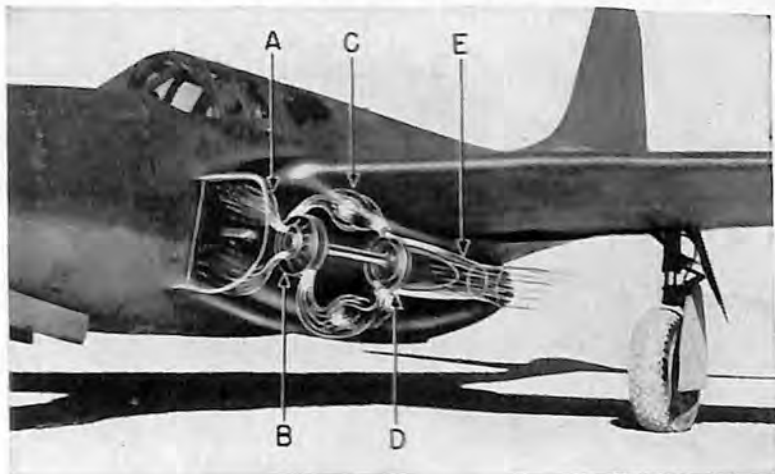
**Many advantages:** By providing extremely accurate, *remote* control of gunfire, the new G-E armament systems have made it possible to locate sighting stations where they give gunners greater visibility, physical comfort, and armor protection. They have facilitated the placing of gunners in pressurized areas, and put them where noise and vibration are markedly less. All of these factors contribute much to the combat efficiency of gunners.

In addition, separation of sighting station from turret has resulted in less drag and better aerodynamic design. Highly important, too, the total weight of these armament systems is less than that of locally controlled armament now in use.

We at G.E. are proud of the part this new gunfire-control system is playing to hasten V-Day. We are proud of it, too, as an outstanding example of how, in peacetime, G-E "can do" will make planes more economical, and easier and safer to fly.

# G-E AIRCRAFT GAS TURBINES

**Lightning-swift speed** and other vitally important advances in performance characteristics have been achieved by propellerless planes powered by the aircraft gas turbine, developed and produced from the original British design by General Electric.



**Operation:** A. Air flows into intake; B. Air is compressed; C. Compressed air goes to blast chamber, where fuel is ignited and temperature raised; D. Turbine is propelled by gas pressure, and it in turn gives power to air compressor at front of engine; E. Nozzle through which air flows at high velocity, creating, by reaction, the force which drives the plane forward.

### SOME OF MANY OTHER G-E AIRCRAFT PRODUCTS

- |                                  |                                 |
|----------------------------------|---------------------------------|
| A-c and d-c power-supply systems | Electric motors                 |
| Aircraft instruments             | Electric heating devices        |
| Aircraft lamps                   | Ignition systems                |
| Amplidynes                       | Radio receivers                 |
| Automatic pilots                 | Radio transmitters              |
| D-c generators                   | Selsyn-operated control systems |
| Electric control devices         | Turbosuperchargers              |

No matter where you are located, there is a G-E representative near you—he'll be glad to serve you in any way he can.  
*General Electric Company, Schenectady 5, New York.*

**GENERAL  ELECTRIC**

640-160

**(Aluminum) Continued**

- Air-Parts, Inc.  
 Air Transport Mfg. Co.  
 Aircraft Engineering Products, Inc.  
 Aircraft Hardware Mfg. Co.  
 Aircraft Products Co.  
 Aircraft Specialties Co.  
 Aircraft Standard Parts Co.  
 The Aircraftsmen Co.  
 Allison Div., General Motors Corp.  
 Alten's Foundry & Machine Works  
 Aluminum Co. of America  
 Aluminum Goods Mfg. Co.  
 Aluminum Ladder Co.  
 American Aluminum Ware Co.  
 American Central Mfg. Corp.  
 American Tube Bending Co., Inc.  
 Anderson Aircraft Inc.  
 Arnolt Motor Co.  
 Atlantic Diesel Corp.  
 Atlas Metal Stamping Co.  
 B. H. Aircraft Co., Inc.  
 Bastian Bros. Co.  
 Booth Manufacturing Corp.  
 Camloc Fastener Corp.  
 Cannon Electric Development Co.  
 Columbia Aircraft Corp.  
 Columbia Aircraft Products, Inc.  
 Consolidated Vultee Aircraft Corp.  
 The Corbin Screw Corp.  
 Corry-Jamestown Mfg. Corp.  
 Criterion Machine Works  
 Crowe Name Plate & Mfg. Co.  
 Cunningham-Hall Aircraft Corp.  
 Dahlstrom Metallic Door Co.  
 Richard M. Decker Co., Inc.  
 Del-Air Corp.  
 Delco-Remy Div., General Motors Corp.  
 Deutsch Co.  
 Dollin Corp.  
 Durham Aircraft Service, Inc.  
 Edo Aircraft Corp.  
 The Electric Sprayit Co.  
 Fairchild Aircraft Div., Fairchild Engine & Airplane Corp.  
 Ferracute Machine Co.  
 Firestone Aircraft Co.  
 The Flour City Ornamental Iron Co.  
 Fox Co.  
 George K. Garrett Co., Inc.  
 General Aircraft Equipment Inc.  
 General Aviation Equipment Co., Inc.  
 The General Tire & Rubber Co.  
 Goodyear Aircraft Corp.  
 The Guiberson Corp., Aircraft & Heater Div.  
 The Hartford Machine Screw Co.  
 Hartwell Aviation Supply Co.  
 Harvill Corp.  
 Hayes Manufacturing Corp.  
 A. W. Hecker  
 Heyer Products Co. Inc.  
 Heyman Mfg. Co.  
 Huntington Precision Products Div., Adel Precision Products Corp.  
 Interstate Aircraft & Engrg. Corp.  
 Kaiser Cargo, Inc., Fleetwings Div.  
 The Kawneer Co.  
 The Laister-Kauffmann Aircraft Corp.  
 Lavelle Aircraft Corp.  
 Liberty Aircraft Products Corp.  
 Luscombe Airplane Corp.  
 Luscombe Engineering Co.  
 Lycoming Div., The Aviation Corp.  
 Lyon Metal Products, Inc.  
 Major Aircraft Foundry  
 The Marquette Metal Products Co.  
 Glenn L. Martin Co.  
 Mercury Aircraft Inc.  
 Merz Engineering Co.  
 Meyers Aircraft Co.  
 Milwaukee Metal Spinning Co.  
 Moore-Eastwood & Co.  
 The Murray Corp. of America  
 National Machine Products  
 The Ohio Piston Co.  
 Olmsted Manufacturing Div., Southwestern Development Co.  
 Otto Aviation Corp.  
 The Parker Appliance Co.  
 The Permold Co.  
 Perry Metal Products Co. Inc.  
 Phillips Aviation Co.  
 Pollak Manufacturing Co.  
 Pressed & Welded Steel Products Co.  
 Reesor Manufacturing Co.  
 Revere Copper & Brass Inc.  
 Reynolds Metals Co.  
 Rigid-Tex Corp.  
 Ritter Co., Inc.  
 Robertson Aircraft Corp.  
 Rocky Mountain Steel Products, Inc.  
 Ryan Aeronautical Co.  
 S & M Lamp Co.  
 Schweizer Aircraft Corp.  
 Scott Aviation Corp.  
 Scovill Manufacturing Co.  
 Skalla Manufacturing Co.  
 So-Cal Foundry  
 South Shore Machine & Tool Works, Inc.  
 Southern Aircraft Corp.  
 Spartan Aircraft Co.

*Cut Production Costs* with **MERZ**



**SPECIAL GAGES  
AND FIXTURES**

\*\*\* With facilities unexcelled in the Central States, we are prepared to undertake a complete production tooling job or to design and manufacture any special gage or fixture required. Standard plain and threaded, plug and ring gages shipped promptly from stock. Write for new literature, just off the press.

**MERZ**

*Engineering Company*

INDIANAPOLIS 7, INDIANA



Registered U.S. Pat. Off.

ALUMINUM COMPANY  
OF AMERICA

**ALCOA ALUMINUM**

**The One Metal  
That Flies Best**

**ALUMINUM COMPANY OF AMERICA**

**Pittsburgh, Pennsylvania**

**(Aluminum) Continued**

Swift Lubricator Co., Inc.  
 Taylorcraft Aviation Corp.  
 Technical Ply-Woods  
 Tennessee Aircraft, Inc.  
 Thompson Products, Inc.  
 Union Aircraft Products Corp.  
 United Aircraft Products, Inc.  
 Utility Fan Corp.  
 Variety Aircraft Corp.  
 The Vimalert Co., Ltd.  
 The Voges Manufacturing Co.  
 Wallace Engineering Co.  
 Weber Showcase & Fixture Co., Inc.  
 The Wellman Bronze & Aluminum Co.  
 Wells Aircraft Parts Co.  
 R. D. Werner Co., Inc.  
 Westinghouse Electric & Manufacturing Co.  
 White Aircraft Corp.  
 E. W. Wiggins Airways, Inc.

**Cork**

Adel Precision Products Corp.  
 Air-Parts, Inc.  
 Jack Best Mfg. Co.  
 Consolidated Vultee Aircraft Corp.  
 Detroit Gasket & Mfg. Co.  
 Huntington Precision Products Div.,  
 Adel Precision Products Corp.  
 Otto Aviation Corp.  
 Phillips Aviation Co.  
 United Aircraft Products, Inc.

**Felt**

Adel Precision Products Corp.  
 Air-Parts, Inc.  
 Automotive Rubber Co.  
 Benray Products Co.  
 Jack Best Mfg. Co.  
 The Booth Felt Co.  
 Charles Manufacturing Co.  
 Consolidated Vultee Aircraft Corp.  
 Huntington Precision Products Div.,  
 Adel Precision Products Corp.  
 Otto Aviation Corp.  
 Peiger, McCaw & Co.  
 The Udyllite Corp.

**Fibre**

Adel Precision Products Corp.  
 Air-Parts, Inc.  
 Jack Best Mfg. Co.  
 Consolidated Vultee Aircraft Corp.

Interstate Aircraft & Engrg. Corp.  
 Kaiser Cargo, Inc., Fleetwings Div.  
 The Laister-Kauffmann Aircraft Corp.  
 Mica Insulator Co.  
 Otto Aviation Corp.  
 Spaulding Fibre Co., Inc.  
 Taylor Fibre Co.  
 Technical Ply-Woods  
 Wells Aircraft Parts Co.  
 E. W. Wiggins Airways, Inc.  
 Wilmington Fibre Specialty Co.

**Leather**

Air-Parts, Inc.  
 Benray Products Co.  
 Blanchard Bros. & Lane  
 Charles Manufacturing Co.  
 Consolidated Vultee Aircraft Corp.  
 Eagle Ottawa Leather Co.  
 Hamilton-Wade Co.  
 E. F. Houghton & Co.  
 Interstate Aircraft & Engineering Corp.  
 The Lackawanna Leather Co.  
 Landers Corp.  
 Otto Aviation Corp.  
 Peiger, McCaw & Co.

**Magnesium**

Aeronautical Products, Inc.  
 Agawam Aircraft Products, Inc.  
 Air-Parts, Inc.  
 Air Transport Mfg. Co.  
 Aircraft Engineering Products, Inc.  
 Aircraft Products Co.  
 Allison Div., General Motors Corp.  
 Aluminum Co. of America  
 Aluminum Ladder Co.  
 American Central Mfg. Corp.  
 Arnolt Motor Co.  
 Atlantic Diesel Corp.  
 B. H. Aircraft Co., Inc.  
 Columbia Aircraft Products, Inc.  
 Consolidated Vultee Aircraft Corp.  
 Cunningham-Hall Aircraft Corp.  
 The Dow Chemical Co.  
 Firestone Aircraft Co.  
 The General Tire & Rubber Co.  
 Goodyear Aircraft Corp.  
 Harvill Corp.  
 Heyer Products Co. Inc.  
 Interstate Aircraft & Engrg. Corp.  
 Kaiser Cargo, Inc., Fleetwings Div.  
 The Laister-Kauffmann Aircraft Corp.  
 Luscombe Airplane Corp.



## MAGNESIUM ALLOYS

When you buy Dowmetal magnesium ingots, castings or wrought products, you are getting the unrivalled advantage of 29 years' experience in the production and fabrication of magnesium. Every step in the production process from the raw material to the finished part is under strict metallurgical control.

INGOTS  
STICKS  
ALLOY INGOTS  
MELTING FLUXES  
PROTECTIVE AGENTS  
WELDING FLUX

WELDING ROD  
SAND CASTINGS  
PERMANENT MOLD  
CASTINGS  
DIE CASTINGS  
BAR, ROD AND TUBING

EXTRUDED SHAPES  
SHEET, STRIP AND PLATE  
FORGING STOCK  
FORGINGS  
FABRICATING SHOP FOR  
MAGNESIUM ASSEMBLIES

### MAGNESIUM DIVISION

THE DOW CHEMICAL COMPANY, MIDLAND, MICHIGAN

New York . Boston . Philadelphia . Washington . Cleveland . Detroit . Chicago  
St. Louis . Houston . San Francisco . Los Angeles . Seattle

## SINCE 1932

- **Welded Tubular Assemblies**
- **Fabricated Alloy Steel Parts and Drop Forgings**

● ● ● **for AIRCRAFT**

DESIGNERS      ENGINEERS      MANUFACTURERS

**AIRCRAFT MECHANICS, Inc.**

Colorado Springs,                      Colorado

**(Magnesium) Continued**

Lycoming Div., The Aviation Corp.  
 Merz Engineering Co.  
 Milwaukee Metal Spinning Co.  
 National Machine Products  
 The Ohio Piston Co.  
 Olmsted Manufacturing Div., South-  
 western Development Co.  
 Otto Aviation Corp.  
 Phillips Aviation Co.  
 Revere Copper & Brass Inc.  
 Rocky Mountain Steel Products, Inc.  
 Spartan Aircraft Co.  
 Swift Lubricator Co., Inc.  
 The Vimalert Co., Ltd.  
 The Wellman Bronze & Aluminum Co.  
 Wells Aircraft Parts Co.  
 E. W. Wiggins Airways, Inc.

**Plastic**

Air-Parts, Inc.  
 Automotive Rubber Co.  
 Ballard Aircraft Div., The Walter M.  
 Ballard Corp.  
 Bastian Bros. Co.  
 Capac Manufacturing Co.  
 Columbia Aircraft Products, Inc.  
 Columbus Plastic Products, Inc.  
 Consolidated Vultee Aircraft Corp.  
 Cunningham-Hall Aircraft Corp.  
 The Dow Chemical Co.  
 Dura Plastics, Inc.  
 Duramold Div., Fairchild Engine &  
 Airplane Corp.  
 The Electric Sprayit Co.  
 G. Felsenthal & Sons  
 The Formica Insulation Co.  
 General Aviation Equipment Co., Inc.  
 The B. F. Goodrich Co.  
 Goodyear Aircraft Corp.  
 Heath Co.  
 Huntington Precision Products Div.,  
 Adel Precision Products Corp.  
 Inland Mfg. Div., General Motors  
 Corp.  
 Interstate Aircraft & Engrg. Corp.  
 Kaiser Cargo, Inc., Fleetwings Div.  
 King Plastics Corp.  
 The Laister-Kauffmann Aircraft Corp.  
 Glenn L. Martin Co.  
 Mica Insulator Co.  
 Olmsted Manufacturing Div., South-  
 western Development Co.  
 Otto Aviation Corp.  
 The Parker Appliance Co.  
 Plastic Manufacturers, Inc.

Ritter Co., Inc.  
 Rohm & Haas Co.  
 Skydyne, Inc.  
 Snapvent Co.  
 Southern Aircraft Corp.  
 Spaulding Fibre Co., Inc.  
 Taylor Fibre Co.  
 Thiokol Corp.  
 The Udylite Corp.  
 United Aircraft Products, Inc.  
 United States Rubber Co.  
 The Voges Manufacturing Co.  
 R. D. Werner Co., Inc.  
 Westinghouse Electric & Manufactur-  
 ing Co.  
 Wilmington Fibre Specialty Co.

**Plywood**

Air-Parts, Inc.  
 Ballard Aircraft Div., The Walter M.  
 Ballard Corp.  
 Berkey & Gay Furniture Co.  
 Charles Manufacturing Co.  
 Consolidated Vultee Aircraft Corp.  
 Del-Air Corp.  
 Duramold Div., Fairchild Engine &  
 Airplane Corp.  
 Fairchild Aircraft Div., Fairchild En-  
 gine & Airplane Corp.  
 Firestone Aircraft Co.  
 Goodyear Aircraft Corp.  
 Heath Co.  
 Interstate Aircraft & Engrg. Corp.  
 Kaiser Cargo, Inc., Fleetwings Div.  
 Kilgen Aircraft Div., The Kilgen Organ  
 Co.  
 The Laister-Kauffmann Aircraft Corp.  
 McQuay, Inc.  
 Marine-Air Research Corp.  
 Glenn L. Martin Co.  
 Meyers Aircraft Co.  
 Otto Aviation Corp.  
 Phillips Aviation Co.  
 Schweizer Aircraft Corp.  
 Skydyne, Inc.  
 Spartan Aircraft Co.  
 Taylorcraft Aviation Corp.  
 Technical Ply-Woods  
 United-Carr Fastener Corp.  
 United States Plywood Corp.  
 Vidal Research Corp.  
 Weber Showcase & Fixture Co., Inc.

**Rubber**

Adel Precision Products Corp.  
 Air Cruisers Inc.

# Low-Pressure Molded Plastics

and other Weldwood Products for the

## Aircraft Industry



**LOW-PRESSURE MOLDED PLASTICS**—This streamlined part is a Weldwood low-pressure, all-plastic (polyfibre) molding now in war use. Any shape or construction can be low-pressure molded using impregnated papers, fabrics, glass cloths and wood veneers.

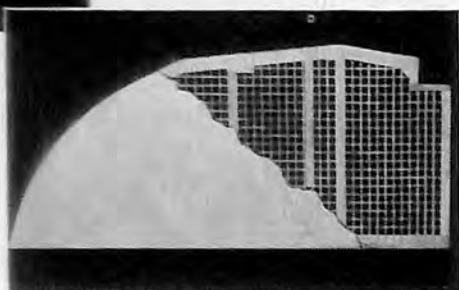


**THIN METALS FACED WITH DECORATIVE WOOD VENEERS** for interiors of post-war airliners. Light weight, easily formed to permanent shape, readily punched or otherwise fabricated. Bonded with Pliobond\*, these decorative sheets offer the beauty of wood plus the advantages of metal.

\*Pliobond—t. m. The Goodyear Tire & Rubber Co.

**FABRICATED WELDWOOD SAVES METAL, SAVES WEIGHT**—Bomber floors, partitions, wing tips, navigators' tables and other aircraft parts are produced in a special Fabricated Parts Plant.

Write now for complete information on Weldwood for aircraft. The services of a qualified technical staff are available.



## WELDWOOD Plywood

*Weldwood Plywood and Plywood Products are manufactured and marketed by*

**UNITED STATES PLYWOOD CORPORATION**  
New York, N. Y.

*World's Largest Producers of Plywood*  
Branches in Principal Cities



**Plastics and Wood Welded for Good**

Waterproof Weldwood, so marked, is bonded with phenol formaldehyde synthetic resin. Other types of water-resistant Weldwood are manufactured with extended urea resins and other approved bonding agents.



**(Rubber) Continued**

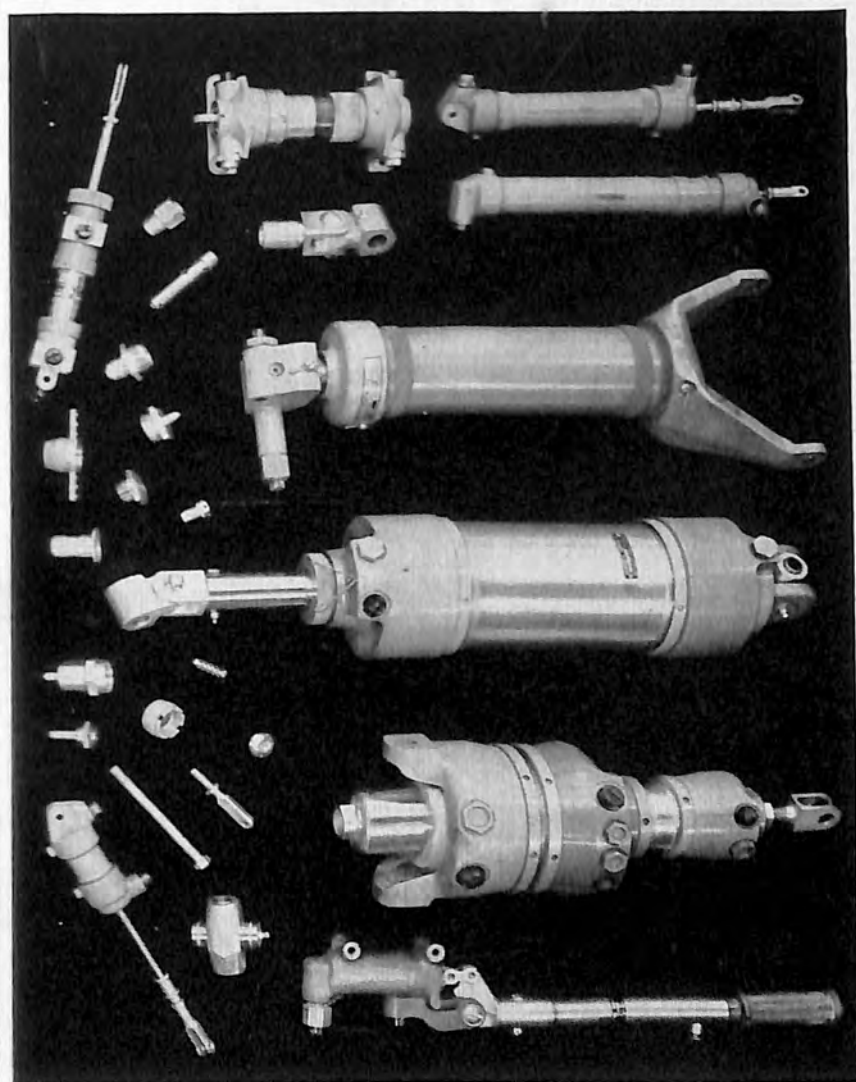
Air-Parts, Inc.  
 Atlantic Diesel Corp.  
 Automotive Rubber Co.  
 The Bowling Green Rubber Co.  
 Connecticut Hard Rubber Co.  
 Consolidated Vultee Aircraft Corp.  
 Richard M. Decker Co., Inc.  
 Detroit Gasket & Mfg. Co.  
 Firestone Aircraft Co.  
 The General Tire & Rubber Co.  
 The B. F. Goodrich Co.  
 Goodyear Aircraft Corp.  
 The Guiberson Corp., Aircraft & Heater Div.  
 Hewitt Rubber Corp.  
 Huntington Precision Products Div., Adel Precision Products Corp.  
 Inland Mfg. Div., General Motors Corp.  
 Interstate Aircraft & Engineering Corp.  
 Johns-Manville Corp.  
 The Manhattan Rubber Mfg. Div., Raybestos-Manhattan, Inc.  
 Melflex Products Co.  
 Nukraft Manufacturing Co.  
 Otto Aviation Corp.  
 Perry Metal Products Co. Inc.  
 Phillips Aviation Co.  
 Plastic & Rubber Products Co.  
 Rodic Rubber Corp.  
 Thiokol Corp.  
 United States Rubber Co.  
 Virginia Rubatex Div., Great American Industries, Inc.

**Steel**

Acme Aluminum Alloys Inc.  
 Adel Precision Products Corp.  
 Aero Supply Mfg. Co. Inc.  
 Aero Trades Co.  
 Aeronautical Products, Inc.  
 Agawam Aircraft Products, Inc.  
 Air-Parts, Inc.  
 Air Transport Mfg. Co.  
 Aircraft Engineering Products  
 Aircraft Hardware Mfg. Co.  
 Aircraft Mechanics, Inc.  
 Aircraft Products Co.  
 Aircraft Standard Parts Co.  
 The Aircraftsmen Co.  
 Allison Div., General Motors Corp.  
 Aluminum Goods Mfg. Co.

American Central Mfg. Corp.  
 American Steel & Wire Co.  
 American Tube Bending Co., Inc.  
 Arnolt Motor Co.  
 Atlantic Diesel Corp.  
 Atlas Metal Stamping Co.  
 B. H. Aircraft Co., Inc.  
 Booth Manufacturing Corp.  
 Brown Lathe & Tool Co.  
 Burgess-Norton Mfg. Co.  
 Butler Manufacturing Co.  
 Camloc Fastener Corp.  
 The Centerless Grinding Co.  
 Columbia Aircraft Corp.  
 Columbia Aircraft Products, Inc.  
 Consolidated Vultee Aircraft Corp.  
 Copperweld Steel Co.  
 The Corbin Screw Corp.  
 Corry-Jamestown Mfg. Corp.  
 Criterion Machine Works  
 Cunningham-Hall Aircraft Corp.  
 Dahlstrom Metallic Door Co.  
 Del-Air Corp.  
 Henry Disston & Sons, Inc.  
 Durham Aircraft Service, Inc.  
 Eaton Manufacturing Co.  
 The Electric Sprayit Co.  
 Engis Equipment Co.  
 Excello Corp.  
 Fairchild Aircraft Div., Fairchild Engine & Airplane Corp.  
 Firestone Aircraft Co.  
 Fox Co.  
 George K. Garrett Co., Inc.  
 General Aircraft Equipment Inc.  
 General Aircraft Supply Corp.  
 General Aviation Equipment Co., Inc.  
 The General Tire & Rubber Co.  
 Globe Steel Tubes Co.  
 Goodyear Aircraft Corp.  
 The Guiberson Corp., Aircraft & Heater Div.  
 The Hartford Machine Screw Co.  
 Hartwell Aviation Supply Co.  
 Hayes Manufacturing Corp.  
 Heyer Products Co. Inc.  
 Heyman Mfg. Co.  
 Huntington Precision Products Div., Adel Precision Products Corp.  
 Hyland Machine Co.  
 Interstate Aircraft & Engrg. Corp.  
 Kaiser Cargo, Inc., Fleetwings Div.  
 The Kawneer Co.  
 The Laister-Kauffmann Aircraft Corp.  
 Lavelle Aircraft Corp.  
 Liberty Aircraft Products Corp.  
 Luscombe Airplane Corp.

DEVOTED EXCLUSIVELY  
 to Engineering and Manufacturing of  
 Hydraulic Struts, Valves, Pumps  
 and Precision Parts



AIRCRAFT ENGINEERING PRODUCTS, INC.

Clifton, New Jersey

*(Steel) Continued*

Luscombe Engineering Co.  
 Lycoming Div., The Aviation Corp.  
 Macwhyte Co.  
 The Marquette Metal Products Co.  
 Glenn L. Martin Co.  
 Merz Engineering Co.  
 Meyers Aircraft Co.  
 Milwaukee Metal Spinning Co.  
 Moore-Eastwood & Co.  
 The Murray Corp. of America  
 National Machine Products  
 Northern Aircraft Products Div., The  
 Aviation Corp.  
 The Ohio Piston Co.  
 Olmsted Manufacturing Div., South-  
 western Development Co.  
 Otto Aviation Corp.  
 The Paulson Tools Inc.  
 Perry Metal Products Co. Inc.  
 Phillips Aviation Co.  
 Pollak Manufacturing Co.  
 Pressed & Welded Steel Products Co.  
 Reasor Manufacturing Co.  
 Republic Aircraft Products Div., The  
 Aviation Corp.  
 Robertson Aircraft Corp.  
 S & M Lamp Co.  
 St. Pierre Chain Corp.  
 Schweizer Aircraft Corp.  
 South Shore Machine & Tool Works,  
 Inc.  
 Spartan Aircraft Co.  
 Superior Tube Co.  
 Swift Lubricator Co., Inc.  
 Taylorcraft Aviation Corp.  
 Thompson Products Inc.  
 Thompson Products, Inc., West Coast  
 Plant  
 Union Drawn Steel Div., Republic  
 Steel Corp.  
 Utility Fan Corp.  
 The Vimalert Co., Ltd.  
 The Voges Manufacturing Co.  
 Waldes Koh-I-Noor Inc.  
 Wallace Engineering Co.  
 Weber Showcase & Fixture Co., Inc.  
 Wells Aircraft Parts Co.  
 White Aircraft Corp.  
 E. W. Wiggins Airways, Inc.  
 N. A. Woodworth Co.

**Synthetic**

Adel Precision Products Corp.  
 Air-Parts, Inc.  
 The Bowling Green Rubber Co.

Connecticut Hard Rubber Co.  
 Consolidated Vultee Aircraft Corp.  
 Cunningham-Hall Aircraft Corp.  
 Detroit Gasket & Mfg. Co.  
 Durham Aircraft Service, Inc.  
 Firestone Aircraft Co.  
 The B. F. Goodrich Co.  
 Huntington Precision Products Div.,  
 Adel Precision Products Corp.  
 Inland Mfg. Div., General Motors  
 Corp.  
 Johns-Manville Corp.  
 The Manhattan Rubber Mfg. Div.,  
 Raybestos-Manhattan, Inc.  
 Melflex Products Co.  
 The Parker Appliance Co.  
 Phillips Aviation Co.  
 Plastic & Rubber Products Co.  
 Resistoflex Corp.  
 Rodic Rubber Corp.  
 United Aircraft Products, Inc.  
 United States Rubber Co.

**Wood**

Aero Trades Co.  
 Air-Parts, Inc.  
 Ballard Aircraft Div., The Walter M.  
 Ballard Corp.  
 Berkey & Gay Furniture Co.  
 Charles Manufacturing Co.  
 Consolidated Vultee Aircraft Corp.  
 Dade Brothers, Inc.  
 Del-Air Corp.  
 Firestone Aircraft Co.  
 Flottorp Mfg. Co.  
 Goodyear Aircraft Corp.  
 Heath Co.  
 Interstate Aircraft & Engrg. Corp.  
 Kaiser Cargo, Inc., Fleetwings Div.  
 Kilgen Aircraft Div., The Kilgen Organ  
 Co.  
 The Laister-Kauffmann Aircraft Corp.  
 Marine-Air Research Corp.  
 Glenn L. Martin Co.  
 Meyers Aircraft Co.  
 Otto Aviation Corp.  
 Phillips Aviation Co.  
 Robertson Aircraft Corp.  
 Schweizer Aircraft Corp.  
 Skydyne, Inc.  
 Spartan Aircraft Co.  
 Taylorcraft Aviation Corp.  
 Technical Ply-Woods  
 Vidal Research Corp.  
 Weber Showcase & Fixture Co., Inc.

# Firestone

## *Extra Values*

• • ASSURE  
**GREATER SAFETY  
 LONGER LIFE**

• Giant planes now in the blueprint stage will need the safest tires that man can make. And that means Firestone Sky Champions, the only aircraft tires made with patented construction features which provide extra safety, and extra strength. Firestone is always ready with tires that will make tomorrow's airplanes safer, more dependable and economical.



**AVIATION PRODUCTS WHICH FIRESTONE  
 IS SUPPLYING OR IS PREPARED TO SUPPLY**

TIRES • TUBES • WHEELS  
 BRAKES  
 AIR SPRING LANDING GEARS  
 BATTERIES  
 SPARK PLUGS

FOAMEX CUSHIONING  
 FUEL AND OIL CELLS  
 BUSHINGS  
 VELON UPHOLSTERING  
 FABRICS

AND MANY OTHER AIRCRAFT SUPPLIES

**FIRESTONE AIRCRAFT COMPANY**  
 AKRON, OHIO • LOS ANGELES, CALIF.

**AIRPORT EQUIPMENT**

Walter Kidde & Co., Inc.  
 Pacific Div., Bendix Aviation Corp.  
 Rohr Aircraft Corp.  
 Standard Aircraft Products, Inc.

**Designers & Builders**

Abrams Instrument Co.  
 Arch Roof Construction Co. Inc.  
 Bowser, Inc.  
 Butler Manufacturing Co.  
 Flottorp Mfg. Co.  
 Otto Aviation Corp.  
 Variety Aircraft Corp.

**Construction Equipment**

Allis-Chalmers Manufacturing Co.  
 Aluminum Ladder Co.  
 Amalgamated Steel Co.  
 Byrne Doors, Inc.  
 Erie Steel Construction Co.  
 Hyster Co.  
 Independent Pneumatic Tool Co.  
 Truscon Steel Co.  
 J. Wiss & Sons Co.

**Maintenance Equipment**

Adel Precision Products Corp.  
 Aircraft Screw Products Co., Inc.  
 Allis-Chalmers Manufacturing Co.  
 Amalgamated Steel Co.  
 American Aircraft Manufacturing Co.  
 B. C. Ames Co.  
 Aurora Equipment Co.  
 Autogroom Co. Inc.  
 Butler Manufacturing Co.  
 Circo Products Co.  
 Clayborne Manufacturing Co.  
 Detroit Tap & Tool Co.  
 Durham Aircraft Service, Inc.  
 Duro Metal Products Co.  
 Electric Products Co.  
 Globe Hoist Co.  
 H-B Electric Co. Inc.  
 Hall Mfg. Co.  
 Heyer Products Co. Inc.  
 The Hilliard Corp.  
 Hyster Co.  
 Independent Pneumatic Tool Co.  
 International Derrick & Equip. Co.  
 Kent-Moore Organization, Inc.  
 Lyon-Raymond Corp.  
 Merrill Engineering Laboratories

Meyers & Martin Machine Co.  
 The Ohio Piston Co.  
 Operadio Manufacturing Co.  
 Otto Aviation Corp.  
 Pacific Engineering Corp.  
 Arthur D. Peterson Co. Inc.  
 Roseman Tractor Mower Co.  
 Snap-On Tools Corp.  
 Snow Removal Equipment Co.  
 Spencer & Morris  
 Stumpp & Walter Co.  
 Van Norman Co.  
 Variety Aircraft Corp.  
 Joseph Weidenhoff, Inc.  
 K. R. Wilson  
 J. Wiss & Sons Co.  
 Worthington Mower Co.

**Operating Equipment**

Air-Parts, Inc.  
 Aircraft Mechanics, Inc.  
 Aircraft Specialties Co.  
 Amalgamated Steel Co.  
 American Foundry & Furnace Co.  
 Aurora Equipment Co.  
 Automatic Electric Co.  
 Butler Manufacturing Co.  
 Circo Products Co.  
 Columbian Steel Tank Co.  
 Crescent Truck Co.  
 Federal Telephone & Radio Corp.  
 Friez Instrument Div., Bendix Aviation Corp.  
 W. & L. E. Gurley  
 W. F. Hebard & Co.  
 Heyer Products Co. Inc.  
 Hyster Co.  
 Imperial Brass Manufacturing Co.  
 Independent Pneumatic Tool Co.  
 International Derrick & Equipment Co.  
 Kenyon Instrument Co., Inc.  
 Lights, Inc.  
 Malabar Machine Co.  
 Operadio Manufacturing Co.  
 Recordograph Div., Frederick Hart & Co., Inc.  
 Scott Aviation Corp.  
 Smith Meter Co.  
 Snow Removal Equipment Co.  
 The Soundscriber Corp.  
 Spencer & Morris  
 M. C. Stewart  
 Stewart-Warner Corp.  
 Towmotor Corp.  
 Variety Aircraft Corp.

# ROSEMAN TRACTOR MOWER CO.

Crawford, Central and Ridge Road, Evanston, Ill.

## MOWING MACHINERY FOR AIRFIELD TURF MAINTENANCE

Of immediate interest to airfield operators is the distinctive design of Roseman mowing machinery. Instead of depending upon narrow side wheels for traction to drive the cutting reel the cutting reel of the Roseman unit is powered through greatly increased traction from light rear rollers. Units may be hooked up in gangs of 3, 5, 7 and 9 units.

## OPERATING ADVANTAGES

The constant, non-slip reel drive accomplished by the modern rear roller traction principle makes possible the cutting of the toughest of airfield grass, in wet or dry weather. Roseman's also perform a distinctively valuable additional function in that their light rolling action helps develop thicker, healthier and smoother landing field turf, important to safe, efficient airfield maintenance. Roseman mowers will operate in gang combination up to the top speed at which any industrial type tractor can pull them.

## MECHANICAL FEATURES

Cutting reel drive is transmitted from non-slip rear rollers by means of a friction free chain drive which runs in a bath of oil. 30 inch cutting reel has power driven from roller-drive shaft through differential which provides high speed cutting, light pull and plenty of power to mow cleanly through "heavy going" without skidding, scalping or bobbing. Patented spring-type bed knife adjustment safeguards against reel damage. Simple, accurate cutting height adjustment. High pressure lubrication.

## STURDY CONSTRUCTION

Stronger, tougher, wear-resisting materials, plus sturdy construction throughout, account for the long span of trouble-free, thrifty years of service. Cutting reel is made of tempered, extra wide heavy-duty chrome nickel steel blades, mounted on semi steel spiders. Oil hardened, carbon molybdenum steel lipped bed knife insures long wear. Timken roller bearing adjustment allows perfect reel alignment. Hyatt roller bearings on roller shaft reduces friction, allows lighter pull.

## REPLACEMENTS AND GUARANTEE

Thirty years experience in designing and manufacturing roller-drive mowers enables us to guarantee the Roseman mower against defective workmanship and materials. Parts, such as bed knives, that inevitably wear, can be replaced at moderate cost.



**THE SEVEN GANG ROSEMAN**  
The seven gang combination of Roseman mowers, shown at right, cuts a swath 16 feet wide. Each mower unit tracks perfectly and independently follows the surface contour. The 9 gang combination cuts a 21 foot swath.

**(Operating Equipment) Continued**

The Wellington Machine Co.  
Westinghouse Electric & Mfg. Co.  
Yates-American Machine Co.

**AMMUNITION BOXES & COUNTERS**

Air Transport Mfg. Co.  
Aluminum Ladder Co.  
Berkey & Gay Furniture Co.  
Charles Manufacturing Co.  
Consolidated Vultee Aircraft Corp.  
Corry-Jamestown Mfg. Corp.  
Dade Brothers, Inc.  
Edo Aircraft Corp.  
General Electric Co.  
Kaiser Cargo, Inc., Fleetwings Div.  
Kilgen Aircraft Div., The Kilgen Organ Co.

King Plastics Corp.  
Luscombe Airplane Corp.  
Lyon Metal Products, Inc.  
McQuay, Inc.  
Perry Metal Products Co. Inc.  
Pollak Manufacturing Co.  
Republic Steel Corp., Berger Manufacturing Div.  
Technical Ply-Woods  
Utility Fan Corp.  
Variety Aircraft Corp.  
Wallace Engineering Co.

**AUXILIARY POWER PLANTS**

Aerojet Engineering Corp.  
American Aircraft Manufacturing Co.  
Atlantic Diesel Corp.  
Bogue Electric Co.  
Columbia Aircraft Products, Inc.  
Eclipse-Pioneer Div., Bendix Aviation Corp.  
The Electric Sprayit Co.  
Firestone Aircraft Co.  
Heyer Products Co. Inc.  
Hyster Co.  
Jack & Heintz, Inc.  
Walter Kidde & Co., Inc.  
Lasalco, Inc.  
Lawrance Aeronautical Corp.  
K. R. Wilson

**BASIC MATERIALS & FABRICATIONS**

Amalgamated Steel Co.  
Blanchard Bros. & Lane

Copperweld Steel Co.  
Firestone Aircraft Co.  
Firth-Sterling Steel Co.  
Goodyear Aircraft Corp.  
Handy & Harman  
The Murray Corp. of America  
National Lead Co.  
Otto Aviation Corp.  
The Parker Appliance Co.  
Perry Metal Products Co. Inc.  
Phillips Mfg. Co.  
Pressed & Welded Steel Products Co. Inc.  
Revere Copper & Brass Inc.  
Reynolds Metals Co.  
Rigid-Tex Corp.  
Rohr Aircraft Corp.  
Spencer & Morris  
Taylor Fibre Co.

**BATTERIES**

Burgess Battery Co.  
Delco-Remy Div., General Motors Corp.  
Durham Aircraft Service, Inc.  
Esso Aviation Products  
Firestone Aircraft Co.  
Gould Storage Battery Corp.  
Ideal Commutator Dresser  
Kellogg Switchboard & Supply Co.  
P. R. Mallory & Co., Inc.  
Otto Aviation Corp.  
Standard Electric Co., Inc.

**BEARINGS**

The Heim Co.  
SKF Industries, Inc.

**Ball**

Durham Aircraft Service, Inc.  
Engis Equipment Co.  
The Federal Bearings Co. Inc.  
Jack & Heintz, Inc.  
Edward D. Maltby Co.  
New Departure Div., General Motors Corp.  
Nice Ball Bearing Co.  
Norma-Hoffmann Bearings Corp.  
Otto Aviation Corp.  
The Schatz Manufacturing Co.

**Roller**

George J. Fix Co.  
The Gwilliam Co.

EASING AIRCRAFT OPERATION



When an SKF Bearing slips into place on a crankshaft, you can be sure of the highest standards of precision manufacture—the product of an organization that has pioneered many bearing applications for the modern airplane. The same thing is true of SKF Bearings for rocker arms, engine controls, magnetos and superchargers of airplane engines . . . of other SKF's on propellers, control pulleys, landing and tail wheels, re-

tracting mechanism and actuators . . . and still other SKF's for radar equipment, fire control mechanisms, indicators, gages, tachometers, bomb sights and midget motors—wherever rotating parts might decide the outcome of battles.

**SKF** INDUSTRIES, INC.,  
 FRONT ST. & ERIE AVE.  
 PHILA. 34, PA.

**SKF**  
 BALL AND ROLLER BEARINGS



# LIBERTY

## AIRCRAFT PRODUCTS

*Precision*—Geared to the Nation's war effort this organization with its modernly equipped plant is "all out" in the production drive. We are ready on request to talk over your production problems.

Precision machine parts—tools—production machine parts to order—screw machine products—milling and gear cutting work—engine cylinders, pistons, crankcases—heat treating and carburizing in electric furnaces with atmospheric control—cadmium plating and hard chrome plating—

anodizing aluminum alloy parts — aircraft sheet metal work — wing assemblies—tail surfaces — pontoons — bomb racks — complete aircraft doping and finishing work.



**Robert Simon**  
*President*

**George H. Hauser**  
*Vice President*

**William G. Holman**  
*Secretary-Treasurer*

**William Ochse**  
*Machine Shop Superintendent*

**Elmer Matzen**  
*Purchasing Agent*

**LIBERTY AIRCRAFT PRODUCTS CORP.**

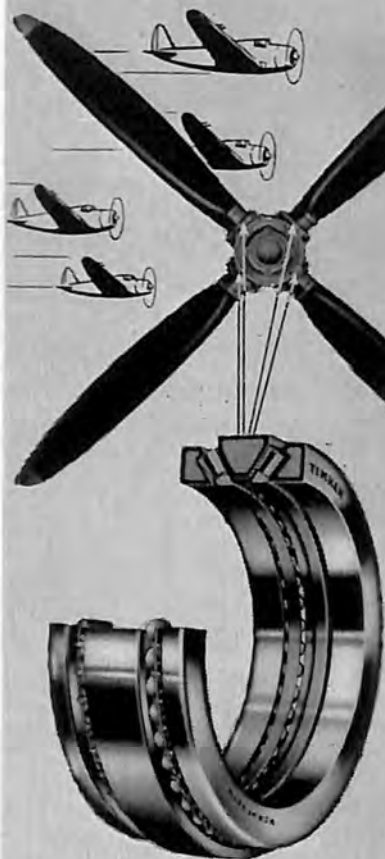
*Manufacturers of Aircraft Parts*

FARMINGDALE

LONG ISLAND

NEW YORK

# Right ON the Button



Without reservation the Timken Propeller Blade Bearing is the most difficult bearing we have ever manufactured.

The bearing surfaces must be finished unbelievably smooth otherwise the blades will not feather correctly at high propeller speeds. Every bearing is given a most severe torque test.

Weight variations between any two complete bearings are held "right on the button," otherwise bearings alone would throw propellers out of balance.

There are thousands of Timken Propeller Blade Bearings in service and they are making an excellent performance record in fighter and bomber planes.

If you are interested in propeller blade feathering bearings we welcome your consultation.

THE TIMKEN ROLLER BEARING COMPANY, CANTON, OHIO

## TIMKEN

TRADEMARK REG. U. S. PAT. OFF.  
TAPERED ROLLER BEARINGS

**(Roller) Continued**

Edward D. Maltby Co.  
 Norma-Hoffmann Bearings Corp.  
 Otto Aviation Corp.  
 The Timken Roller Bearing Co.

**Sleeve**

Aircraft Products Co.  
 Allison Div., General Motors Corp.  
 Atlas Brass Foundry  
 Bearnium Metals Corp.  
 Chrysler Corp., Amplex Div.  
 The Cleveland Graphite Bronze Co.  
 Ertel Machine Co.  
 George J. Fix Co.  
 Keystone Carbon Co.  
 Kirsch Co.  
 P. R. Mallory & Co., Inc.  
 National Lead Co.  
 Olds Alloys Co.  
 Perry Metal Products Co. Inc.  
 Randall Graphite Products Corp.

**BLIND LANDING  
SYSTEMS**

Federal Telephone & Radio Corp.  
 RCA-Victor Div., Radio Corp. of  
 America  
 Raytheon Manufacturing Co.  
 Sperry Gyroscope Co., Inc.

**BOMB RACKS**

Air Transport Mfg. Co.  
 All American Aircraft Products, Inc.  
 Consolidated Vultee Aircraft Corp.  
 The Flour City Ornamental Iron Co.  
 General Aviation Equipment Co., Inc.  
 Goodyear Aircraft Corp.  
 The Guiberson Corp., Aircraft &  
 Heater Div.  
 Interstate Aircraft & Engineering  
 Corp.  
 The Kawneer Co.  
 Kirsch Co.  
 Liberty Aircraft Products Corp.  
 Luscombe Airplane Corp.  
 McGrath St. Paul Co.  
 Moore-Eastwood & Co.  
 National Machine Products  
 Perry Metal Products Co. Inc.  
 Pollak Manufacturing Co.  
 Republic Steel Corp., Berger Manufac-  
 turing Div.  
 Rohr Aircraft Corp.

The Steel Products Engineering Co.  
 Variety Aircraft Corp.  
 Wallace Engineering Co.  
 Wells Aircraft Parts Co.  
 Westinghouse Electric & Manufactur-  
 ing Co.

**BRAKES & PARTS**

Adel Precision Products Corp.  
 Bendix Products Div., Bendix Aviation  
 Corp.  
 The Electric Sprayit Co.  
 Firestone Aircraft Co.  
 General Aircraft Supply Corp.  
 The General Tire & Rubber Co.  
 The B. F. Goodrich Co.  
 Goodyear Aircraft Corp.  
 Hayes Industries, Inc.  
 Johns-Manville Corp.  
 The Manhattan Rubber Mfg. Div.,  
 Raybestos-Manhattan, Inc.  
 Otto Aviation Corp.  
 The Parker Appliance Co.  
 Scott Aviation Corp.  
 Wells Aircraft Parts Co.

**BUSHINGS**

Acme Aluminum Alloys Inc.  
 Aeronautical Products, Inc.  
 Aircraft Products Co.  
 Aircraft Screw Products Co., Inc.  
 Atlantic India Rubber Works, Inc.  
 Atlas Brass Foundry  
 The Bowling Green Rubber Co.  
 The Cleveland Graphite Bronze Co.  
 Colonial Brooch Co.  
 Excello Corp.  
 Firestone Aircraft Co.  
 George J. Fix Co.  
 Kaiser Cargo, Inc., Fleetwings Div.  
 Keystone Carbon Co.  
 Lycoming Div., The Aviation Corp.  
 The Marquette Metal Products Co.  
 Olds Alloys Co.  
 Otto Aviation Corp.  
 Perry Metal Products Co. Inc.  
 Phillips Aviation Co.  
 Randall Graphite Products Corp.  
 Republic Aircraft Products Div., The  
 Aviation Corp.  
 Rohr Aircraft Corp.  
 Spaulding Fibre Co., Inc.  
 Swift Lubricator Co., Inc.  
 Taylor Fibre Co.  
 Taylorcraft Aviation Corp.



**Federal's Instrument Landing System  
is Ready to Serve the Great New Air Age**



Through fog, sleet, rain and blackness the science of radio brings the airliner home.

The pilot *knows* his course, position and landing.

Federal's Instrument Landing System guides the homing pilot with unfailing accuracy. He can set his ship down on a dime.

Federal's equipment has made a great contribution to safety in the air. It is dependable and, moreover, is less subject to atmospheric disturbances. It reduces initial, maintenance and operating costs.

Federal—one of the largest manufacturers of instrument landing equipment for ground installations—is prepared now to discuss your plans and probable requirements.

*Federal Telephone and Radio Corporation*



Newark 1, N. J.

**(Bushings) Continued**

Thompson Products, Inc.  
 United States Rubber Co.  
 Variety Aircraft Corp.  
 Wells Aircraft Parts Co.  
 York Tool Sales Co.

### CABIN HARDWARE & FURNISHINGS

Benray Products Co.  
 Burklyn Co.  
 Consolidated Vultee Aircraft Corp.  
 P. & F. Corbin  
 Richard M. Decker Co. Inc.  
 Fox Co.  
 General Aircraft Supply Corp.  
 The General Tire & Rubber Co.  
 Hartwell Aviation Supply Co.  
 King Plastics Corp.  
 Otto Aviation Corp.  
 Perry Metal Products Co. Inc.  
 Robertson Aircraft Corp.  
 Snapvent Co.  
 Vidal Research Corp.  
 Weber Showcase & Fixture Co., Inc.

### CAMERAS & SUPPLIES

Abrams Instrument Co.  
 Adel Precision Products Corp.  
 Bell & Howell Co.  
 Chicago Aerial Survey Co.  
 Eastman Kodak Co.  
 Fairchild Camera & Instrument Corp.  
 The Folmer Graflex Corp.  
 Huntington Precision Products Div.,  
 Adel Precision Products Corp.  
 Skyview Camera Co.  
 Specialties, Inc.

### CARBURETORS

Bendix Products Div., Bendix Aviation Corp.  
 Durham Aircraft Service, Inc.  
 Otto Aviation Corp.

### CARGO LOADING EQUIPMENT

The Brady Conveyors Corp.  
 Burklyn Co.  
 Crescent Truck Co.  
 Del-Air Corp.  
 Eclipse-Pioneer Div., Bendix Aviation Corp.

Globe Hoist Co.  
 The Guiberson Corp., Aircraft & Heater Div.  
 Hyster Co.  
 Interstate Aircraft & Engrg. Corp.  
 The Laister-Kauffmann Aircraft Corp.  
 Lyon-Raymond Corp.  
 Malabar Machine Co.  
 Mechanical Handling Systems, Inc.  
 Arthur D. Peterson Co. Inc.  
 Preco Inc.  
 Rocky Mountain Steel Products, Inc.  
 Spencer & Morris  
 Towmotor Corp.

### CASTINGS

Acme Aluminum Alloys, Inc.  
 Advance Aluminum Castings Corp.  
 Alten's Foundry & Machine Works  
 Aluminum Co. of America  
 American Chain & Cable Co., Inc.,  
 American Chain Div.  
 American Chain & Cable Co., Inc.,  
 Reading Steel Casting Div.  
 Atlas Brass Foundry  
 Bearium Metals Corp.  
 Delco-Remy Div., General Motors Corp.  
 Dollin Corp.  
 Eaton Manufacturing Co.  
 Eclipse-Pioneer Div., Bendix Aviation Corp.  
 The Flour City Ornamental Iron Co.  
 General Aviation Equipment Co., Inc.  
 Harvill Corp.  
 The Laister-Kauffmann Aircraft Corp.  
 Major Aircraft Foundry  
 Olds Alloys Co.  
 Otto Aviation Corp.  
 The Parker Appliance Co.  
 The Permold Co.  
 Perry Metal Products Co. Inc.  
 Reynolds Metals Co.  
 Ritter Co., Inc.  
 Scott Aviation Corp.  
 Scovill Manufacturing Co.  
 So-Cal Foundry  
 Spiegel Sales Co.  
 Union Mfg. Co.  
 The Wellman Bronze & Aluminum Co.

### CHARGERS, BATTERY

The Benwood-Linze Co.  
 McColpin-Christie Corp., Ltd.

**1** *st choice*  
*without question*

**for American-built Planes**

**STROMBERG**



**carburetors**

Why has this one make of aircraft carburetor been singled out and made the undisputed leader on American-built planes?

The answer is this:—their consistent over-all performance records under all possible flying conditions—in peacetime and wartime use—have proved Stromberg Carburetors the high point of present achievement in aircraft carburetion.

No endorsement could say more than that voiced in this fact: *more aircraft use Stromberg Carburetors than any other make.*

BENDIX AND STROMBERG ARE TRADE-MARKS OF BENDIX AVIATION CORPORATION

**Bendix**

**PRODUCTS DIVISION**

Bendix Aviation Corporation, South Bend 20, Indiana

## BETTER POWER TRANSMISSION ...THROUGH BETTER GEARS

Today, at Foote Bros., aircraft gears—which power the engines of many of America's mightiest war planes—roll off production lines in tremendous quantities.

These gears—with each dimension held to amazingly close tolerance—offer the advantages of greater mechanical efficiency, lighter weight, longer life, greater compactness, quieter operation. This new development in gear design and production may have an application on the equipment you are making or planning to make. Foote Bros. engineers will be glad to aid you with your power transmission problem—whatever it may be.

FOOTE BROS. GEAR AND  
MACHINE CORPORATION  
Dept. AY, 5225 S. Western Blvd.  
Chicago 9, Illinois

### FOOTE BROS. PRODUCTS

- Aircraft Engine Gears
- "A-Q" Gears  
(aircraft-quality)
- Industrial Gears
- Speed Reducers
- Aircraft Devices
- Couplings
- Clutches

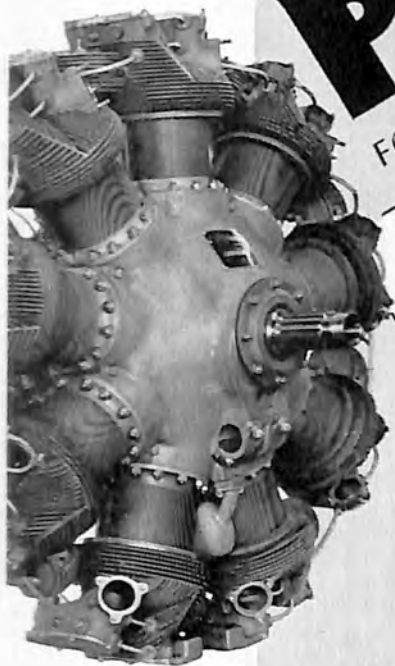


# FOOTE BROS.

*Better Power Transmission Through Better Gears*



ESTABLISHED  
1919



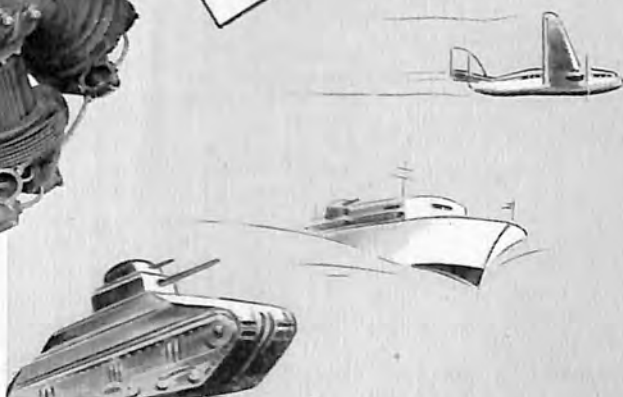
**THE  
GUIBERSON**

AMERICA'S  
RADIAL AIR-COOLED  
DIESEL ENGINE

**SAFE**

DEPENDABLE LIGHT WEIGHT DIESEL  
**POWER**  
FOR PLANES, TANKS AND SHIPS

- ★ LOW FUEL CONSUMPTION
- ★ LOW FUEL COST
- ★ NO IGNITION SYSTEM
- ★ MINIMUM FIRE HAZARD
- ★ DEPENDABLE OPERATION



*Guiberson U.S.A.*

GUIBERSON DIESEL ENGINE COMPANY ★ THE GUIBERSON CORPORATION  
Dallas, Texas *Aircraft and Heater Division*



**CHEMICALS**

American Chemical Paint Co.  
 Autogroom Co. Inc.  
 Avondale Chemical Co.  
 The Barrett Div., Allied Chemical &  
 Dye Corp.  
 The Bell Co., Inc.  
 The C. G. Buchanan Chemical Co.  
 Detrex Corp.  
 The Dow Chemical Co.  
 Eastman Kodak Co.  
 Hanson-Van Winkle-Munning Co.  
 Haynes Stellite Co.  
 R. M. Hollingshead Corp.  
 The Laister-Kauffmann Aircraft Corp.  
 Lasalco, Inc.  
 National Lead Co.  
 Arthur D. Peterson Co. Inc.  
 Petroleum Solvents Corp.  
 Phillips Mfg. Co.  
 Pyroxylin Products Inc.  
 Rohm & Haas Co.  
 Scott Aviation Corp.  
 Thiokol Corp.  
 The Udyllite Corp.  
 United States Rubber Co.

**CLAMPS**

Actus Products Co.  
 Adel Precision Products Corp.  
 Adjustable Clamp Co.  
 Aircraft Standard Parts Co.  
 Automotive Rubber Co.  
 Burndy Engineering Co. Inc.  
 Camloc Fastener Corp.  
 The Corbin Screw Corp.  
 Durham Aircraft Service, Inc.  
 Firestone Aircraft Co.  
 Goodyear Aircraft Corp.  
 The Guiberson Corp., Aircraft &  
 Heater Div.  
 Heyman Mfg. Co.  
 Huntington Precision Products Div.,  
 Adel Precision Products Corp.  
 Hyland Machine Co.  
 The Laister-Kauffmann Aircraft Corp.  
 Monogram Manufacturing Co.  
 Perry Metal Products Co. Inc.  
 Pollak Manufacturing Co.  
 V. E. Sprouse Co.  
 United-Carr Fastener Corp.  
 J. H. Williams & Co.

**CLEANERS & CLEANING  
COMPOUNDS**

Aircraft Specialties Co.  
 American Chemical Paint Co.  
 The Bell Co., Inc.  
 The C. G. Buchanan Chemical Co.  
 Circo Products Co.  
 Detrex Corp.  
 Dibble Color Co.  
 Gaybex Corp.  
 General Aircraft Supply Corp.  
 Hanson-Van Winkle-Munning Co.  
 R. M. Hollingshead Corp.  
 E. F. Houghton & Co.  
 Lasalco, Inc.  
 Magnus Chemical Co., Inc.  
 Otto Aviation Corp.  
 Petroleum Solvents Corp.  
 Phillips Mfg. Co.  
 Scott Aviation Corp.  
 The Udyllite Corp.  
 Wayne Chemical Products Co.  
 Weldon Roberts Rubber Co., Bright-  
 boy Industrial Div.  
 Wyandotte Chemicals Corp.

**Buffing, Burring &  
Polishing**

American Plating Rack Co.  
 Ekstrom Carlson & Co.  
 General Aircraft Supply Corp.  
 The Lea Manufacturing Co.  
 Major Aircraft Foundry  
 Mead Specialties Co.  
 Mid-West Abrasive Co.  
 The Udyllite Corp.  
 Variety Aircraft Corp.  
 Wayne Chemical Products Co.

**CLUTCHES**

Foote Bros. Gear & Machine Corp.  
 The Hilliard Corp.  
 L. G. S. Spring Clutch Corp.  
 Rockford Drilling Machine Div., Borg-  
 Warner Corp.

**CLOSURES, DRUMS**

American Flange & Mfg. Co. Inc.

**COLLECTOR RINGS**

Air Transport Mfg. Co.  
 Aircraft Mechanics, Inc.



## FORMATIONS FOR VICTORY

**L**OOK at a perfect formation of fighter planes in the sky . . . and you'll see the significance of a "formation" of drums on a beach head. Inside those drums is the fuel for victory in the air. And to guard that fuel—to keep it safe from seepage, dust and contamination—is the war-time job of Tri-Sure Closures.

The critical needs of war have proved repeatedly what every user of drums should know: if Tri-Sure

Closures are on a drumhead, every drop inside that drum is safe. The reason is that Tri-Sure Closures seal a drum hermetically with a seal, plug and flange that no water or impurities can pass.

This is Tri-Sure's famous triple protection that enables drums to be stored in the open for months, or shipped thousands of miles, without leakage, seepage or loss. And that is the kind of protection that every drum should have.



American Flange & Manufacturing Co. Inc., 30 Rockefeller Plaza, New York 20, N. Y.  
Tri-Sure Products Limited, St. Catharines, Ontario, Canada

**(Collector Rings) Continued**

Aircraft Welders, Inc.  
 American Central Mfg. Corp.  
 American Tube Bending Co., Inc.  
 Baker & Co., Inc.  
 Buhl Manufacturing Co.  
 Consolidated Vultee Aircraft Corp.  
 Goodyear Aircraft Corp.  
 The Guiberson Corp., Aircraft &  
 Heater Div.  
 The Murray Corp. of America  
 Perry Metal Products Co. Inc.  
 Pollak Manufacturing Co.  
 Ryan Aeronautical Co.  
 Solar Aircraft Co.  
 Thompson Products, Inc.  
 The Vimalert Co., Ltd.  
 Wallace Supplies Manufacturing Co.

### COMMUNICATIONS SYSTEMS

Airadio, Inc.  
 Automatic Electric Co.  
 S. H. Couch Co., Inc.  
 Executone, Inc.  
 Federal Telephone & Radio Corp.  
 General Electric Co.  
 Harvey Radio Laboratories, Inc.  
 Harvey-Wells Electronics, Inc.  
 Heath Co.  
 Heyer Products Co. Inc.  
 Jefferson-Travis Radio Mfg. Corp.  
 Kellogg Switchboard & Supply Co.  
 RCA-Victor Div., Radio Corp of Amer-  
 ica  
 Raytheon Manufacturing Co.  
 Srew Machine Products Co., Inc.  
 United Cinephone Corp.  
 Variety Aircraft Corp.

### CONTROLS

Aero Supply Mfg. Co. Inc.  
 Airesearch Manufacturing Co.  
 Burklyn Co.  
 Thomas A. Edison, Inc., Instrument  
 Div.  
 Kellogg Switchboard & Supply Co.  
 Michigan Tool Co.  
 The Tomkins-Johnson Co.

### Cables & Assemblies

A. B. C. Products, Inc.  
 Adel Precision Products Corp.  
 Agawam Aircraft Products, Inc.

All American Aircraft Products, Inc.  
 American Chain & Cable Co., Inc.,  
 Automotive & Aircraft Div.  
 American Steel & Wire Co.  
 Arens Controls, Inc.  
 Consolidated Vultee Aircraft Corp.  
 Durham Aircraft Service, Inc.  
 Federal Telephone & Radio Corp.  
 General Aircraft Supply Corp.  
 Goodyear Aircraft Corp.  
 Hyland Machine Co.  
 Jack & Heintz, Inc.  
 Jacoel Cable Splicing Equipment Co.  
 Kenyon Instrument Co., Inc.  
 The Laister-Kauffmann Aircraft Corp.  
 Macwhyte Co.  
 Meyers Aircraft Co.  
 Moore-Eastwood & Co.  
 Olmsted Manufacturing Div., South-  
 western Development Co.  
 Ritter Co., Inc.  
 Robertson Aircraft Corp.  
 John A. Roebing's Sons Co.  
 Rohr Aircraft Corp.  
 Schweizer Aircraft Corp.  
 Shakespeare Products Co.  
 F. W. Stewart Mfg. Corp.  
 Tylorcraft Aviation Corp.  
 United Aircraft Products, Inc.  
 White Aircraft Corp.

### Chains, Sprockets & Assemblies

Consolidated Vultee Aircraft Corp.  
 George J. Fix Co.  
 Kenyon Instrument Co., Inc.  
 Edward D. Maltby Co.  
 Otto Aviation Corp.  
 Ritter Co., Inc.  
 Robertson Aircraft Corp.  
 Simmonds Aeroaccessories, Inc.

### Pulleys

Durham Aircraft Service, Inc.  
 General Aircraft Supply Corp.  
 General Aviation Equipment Co., Inc.  
 Jack & Heintz, Inc.  
 King Plastics Corp.  
 Olmsted Manufacturing Div., South-  
 western Development Co.  
 Otto Aviation Corp.  
 Plastic Manufacturers, Inc.  
 Ritter Co., Inc.  
 Scott Aviation Corp.  
 Variety Aircraft Corp.  
 Westinghouse Electric & Mfg. Co.

# HERE'S EXPERIENCED HELP

On Your Aviation Communication Requirements

## COMMUNICATION AND ELECTRICAL EQUIPMENT *by* KELLOGG



**Military  
Switchboards**



**Multi-contact  
Plugs and Sockets**



**Head and Chest  
Sets**



**Capacitors — Wax  
and Oil Impregnated**



**Aircraft Radio  
Noise Filters**



**Volume Controls**



**Microphones —  
All Types**



**Retractable Electrical  
Coiled Kords**

### *... and on the ground*

Airport communication, protection, signalling, paging, etc. are vitally important subjects these days. Check with Kellogg, where engineering and manufacturing facilities are ready to help you install airport systems that incorporate the most advanced developments.

There is no substitute for experience—and in the development and manufacture of fine communication equipment, Kellogg is an outstanding leader. For 48 years Kellogg engineering research has been at work pioneering one far-reaching development after another. This includes the production of large quantities of radio and telephone apparatus like those shown above. And this experience is available to you now to help on present or post-war communication problems. Whatever problems you may have, write us today.

# KELLOGG

SWITCHBOARD & SUPPLY COMPANY  
6680 South Cicero Ave., Chicago 38, Illinois

REPRESENTATION THROUGHOUT THE NATION  
Branch Offices: Los Angeles, San Francisco, Kansas City, Minneapolis

**Sticks & Wheels**

All American Aircraft Products  
 Richard M. Decker Co., Inc.  
 Inland Mfg. Div., General Motors  
 Corp.  
 National Machine Products  
 Otto Aviation Corp.  
 Ritter Co., Inc.  
 Robertson Aircraft Corp.  
 Taylorcraft Aviation Corp.  
 Variety Aircraft Corp.

**COOLING SYSTEMS**

Airesearch Manufacturing Co.  
 American Machine & Metals, Inc.

**COVERS (ENGINE, COCKPIT, WINDSHIELD)**

Air Cruisers, Inc.  
 Air-Parts, Inc.  
 Benray Products Co.  
 Charles Manufacturing Co.  
 Consolidated Vultee Aircraft Corp.  
 Dura Plastic Inc.  
 The Dura-Products Manufacturing Co.  
 General Aircraft Supply Corp.  
 Otto Aviation Corp.  
 Perry Metal Products Co., Inc.  
 Rohr Aircraft Corp.  
 Schweizer Aircraft Corp.  
 United States Rubber Co.  
 Variety Aircraft Corp.

**COWLINGS**

Aero Trades Co.  
 Air Transport Mfg. Co.  
 The Aircraftmen Co.  
 B. H. Aircraft Co., Inc.  
 Buhl Manufacturing Co.  
 Columbia Aircraft Corp.  
 Consolidated Vultee Aircraft Corp.  
 Richard M. Decker Co., Inc.  
 Dura Plastics Inc.  
 General Aircraft Equipment Inc.  
 The Guiberson Corp., Aircraft &  
 Heater Div.  
 Kaiser Cargo, Inc., Fleetwings Div.  
 Luscombe Airplane Corp.  
 Milwaukee Metal Spinning Co.  
 Perry Metal Products Co., Inc.  
 Phillips Aviation Co.  
 Pollak Manufacturing Co.  
 Rohr Aircraft Corp.

Ryan Aeronautical Co.  
 Schweizer Aircraft Corp.  
 Solar Aircraft Co.  
 Spartan Aircraft Co.  
 Taylorcraft Aviation Corp.  
 Tennessee Aircraft, Inc.  
 United-Carr Fastener Corp.  
 Variety Aircraft Corp.  
 Vidal Research Corp.  
 White Aircraft Corp.

**CYLINDER DEFLECTORS, BAFFLES, BRACKETS**

American Aluminum Ware Co.  
 Consolidated Vultee Aircraft Corp.  
 Crowne Name Plate & Mfg. Co.  
 The Guiberson Corp., Aircraft &  
 Heater Div.  
 King Plastics Corp.  
 Luscombe Airplane Corp.  
 Milwaukee Metal Spinning Co.  
 Pollak Manufacturing Co.  
 Rohr Aircraft Corp.  
 Variety Aircraft Corp.

**DEHYDRATED PACKING**

Angier Corp.  
 Chandler-Evans Corp.  
 United States Rubber Co.

**DE-ICING FLUIDS & EQUIPMENT**

Adel Precision Products Corp.  
 American Tube Bending Co., Inc.  
 Anemostat Corp. of America  
 B. B. Chemical Co.  
 B. H. Aircraft Co., Inc.  
 The Bell Co., Inc.  
 Consolidated Vultee Aircraft Corp.  
 Eclipse-Pioneer Div., Bendix Aviation  
 Corp.  
 The Electric Sprayit Co.  
 Firestone Aircraft Co.  
 General Controls Co.  
 General Electric Co.  
 The B. F. Goodrich Co.  
 Huntington Precision Products Div.,  
 Adel Precision Products Corp.  
 Imperial Brass Mfg. Co.  
 The Keeney Manufacturing Co.  
 The Marquette Metal Products Co.  
 Mercury Aircraft Inc.  
 Otto Aviation Corp.  
 The Parker Appliance Co.

**Every Accessory  
any plane needs . . .**



**engineered and built  
with Eclipse Craftsmanship**

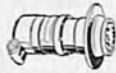
# Bendix

**AVIATION CORPORATION**

**Eclipse-Pioneer Division**

**Teterboro, N. J. • Los Angeles 36, Calif.**

BENDIX AND ECLIPSE ARE TRADE-MARKS OF BENDIX AVIATION CORPORATION



**Aviation Engine  
Starting Equipment**



**Aircraft Electric  
Power Supply  
Equipment**



**Aircraft Suction  
and Air Pressure  
Equipment**



**Aircraft Mechanical  
Ice Elimination  
Equipment**



**Aircraft Suction  
and Air Pressure  
Equipment**



**Aircraft Propeller  
Control Equipment**



**Aviation Engine  
Control Equipment**



**Hydraulic  
Equipment**



**Aircraft Electric  
Motor Actuators**



## *Eclipse* AVIATION ACCESSORIES

(De-Icing Fluids & Equipment) N. A. Woodworth Co.

*Continued*

Pesco Products Co.  
Romec Pump Co.  
Solar Aircraft Co.  
Stewart-Warner Corp.  
Surface Combustion Co.  
United States Rubber Co.

**DESIGNERS &  
INDUSTRIAL  
ENGINEERS**

Carney Engineering Co.  
Intercontinental Engineers, Inc.  
Pioneer Engineering & Mfg. Co.

**DIES, PATTERNS, JIGS**

Acme Aluminum Alloys Inc.  
The Acromark Co.  
Aircraft Mechanics, Inc.  
Aircraft Welders, Inc.  
Alofs Manufacturing Co.  
Alten's Foundry & Machine Works  
Atlas Metal Stamping Co.  
Booth Manufacturing Corp.  
Consolidated Vultee Aircraft Corp.  
Edwards Co.  
Ekstrom Carlson & Co.  
Firth-Sterling Steel Co.  
Floorola Products Inc.  
Goodyear Aircraft Corp.  
The Guiberson Corp., Aircraft &  
Heater Div.  
Harvill Corp.  
Hayes Manufacturing Corp.  
Hyland Machine Co.  
Los Angeles Stamp & Stationery Co.  
Merz Engineering Co.  
Models, Inc.  
Moore-Eastwood & Co.  
The Ohio Piston Co.  
Pacific Engineering Corp.  
The Parker Stamp Works, Inc.  
Peerless Machine Co.  
The Perry Metal Products Co., Inc.  
Plastic & Rubber Products Co.  
Progressive Welder Co.  
Schweizer Aircraft Corp.  
Spartan Aircraft Co.  
Spiegel Sales Co.  
Tennessee Aircraft Co. Inc.  
Variety Aircraft Corp.  
Wales-Strippit Corp.  
Wallace Engineering Co.  
White Aircraft Corp.

**ELECTRICAL  
EQUIPMENT**

Acme Electric Heating Co.  
Adel Precision Products Corp.  
Aerco Corp.  
Aeronautical Manufacturing Corp.  
American Aircraft Manufacturing Co.  
American Bosch Corp.  
Automatic Electric Co.  
The Benwood-Linze Co.  
The W. W. Boes Co.  
Bussman Mfg. Co.  
Cannon Electric Development Co.  
Delco-Remy Div., General Motors  
Corp.  
Durham Aircraft Service, Inc.  
Thomas A. Edison, Inc., Instrument  
Div.  
Faraday Electric Corp.  
Federal Telephone & Radio Corp.  
General Electric Co.  
The Hart Manufacturing Co.  
Heinemann Circuit Breaker Co.  
Heyer Products Co., Inc.  
Ideal Commutator Dresser Co.  
Johns-Manville Corp.  
Kellogg Switchboard & Supply Co.  
Lawrance Aeronautical Corp.  
Lights, Inc.  
Littelfuse, Inc.  
McColphin-Christie Corp., Ltd.  
Magnetic Engineering & Mfg. Co.  
National Machine Products  
Ohmite Manufacturing Co.  
Otto Aviation Corp.  
Pacific Div., Bendix Aviation Corp.  
Perry Metal Products Co., Inc.  
Pollak Manufacturing Co.  
Rohr Aircraft Corp.  
Sola Electric Co.  
Standard Aircraft Products, Inc.  
Union Aircraft Products Corp.  
United-Carr Fastener Corp.  
Woodward Governor Co.

**Auxiliary Motors**

Adel Precision Products Corp.  
American Aircraft Manufacturing Co.  
Bodine Electric Co.  
Bogue Electric Co.  
Eclipse-Pioneer Div., Bendix Aviation  
Corp.  
The Electric Sprayit Co.

# EDISON



... in electrical manufacturing since 1887, in aircraft instruments and aeronautical accessories since 1939, the EDISON name has meant inventive ingenuity, quality in manufacture and **DEPENDABLE SERVICE.**

\*

ELECTRICAL INSTRUMENTS FOR AIRCRAFT  
MECHANICAL INSTRUMENTS FOR AIRCRAFT  
AIRCRAFT FIRE DETECTION SYSTEMS  
AERONAUTICAL ACCESSORIES

\*

*Thomas A Edison*

INSTRUMENT DIVISION

INCORPORATED, WEST ORANGE, N. J.



**(Auxiliary Motors) Continued**

The Emerson Electric Mfg. Co.  
 Fairbanks, Morse & Co.  
 Fairchild Camera & Instrument Corp.  
 General Electric Co.  
 Grimes Manufacturing Corp.  
 Huntington Precision Products Div.,  
 Adel Precision Products Corp.  
 Jack & Heintz, Inc.  
 The Leece-Neville Co.  
 The Leland Electric Co.  
 The Ohio Electric Mfg. Co.  
 Ritter Co., Inc.  
 F. A. Smith Manufacturing Co.  
 Westinghouse Electric & Manufacturing Co.

**Disconnect Plugs**

Aircraft Radio Corp.  
 Breeze Corporations, Inc.  
 Burndy Engineering Co. Inc.  
 Cannon Electric Development Co.  
 Durham Aircraft Service, Inc.  
 The Harwood Co.  
 Kellogg Switchboard & Supply Co.  
 Kenyon Instrument Co.  
 The Lewis Engineering Co.  
 Littelfuse, Inc.  
 Otto Aviation Corp.

**Dynamotors**

Airadio, Inc.  
 Carter Motor Co.  
 Eclipse-Pioneer Div., Bendix Aviation Corp.  
 Eicor, Inc.  
 The Electric Sprayit Co.  
 Fairbanks, Morse & Co.  
 General Armature Corp.  
 General Electric Co.  
 Heyer Products Co., Inc.  
 Westinghouse Electric & Manufacturing Co.

**Generators**

Airadio, Inc.  
 American Aircraft Manufacturing Co.  
 Bogue Electric Co.  
 Carter Motor Co.  
 Delco-Remy Div., General Motors Corp.  
 Durham Aircraft Service, Inc.  
 Eclipse-Pioneer Div., Bendix Aviation Corp.

The Electric Sprayit Co.  
 Fairbanks, Morse & Co.  
 Fairchild Camera & Instrument Corp.  
 General Aircraft Supply Corp.  
 General Electric Co.  
 Jack & Heintz, Inc.  
 Kato Engineering Co.  
 Lasalco, Inc.  
 The Leece-Neville Co.  
 The Leland Electric Co.  
 The Udylyte Corp.  
 Westinghouse Electric & Manufacturing Co.

**Ignition Assemblies,  
Radio Shielded**

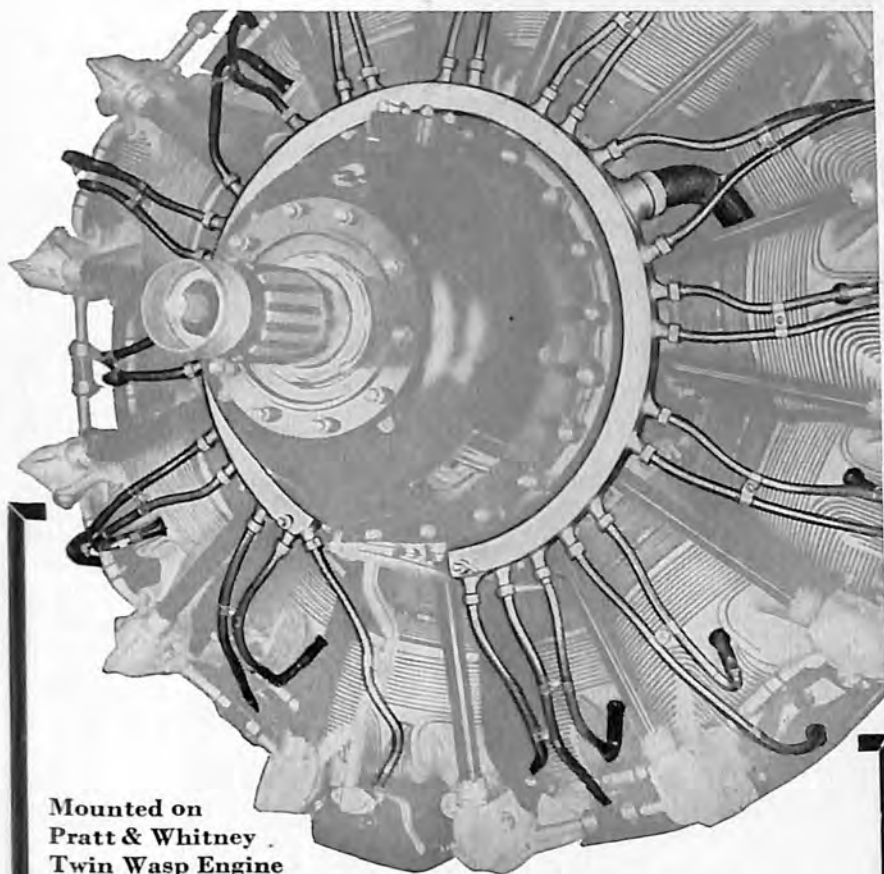
Bolton Manufacturing Corp.

**Magnetos**

American Bosch Corp.  
 Delco-Remy Div., General Motors Corp.  
 Edison-Splittdorf Corp.  
 Eisemann Corp.  
 The Electric Sprayit Co.  
 Fairbanks, Morse & Co.  
 General Electric Co.  
 Jack & Heintz, Inc.  
 Scintilla Magneto Div., Bendix Aviation Corp.  
 Wico Electric Co.

**Relays**

Airadio, Inc.  
 Automatic Electric Co.  
 C. P. Clare & Co.  
 Delco-Remy Div., General Motors Corp.  
 Durham Aircraft Service, Inc.  
 Eclipse-Pioneer Div., Bendix Aviation Corp.  
 Thomas A. Edison, Inc., Instrument Div.  
 The Electric Sprayit Co.  
 Federal Telephone & Radio Corp.  
 G-M Laboratories, Inc.  
 General Electric Co.  
 H-B Electric Co. Inc.  
 The Hart Manufacturing Co.  
 Hartwell Aviation Supply Co.  
 Heyer Products Co., Inc.  
 Jack & Heintz, Inc.  
 Kellogg Switchboard & Supply Co.  
 Leach Relay Co.



Mounted on  
Pratt & Whitney  
Twin Wasp Engine

## *Built for the Engines of Combat*

**BOLTON** Assemblies are used on war plane, tank and boat engines to drain off spark interference.

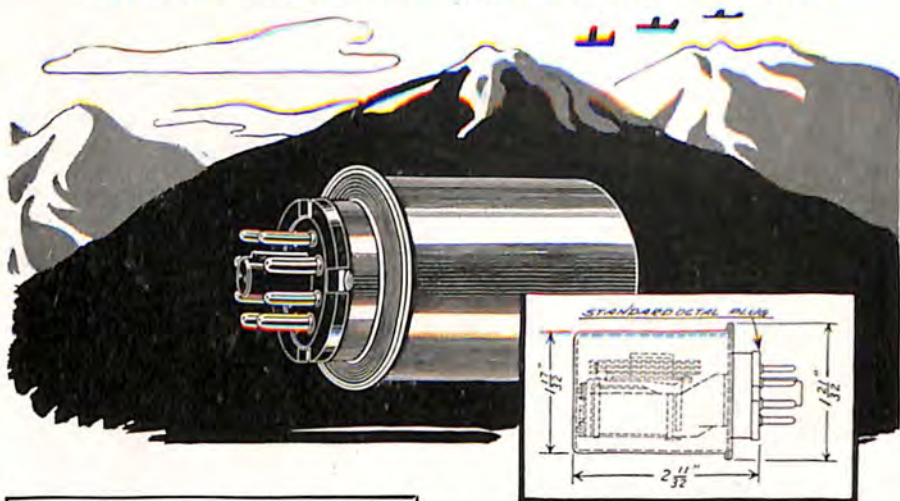
*Electrically*, they are designed to accomplish this with maximum effectiveness. *Physically*, they have the good fit and extreme ruggedness to insure dependable service under the severe grind of modern combat!

**BOLTON  
SHIELDED  
IGNITION  
ASSEMBLIES**

**BOLTON MANUFACTURING  
CORPORATION  
WEST HAVEN, CONN.**

## CLARE TYPE "K" SEALED-IN RELAY

### Assures Perfect Operation At Any Altitude



#### Special Features of CLARE Type "K" RELAY

1. Spring insulators of  $\frac{1}{8}$ " Mycalex are provided for high frequency circuits.
2. Pile-up screws are enclosed in Polystyrene tubing insulation. Both screws and tubing are completely sealed at head and foot by Glyptol.
3. The armature assembly, heelpiece and coil core are made of magnetic metal, carefully annealed. The armature assembly is available with either single or double arm.
4. The small coil is equipped with a front spool head having a flat side. This locks the entire coil in place against the heelpiece, preventing it from turning or becoming loose.
5. Uniform armature movement is assured by a hinge of "fatigueless" beryllium copper, heat treated and designed to provide a wide margin of safety, insuring long life under vibration.
6. Contact springs are made of nickel silver to the user's specifications. The contacts are over-all welded to these springs by a special process.
7. Spring bushing insulators are made of Bakelite rod under a patented process.

The Clare Type "K" Relay is a precise, small relay that is widely used in aircraft because of its ruggedness and dependability.

Ideal working conditions may now be sealed in with the Clare Type "K" Relay to insure the same perfect operation at high altitudes as at sea level. *Dry air or inert gas* may be sealed in according to requirements. Dimensions of the sealed-in relay are 2-11/32" long by 1-21/32" wide.

The Clare Type "K" Relay, which may be "custom-built" to fit exact specifications, is especially designed for applications where vibration is a factor. No anti-vibration springs are needed. There are no bearings to rattle loose. Uniform armature movement is assured by use of a "fatigueless" beryllium copper hinge, heat treated and designed to provide a wide margin of safety.

Let Clare engineers "custom-build" a relay to fit your specific requirements. Send for the Clare catalog and data book. C. P. Clare and Company, 4719 West Sunnyside Ave., Chicago 30, Ill., U. S. A. Sales engineers in all principal cities. Cable address: CLARELAY.

# CLARE RELAYS

"Custom-built" Multiple Contact Relays for Electrical, Electronic and Industrial Use



**Here's Why Micro Switch  
and Micro Switch Brackets  
Are The  
Standard of Comparison**

Thumb-size, feather-weight, rugged, and sensitive, Micro Switch is accurately built to exact standards from precisely made parts. Its performance characteristics can be changed to meet functional requirements . . . Type R-31, shown above, is designed to operate satisfactorily at 40,000 feet and in extremes of temperature. All switches must pass a factory harmonics

vibration test up to 60 cycles per second. It is designed and constructed to withstand acceleration of 10 G's. Strong, light weight actuator brackets, shown below, permit fast installation of the switch and easy replacement in the field. They are specifically designed to accommodate Type R-31 Micro Switch. They require no deviation permit.



This new Type M-B skeleton bracket is complete with over-travel plunger. Is interchangeable with Army switches A-1 and A-2. Weighs only .14 pound with switch. Plunger has controlled pre-travel and over-travel total of  $\frac{1}{4}$ ". Mounting holes in top of bracket are on standard 1-15/16" centers and accept number 6-32 bolts.



The Type T series bracket has met instant adoption as a throttle warning switch, singly or in gangs. They are operated by cams on the throttle quadrant or dogs on the cables. Any switch held depressed can be instantly opened by manual release without disturbing others in the gang.



Send for this new catalog which contains information regarding switches specifically designed for aircraft use.

© 1944



**Let's All Back the Attack  
... Buy Extra  
WAR BONDS**

**MICRO** MARK  
TRADE **MS** **SWITCH**

A DIVISION OF FIRST INDUSTRIAL CORPORATION

**FREEMONT, ILL., U.S.A.** Sales Offices in New York, Chicago, Cleveland, Los Angeles, Boston, Dallas, Portland, (Ore.)

**(Relays) Continued**

The Leece-Neville Co.  
Ritter Co., Inc.  
Westinghouse Electric & Mfg. Co.

**Rheostats**

Adel Precision Products Corp.  
General Electric Co.  
Hanson-Van Winkle-Munning Co.  
Hartwell Aviation Supply Co.  
Heyer Products Co., Inc.  
Huntington Precision Products Div.,  
Adel Precision Products Corp.  
Jack & Heintz, Inc.  
Lasalco, Inc.  
P. R. Mallory & Co., Inc.  
Ohmite Manufacturing Co.  
The Udylite Corp.

**Switches**

Advance Pump Co.  
Burklyn Co.  
Chicago Aerial Survey Co.  
Richard M. Decker Co., Inc.  
Delco-Remy Div., General Motors Corp.  
Dietz Manufacturing Co.  
Durham Aircraft Service, Inc.  
Eclipse-Pioneer Div., Bendix Aviation Corp.  
Federal Telephone & Radio Corp.  
General Electric Co.  
The Hart Manufacturing Co.  
Hartwell Aviation Supply Co.  
Robert Hetherington & Son, Inc.  
Heyer Products Co., Inc.  
Huntington Products Div., Adel Precision Products Corp.  
Kellogg Switchboard & Supply Co.  
Jack & Heintz, Inc.  
The Lewis Engineering Co.  
Littelfuse, Inc.  
P. R. Mallory & Co., Inc.  
Micro Switch Div., First Industrial Corp.  
Perry Metal Products Co., Inc.  
Scintilla Magneto Div., Bendix Aviation Corp.  
United-Carr Fastener Corp.  
Variety Aircraft Corp.  
Westinghouse Electric & Manufacturing Co.

**Terminals**

Burndy Engineering Co. Inc.  
Cannon Electric Development Co.  
Durham Aircraft Service, Inc.  
Eisemann Corp.  
Federal Telephone & Radio Corp.  
General Electric Co.  
The Hart Manufacturing Co.  
Hartwell Aviation Supply Co.  
Heyman Mfg. Co.  
Kellogg Switchboard & Supply Co.  
Littelfuse, Inc.  
Menaugh-Dutterer Co.  
Otto Aviation Corp.  
Scovill Manufacturing Co.  
United-Carr Fastener Corp.

**ENGINE EQUIPMENT**

Aeroquip Corp.  
Aircraft Screw Products Co., Inc.  
American Tube Bending Co., Inc.  
Burklyn Co.  
Chandler-Evans Corp.  
General Electric Co.  
Goodyear Aircraft Corp.  
The Keeney Manufacturing Co.  
Merz Engineering Co.  
Pacific Engineering Corp.  
The Parker Appliance Co.  
Simmonds Aeroaccessories, Inc.  
V. E. Sprouse Co.  
Standard Aircraft Products, Inc.  
United Aircraft Products, Inc.  
White Aircraft Corp.

**ENGINE MOUNTS**

Aero Trades Co.  
Air-Parts, Inc.  
Aircraft Mechanics, Inc.  
Aircraft Welders, Inc.  
American Tube Bending Co., Inc.  
B. H. Aircraft Co., Inc.  
The Bowling Green Rubber Co.  
Columbia Aircraft Corp.  
Connecticut Hard Rubber Co.  
Consolidated Vultee Aircraft Corp.  
Firestone Aircraft Co.  
The General Tire & Rubber Co.  
The B. F. Goodrich Co.  
Goodyear Aircraft Corp.  
The Guiberson Corp., Aircraft & Heater Div.  
Houde Engineering Div., Houdaille-Hershey Corp.

# BETTER THINGS FOR FLYING!



**T**ODAY, Jack & Heintz equipment is used in pursuit planes, bombers, transports, patrol boats, trainers, gliders . . . and even blimps. Its performance has been such that the Jack & Heintz nameplate is now a welcome sign of dependability to the men who gamble their lives on it daily in every corner of the globe.

From the first, Jack & Heintz has led the way in reducing weight, boosting output and increasing service life on every job undertaken. Engineering like this has helped keep America's air fleet first in the war . . . it will be equally effective in holding that place in peace. Watch Jack & Heintz for new things in aircraft!

  
**JACK & HEINTZ**  
*Incorporated*

*Jack & Heintz, Inc., Cleveland, Ohio. manufacturers of Aircraft Engine Starters — Generators — Gyro Pilots — Gyro Flight Instruments — Magnetos — Motors*

**(Engine Mounts) Continued**

Inland Mfg. Div., General Motors Corp.  
 Kellett Aircraft Corp.  
 The Manhattan Rubber Mfg. Div., Raybestos-Manhattan, Inc.  
 Meyers Aircraft Co.  
 Pacific Engineering Corp.  
 Perry Metal Products Co., Inc.  
 Rohr Aircraft Corp.  
 Schweizer Aircraft Corp.  
 Spartan Aircraft Co.  
 Spencer & Morris  
 Taylorcraft Aviation Corp.  
 United States Rubber Co.  
 Variety Aircraft Corp.  
 Wallace Supplies Manufacturing Co.  
 Wells Aircraft Parts Co.  
 White Aircraft Corp.

**ENGINE PARTS**

Excello Corp.  
 Jack & Heintz, Inc.  
 Liberty Aircraft Products Corp.  
 Rohr Aircraft Corp.

**Cams**

Air-Parts, Inc.  
 Atlantic Diesel Corp.  
 Indiana Gear Works  
 The Marquette Metal Products Co.  
 Otto Aviation Corp.  
 Perry Metal Products Co., Inc.  
 Thompson Products, Inc.

**Camshafts**

Air-Parts, Inc.  
 Atlantic Diesel Corp.  
 Merz Engineering Co.  
 Otto Aviation Corp.  
 Thompson Products, Inc.

**Crankshafts**

Air-Parts, Inc.  
 Atlantic Diesel Corp.  
 Eaton Manufacturing Co.  
 Merz Engineering Co.  
 Otto Aviation Corp.

**Pistons**

Air-Parts, Inc.  
 Atlantic Diesel Corp.

Burgess-Norton Mfg. Co.  
 Merz Engineering Co.  
 The Ohio Piston Co.  
 Otto Aviation Corp.  
 Ypsilanti Machine & Tool Co.

**Rings**

Air-Parts, Inc.  
 Atlantic Diesel Corp.  
 Burd Piston Ring Co.  
 George K. Garrett Co., Inc.  
 General Aircraft Supply Corp.  
 Moog Industries, Inc.  
 Muskegon Piston Ring Co.  
 Otto Aviation Corp.  
 Richmond Ring Co.  
 Spaulding Fibre Co., Inc.  
 Waldes Koh-I-Noor Inc.  
 Wilkening Manufacturing Co.

**Shims**

Air-Parts, Inc.  
 Atlantic Diesel Corp.  
 George K. Garrett Co., Inc.  
 P. R. Mallory & Co., Inc.  
 Otto Aviation Corp.  
 Perry Metal Products Co., Inc.  
 Spaulding Fibre Co., Inc.  
 Whitehead Stamping Co.

**Valves & Valve Parts**

Aero Supply Mfg. Co. Inc.  
 Aeronautical Products, Inc.  
 Air-Parts, Inc.  
 Arnolt Motor Co.  
 Atlantic Diesel Corp.  
 Burd Piston Ring Co.  
 Deutsch Co.  
 Eaton Manufacturing Co.  
 Engis Equipment Co.  
 Haynes Stellite Co.  
 Kenyon Instrument Co., Inc.  
 Walter Kidde & Co., Inc.  
 Koehler Aircraft Products Co.  
 The Marquette Metal Products Co.  
 Otto Aviation Corp.  
 The Parker Appliance Co.  
 Perry Metal Products Co., Inc.  
 Republic Aircraft Products Div., The Aviation Corp.  
 Spaulding Fibre Co., Inc.  
 Superior Tube Co.  
 Thompson Products, Inc.



**Ground Handling Equipment  
Speeds Servicing-Reduces Costs**

**AEROSTAND** - A safe, portable workstand. Strong and adaptable. Simple hand-pump hydraulic action raises platform to desired height. Several models available.

**PROPSTAND**  
- A sturdy portable support for handling propeller-servicing jobs - quicker and safer.



*For information write -*



**PACIFIC ENGINEERING CORPORATION**

3123 SAN FERNANDO ROAD, LOS ANGELES 41, CALIFORNIA • TELEPHONE: ALBANY 1191

**FROM  
STAINLESS  
ALUMINUM  
ALL STEELS  
TOBIN BRONZE**

We manufacture precision screw machine products special and standard Army-Navy specifications exclusively for the AIRCRAFT INDUSTRY.

**AIRCRAFT HARDWARE  
MFG. Co.**

1381 Lafayette Avenue  
New York, N. Y.

**hi-g** CONTROLS  
FOR AIRCRAFT

**hi-g** Engine Temperature, Electro-Magnetic and Hydraulic Controls (2-, 3- and 4-Way Valves) will operate in any position, regardless of acceleration or change of motion. Hi-G valves are unaffected by vibration. Their lightness, compactness, and small size save weight, space and materials. Used for engine priming, anti-icing, oil dilution, cabin heating, propeller feathering, wing flap and other aircraft functions. Write for Catalog 52B.



TYPE AV-1



**GENERAL CONTROLS**

801 ALLEN AVENUE, GLENDALE 1, CALIF.  
BRANCHES: Atlanta, Boston, Chicago, Kansas City, Cleveland, Dallas, Denver, Detroit, Philadelphia, New York, San Francisco, Houston



**(Valves & Valve Parts) Continued**

Thompson Products, Inc., West Coast Plant  
N. A. Woodworth Co.

**EXHAUST MANIFOLDS**

Aero Trades Co.  
Aircraft Mechanics, Inc.  
Aircraft Welders, Inc.  
The Aircraftsmen Co.  
American Tube Bending Co., Inc.  
B. H. Aircraft Co., Inc.  
Buhl Manufacturing Co.  
Columbia Aircraft Corp.  
Ferracuta Machine Co.  
Goodyear Aircraft Corp.  
The Guiberson Corp., Aircraft & Heater Div.  
The Keeney Manufacturing Co.  
Kirsch Co.  
Meyers Aircraft Co.  
The Murray Corp. of America  
Pollak Manufacturing Co.  
Pressed & Welded Steel Products Co. Inc.  
Rohr Aircraft Corp.  
Ryan Aeronautical Co.  
Solar Aircraft Co.  
Spartan Aircraft Co.  
Taylorcraft Aviation Corp.  
Utility Fan Corp.  
Variety Aircraft Corp.  
Wallace Supplies Manufacturing Co.  
White Aircraft Corp.

**FABRICS, CLOTHS,  
TAPES**

Adhere, Inc.  
Air Cruisers Inc.  
Associated Suppliers Co.  
Benray Products Co.  
Botany Worsted Mills  
Charles Manufacturing Co.  
The Duplan Corp.  
Flightex Fabrics, Inc.  
General Aircraft Supply Corp.  
John W. Gillette & Co.  
Goodyear Aircraft Corps.  
Grand Rapids Varnish Corp.  
Hamilton-Wade Co.  
Hope Webbing Co.  
Johns-Manville Corp.  
The Laister-Kauffmann Aircraft Corp.  
Landers Corp.  
Mica Insulator Co.

Otto Aviation Corp.  
Peiger, McCaw & Co.  
Pyroxylin Products Inc.  
Standard Felt Co.  
J. H. Thorp & Co. Inc.  
W. Harris Thurston, Inc.  
The Udylite Corp.  
Uniform Hood Lace Co.  
United States Rubber Co.  
White Aircraft Corp.  
York Tool Sales Co.  
Zapon Div., Atlas Powder Co.

**FAIRINGS**

Aero Trades Co.  
Air Transport Mfg. Co.  
The Aircraftsmen Co.  
American Central Mfg. Corp.  
Consolidated Vultee Aircraft Corp.  
Edo Aircraft Corp.  
The Formica Insulation Co.  
Goodyear Aircraft Corp.  
The Guiberson Corp., Aircraft & Heater Div.  
Kellett Aircraft Corp.  
Kilgen Aircraft Div., The Kilgen Organ Co.  
King Plastics Corp.  
The Laister-Kauffmann Aircraft Corp.  
Marine-Air Research Corp.  
Mica Insulator Co.  
The Murray Corp. of America  
Phillips Aviation Co.  
Pollak Manufacturing Co.  
Rohr Aircraft Corp.  
Schweizer Aircraft Corp.  
Taylor Fibre Co.  
Taylorcraft Aviation Corp.  
United-Carr Fastener Corp.  
Variety Aircraft Corp.  
Vidal Research Corp.  
Weber Showcase & Fixture Co., Inc.  
White Aircraft Corp.

**FASTENERS, NUTS,  
BOLTS, SCREWS  
& WASHERS**

Active Screw & Manufacturing Co.  
Adel Precision Products Corp.  
Aero Screw Co.  
Aero Supply Mfg. Co. Inc.  
Aircraft Products Co.  
Aircraft Screw Products Co., Inc.  
Aircraft Standard Parts Co.  
Aluminum Co. of America



The New Douglas DC-7

**\*BOTANY** *"Flying Fabrics"*

BLAZE A TRAIL WITH

**PAN AMERICAN**



Strata Clipper Interior



Passenger Compartment

Pan American World Airways turns to Botany for their finest woven wool fabrics. Lightness is essential, for every ounce counts in the air. Durability must be absolute, for these Winged Giants fly from the moist tropics to the dry and frigid Arctic. Changing climatic conditions require that all drapes and upholstery fabrics must be impervious to the elements and wear indefinitely. That's why Pan American World Airways depends on Botany. Each is a pioneer in its own field and together they fly to a brilliant future!

**BOTANY WORSTED MILLS**  
Passaic, New Jersey

\*Reg. U. S. Pat. Off.  
Copyright 1945 by Botany Worsted Mills

**(Fasteners, Nuts, Bolts, Screws & Washers) Continued**

American Screw Co.  
 Bethlehem Steel Co.  
 Camloc Fastener Corp.  
 The Centerless Grinding Co., Inc.  
 Central Screw Co.  
 Consolidated Vultee Aircraft Corp.  
 Continental Screw Co.  
 The Corbin Screw Corp.  
 Dardelet Threadlock Corp.  
 Durham Aircraft Service, Inc.  
 Dzus Fastener Co., Inc.  
 Firestone Aircraft Co.  
 General Aircraft Supply Corp.  
 The B. F. Goodrich Corp.  
 The Hartford Machine Tool Co.  
 Hartwell Aviation Supply Co.  
 The Holo-Krome Screw Corp.  
 Hyland Machine Co.  
 The Lamson & Sessions Corp.  
 Manufacturers Screw Products  
 The Maryland Bolt & Nut Co.  
 Metropolitan Supply Co.  
 Otto Aviation Corp.  
 Perry Metal Products Co., Inc.  
 Pheoll Manufacturing Co.  
 Pollak Manufacturing Co.  
 Rockford Screw Products Co.  
 Rohr Aircraft Corp.  
 Shakeproof Inc.  
 Simmonds Aerocessories, Inc.  
 Solar Aircraft Co.  
 The Spool Cotton Co., Crown Fastener Div.  
 Swift Lubricator Co., Inc.  
 Thompson Products, Inc., West Coast Plant  
 United-Carr Fastener Corp.  
 Variety Aircraft Corp.  
 Waldes Koh-I-Noor Inc.  
 Wells Aircraft Parts Co.  
 Western Automatic Machine Screw Co.  
 White Aircraft Corp.  
 Whitehead Stamping Co.

**FENCES**

American Chain & Cable Co., Inc.,  
 Page Steel & Wire Div.  
 American Steel & Wire Co.  
 Anchor Post Fence Co.  
 Bethlehem Steel Co.  
 Continental Steel Corp.

**FILTERS & STRAINERS**

Aero Supply Mfg. Co. Inc.

Heath Co.  
 The Hilliard Corp  
 Imperial Brass Manufacturing Co.  
 Koehler Aircraft Products Co.  
 United Aircraft Products, Inc.

**Air**

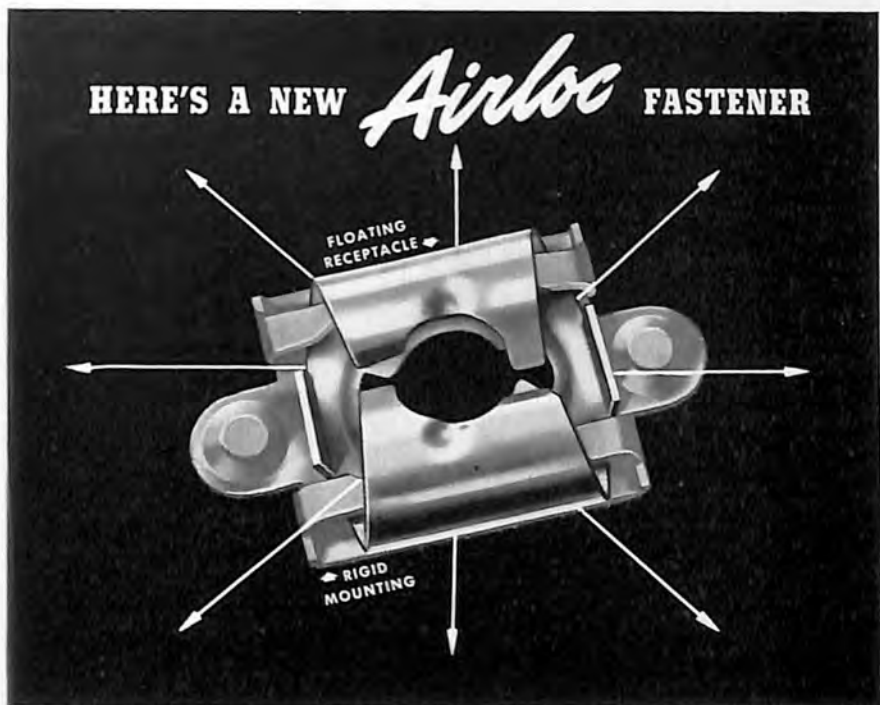
Adel Precision Products Corp.  
 Aircraft Specialties Co.  
 Eugene Cantin Co. Inc.  
 Chrysler Corp., Amplex Div.  
 Cuno Engineering Corp.  
 Durham Aircraft Service, Inc.  
 Eclipse-Pioneer Div., Bendix Aviation Corp.  
 Huntington Precision Products Div.,  
 Adel Precision Products Corp  
 The Alexander Milburn Co.  
 The Parker Appliance Co.  
 Pesco Products Co.  
 Purolator Products, Inc.  
 Skinner Purifiers, Inc.

**Oil**

Adel Precision Products Corp.  
 Bowser, Inc.  
 Eugene Cantin Co. Inc.  
 Chrysler Corp., Amplex Div.  
 Cuno Engineering Corp.  
 Durham Aircraft Service, Inc.  
 Eclipse-Pioneer Div., Bendix Aviation Corp.  
 The Hilliard Corp.  
 Hub Industries, Inc.  
 Huntington Precision Products Div.,  
 Adel Precision Products Corp.  
 Kenyon Instrument Co., Inc.  
 The Parker Appliance Co.  
 Purolator Products, Inc.  
 Smith Meter Co.  
 Thompson Products, Inc.

**Water**

Adel Precision Products Corp.  
 Bowser, Inc.  
 Chrysler Corp., Amplex Div.  
 Dura Plastics Inc.  
 Durham Aircraft Service, Inc.  
 Huntington Precision Products Div.,  
 Adel Precision Products Corp.  
 The Parker Appliance Co.  
 Skinner Purifiers Inc.  
 Smith Meter Co.



*It Floats . . .* **ALLOWS MAXIMUM  
FLOAT OF 1/8" IN ANY DIRECTION**

This new floating receptacle is an important addition to the Airloc line. It allows for misalignment of as much as an eighth of an inch in any direction.

A supplement to our Airloc Catalog gives full information and instructions for specifying the proper stud to use with floating Airloc receptacles. Send for this supplement . . . or for your copy of the complete Catalog. Address Department Y-45.

**UNITED-CARR FASTENER CORP.**

2832 East Grand Boulevard, Detroit

### FINISHES, PAINTS, VARNISHES

American Chemical Paint Co.  
Avondale Chemical Co.  
Dibble Color Co.  
General Aircraft Supply Corp.  
General Electric Co.  
Grand Rapids Varnish Corp.  
The Lowe Brothers Co.  
Monsanto Chemical Co., Merrimac  
Div.  
Murphy Finishes Corp.  
National Lead Co.  
Otto Aviation Corp.  
Pyroxylin Products Inc.  
Roxalin Flexible Finishes, Inc.  
United States Varnish Co.  
Wales Dove-Hermiston Corp.  
Zapon Div., Atlas Powder Co.

### FIRE FIGHTING EQUIPMENT

Air Cruisers, Inc.  
American-Lafrance-Foamite Corp.  
C-O-Two Fire Equipment Co.  
The Fyr-Fyter Co.  
General Aircraft Supply Corp.  
The General Detroit Corp.  
Hewitt Rubber Corp.  
Walter Kidde & Co., Inc.  
Johns-Manville Corp.  
Otto Aviation Corp.  
Pacific Fire Extinguisher Co.  
Pyrene Manufacturing Co.

### FIRST AID EQUIPMENT

First Aid Supply Co.  
General Aircraft Supply Corp.  
The General Detroit Corp.  
Otto Aviation Corp.

### FITTINGS

Aero Trades Co.  
Aeroquip Corp.  
Agawam Aircraft Products, Inc.  
Aircraft Products Co.  
Alten's Foundry & Machine Works  
Aluminum Co. of America  
American Central Mfg. Corp.  
American Chain & Cable Co., Inc.,  
Automotive & Aircraft Div.  
Consolidated Vultee Aircraft Corp.  
Deutsch Co.

Dollin Corp.  
Durham Aircraft Service, Inc.  
The Electric Sprayit Co.  
General Aviation Equipment Co. Inc.  
The B. F. Goodrich Corp.  
Goodyear Aircraft Corp.  
Hartwell Aviation Supply Co.  
Imperial Brass Manufacturing Co.  
Kirsch Co.  
Kohler Co.  
Lights, Inc.  
Lincoln Engineering Co.  
Metropolitan Supply Co.  
Meyers Aircraft Co.  
The Parker Appliance Co.  
Perry Metal Products Co., Inc.  
Phillips Aviation Co.  
Robertson Aircraft Corp.  
Schweizer Aircraft Corp.  
Swift Lubricator Co., Inc.  
Taylorcraft Aviation Corp.  
Tube Turns, Inc.  
The Weatherhead Co.  
Weber Showcase & Fixture Co., Inc.  
Wells Aircraft Parts Co.  
White Aircraft Corp.  
E. W. Wiggins Airways, Inc.

### FLARES & SIGNALS

Eclipse-Pioneer Div., Bendix Aviation  
Corp.  
Durham Aircraft Service, Inc.  
The General Detroit Corp.  
The Kilgore Manufacturing Co., Inter-  
national Flare Signal Div.  
Variety Aircraft Corp.

### FLOATS, SKIIS

Air Cruisers, Inc.  
Air Transport Mfg. Co.  
Edo Aircraft Corp.  
Firestone Aircraft Co.  
General Aircraft Supply Corp.  
The B. F. Goodrich Corp.  
Goodyear Aircraft Corp.  
Heath Co.  
King Plastics Corp.  
Mercury Aircraft Inc.  
Milwaukee Metal Spinning Co.  
Northwest Air Service, Inc.  
Spartan Aircraft Co.  
Variety Aircraft Corp.  
Vidal Research Corp.  
White Aircraft Corp.



*A Specific Finish*  
**FOR EVERY AIRCRAFT NEED**

**FABRIC FINISHES:**

Emycel speed system of fabric doping  
 (C. A. A. approved)

Army-Navy specification clear and pigmented dopes — all types

**METAL FINISHES:**

Army-Navy specification-Zinc Chromate Primer

Non-specular (camouflage) lacquer enamels

Gloss lacquers

Non-specular (camouflage) synthetic enamels

Rincontrol textured enamels

Flight instrument and communications equipment finishes

Special types engineered for specific performance

**PLYWOOD FINISHES:**

Fillers • Sealers • Surfacers

Non-specular lacquer and synthetic enamels

Gasoline resistant lacquers



**ROXALIN** *Flexible* **FINISHES**  
 I N C O R P O R A T E D  
 ELIZABETH • NEW JERSEY



## RESEARCH - Basic Reason for Better Carbides

Years of unrelenting research by Philip M. McKenna resulted, in 1937, in the discovery of the hardest man-made material—a unique intermetallic compound, tungsten-titanium-carbide, corresponding to the chemical formula  $WTiC_2$ . This compound is the basic ingredient of steel-cutting compositions of Kennametal. It distinguishes them from all other cemented carbides.

Introduced in 1938, Kennametal quickly became established as the tool material that made possible machining of hard steel, accurately, at greatly increased speeds. Kennametal's spectacular performance in this field was a tremendous stimulus to increased research activities, which since 1938, have led to the successful development of:

- a series of Kennametal compositions, of varying degrees of hardness, strength, and toughness, exactly suited for machining various types of steel, as well as tough, stringy non-ferrous alloys.
- a new, highly abrasion-resistant tungsten carbide Kennametal composition that cuts cast iron at greatly accelerated rates, with amazing tool life.
- a complete line of machining tools, designed to make fullest utilization of possibilities inherent in Kennametal compositions.
- Kennametal lathe files, that outlast steel files up to 200 times, and produce a superior finish.
- a wide variety of wear-resistant products, including lathe and grinder centers, pump valve balls and seats, gage tips, etc.
- negative-rake carbide milling cutters, notable among which is the widely used inserted-blade Kennamill step-cutter.

Research—looking to still further improvements in the properties and applicability of Kennametal—will continue, and expand, so long as the useful products of inventive genius are protected under an uninhibited American system of free enterprise.





*Post*

**READY WITH WAR PLANS**



Whatever the plane of the future, **INTERNATIONAL** will be ready to supply it with dependable flare and signal equipment. War found us prepared, through many years experience designing and manufacturing pyrotechnic equipment for airlines and commercial planes.



Flares and signals with the name "**INTERNATIONAL**" are not "war babies" — they grew up with aviation and will progress with it.



**INTERNATIONAL  
FLARE-SIGNAL DIV.**

of THE KILGORE MFG. CO. *Tipp City, Ohio*



**FORGINGS**

Aircraft Mechanics, Inc.  
 Alten's Foundry & Machine Works  
 Aluminum Co. of America  
 Amalgamated Steel Co.  
 Bethlehem Steel Co.  
 The Billings & Spencer Co.  
 Bonney Forge & Tool Works  
 The E. D. Clapp Mfg. Co.  
 Consolidated Vultee Aircraft Corp.  
 Endicott Forging & Mfg. Co., Inc.  
 Imperial Brass Manufacturing Co.  
 Interstate Drop Forge Co.  
 Kropp Forge Aviation Co.  
 The Parker Appliance Co.  
 The Paulson Tools, Inc.  
 Perry Metal Products Co., Inc.  
 Revere Copper & Brass Inc.  
 Reynolds Metals Co.  
 St. Pierre Chain Corp.  
 Scovill Manufacturing Co.  
 Thompson Products, Inc.  
 Thompson Products, Inc., West Coast  
 Plant  
 Tube Turns, Inc.  
 J. H. Williams & Co.  
 Wyman-Gordon Co.

**FUEL PUMPS &  
SYSTEMS—AIRCRAFT**

Adel Precision Products Corp.  
 American Bosch Corp.  
 Consolidated Vultee Aircraft Corp.  
 Durham Aircraft Service, Inc.  
 The Electric Sprayit Co.  
 Hewitt Rubber Corp.  
 Huntington Precision Products Div.,  
 Adel Precision Products Corp.  
 Imperial Brass Manufacturing Co.  
 Metropolitan Supply Co.  
 Pesco Products Co.  
 Standard Aircraft Products, Inc.  
 Stewart-Warner Corp.  
 Taylorcraft Aviation Corp.  
 United Aircraft Products, Inc.  
 Variety Aircraft Corp.  
 Wells Aircraft Parts Co.

**FUEL SYSTEMS—  
AIRPORT**

Aerojet Engineering Corp.  
 Bowser, Inc.  
 Esso Aviation Products  
 Huntington Precision Products Div.,  
 Adel Precision Products Corp.

The Keeney Manufacturing Co.  
 Romec Pump Co.  
 Thompson Products, Inc.

**FUELS**

Esso Aviation Products  
 Gulf Oil Corp.  
 Shell Oil Co.  
 Sinclair Refining Co.  
 Socony-Vacuum Oil Co., Inc.  
 Standard Oil Co. of California  
 The Texas Co.  
 Wolf's Head Oil Refining Co., Inc.

**GASKETS**

Adel Precision Products Corp.  
 American Aluminum Ware Co.  
 American Flange & Mfg. Co. Inc.  
 Atlantic India Rubber Works, Inc.  
 The B G Corp.  
 Jack Best Mfg. Co.  
 The Bowling Green Rubber Co.  
 Connecticut Hard Rubber Co.  
 Detroit Gasket & Mfg. Co.  
 Durham Aircraft Service, Inc.  
 Eclipse-Pioneer Div., Bendix Aviation  
 Corp.  
 The Formica Insulation Co.  
 General Aircraft Supply Corp.  
 The General Tire & Rubber Co.  
 The B. F. Goodrich Co.  
 E. F. Haughton & Co.  
 Huntington Precision Products Div.,  
 Adel Precision Products Corp.  
 Johns-Manville Corp.  
 The Manhattan Rubber Mfg. Div.,  
 Raybestos-Manhattan, Inc.  
 Otto Aviation Corp.  
 Plastic & Rubber Products Co.  
 Resistoflex Corp.  
 Rodic Rubber Corp.  
 Spaulding Fibre Co., Inc.  
 Taylor Fibre Co.  
 United Aircraft Products, Inc.  
 United States Rubber Co.  
 The Vellumoid Co.  
 Wilmington Fibre Specialty Co.

**Gauges  
(SEE INSTRUMENTS)**

American Gauge Co.  
 B. C. Ames Co.  
 Continental Machines Inc.  
 Federal Products Corp.

# ENGINE CONTROLS LIGHTING EQUIPMENT

*for Aircraft*



### COCKPIT LAMP ASSEMBLY

TYPE C-4  
A.A.F. Specification  
94-32294-A  
Standard Aircraft No.  
SA-1007-D

Used as auxiliary light source on all types of aircraft.  
Weight—11 oz.  
Overall size—length 5-1/16"; diameter 1 3/4".



### WARNING LIGHT

A.A.F. Drawing No. 4283593  
Standard Aircraft No. SA-3821-B

Completely sealed. Equipped with curtain opening and closing ring. Simplifies checking oxygen, landing gear, prop limit, etc.  
Wt.—7/10 oz. Overall length 2 1/4"; diameter 7/8".



### CABIN LAMP ASSEMBLY

TYPE A-7 VAPOR-PROOF Specification  
AN-3039-1 13 VOLT LAMP  
AN-3039-2 28 VOLT LAMP  
Standard Aircraft No. SA-2672-B

Moisture proof. Clear light regardless of varying atmospheric conditions.  
Wt.—1 lb. 10 oz. Overall—length 6 7/8"; diameter 5 7/8".



### OIL TANK VENT VALVE

A double action valve which maintains a predetermined pressure on oil tank thereby preventing cavitation in system. Incorporated safety feature prevents vacuum developing in tank. Weight 6 oz. Overall size—length 5 7/8"; width 3"; height 2".



### FUEL TANK PRESSURE CONTROL VALVE

An aneroid valve which prevents cavitation and vapor-lock in fuel system by maintaining a predetermined pressure in fuel tank under all flight conditions. Wt.—1 lb., 2 oz. Overall—4 1/4" x 5".



### ALTITUDE COMPENSATING VALVE

A pressure maintaining valve which maintains a predetermined pressure on the system at all times regardless of altitude. Weight—7 oz. Overall size—2-9/16" x 1 7/8".

These are only a few of the Standardair line of precision controls for aircraft power plants; lighting equipment; accessories; metal stampings. Specified in many leading makes of American, British, Canadian aircraft. Write for data, prices.

STANDARD



**Standard Aircraft Products Inc., Dayton 2, Ohio**

SALES OFFICES:

Standard Aircraft Products, Inc., 1831 Graybar Bldg., New York City  
L. M. Payne Company, Inc., 417 Curtis Building, Detroit, Michigan  
Hartwell Aviation Supply Co., 3417 Crenshaw Blvd., Los Angeles, Calif.  
Hartwell Aviation Supply Co., Huron Building, Kansas City, Kansas  
Hartwell Aviation Supply Co., 608 North St. Paul St., Dallas, Texas

**(Gauges) Continued**

Kaiser Cargo, Inc., Fleetwings Div.  
 The Liquidometer Corp.  
 Merz Engineering Co.  
 Phillips Aviation Co.  
 Products Engineering Co.  
 N. A. Woodworth Co.

**GEARS**

The Adams Co.  
 Adhere, Inc.  
 Cunningham-Hall Aircraft Corp.  
 Engis Equipment Co.  
 Foote Bros. Gear & Machine Corp.  
 Geo. J. Fix Co.  
 The Gear Grinding Machine Co.  
 Gleason Works  
 Indiana Gear Works  
 Jack & Heintz, Inc.  
 Merz Engineering Co.  
 Michigan Tool Co.  
 Peerless Machine Co.  
 Perry Metal Products Co., Inc.  
 St. Louis Tool & Mfg. Co.  
 Taylor Fibre Co.

**GLASS**

Kopp Glass, Inc.

**GRASS SEED**

Arthur D. Peterson Co., Inc.  
 O. M. Scott & Sons Inc.  
 Stump & Walter Co.

**GLUES & ADHESIVES**

Avondale Chemical Co.  
 Casein Company of America  
 Consolidated Vultee Aircraft Corp.  
 General Aircraft Supply Corp.  
 The B. F. Goodrich Co.  
 Goodyear Aircraft Corp.  
 Hanson-Van Winkle-Munning Co.  
 R. M. Hollingshead Corp.  
 I. F. Laucks, Inc.  
 Monite Waterproof Glue Co.  
 Perry Metal Products Co., Inc.  
 The Udylyte Corp.  
 Wesley Lacquer Co.

**GROMMETS**

Active Screw & Mfg. Co.  
 Arens Controls, Inc.  
 Atlantic India Rubber Works, Inc.

The Bowling Green Rubber Co.  
 Camloc Fastener Corp.  
 Dura Plastics Inc.  
 Durham Aircraft Service, Inc.  
 Firestone Aircraft Co.  
 General Aircraft Supply Corp.  
 The General Tire & Rubber Co.  
 The B. F. Goodrich Co.  
 Hartwell Aviation Supply Co.  
 Heath Co.  
 The Manhattan Rubber Mfg. Div.,  
 Raybestos-Manhattan, Inc.  
 Otto Aviation Corp.  
 Rodic Rubber Corp.  
 Scovill Manufacturing Co.  
 Spaulding Fibre Co., Inc.  
 Taylorcraft Aviation Corp.  
 United States Rubber Co.  
 Wilmington Fibre Specialty Co.

**HARDWARE  
(MISCELLANEOUS)**

The Acromark Co.  
 Active Screw & Mfg. Co.  
 Aero Supply Mfg. Co., Inc.  
 Aircraft Standard Parts Co.  
 Alten's Foundry & Machine Works  
 Automotive Rubber Co.  
 Burklyn Co.  
 Camloc Fastener Corp.  
 P. & F. Corbin  
 The Corbin Screw Corp.  
 Richard M. Decker Co., Inc.  
 Deutsch Co.  
 Dollin Corp.  
 Durham Aircraft Service, Inc.  
 Fox Co.  
 George K. Garrett Co., Inc.  
 General Aircraft Supply Corp.  
 Hyland Machine Co.  
 McGrath St. Paul Co.  
 Manufacturers Screw Products  
 The Parker Appliance Co.  
 Perry Metal Products Co., Inc.  
 Rohr Aircraft Corp.  
 Rohlm Manufacturing Co., Inc.  
 Union Aircraft Products Corp.  
 United-Carr Fastener Corp.  
 Weber Showcase & Fixture Co., Inc.  
 J. Wiss & Sons Co.  
 X. L. Radio Laboratories

**HEATERS**

Abrams Instrument Co.  
 Acme Electric Heating Co.

**For Rugged, Strong-Matted  
AIRPORT TURF Sow**

*Stump & Walter Co*

*Grass Seed of Known Quality*

Special Airport formulas made up in accordance with your particular soil and climatic conditions by experts who understand your problems, or we will supply grass seed according to your own formula.

For over 46 years Stump & Walter Co. has been famous for grass seed mixtures of the highest quality and are responsible for the turf of many of America's finest lawns, polo fields, golf courses and air fields.

*If you have a Turf or Maintenance Problem  
please write us—without obligation.*

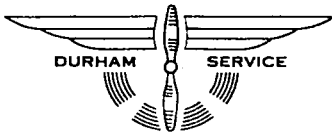
*Stump & Walter Co*

132-138 Church St. Dept. New York 8, N. Y.

Suppliers of Grass Seed Mixtures—Fertilizers—Mowers—Tools—  
Sprinkler Systems—Rollers

Also Seeds and Garden Supplies for the Home Garden  
*Catalogue Free on Request*

DURHAM



*Specialists in  
hydraulic and electrical  
fittings and valves*

AUTHORIZED DISTRIBUTOR  
with  
ACCESSORY OVERHAUL SHOP

AMERICAN BOSCH AIRCRAFT MAGNETOS

CHAMPION SPARK PLUGS—MARVEL CARBURETORS

FAFNIR AND NORMA-HOFFMANN BALL BEARINGS

PARKER AND WEATHERHEAD FITTINGS

DURHAM AIRCRAFT SERVICE, Inc.

Northern Blvd. at Prince St., Flushing, New York

**(Heaters) Continued**

Air Transport Mfg. Co.  
 Anchor Post Fence Co.  
 Burd Piston Ring Co.  
 Dietz Manufacturing Co.  
 Eclipse Fuel Engineering Co.  
 Girdler Corp.  
 The Guiberson Corp., Aircraft &  
 Heater Div.  
 Harvey-Whipple Inc.  
 McQuay, Inc.  
 Solar Aircraft Co.  
 V. E. Sprouse Co.  
 Stewart-Warner Corp.  
 Surface Combustion  
 Taylorcraft Aviation Corp.  
 Westinghouse Electric & Mfg. Co.  
 Young Radiator Co.

**HOISTS, CRANES,  
LIFTS, ETC.**

Baker Industrial Truck Div., The  
 Baker-Raulang Co.  
 Curtis Pneumatic Machinery Div.,  
 Curtis Manufacturing Co.  
 Erie Steel Construction Co.  
 Geo. J. Fix Co.  
 Globe Hoist Co.  
 W. A. Hebard & Co.  
 The Hughes Keenan Co.  
 Hyster Co.  
 Independent Pneumatic Tool Co.  
 Lyon-Raymond Corp.  
 Malabar Machine Co.  
 Mechanical Handling Systems, Inc.  
 Pacific Engineering Corp.  
 Arthur D. Peterson Co., Inc.  
 Preco Inc.  
 Revolvator Co.  
 Spencer & Morris  
 Templeton, Kenly & Co.  
 Union Mfg. Co.  
 Variety Aircraft Corp.  
 West Bend Equipment Corp.  
 Whiting Corp.

**HOSE - RUBBER  
& SYNTHETIC**

Aero-Coupling Corp.  
 Aeroquip Corp.  
 Air Cruisers, Inc.  
 The Bowling Green Rubber Co.  
 Connecticut Hard Rubber Co.  
 Durham Aircraft Service, Inc.  
 Firestone Aircraft Co.

Flex-O-Tube Co.  
 General Aircraft Supply Corp.  
 The General Detroit Corp.  
 The General Tire & Rubber Co.  
 The B. F. Goodrich Co.  
 Goodyear Aircraft Corp.  
 Hewitt Rubber Corp.  
 Independent Pneumatic Tool Co.  
 The Manhattan Rubber Mfg. Div.,  
 Raybestos-Manhattan, Inc.  
 Resistoflex Corp.  
 Rodic Rubber Corp.  
 United States Rubber Co.  
 The Weatherhead Co.

**HOSE CLAMPS &  
HOSE FITTINGS**

Actus Products Co.  
 Adel Precision Products Corp.  
 Aero-Coupling Corp.  
 Aeroquip Corp.  
 Aircraft Standard Parts Co.  
 The Corbin Screw Corp.  
 Durham Aircraft Service, Inc.  
 Firestone Aircraft Co.  
 Flex-O-Tube Co.  
 George K. Garrett Co., Inc.  
 General Aircraft Supply Corp.  
 General Aviation Equipment Co., Inc.  
 The General Detroit Corp.  
 The B. F. Goodrich Co.  
 Hartwell Aviation Supply Co.  
 Heyman Mfg. Co.  
 Imperial Brass Manufacturing Co.  
 Independent Pneumatic Tool Co.  
 The Manhattan Rubber Mfg. Div.,  
 Raybestos-Manhattan, Inc.  
 Paasche Airbrush Co.  
 The Parker Appliance Co.  
 Perry Metal Products Co., Inc.  
 Resistoflex Corp.  
 Schweizer Aircraft Corp.  
 Screw Machine Products Co., Inc.  
 V. E. Sprouse Co.  
 United-Carr Fastener Corp.  
 United States Rubber Co.  
 The Weatherhead Co.

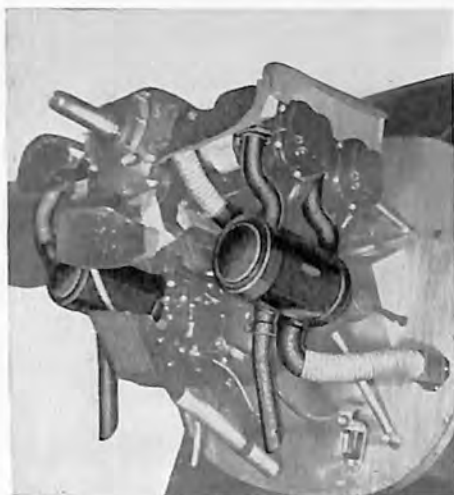
**HYDRAULIC CONTROLS  
& ASSEMBLIES**

Adel Precision Products Corp.  
 Aero Corp.  
 Aero-Coupling Corp.  
 Aeroquip Corp.  
 Aircraft Accessories Corp.

# SPROUSE PRODUCTS FOR THE AIRCRAFT INDUSTRY

- MUFFLERS
- HEATERS
- HOSE CLAMPS
- FORMED TUBES AND  
TUBE ASSEMBLIES
- BRACKETS, CLIPS, CLAMPS
- SHEET METAL ASSEMBLIES

Use our experience and engineering department to help meet your special needs. Write today for descriptive literature.



*Sprouse Muffler and Cabin Heater*



*Sprouse Double Wrap Hose Clamp*

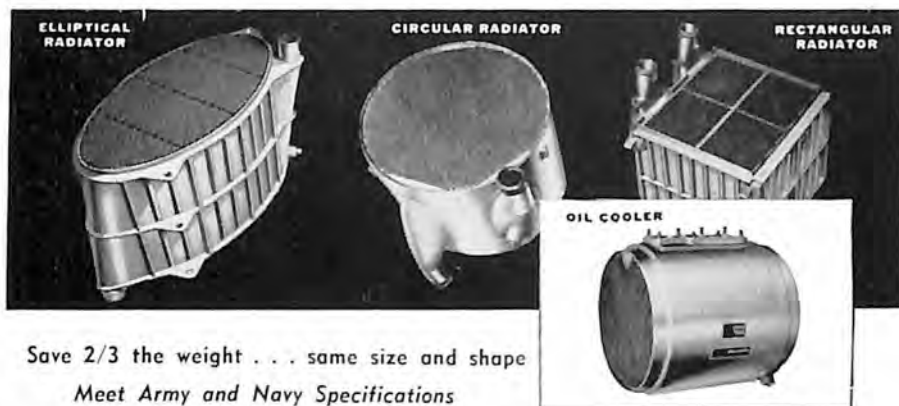
**V. E. SPROUSE  
COMPANY**

COLUMBUS, INDIANA  
1804 TWENTY-SECOND ST.

## CLIFFORD MANUFACTURING CO.

BOSTON 27, MASS.

*Manufacturers of Hydron Metallic Bellows and Feather-Weight Oil Coolers and Coolant Radiators*



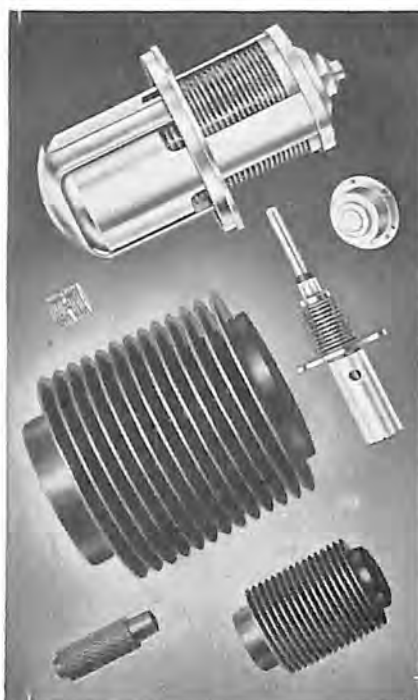
Clifford's discovery of the method of brazing aluminum in thin sections has resulted in all-aluminum alloy oil coolers and coolant radiators replacing heavy-weight copper units in several types of fighting planes of the USAAF with a 2/3 weight-saving in each case.

Aluminum alloy's greater strength and resistance to temperature and pressure make possible unusual shapes without extra reinforcement.

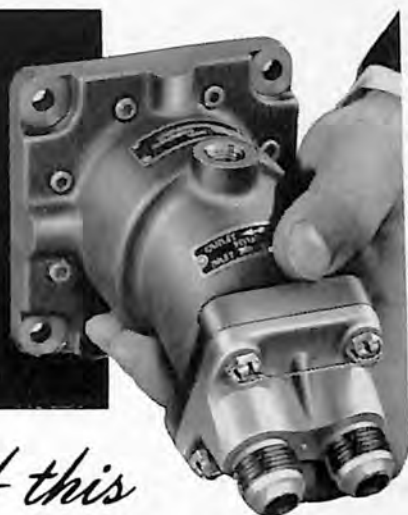
Industry's First Hydraulically-formed Bellows

Clifford—*First with the Facts on Hydraulically-formed Bellows*—specializes in Hydron metallic bellows and bellows assemblies for remote and direct temperature control, for remote control of gasoline valves, for oxygen regulators, for oxygen flow indicators, for refrigerator controls, for thermostatic units in liquid cooled aircraft engines, for refrigerator switches, etc.

Write for the facts to Clifford Manufacturing Co., 575 E. First Street, Boston 27, Mass.



**2.5**  
**HORSEPOWER**  
**PER POUND**



*Is the Output of this*

**VICKERS AIRCRAFT**  
**HYDRAULIC MOTOR**  
 (PISTON TYPE CONSTANT DISPLACEMENT)

This Vickers Aircraft Hydraulic Motor weighs only 6.4 pounds yet it has a normal output rating of 16 horsepower at 3000 psi and 3750 rpm.

But a high horsepower/weight ratio is not the only advantage of using Vickers Hydraulic Motors for delivering rotary mechanical motion on many aircraft applications. These hydraulic motors save space as well as weight. Starting and stalled torque can be higher than operating torque if desired. They can be stopped accurately to position . . . no clutches or brakes are required. They are used for dynamic braking and can be stalled for long periods without damage. These hydraulic motors can be started and stopped instantly due to the very low inertia of the moving parts. They cause no radio interference. Reversal and accurate control of speed are very simply and easily accomplished.

Vickers Aircraft Hydraulic Motors are inherently simple and rugged; they are available in a variety of models for pressures up to 3000 psi.

**VICKERS Incorporated • 1486 OAKMAN BLVD.**  
**DETROIT 32, MICHIGAN**

*Engineers and Builders of Oil Hydraulic Equipment Since 1921*



**(Hydraulic Controls & Assemblies)***Continued*

Aircraft Engineering Products, Inc.  
 Aircraft Products Co.  
 All American Aircraft Products, Inc.  
 Associated Foundries & Mfrs., Inc.  
 Atlantic Diesel Corp.  
 Booth Manufacturing Corp.  
 Bowser, Inc.  
 Deutsch Co.  
 Edwards Co.  
 The Electric Sprayit Co.  
 Electrol Inc.  
 Excello Corp.  
 Houde Engineering Div., Houdaille-Hershey Corp.  
 Hub Industries, Inc.  
 Interstate Aircraft & Engrg. Corp.  
 Jack & Heintz, Inc.  
 Kaiser Cargo, Inc., Fleetwings Div.  
 Kenyon Instrument Co., Inc.  
 Lawrance Aeronautical Corp.  
 The Manhattan Rubber Mfg. Div., Raybestos-Manhattan, Inc.  
 The Marquette Metal Products Co.  
 Otto Aviation Corp.  
 Pacific Div., Bendix Aviation Corp.  
 Pacific Pumps Inc.  
 The Parker Appliance Co.  
 Peerless Machine Co.  
 Pesco Products Co.  
 Phillips Aviation Co.  
 Romec Pump Co.  
 Scott Aviation Corp.  
 Simmonds Aerocessories, Inc.  
 South Shore Machine & Tool Works, Inc.  
 Sperry Gyroscope Co., Inc.  
 Sperry Products, Inc.  
 Standard Aircraft Products, Inc.  
 Swift Lubricator Co., Inc.  
 The Tomkins-Johnson Co.  
 United Aircraft Products, Inc.  
 Vard, Inc.  
 Vickers, Inc.  
 The Warner Aircraft Corp.  
 Wells Aircraft Parts Co.  
 K. R. Wilson

**HYDRAULIC FLUIDS**

The Bell Co., Inc.

**INSTRUMENTS**

Thomas A. Edison, Inc., Instrument Div.  
 Standard Aircraft Products, Inc.

**Aircraft**

Adel Precision Products Corp.  
 Air-Parts, Inc.  
 Bastian Bros. Co.  
 The Boston Auto Gage Co.  
 Cambridge Instrument Co., Inc.  
 Dietz Manufacturing Co.  
 Durham Aircraft Service, Inc.  
 Eclipse-Pioneer Div., Bendix Aviation Corp.  
 Edison-Splitdorf Corp.  
 Electrol Inc.  
 G. Felsenthal & Sons  
 General Electric Co.  
 Heyer Products Co.  
 Kenyon Instrument Co., Inc.  
 Kollsman Instrument, Div. Square D Co.  
 The Lewis Engineering Co.  
 Link Aviation Devices, Inc.  
 The Liquidometer Corp.  
 Phillips Aviation Co.  
 Rieker Instrument Co.  
 Ritter Co., Inc.  
 Rochester Manufacturing Co., Inc.  
 Sperry Gyroscope Co., Inc.  
 Thompson Products, Inc.  
 The Triplett Electrical Instrument Co.  
 Variety Aircraft Corp.  
 Weston Electrical Instrument Corp.

**Engine**

Adel Precision Products Corp.  
 Bowser, Inc.  
 The Brown Instrument Co.  
 Cambridge Instrument Co., Inc.  
 Eclipse-Pioneer Div., Bendix Aviation Corp.  
 Thomas A. Edison, Inc., Instrument Div.  
 Edison-Splitdorf Corp.  
 Charles Engelhard, Inc.  
 G. Felsenthal & Sons  
 General Electric Co.  
 Heyer Products Co.  
 Kollsman Instrument, Div. Square D Co.  
 The Lewis Engineering Co.  
 Phillips Aviation Co.  
 Ritter Co., Inc.  
 Rochester Manufacturing Co., Inc.  
 Sperry Gyroscope Co. Inc.  
 Standard Aircraft Products, Inc.  
 Thompson Products, Inc.  
 The Triplett Electrical Instrument Co.

# HUB

## INDUSTRIES, INC.

formerly DOWTY EQUIPMENT CORPORATION

*Specialists in*

**LANDING GEAR & HYDRAULIC EQUIPMENT FOR AIRCRAFT**

LONG ISLAND CITY • NEW YORK

### LIQUIDOMETER TANK QUANTITY GAUGES



Liquidometer Gauges are used on thousands of military, naval and commercial airplanes in service throughout the

world. They provide positive, dependable and accurate knowledge of the quantity of fuel, oil, de-icer fluid, or other liquids contained in tanks.

**The Liquidometer Corp.**

37th Street and Skillman Ave.  
Long Island City, N. Y.

## HYDRAULIC FLUIDS

*for  
Airplanes*



**THE BELL COMPANY**

INCORPORATED

411-15 N. WOLCOTT, CHICAGO, ILL.

**(Engine) Continued**

Variety Aircraft Corp.  
Weston Electrical Instrument Corp.

**Flight**

The Brown Instrument Co.  
C-Thru Ruler Co.  
Cambridge Instrument Co., Inc.  
Eclipse-Pioneer Div., Bendix Aviation Corp.  
Edison-Splitdorf Corp.  
G. Felsenthal & Sons  
General Electric Co.  
Harris-Seybold-Potter Co., Seybold Div.  
Jack & Heintz, Inc.  
Kenyon Instrument Co., Inc.  
Kollsman Instrument, Div. Square D Co.  
Lawrance Aeronautical Corp.  
The Lewis Engineering Co.  
Ritter Co., Inc.  
Specialties, Inc.  
Sperry Gyroscope Co., Inc.  
Variety Aircraft Corp.  
Weems System of Navigation  
Weston Electrical Instrument Corp.

**Ground**

The Brown Instrument Co.  
C-Thru Ruler Co.  
Cambridge Instrument Co., Inc.  
Consolidated Vultee Aircraft Corp.  
Cox and Stevens Aircraft Corp.  
Friez Instrument Div., Bendix Aviation Corp.  
W. & L. E. Gurley  
Kenyon Instrument Co., Inc.  
The Lewis Engineering Co.  
Malabar Machine Co.  
Merrill Engineering Laboratories  
M. C. Stewart  
Variety Aircraft Corp.  
Weems System of Navigation

**Shop**

B. C. Ames Co.  
R. B. Annis Co.  
Brand Tool & Supply Co.  
The Brown Instrument Co.  
Cambridge Instrument Co., Inc.  
The Comtor Co.  
Consolidated Vultee Aircraft Corp  
Continental Machines Inc.

Detroit Tap & Tool Co.  
Durham Aircraft Service, Inc.  
Heyer Products Co.  
The Lewis Engineering Co.  
McGrath St. Paul Co.  
Malabar Machine Co.  
Merrill Engineering Laboratories  
Merz Engineering Co.  
George Scherr Co., Inc.

**Testing & Measuring**

American Aircraft Manufacturing Co.  
B. C. Ames Co.  
Bartelt Engineering Co.  
Bastian Bros. Co.  
Bendix Radio Div., Bendix Aviation Corp.  
Brand Tool & Supply Co.  
The Brown Instrument Co.  
Burton-Rogers Co.  
Cambridge Instrument Co., Inc.  
The Comtor Co.  
Consolidated Vultee Aircraft Corp.  
Continental Machines Inc.  
Cox and Stevens Aircraft Corp.  
Detroit Tap & Tool Co.  
Eclipse-Pioneer Div., Bendix Aviation Corp.  
Electrol Inc.  
Charles Engelhard, Inc.  
The Esterline-Angus Co., Inc.  
G. Felsenthal & Sons  
Friez Instrument Div., Bendix Aviation Corp.  
Garrison Machine Works, Inc.  
General Electric Co.  
Hathaway Instrument Co.  
Heyer Products Co.  
Jack & Heintz, Inc.  
Kellogg Switchboard & Supply Co.  
The Lewis Engineering Co.  
Littelfuse Inc.  
McGrath St. Paul Co.  
Merrill Engineering Laboratories  
Merz Engineering Co.  
Models, Inc.  
Raytheon Manufacturing Co.  
Reasor Manufacturing Co.  
George Scherr Co., Inc.  
Specialties, Inc.  
Spencer Lens Co.  
Sperry Gyroscope Co., Inc.  
C. J. Tagliabue Mfg. Co.  
The Takk Corp.  
The Triplett Electrical Instrument Co.  
United States Testing Co., Inc



The Greeks gave us a word for it . . .  
 now we give it to *you*

WHEN Sperry first developed its velocity-modulated, ultra-high-frequency tube, "KLYSTRON" was registered as the name of the new device.

"Klystron"—from the Greek, as coined by scientists of Stanford University—is a good name. So good, that it has come into widespread use as the handy way to designate *any* tube of its general type, whether a Sperry product or not.

This has prompted many requests from standardization agencies—in-

cluding those of the Army and Navy—for unrestricted use of the name Klystron. In the public interest, Sperry has been glad to comply. . .

*The name KLYSTRON now belongs to the public, and may be used by anyone as the designation for velocity-modulated tubes of any manufacture.*

Sperry will, of course, continue to make the many types of Klystrons it now produces, and to develop new ones. On request, information will be sent, subject to military restrictions.

**SPERRY GYROSCOPE COMPANY, INC. GREAT NECK, N. Y.**

*Division of the Sperry Corporation*

★  
 LOS ANGELES • SAN FRANCISCO • NEW ORLEANS.  
 HONOLULU • CLEVELAND • SEATTLE

**GYROSCOPICS • ELECTRONICS • RADAR • AUTOMATIC COMPUTATION • SERVO-MECHANISMS**

**(Testing & Measuring) Continued**

Variety Aircraft Corp.  
 Weston Electrical Instrument Corp. †  
 Wilson Mechanical Instrument Co.,  
 Inc.  
 N. A. Woodworth Co.

**INSULATING MATERIALS**

American Flange & Mfg. Co. Inc.  
 American Hair & Felt Co.  
 The Barrett Div., Allied Chemical &  
 Dye Corp.  
 William Brand & Co.  
 Burndy Engineering Co., Inc.  
 Detroit Gasket & Mfg. Co.  
 The Duplan Corp.  
 Federal Telephone & Radio Corp.  
 Firestone Aircraft Co.  
 The Formica Insulation Co.  
 General Electric Co.  
 The B. F. Goodrich Co.  
 Goodyear Aircraft Corp.  
 Hamilton-Wade Co.  
 Hope Webbing Co.  
 Johns-Manville Corp.  
 Mica Insulator Co.  
 Monsanto Chemical Co., Merrimac  
 Div.  
 Printloid Inc.  
 Reynolds Metals Co.  
 Saylor Electric Products Corp.  
 Seaman Paper Co.  
 Spaulding Fibre Co., Inc.  
 Uniform Hood Lace Co.  
 United States Rubber Co.  
 Virginia Rubatex Div., Great Ameri-  
 can Industries, Inc.  
 Westinghouse Electric & Manufactur-  
 ing Co.  
 Wilmington Fibre Specialty Co.

**JOINTS & COUPLINGS**

Burklyn Co.  
 Chiksan Tool Co.  
 Firestone Aircraft Co.  
 Geo. J. Fix Co.  
 The Gear Grinding Machine Co.  
 The B. F. Goodrich Co.  
 Interstate Aircraft & Engineering  
 Corp.  
 Otto Aviation Corp.  
 Republic Aircraft Products Div., The  
 Aviation Corp.  
 Schweizer Aircraft Corp.  
 Thompson Products, Inc.

The Vimalert Co., Ltd.  
 White Aircraft Corp.

**LANDING GEAR**

Bendix Products Div., Bendix Aviation  
 Corp.

**Mechanism**

Adel Precision Products Corp.  
 Aircraft Products Co.  
 Chiksan Tool Co.  
 Edwards Co.  
 The Electric Sprayit Co.  
 Firestone Aircraft Co.  
 General Aviation Equipment Co., Inc.  
 Pacific Pumps Inc.  
 Ritter Co., Inc.  
 South Shore Machine & Tool Works,  
 Inc.  
 Spartan Aircraft Co.  
 United Aircraft Products, Inc.  
 White Aircraft Corp.  
 E. W. Wiggins Airways, Inc.

**Nose Wheel Assemblies**

Aerco Corp.  
 Air Transport Mfg. Co.  
 Aircraft Mechanics Inc.  
 Chiksan Tool Co.  
 The Cleveland Pneumatic Tool Co.  
 Edwards Co.  
 The Electric Sprayit Co.  
 Ferracuta Machine Co.  
 Firestone Aircraft Co.  
 The General Tire & Rubber Co.  
 Globe Hoist Co.  
 Hub Industries, Inc.  
 Interstate Aircraft & Engineering  
 Corp.  
 Pacific Pumps Inc.  
 Scott Aviation Corp.  
 United Aircraft Products, Inc.  
 White Aircraft Corp.

**Shock Struts—Hydraulic**

Aerco Corp.  
 Aircraft Mechanics Inc.  
 Associated Foundries & Mfrs., Inc.  
 Atlantic Diesel Corp.  
 Bendix Products Div., Bendix Aviation  
 Corp.  
 Bowser, Inc.  
 Cleveland Pneumatic Tool Co.

THE LIGHT MATERIAL  
THAT *Stays Put!*



In hundreds of aviation applications Formica is used because it is a light material (specific gravity 1.35 or half the weight of aluminum); because it holds its dimensions under either varying humidity or varying temperature. It is chemically inert, does not corrode, maintains a smooth surface indefinitely.

You will find it in America's leading planes used for control pulleys, fair leads, propeller parts, air frame parts, electrical insulation in the communications and ignition and lighting circuits, instrument panels, instruction plates, and for such parts as ammunition chutes where it takes the place of sheet metal.

Its use steadily increases, as more and more ways are found to adapt its fundamental characteristics to plane construction.

We are glad to send detailed engineering data on request.

THE FORMICA  
INSULATION COMPANY  
4677 Spring Grove Avenue  
Cincinnati 32, Ohio



**(Testing & Measuring) Continued**

Variety Aircraft Corp.  
 Weston Electrical Instrument Corp.  
 Wilson Mechanical Instrument Co.,  
 Inc.  
 N. A. Woodworth Co.

**INSULATING MATERIALS**

American Flange & Mfg. Co. Inc.  
 American Hair & Felt Co.  
 The Barrett Div., Allied Chemical &  
 Dye Corp.  
 William Brand & Co.  
 Burndy Engineering Co., Inc.  
 Detroit Gasket & Mfg. Co.  
 The Duplan Corp.  
 Federal Telephone & Radio Corp.  
 Firestone Aircraft Co.  
 The Formica Insulation Co.  
 General Electric Co.  
 The B. F. Goodrich Co.  
 Goodyear Aircraft Corp.  
 Hamilton-Wade Co.  
 Hope Webbing Co.  
 Johns-Manville Corp.  
 Mica Insulator Co.  
 Monsanto Chemical Co., Merrimac  
 Div.  
 Printloid Inc.  
 Reynolds Metals Co.  
 Saylor Electric Products Corp.  
 Seaman Paper Co.  
 Spaulding Fibre Co., Inc.  
 Uniform Hood Lace Co.  
 United States Rubber Co.  
 Virginia Rubatex Div., Great American  
 Industries, Inc.  
 Westinghouse Electric & Manufacturing  
 Co.  
 Wilmington Fibre Specialty Co.

**JOINTS & COUPLINGS**

Burklyn Co.  
 Chiksan Tool Co.  
 Firestone Aircraft Co.  
 Geo. J. Fix Co.  
 The Gear Grinding Machine Co.  
 The B. F. Goodrich Co.  
 Interstate Aircraft & Engineering  
 Corp.  
 Otto Aviation Corp.  
 Republic Aircraft Products Div., The  
 Aviation Corp.  
 Schweizer Aircraft Corp.  
 Thompson Products, Inc.

The Vimalert Co., Ltd.  
 White Aircraft Corp.

**LANDING GEAR**

Bendix Products Div., Bendix Aviation  
 Corp.

**Mechanism**

Adel Precision Products Corp.  
 Aircraft Products Co.  
 Chiksan Tool Co.  
 Edwards Co.  
 The Electric Sprayit Co.  
 Firestone Aircraft Co.  
 General Aviation Equipment Co., Inc.  
 Pacific Pumps Inc.  
 Ritter Co., Inc.  
 South Shore Machine & Tool Works,  
 Inc.  
 Spartan Aircraft Co.  
 United Aircraft Products, Inc.  
 White Aircraft Corp.  
 E. W. Wiggins Airways, Inc.

**Nose Wheel Assemblies**

Aerco Corp.  
 Air Transport Mfg. Co.  
 Aircraft Mechanics Inc.  
 Chiksan Tool Co.  
 The Cleveland Pneumatic Tool Co.  
 Edwards Co.  
 The Electric Sprayit Co.  
 Ferracute Machine Co.  
 Firestone Aircraft Co.  
 The General Tire & Rubber Co.  
 Globe Hoist Co.  
 Hub Industries, Inc.  
 Interstate Aircraft & Engineering  
 Corp.  
 Pacific Pumps Inc.  
 Scott Aviation Corp.  
 United Aircraft Products, Inc.  
 White Aircraft Corp.

**Shock Struts—Hydraulic**

Aerco Corp.  
 Aircraft Mechanics Inc.  
 Associated Foundries & Mfrs., Inc.  
 Atlantic Diesel Corp.  
 Bendix Products Div., Bendix Aviation  
 Corp.  
 Bowser, Inc.  
 Cleveland Pneumatic Tool Co.

**THE LIGHT MATERIAL**  
**THAT** *Stays Put!*



In hundreds of aviation applications Formica is used because it is a light material (specific gravity 1.35 or half the weight of aluminum); because it holds its dimensions under either varying humidity or varying temperature. It is chemically inert, does not corrode, maintains a smooth surface indefinitely.

You will find it in America's leading planes used for control pulleys, fair leads, propeller parts, air frame parts, electrical insulation in the communications and ignition and lighting circuits, instrument panels, instruction plates, and for such parts as ammunition chutes where it takes the place of sheet metal.

Its use steadily increases, as more and more ways are found to adapt its fundamental characteristics to plane construction.

We are glad to send detailed engineering data on request.

**THE FORMICA  
INSULATION COMPANY**  
4677 Spring Grove Avenue  
Cincinnati 32, Ohio





**(Shock Struts—Hydraulic) Continued**

Edwards Co.  
 The Electric Sprayit Co.  
 Excello Corp.  
 Firestone Aircraft Co.  
 Houde Engineering Div., Houdaille-Hershey Corp.  
 Hub Industries, Inc.  
 Interstate Aircraft & Engineering Corp.  
 Jack & Heintz, Inc.  
 Meyers Aircraft Co.  
 Pacific Pumps Inc.  
 Randall Graphite Products Corp.  
 Scott Aviation Corp.  
 United Aircraft Products, Inc.  
 Wells Aircraft Parts Co.  
 Weston Aircraft Corp.

**Tail Wheel Assemblies**

Aerco Corp.  
 Aero Trades Co.  
 Air Transport Mfg. Co.  
 Aircraft Mechanics, Inc.  
 Aircraft Welders, Inc.  
 Chiksan Tool Co.  
 Edwards Co.  
 The Electric Sprayit Co.  
 Electrol Inc.  
 Ferracute Machine Co.  
 Firestone Aircraft Co.  
 General Aircraft Supply Corp.  
 The General Tire & Rubber Co.  
 Goodyear Aircraft Corp.  
 Heath Co.  
 Hub Industries, Inc.  
 Interstate Aircraft & Engineering Corp.  
 Pacific Pumps Inc.  
 Perry Metal Products Co., Inc.  
 Scott Aviation Corp.  
 United Aircraft Products, Inc.  
 Variety Aircraft Corp.  
 E. W. Wiggins Airways, Inc.

**LIFE SAVING  
EQUIPMENT**

Air Cruisers, Inc.  
 B. H. Aircraft Co., Inc.  
 Benray Products Co.  
 Federal Telephone & Radio Corp.  
 Firestone Aircraft Co.  
 The General Tire & Rubber Co.  
 The B. F. Goodrich Co.  
 Goodyear Aircraft Corp.

Walter Kidde & Co., Inc.  
 Specialties, Inc.  
 United States Rubber Co.

**LIGHTING EQUIPMENT****Aircraft**

The Electric Sprayit Co.  
 Durham Aircraft Service, Inc.  
 General Aircraft Supply Corp.  
 Grimes Manufacturing Co.  
 Hartwell Aviation Supply Co.  
 Lights, Inc.  
 Standard Aircraft Products, Inc.  
 Union Aircraft Products Corp.

**Airport**

Fibre Conduit Co.  
 The General Detroit Corp.  
 Lights, Inc.  
 S & M Lamp Co.

**Shop**

General Aircraft Supply Corp.  
 S & M Lamp Co.

**LUBRICANTS**

Black Bear Co., Inc., Aviation Div.  
 Esso Aviation Products  
 Gulf Oil Corp.  
 R. M. Hollingshead Corp.  
 E. F. Houghton & Co.  
 Lubriplate Div., Fiske Brothers Refining Co.  
 The Parker Appliance Co.  
 The Pennzoil Co.  
 Royal Engineering Co.  
 Shell Oil Co.  
 Sinclair Refining Co.  
 Socony-Vacuum Oil Co., Inc.  
 Standard Oil Co. of California  
 The Texas Co.  
 Wayne Chemical Products Co.  
 The White & Bagley Co.  
 Wolf's Head Oil Refining Co., Inc.

**MACHINE TOOLS**

A B C Products, Inc.  
 Abrasive Machine Tool Co.  
 The Acromark Co.  
 The Adams Co.  
 American Chain & Cable Co., Inc.,  
 Andrew C. Campbell Div.

*Lights*

INCORPORATED

ALHAMBRA, CALIF.

PRIME CONTRACTORS

★ EMPLOYING EXTENSIVE SUB-CONTRACTING ASSOCIATES—PRESENTS FIVE SPECIALIZED DIVISIONS.

- AIRCRAFT AND MARINE FITTINGS
- AIRCRAFT AND AIRPORT LIGHTING
- ORDNANCE MATERIAL
- LATISTEEL—DESIGNERS AND FABRICATORS OF LATISTEEL STRUCTURES.
- PACKAGING—SPECIALIZING IN EXPORT PACKAGING AND PROCESSING.

*ACHIEVING SPECIALIZATION THROUGH DECENTRALIZATION*





These Grimes Aircraft Lights and many others in our complete line fly with our boys on every fighting and bombing mission.

Many of these lights have been developed by our engineers to meet specific requirements of the air forces. Others are war adaptations of original Grimes peacetime types. All have proven the soundness of their basic design under the most trying conditions ever faced by lighting equipment.

This "trial by fire" will serve us well in designing the aircraft lighting we shall offer commercial and private flying when peace comes.

**GRIMES MANUFACTURING COMPANY • Urbana, Ohio**

*If it's Aircraft Lighting...*

**GRIMES**

*Designs and Makes it!*





**AIR CYLINDERS**



**AIRCRAFT RIVITORS**



**HYDRAULIC CYLINDERS**

**For Today and Tomorrow**  
**T-J** FOR  
*Tough Jobs*

Whether it's a job for Rivitors ...hydraulic cylinders...air cylinders...cutters...Clinchors...or air controls...you can count on T-J for unbeatable efficiency, accuracy and dependable performance! All T-J products built to precise standards of manufacture...rigidly inspected...backed by practical-minded experienced engineering. In planning a better production set-up for better products...specify T-J Quality! Write for bulletins. The Tomkins-Johnson Co. Jackson, Mich.

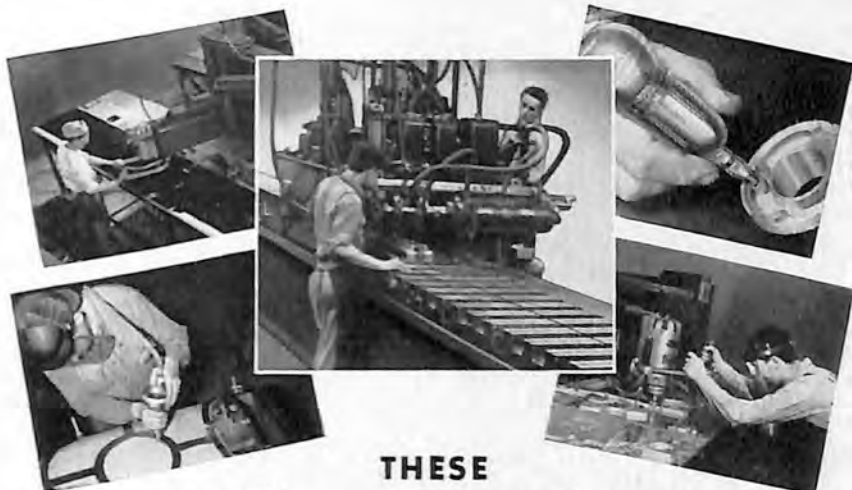
**TOMKINS-JOHNSON**

**(Machine Tools) Continued**

Arter Grinding Machine Co.  
 Atlas Metal Stamping Co.  
 Benchmark Manufacturing Co.  
 The Billings & Spencer Co.  
 Boice-Crane Co.  
 Brown & Sharpe Mfg. Co.  
 Bryant Chucking Grinder Co.  
 The Burke Machine Tool Co.  
 Chicago Rivet & Machine Co.  
 The Cincinnati Lathe & Tool Co.  
 The Cleveland Tool Engineering Co.  
 The Cleveland Automatic Machine Co.  
 Colonial Broach Co.  
 Consolidated Vultee Aircraft Corp.  
 Continental Machines Inc.  
 Criterion Machine Works  
 Davis & Thompson Co.  
 Defiance Machine Works, Inc.  
 Detroit Tap & Tool Co.  
 Duro Metal Products Co.  
 Edwards Co.  
 Ekstrom Carlson & Co.  
 Excello Corp.  
 Ferracuta Machine Co.  
 The Gear Grinding Machine Co.  
 General Aircraft Equipment Inc.  
 The Geometric Tool Co., Div. of  
 Greenfield Tap & Die Corp.  
 Gleason Works  
 George Gorton Machine Co.  
 The G. A. Gray Co.  
 The Hamilton Tool Co.  
 Jack & Heintz, Inc.  
 L. & J. Press Corp.  
 LempcO Products, Inc.  
 The McGonegal Mfg. Co.  
 McGrath St. Paul Co.  
 Merz Engineering Co.  
 Michigan Tool Co.  
 Onsrud Machine Works, Inc.  
 Peerless Machine Co.  
 Procutier Safety Chuck Co.  
 Reasor Manufacturing Co.  
 Reed-Prentice Corp.  
 St. Louis Tool & Mfg. Co.  
 W. J. Savage Co.  
 George Scherr Co., Inc.  
 W. A. Schuyler  
 Spiegel Sales Co.  
 The Standard Electrical Tool Co.  
 Standard Machinery Co.  
 Thompson Grinder Co.  
 The Tomkins-Johnson Co.  
 U. S. Tool Co., Inc.  
 Union Mfg. Co.  
 Van Norman Co.  
 Vard, Inc.  
 Variety Aircraft Corp.  
 Vickers, Inc.  
 Wallace Supplies Manufacturing Co.  
 Walls Sales Corp.  
 Westcott Chuck Co.  
 White Aircraft Corp.  
 Wickes Brothers  
 J. H. Williams & Co.  
 Williams, White & Co.  
 York Tool Sales Co.

### MACHINERY & MACHINE PARTS

The Acromark Co.  
 Aeronautical Products, Inc.  
 Air Transport Mfg. Co.  
 Aircraft Products Co.  
 Amalgamated Steel Co.  
 Atlas Metal Stamping Co.  
 Benchmark Manufacturing Co.  
 Bryant Chucking Grinder Co.  
 The Cincinnati Lathe & Tool Co.  
 Circo Products Co.  
 The Cleveland Automatic Machine  
 Co.  
 Consolidated Vultee Aircraft Corp.  
 Criterion Machine Works  
 Detrex Corp.  
 Deutsch Co.  
 Ekstrom Carlson & Co.  
 Engineering & Research Corp.  
 Farnham Manufacturing Co.  
 Ferracuta Machine Co.  
 Garrison Machine Works, Inc.  
 The General Tire & Rubber Co.  
 The Hamilton Tool Co.  
 Haynes Stellite Co.  
 The Hydraulic Press Mfg. Co.  
 Hyster Co.  
 Lake Erie Engineering Corp.  
 LempcO Products, Inc.  
 Liberty Aircraft Products Corp.  
 Mead Specialties Co.  
 Merz Engineering Co.  
 Milwaukee Electric Tool Corp.  
 Olmsted Manufacturing Div., South-  
 western Development Co.  
 Ozalid Div., General Aniline & Film  
 Corp.  
 The Parker Stamp Works, Inc.  
 Peerless Machine Co.  
 Phillips Aviation Co.  
 Rebstock Conveyor Co.  
 St. Louis Tool & Mfg. Co.  
 H. B. Smith Machine Co.



THESE

*Hour-Stretchers*

**CUT YOUR COSTS - SAVE TIME**

In aircraft plants throughout America, per hour production of vital parts has been greatly increased by these tools and machines. Some of the operations pictured above represent production rate increases of several hundred per cent.

You find the name "Onsrud" on all these tools. Each brings to its job the high speed technique that literally makes metal fly. Almost unbelievable savings of time and materials have been made possible by the high cutter speeds and fast feeds that feature Onsrud machines.

Here is a partial list of the production operations on which these tools do better work, faster. Routing and Drilling of stacked flat sheets—Automatic Contour Milling of spar beams and similar long parts—Bevel Milling of flat sheets—Portable Routing—Portable Grinding.

Get complete details about what Onsrud tools and machines can do for you. Write today for specifications or recommendations on machines suited to your particular production problems.

**ONSRUD MACHINE WORKS, INC.**

3900-3932 Palmer Street

Chicago 47, Illinois



HIGH CYCLE AND AIR TURBINE TOOLS AND MACHINES  
FOR AIRCRAFT NONFERROUS METALWORKING

**(Machinery & Machine Parts)***Continued*

South Shore Machine & Tool Works, Inc.  
 Spaulding Fibre Co., Inc.  
 The Standard Electrical Tool Co.  
 Standard Machinery Co.  
 Tal's Prestal Bender, Inc.  
 White Aircraft Corp.  
 N. A. Woodworth Co.  
 Yates-American Machine Co.

**MANIFOLDS**

Aero Trades Co.  
 Alten's Foundry & Machinery Works  
 American Tube Bending Co., Inc.  
 B. H. Aircraft Co., Inc.  
 Buhl Manufacturing Co.  
 Ferracute Machine Co.  
 Goodyear Aircraft Corp.  
 The Keeney Manufacturing Co.  
 Pollak Manufacturing Co.  
 Ryan Aeronautical Co.  
 Solar Aircraft Co.  
 Taylorcraft Aviation Corp.  
 Wallace Supplies Manufacturing Co.

**OIL SEALS**

The Bowling Green Rubber Co.  
 Connecticut Hard Rubber Co.  
 Firestone Aircraft Co.  
 The General Tire & Rubber Co.  
 The B. F. Goodrich Co.  
 Huntington Precision Products Div.,  
 Adel Precision Products Corp.  
 Johns-Manville Corp.  
 Edward D. Maltby Co.  
 The Manhattan Rubber Mfg. Div.,  
 Raybestos-Manhattan, Inc.  
 Rodic Rubber Corp.  
 United Aircraft Products, Inc.  
 White Aircraft Corp.

**OXYGEN EQUIPMENT,  
FLIGHT**

Air Cruisers, Inc.  
 Deutsch Co.  
 Eclipse-Pioneer Div., Bendix Aviation Corp.  
 The B. F. Goodrich Co.  
 The Parker Appliance Co.  
 Puritan Compressed Gas Corp.  
 Scott Aviation Corp.

**PANELS**

American Aluminum Ware Co.  
 American Central Mfg. Corp.  
 Crowe Name Plate & Mfg. Co.  
 Faraday Electric Corp.  
 Federal Telephone & Radio Corp.  
 The Formica Insulation Co.  
 Goodyear Aircraft Corp.  
 Kellogg Switchboard & Supply Co.  
 King Plastics Corp.  
 Littelfuse Inc.  
 Los Angeles Stamp & Stationery Co.  
 Luscombe Airplane Corp.  
 Lyon Metal Products, Inc.  
 Mica Insulator Co.  
 The Murray Corp. of America  
 Phillips Aviation Co.  
 Pressed & Welded Steel Products Co., Inc.  
 Rohr Aircraft Corp.  
 Schweizer Aircraft Corp.  
 Spartan Aircraft Co.  
 Spaulding Fibre Co., Inc.  
 Taylorcraft Aviation Corp.  
 Technical Ply-Woods  
 Union Aircraft Products Corp.  
 United States Plywood Corp.  
 Vidal Research Corp.

**PARACHUTE PARTS  
AND HARDWARE**

Airchox Co.  
 American Aluminum Ware Co.  
 Belding Heminway Co.  
 Benray Products Co.  
 P. & F. Corbin  
 The B. F. Goodrich Co.  
 Hope Webbing Co.  
 Kirsch Co.  
 Nukraft Manufacturing Co.  
 Pioneer Parachute Co., Inc.  
 Switlik Parachute Co.  
 United-Carr Fastener Corp.  
 United States Rubber Co.  
 Variety Aircraft Corp.

**PARACHUTES**

The Duplan Corp.  
 Eagle Parachute Corp.  
 Hayes Manufacturing Corp.  
 Pioneer Parachute Co., Inc.  
 Switlik Parachute Co.

# Old and New Solar Products

*for the Aircraft Industry*

Aircraft Exhaust Systems today are more complex in structure and are subject to vibration and operating temperatures of a severity unknown before engine horsepowers were so greatly increased. Solar's production of such equipment, accepted as the standard for the Industry in design, performance, and durability, has increased tremendously both in scope and output.

Capitalizing on long experience in the fabrication of high temperature alloys, Solar has greatly expanded its activities into other fields. Production of major Jet Propulsion engine parts for the General Electric Company and General Motors Corporation began in 1944 — an event of importance to the war effort and to Solar's future plans.

Solar figured prominently in re-design and manufacture of Exhaust



Equipment for the Boeing Super. Fortress. Changes suggested by Solar Engineers have greatly increased Exhaust System service life and performance of this airplane.



THE SOLAR ALTIHEATER is distinguished by high heat output relative to weight. This is a combustion type heater for airplane cabins and for anti-icing of wings and control surfaces operable at 35,000 ft. altitude.



THE SOL-A-NUT, self-locking stainless steel high temperature nut-plate, is saving time, labor, and material in aircraft construction because it can be spotwelded. It is U S Army approved and built to A-N specifications.



SOLAR WELDING FLUX NO. 16GH has no equal for stainless steel welding. It contains no organic binder, yet adheres tenaciously to metal . . . helps prevent oxidation by prohibiting penetration of oxygen . . . does not cause carbon pickup.



SOLAR AIRCRAFT COMPANY SAN DIEGO 12, CALIF. DES MOINES 5, IA.



**PLASTICS**

Adhere, Inc.  
 Auburn Button Works, Inc.  
 Capac Manufacturing Co.  
 Chemaco Corp.  
 Columbus Plastic Products, Inc.  
 Consolidated Vultee Aircraft Corp.  
 Dade Brothers Inc.  
 Richard M. Decker Co., Inc.  
 Detroit Gasket & Mfg. Co.  
 The Dow Chemical Co.  
 Dura Plastics Inc.  
 G. Felsenthal & Sons  
 The Formica Insulation Co.  
 General Aircraft Supply Corp.  
 General Electric Co.  
 Goodyear Aircraft Corp.  
 Grimes Manufacturing Co.  
 Heath Co.  
 Huntington Precision Products Div.,  
   Adel Precision Products Corp.  
 Kellogg Switchboard & Supply Co.  
 King Plastics Corp.  
 The Laister-Kauffmann Aircraft Corp.  
 Lyon Metal Products, Inc.  
 Mica Insulator Co.  
 The Parker Appliance Co.  
 Perry Metal Products Co., Inc.  
 Plastic & Rubber Products Co.  
 Printloid Inc.  
 Resistoflex Corp.  
 Rodic Rubber Corp.  
 Rohm & Haas Co.  
 Spaulding Fibre Co., Inc.  
 Taylor Fibre Co.  
 Tennessee Eastman Corp.  
 The Udylite Corp.  
 The Voges Manufacturing Co.  
 R. D. Werner Co., Inc.  
 Westinghouse Electric & Manufactur-  
   ing Co.

**PRIMERS (ENGINE)**

Adel Precision Products Corp.  
 Durham Aircraft Service, Inc.  
 The Parker Appliance Co.

**PROPELLER PARTS**

Aero Supply Mfg. Co. Inc.  
 Aeroproducts Div., General Motors  
   Corp.

Aircraft Engineering Products, Inc.  
 The Aircraftsmen Co.  
 American Aluminum Ware Co.  
 American Propeller Corp.  
 American Tube Bending Co., Inc.  
 Atlantic Diesel Corp.  
 B. H. Aircraft Co., Inc.  
 Excello Corp.  
 The Formica Insulation Co.  
 General Electric Co.  
 Hamilton Standard Propellers, Div. of  
   United Aircraft Corp.  
 The Hartford Machine Screw Co.  
 The Keeney Manufacturing Co.  
 Koppers Co. Inc., Bartlett Hayward  
   Div.  
 Lycoming Div., The Aviation Corp.  
 McCauley Steel Propeller Co.  
 The Marquette Metal Products Co.  
 Models, Inc.  
 Northern Aircraft Products, Div. The  
   Aviation Corp.  
 The Ohio Piston Co.  
 Perry Metal Products Co., Inc.  
 Republic Aircraft Products Div. The  
   Aviation Corp.  
 Sensenich Brothers  
 Thompson Products, Inc.  
 Variety Aircraft Corp.  
 Wells Aircraft Parts Co.

**PROPELLERS**

Aeroproducts Div., General Motors  
   Corp.  
 Air-Parts, Inc.  
 Aircraft Engineering Products, Inc.  
 Aircraft Specialties, Div. of Zimmer-  
   Thomson Corp.  
 Associated Foundries & Mfrs., Inc.  
 Atlantic Diesel Corp.  
 Curtiss-Wright Corp., Propeller Div.  
 Fahlin Manufacturing Co.  
 Flottorp Mfg. Co.  
 General Aircraft Supply Corp.  
 Hamilton Standard Propellers, Div. of  
   United Aircraft Corp.  
 Hartzell Propeller Co.  
 Koppers Co. Inc., Bartlett Hayward  
   Div.  
 G. B. Lewis Co.  
 McCauley Steel Propellers Co.  
 Marine-Air Research Corp.  
 Models, Inc.  
 Northwest Air Service, Inc.  
 Otto Aviation Corp.  
 Sensenich Brothers



## Advantages of the War-Proved **Aero-prop**

- *Lightness* for payload
- *Strength* for safety
- *Simplicity* for easy service
- *Faster Automatic Pitch Change* for flight efficiency
- *Full Feathering* for engine protection
- *Engineered* for reliability

# AEROPRODUCTS DIVISION



**GENERAL MOTORS  
CORPORATION**  
DAYTON, OHIO



**PULLEYS AND  
FAIRLEADS**

General Aircraft Supply Co.  
General Aviation Equipment Co., Inc.  
Goodyear Aircraft Corp.  
King Plastics Corp.  
Spaulding Fibre Co., Inc.  
Taylor Fibre Co.  
Taylorcraft Aviation Corp.  
Westinghouse Electric & Manufacturing Co.  
White Aircraft Corp.

**PUMPS**

Adel Precision Products Corp.  
Advance Pump Co.  
Aero Supply Mfg. Co. Inc.  
Aircraft Engineering Products, Inc.  
Atlantic Diesel Corp.  
B. H. Aircraft Co., Inc.  
Blackmer Pump Co.  
Chandler-Evans Corp.  
De Val Stream Turbine Co.  
Durham Aircraft Service, Inc.  
Eclipse-Pioneer Div., Bendix Aviation Corp.  
Edwards Co.  
Electrol, Inc.  
Fairbanks, Morse & Co.  
Harvill Corp.  
Hub Industries, Inc.  
Lincoln Engineering Co.  
Lycoming Div. The Aviation Corp.  
Lyon-Raymond Corp.  
Major Aircraft Foundry  
Peerless Machine Co.  
Pesco Products Co.  
Romec Pump Co.  
Geo. D. Roper Corp.  
The Ruthman Machinery Co.  
Thompson Products, Inc.  
United Aircraft Products, Inc.  
Variety Aircraft Corp.  
Vickers Inc.  
Worthington Pump & Machinery Co.

**RADIATORS**

Acme Electric Heating Co.  
Airesearch Manufacturing Co.  
Clifford Manufacturing Co.  
The G & O Manufacturing Co.  
United Aircraft Products, Inc.  
Winchester Repeating Arms Co., Div.  
Western Cartridge Co.

Yates-American Machine Co.  
Young Radiator Co.

**RADIO ACCESSORIES  
& EQUIPMENT**

A. B. C. Products, Inc.  
Abrams Instrument Co.  
Airadio, Inc.  
Aircraft Accessories Corp.  
Aircraft Radio Corp.  
Airplane & Marine Instrument, Inc.  
American Aluminum Ware Co.  
Atlas Metal Stamping Co.  
Rex Bassett, Inc.  
Belmont Radio Corp.  
Bendix Radio Div., Bendix Aviation Corp.  
Crowe Name Plate & Mfg. Co.  
Federal Telephone & Radio Corp.  
General Electric Co.  
Harvey Radio Laboratories, Inc.  
Harvey-Wells Electronics, Inc.  
Heath Co.  
Heyer Products Co., Inc.  
Jefferson-Travis Radio Mfg. Corp.  
The Keeney Manufacturing Co.  
Kellogg Switchboard & Supply Co.  
The Lewis Engineering Co.  
Lyon Metal Products, Inc.  
P. R. Mallory & Co., Inc.  
Permoflux Corp.  
RCA-Victor Div., Radio Corp. of America  
Raytheon Manufacturing Co.  
Recordgraph Div., Frederick Hart & Co., Inc.  
The Soundscriber Corp.  
Spartan Aircraft Co.  
Spaulding Fibre Co., Inc.  
Sperry Gyroscope Co., Inc.  
Technical Ply-Woods  
United-Carr Fastener Corp.  
Weltronic Co.  
Western Electric Co., Inc., Radio Div.  
Westinghouse Electric & Manufacturing Co.  
  
Airplane & Marine Instrument, Inc.  
Bendix Radio Div., Bendix Aviation Corp.  
The W. W. Boes Co.  
Federal Telephone & Radio Corp.  
Gray Radio Co.  
Harvey-Wells Electronics, Inc.

**RADIO COMPASSES**

# On the AIRWAYS of tomorrow



**A**LL of you in the aviation industry are planning for the great age of air transportation that will begin when the war ends.

We at Western Electric—who pioneered aviation radio in 1917 and have fostered its development ever since—are looking forward too.

Today, nine out of every ten American military planes carry Western Electric equipment. As a result of this wartime experience, we'll be better fitted than ever to meet your communications needs.

We look forward to working with you on the great job that lies ahead!

*To speed Victory, buy more War Bonds—and keep them!*



## Western Electric

ARSENAL OF COMMUNICATIONS EQUIPMENT



**(Radio Compasses) Continued**

RCA-Victor Div., Radio Corp. of  
America  
Raytheon Manufacturing Co.  
Sperry Gyroscope Co., Inc.

**R A D I O S**

Airadio, Inc.  
Aircraft Radio Corp.  
Airplane & Marine Instruments, Inc.  
Rex Bassett, Inc.  
Belmont Radio Corp.  
Bendix Radio Div., Bendix Aviation  
Corp.  
Fairchild Camera & Instrument Corp.  
Federal Telephone & Radio Corp.  
General Electric Co.  
Gray Radio Co.  
The Hallicrafters Co.  
Harvey Radio Laboratories, Inc.  
Harvey-Wells Electronics, Inc.  
Heath Co.  
Jefferson-Travis Radio Mfg. Corp.  
RCA-Victor Div., Radio Corp. of  
America  
Raytheon Manufacturing Co.  
Spartan Aircraft Co.  
Western Electric Co., Inc., Radio Div.  
Westinghouse Electric & Manufactur-  
ing Co.

**R I V E T S**

Active Screw & Manufacturing Co.  
Aero Tool Co.  
Aluminum Co. of America  
Bethlehem Steel Co.  
Central Screw Co.  
Chicago Rivet & Machine Co.  
Consolidated Vultee Aircraft Corp.  
General Aircraft Supply Co.  
The B. F. Goodrich Co.  
The Milford Rivet & Machine Co.  
Otto Aviation Corp.  
Perry Metal Products Co., Inc.

**S A F E T Y B E L T S**

Airchox Co.  
Richard M. Decker Co., Inc.  
General Aircraft Supply Co.  
The General Detroit Corp.  
Hope Webbing Co.  
Luscombe Airplane Corp.  
United States Rubber Co.

**S C A L E S**

The Black & Decker Mfg. Co.  
Cox and Stevens Aircraft Corp.  
Crowe Name Plate & Mfg. Co.  
The Exact Weight Scale Co.  
Fairbanks, Morse & Co.  
The Howe Scale Co.  
Malabar Machines Co.  
Toledo Scale Co.

**S E A T S**

Aero Trades Co.  
Air Transport Mfg. Co.  
Firestone Aircraft Co.  
General Aircraft Supply Co.  
The Guiberson Corp., Aircraft &  
Heater Div.  
Kilgen Aircraft Div., The Kilgen Organ  
Co.  
King Plastics Corp.  
The Laister-Kauffmann Aircraft Corp.  
Luscombe Airplane Corp.  
Meyers Aircraft Co.  
Nukraft Mfg. Co.  
Schweizer Aircraft Corp.  
Taylorcraft Aviation Corp.  
Technical Ply-Woods  
United States Plywood Corp.  
United States Rubber Co.

**S H I E L D I N G  
(R A D I O & I G N I T I O N)**

Air-Shields Inc.  
Aluminum Co. of America  
American Aluminum Ware Co.  
The B G Corp.  
Connecticut Hard Rubber Co.  
Durham Aircraft Service, Inc.  
General Electric Co.  
The Keeney Manufacturing Co.  
Kellogg Switchboard & Supply Co.  
The Manhattan Rubber Mfg. Div.  
Raybestos-Manhattan, Inc.  
Menaugh-Dutterer Co.  
Packard Electric Div., General Motors  
Corp.  
Saylor Electric Products Corp.  
Scintilla Magneto Div., Bendix Avia-  
tion Corp.  
Union Aircraft Products Corp.

**S H O C K A B S O R B E R S**

The Cleveland Pneumatic Tool Co.  
Edwards Co.

# how high is very high?



★ Engineers at Hallicrafters are continually striving for new heights of perfection in high frequency development work. The Model S-37 is one example of the progress they have made. This is the first and only set of its kind—covering both AM and FM and operating in the range of 130 to 210 Mc. Instruments like this, developed by Hallicrafters, will play an important part in the future development of aviation communications.



*Model S-37. The highest frequency range of any continuous tuning commercial type receiver.*

Buy a War Bond Today!



## hallicrafters RADIO



THE HALLCRAFTERS COMPANY, MANUFACTURERS OF RADIO AND ELECTRONIC EQUIPMENT, CHICAGO 16, U. S. A.

**CLECO TOOLS**  
 FOR FASTER PRODUCTION  
**AEROLS**  
 FOR BETTER PERFORMANCE

Over 400 sizes and styles of Cleco pneumatic tools are speeding aircraft fabrication. This extensive line of riveters, drills, squeezers, screw drivers, nut setters, etc., offers the *right* tool for every job.

AEROLS (shock absorbing landing gear units) always insure safe, smooth landings and take-offs. Overwhelmingly preferred by the industry, Aerols are used on every type of plane from the fastest fighter to the biggest bomber.

To put these products to the best possible use, Cleveland Pneumatic engineers are always at your service.



Typical Main  
Leg Aerol



Light Riveter  
with BW handle



9D020 Multiple  
Angle Drill



Model 41C, a popular  
Cleco Squeezer

**THE CLEVELAND PNEUMATIC TOOL CO.**  
 Cleveland ★ Ohio



Model AWA  
Seat Grinder  
as used for  
radial engines.

Only the **BEST** is good enough in airplane valve performance. **HALL** grinding equipment is widely used in the production and servicing of airplane engines because of the finer precision and finish it produces. Write for literature describing these and other types of **HALL** valve and valve seat grinding equipment.



Model AWA  
Seat Grinder as  
used in in-line  
engines.



Model EJA  
Seat Grinder for  
seats in in-line  
cylinders.



Model AW  
Seat Grinder for  
seats in radial  
engines.



One type  
of **HALL**  
Production  
Seat Grinder

**HALL** Valve  
Refacer with  
dual motors and  
rheostat control.



Battery of **AWP**  
Seat Grinders  
used by one  
manufacturer.

# HALL

**THE HALL MANUFACTURING CO., TOLEDO 7, OHIO**



**(Shock Absorbers) Continued**

Firestone Aircraft Co.  
 Houde Engineering Div. of Houdaille-  
 Hershey Corp.  
 Meyers Aircraft Co.  
 Perry Metal Products Co., Inc.  
 Preco Inc.  
 Scott Aviation Corp.  
 Uniform Hood Lace Co.  
 White Aircraft Corp.

**SHOP EQUIPMENT**

Amalgamated Steel Co.  
 R. B. Annis Co.  
 The Black & Decker Mfg. Co.  
 Brown & Sharpe Mfg. Co.  
 Crescent Truck Co.  
 Detroit Tap & Tool Co.  
 Durham Aircraft Service, Inc.  
 Duro Metal Products Co.  
 Eclipse Fuel Engineering Co.  
 Electric Service Manufacturing Co.  
 The Electric Sprayit Co.  
 Engine Equipment Co.  
 Globe Hoist Co.  
 Greenfield Tap & Die Corp.  
 Hall Mfg. Co.  
 Heyer Products Co., Inc.  
 Ideal Commutator Dresser Co.  
 Imperial Brass Manufacturing Co.  
 Lamson Corp.  
 Lempeco Products, Inc.  
 Lincoln Schlueter Floor Machinery  
 Co., Inc.  
 Lyon Metal Products, Inc.  
 The Parker Appliance Co.  
 Phillips Mfg. Co.  
 The Porcupine Co.  
 Republic Steel Corp., Berger Manufac-  
 turing Div.  
 Revolver Co.  
 Snap-on Tool Corp.  
 Spencer & Morris  
 The Standard Electrical Tool Co.  
 Sterling Tool Products Co.  
 Variety Aircraft Corp.  
 Joseph Weidenhoff, Inc.

**SPARK PLUGS**

Air-Shields Inc.  
 The B G Corp.  
 Champion Spark Plug Co.  
 Durham Aircraft Service, Inc.  
 Edison-Splitdorf Corp.  
 Firestone Aircraft Co.

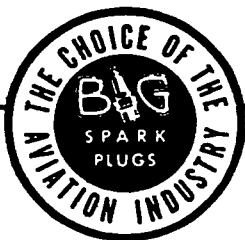
General Aircraft Supply Co.  
 Menaugh-Dutterer Co.  
 Otto Aviation Corp.  
 Scintilla Magneto Div., Bendix Avia-  
 tion Corp.  
 Simmonds Aeroaccessories, Inc.

**SPRINGS**

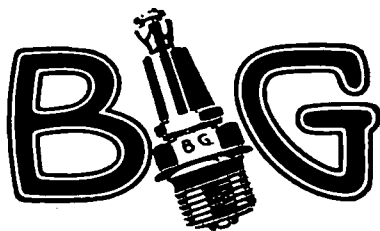
American Steel & Wire Co.  
 Eaton Manufacturing Co.  
 George K. Garrett Co., Inc.  
 General Aircraft Supply Co.  
 Moog Industries, Inc.  
 Otto Aviation Corp.  
 Perry Metal Products Co., Inc.  
 Raymond Mfg. Co. Div. Associated  
 Spring Corp.

**STAMPINGS**

A. B. C. Products, Inc.  
 The Acromark Co.  
 Adel Precision Products Corp.  
 Air Transport Mfg. Co.  
 Alofs Manufacturing Co.  
 Aluminum Co. of America  
 Aluminum Goods Mfg. Co.  
 American Aluminum Ware Co.  
 American Central Mfg. Corp.  
 Aurora Equipment Co.  
 B. H. Aircraft Co., Inc.  
 Bastian Bros. Co.  
 Buhl Manufacturing Co.  
 Crowe Name Plate & Mfg. Co.  
 Dahlstrom Metallic Door Co.  
 Richard M. Decker Co., Inc.  
 Eaton Manufacturing Co.  
 The Flour City Ornamental Iron Co.  
 Fox Co.  
 George K. Garrett Co., Inc.  
 General Aviation Equipment Co., Inc.  
 Goodyear Aircraft Corp.  
 The Guiberson Corp., Aircraft &  
 Heater Div.  
 Hyland Machine Co.  
 The Kawneer Co.  
 The Keeney Manufacturing Co.  
 Lancing Stamping Co.  
 Lempeco Products, Inc.  
 Los Angeles Stamp & Stationery Co.  
 Luscombe Airplane Corp.  
 Lyon Metal Products, Inc.  
 Manufacturers Screw Products  
 Mica Insulator Co.  
 The Murray Corp. of America  
 Numberall Stamp & Tool Co.



*There is a*



# SPARK PLUG

*for every type of aviation engine*



**THE BAG CORPORATION**

136 WEST 52nd STREET, NEW YORK 19, N.Y.

*Manufacturers of both mica-insulated and ceramic-insulated aviation spark plugs*

*Contractors to*

*the United States Army, Navy and Coast Guard and Aircraft Engine Builders*

**(Stampings) Continued**

Perry Metal Products Co., Inc.  
 Pressed & Welded Steel Products Co.  
 Inc.  
 Raymond Mfg. Co. Div. Associated  
 Spring Corp.  
 Revere Copper & Brass Inc.  
 Reynolds Metals Co.  
 Robertson Aircraft Corp.  
 Rohr Aircraft Corp.  
 Ryan Aeronautical Co.  
 Scovill Manufacturing Co.  
 Shakeproof Inc.  
 Spartan Aircraft Co.  
 South Shore Machine & Tool Works,  
 Inc.  
 Spaulding Fibre Co., Inc.  
 Union Aircraft Products Corp.  
 United-Carr Fastener Corp.  
 Utility Fan Corp.  
 Variety Aircraft Corp.  
 Wallace Supplies Manufacturing Co.  
 Weber Showcase & Fixture Co., Inc.  
 White Aircraft Corp.  
 Whitehead Stamping Co.  
 Wilmington Fibre Specialty Co.

**STANDS (ENGINE,  
 PROPELLER,  
 SERVICING)**

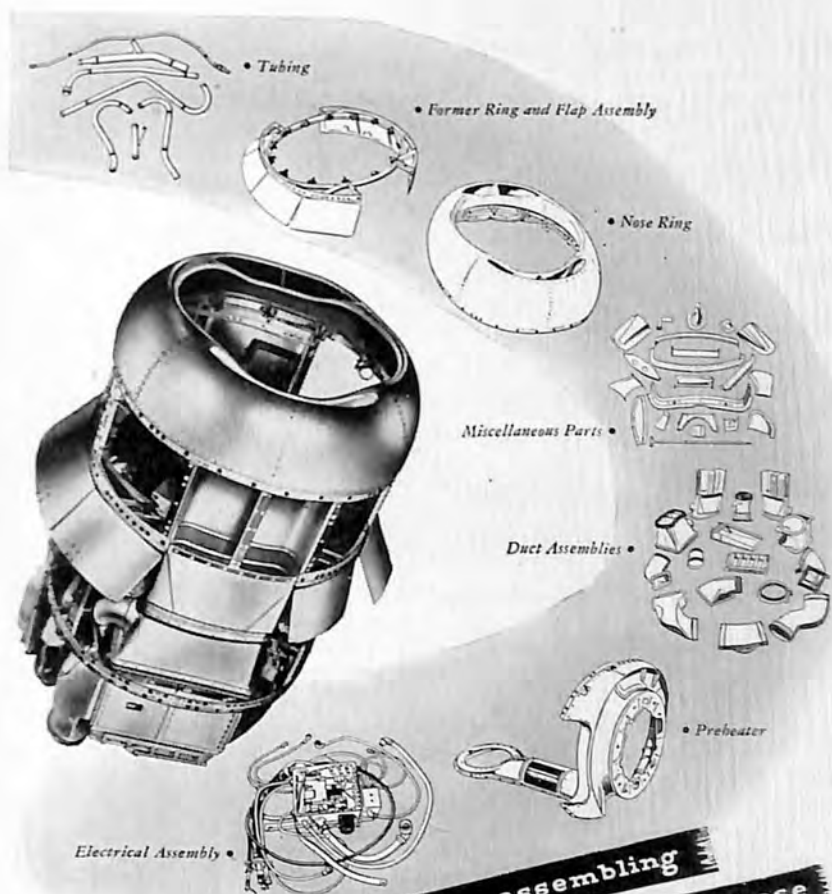
Aircraft Welders, Inc.  
 B. H. Aircraft Co., Inc.  
 Charles Manufacturing Co.  
 Columbia Aircraft Corp.  
 Columbian Steel Tank Co.  
 Consolidated Vultee Aircraft Corp.  
 Del-Air Corp.  
 The Denison Engineering Co.  
 Durham Aircraft Service, Inc.  
 Lyon Metal Products, Inc.  
 Lyon-Raymond Corp.  
 Meyers Aircraft Co.  
 Spencer & Morris  
 The Wellington Machine Co.  
 Whiting Corp.

**STARTERS**

Delco-Remy Div., General Motors  
 Corp.  
 Durham Aircraft Service, Inc.  
 Eclipse-Pioneer Div., Bendix Aviation  
 Corp.  
 Jack & Heintz, Inc.

**SUBASSEMBLIES**

Aluminum Co. of America  
 American Central Mfg. Corp.  
 B. H. Aircraft Co., Inc.  
 B-W Superchargers, Inc.  
 Baker & Co., Inc.  
 Berkey & Gay Furniture Co.  
 Buhl Manufacturing Co.  
 California Flyers, Inc.  
 Consolidated Vultee Aircraft Corp.  
 The Corbin Screw Corp.  
 Criterion Machine Works  
 Edo Aircraft Corp.  
 The Electric Sprayit Co.  
 George K. Garrett Co., Inc.  
 General Aircraft Equipment Inc.  
 General Aviation Equipment Co., Inc.  
 Goodyear Aircraft Corp.  
 Harlow Aircraft Co.  
 Huntington Precision Products Div. of  
 Adel Precision Products Corp.  
 Hyland Machine Co.  
 Interstate Aircraft & Engrg. Corp.  
 The Kawneer Co.  
 The Keeney Manufacturing Co.  
 Kellett Aircraft Corp.  
 Kilgen Aircraft Div., The Kilgen Organ  
 Co.  
 King Plastics Corp.  
 The Laister-Kauffmann Aircraft Corp.  
 Link Aviation Devices, Inc.  
 Luscombe Airplane Corp.  
 McDonnell Aircraft Corp.  
 The Marquette Metal Products Co.  
 Meyers Aircraft Co.  
 Models, Inc.  
 The Murray Corp. of America  
 National Machine Products  
 Olmsted Mfg. Div., Southwestern De-  
 velopment Co.  
 Pacific Car & Foundry Co.  
 The Parker Appliance Co.  
 Perry Metal Products Co., Inc.  
 Pollak Manufacturing Co.  
 Preco Inc.  
 Pressed & Welded Steel Products Co.  
 Reasor Manufacturing Co.  
 Rohr Aircraft Corp.  
 Schweizer Aircraft Corp.  
 Scott Aviation Corp.  
 South Shore Machine & Tool Works,  
 Inc.  
 Spartan Aircraft Co.  
 V. E. Sprouse Co.  
 The Steel Products Engineering Co  
 Taylor Fibre Co.



over 5000 manufacturing, assembling  
and inspecting operations get these  
power plants ready to fly!

COMPLETE POWER PLANT ASSEMBLIES FOR  
MILITARY AND CIVILIAN AIRCRAFT



ROHR AIRCRAFT CORPORATION, CHULA VISTA, CALIFORNIA • Helping to write the story of tomorrow

**(Subassemblies) Continued**

The Tomkins-Johnson Co.  
 Union Aircraft Products Corp.  
 Variety Aircraft Corp.  
 The Voges Manufacturing Co.  
 Weber Showcase & Fixtures Co., Inc.  
 Wells Aircraft Parts Co.  
 White Aircraft Corp.  
 E. W. Wiggins Airways, Inc.  
 Ypsilanti Machine & Tool Co.

**SUPERCHARGERS**

Haynes Stellite Co.

**Engine**

Air Transport Mfg. Co.  
 Allis-Chalmers Manufacturing Co.  
 Haynes Stellite Co.  
 Rohr Aircraft Corp.  
 Thompson Products, Inc.  
 Turbo Engineering Corp.

**Cabin**

Airesearch Manufacturing Co.  
 Eclipse-Pioneer Div., Bendix Aviation Corp.  
 Lawrance Aeronautical Corp.  
 B. F. Sturtevant Co., Inc.

**TANKS**

Aero Trades Co.  
 Air Transport Mfg. Co.  
 Aircraft Mechanics, Inc.  
 Aircraft Welders, Inc.  
 Alten's Foundry & Machine Works  
 Aluminum Co. of America  
 Aluminum Goods Mfg. Co.  
 B. H. Aircraft Co., Inc.  
 Berkey & Gay Furniture Co.  
 Butler Manufacturing Co.  
 Columbian Steel Tank Co.  
 Curtis Pneumatic Machinery Div.,  
 Curtis Manufacturing Co.  
 Detrex Corp.  
 Firestone Aircraft Co.  
 The Flour City Ornamental Iron Co.  
 The B. F. Goodrich Co.  
 Goodyear Aircraft Corp.  
 The Guiberson Corp., Aircraft &  
 Heater Div.  
 Hewitt Rubber Corp.  
 Kaiser Cargo, Inc., Fleetwings Div.  
 King Plastics Corp.

The Laister-Kauffmann Aircraft Corp.  
 Lasalco, Inc.  
 Luscombe Airplane Corp.  
 Magnux Chemical Co., Inc.  
 Mercury Aircraft Inc.  
 Meyers Aircraft Co.  
 Perry Metal Products Co., Inc.  
 Phillips Mfg. Co.  
 Pollak Manufacturing Co.  
 Preco Inc.  
 Spartan Aircraft Co.  
 Taylorcraft Aviation Corp.  
 The Udylyte Corp.  
 United Aircraft Products, Inc.  
 United States Rubber Co.  
 Utility Fan Corp.  
 Variety Aircraft Corp.  
 Weber Showcase & Fixture Co., Inc.  
 Westinghouse Electric & Manufacturing Co.  
 White Aircraft Corp.

**TESTING & INSPECTION EQUIPMENT**

Airadio, Inc.  
 American Aircraft Manufacturing Co.  
 American Machine & Metals, Inc.  
 R. B. Annis Co.  
 The B G Corp.  
 The Benwood-Linze Co.  
 The Comtor Co.  
 Consolidated Vultee Aircraft Corp.  
 Davis & Thompson Co.  
 The Denison Engineering Co.  
 Detroit Tap & Tool Co.  
 Durham Aircraft Service, Inc.  
 Eisemann Corp.  
 Federal Telephone & Radio Corp.  
 General Electric Co.  
 Gleason Works  
 Goodyear Aircraft Corp.  
 Harvey Radio Laboratories, Inc.  
 Henry L. Scott Co.  
 Ideal Commutator Dresser Co.  
 Industrial Sound Control  
 Jack & Heintz, Inc.  
 Jacoel Cable Splicing Equipment Co.  
 The Lewis Engineering Co.  
 McColpin-Christie Corp., Ltd.  
 McGrath St. Paul Co.  
 Major Aircraft Foundry  
 Merz Engineering Co.  
 Models, Inc.  
 Pacific Engineering Corp.  
 The Parker Appliance Co.  
 Rocky Mountain Steel Products, Inc.



# SCOTT TESTERS

\*Registered Trademark

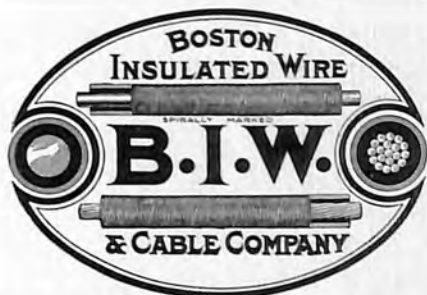
For controlled purchasing and utilization of wire, strip and rubber items, use \*Scott Testers. Our 67 models are recognized standard for testing for tensile strength, hysteresis, flexing, compression-cutting, twist, adhesion, plasticity, burst, etc. Capacities from finest filament to 1 ton tensile. Results are produced in the form of picturized charts, convenient for comparison and filing.

Request Bulletins

HENRY L. SCOTT CO.

130 Blackstone St., Providence, R. I.

*Standard of the World*



**ELECTRIC CABLES for AIRCRAFT**  
**LIGHTING AND POWER CABLES**  
**SHIELDING IGNITION CABLE**  
**BONDING WIRE ANTENNA WIRE**  
**INSTRUMENT WIRES AND CABLES**

*Manufactured in accordance with latest Army and Navy Specifications*

Special multiple conductor cable made to order — designed for particular applications on instruments and apparatus

**BOSTON INSULATED WIRE AND CABLE COMPANY**  
 BOSTON, MASSACHUSETTS

**(Testing & Inspection Equipment)***Continued*

Rohr Aircraft Corp.  
 The Soundsciber Corp.  
 Spencer & Morris  
 Toledo Scale Co.  
 United States Testing Co., Inc.  
 Variety Aircraft Corp.  
 Joseph Weidenhoff, Inc.  
 White Aircraft Corp.  
 Whiting Corp.  
 Wilson Mechanical Instrument Co.,  
 Inc.

**TIRES & TUBES**

Bonney Forge & Tool Works  
 Firestone Aircraft Co.  
 General Aircraft Supply Co.  
 The General Tire & Rubber Co.  
 The B. F. Goodrich Co.  
 Goodyear Aircraft Corp.  
 Otto Aviation Corp.  
 Scott Aviation Corp.  
 United States Rubber Co.  
 The Wellington Machine Co.

**TOOLS**

The Acromark Co.  
 Aero Tool Co.  
 Aircraft Screw Products Co., Inc.  
 Amalgamated Steel Co.  
 The Billings & Spencer Co.  
 The Black & Decker Mfg. Co.  
 Brand Tool & Supply Co.  
 The Bridgeport Hardware Mfg. Corp.  
 Brown & Sharpe Mfg. Co.  
 Buckeye Tool Corp.  
 The Cincinnati Lathe & Tool Co.  
 The Cleveland Automatic Machine Co.  
 Colonial Broach Co.  
 Consolidated Vultee Aircraft Corp.  
 Continental Machines Inc.  
 Cowles Tool Co.  
 Criterion Machine Works  
 Davis & Thompson Co.  
 Detroit Tap & Tool Co.  
 Duro Metal Products Co.  
 Ekstrom Carlson & Co.  
 Excello Corp.  
 Firth-Sterling Steel Co.  
 Floorola Products Inc.  
 General Aircraft Co.  
 General Aircraft Equipment Inc.  
 Genesee Tool Co.

The Geometric Tool Co., Div. of  
 Greenfield Tap & Die Corp.  
 Goodyear Aircraft Corp.  
 Greenfield Tap and Die Corp.  
 The Hamilton Tool Co.  
 Haynes Stellite Co.  
 A. W. Hecker  
 Imperial Brass Manufacturing Co.  
 Independent Pneumatic Tool Co.  
 Jack & Heintz, Inc.  
 Jacoel Cable Splicing Equipment Co.  
 Kennametal Inc.  
 Kent-Moore Organization, Inc.  
 Lempeco Products, Inc.  
 Los Angeles Stamp & Stationery Co.  
 The Lufkin Rule Co.  
 Luscombe Airplane Corp.  
 Jas. H. Matthew & Co.  
 Metal & Tool Reconditioning Corp.  
 Meyers & Martin Machine Co.  
 Michigan Tool Co.  
 Millers Falls Co.  
 Milwaukee Electric Tool Corp.  
 Moore-Eastwood & Co.  
 Otto Aviation Corp.  
 The Parker Appliance Co.  
 The Parker Stamp Works, Inc.  
 The Paulson Tools Inc.  
 Products Engineering Co.  
 The Ready Tool Co.  
 The Rotor Tool Co.  
 St. Louis Tool & Mfg. Co.  
 George Scherr Co., Inc.  
 Snap-on Tool Co.  
 South Shore Machine & Tool Works,  
 Inc.  
 Spiegel Sales Co.  
 P. A. Sturtevant Co.  
 George A. Terry Co.  
 The Tobrin Tool Co.  
 The Turner Brass Works  
 Utica Drop Forge & Tool Corp.  
 Variety Aircraft Corp.  
 Waldes Koh-I-Noor Inc.  
 The Walton Co.  
 Wesson Co.  
 White Aircraft Corp.  
 J. H. Williams & Co.  
 K. R. Wilson  
 J. Wiss & Sons Co.

**TRACTORS**

Baker Industrial Truck Div., The  
 Baker-Raulang Co.  
 Crescent Truck Co.  
 W. F. Hebard & Co.

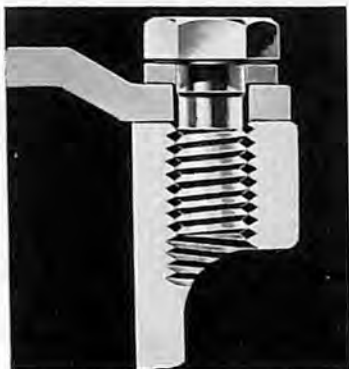


**Heli-Coil** INSERTS

MAKE ALUMINUM  
TAPPED THREADS  
WEAR LIKE IRON!

"Heli-Coil" Screw Thread Inserts give the protection of steel to light-metal products at the points where they are most vulnerable to wear—in holes tapped for threaded fastenings. These precision-shaped helical coils of stainless steel or phosphor bronze wire are used with 'NF' and 'NC' screws or studs for original installations, salvage and maintenance in aircraft engines and parts, where solid screw bushings were used previously.

THE SCREW SYSTEM WITH THE  
ANTI-FRICTION THREAD LINING



The "Aero-Thread" System

The "Aero-Thread" Screw Thread System uses screws or studs with a circular thread form to engage precision-shaped phosphor bronze or stainless steel helical coil inserts in the tapped threads. Such fastenings have 100% more dynamic strength and 25% more static strength than conventional fastenings.

U.S. and Foreign Patents  
Issued and Pending.



**AIRCRAFT SCREW PRODUCTS COMPANY, INC.**  
47-23 35th STREET • LONG ISLAND CITY, 1, N. Y.



No. 7 FLUXINE for welding all types of aluminum.  
No. 18 FLUXINE for gas and atomic hydrogen welding of stainless steels and inconel.  
No. 41 FLUXINE used with high-melting silver solders on copper and its alloys and on steel.  
No. 43 FLUXINE . . . non-glaring . . . used whenever low-melting silver solders are specified. No injurious fumes. Wherever a flux is required "FLUXINE" Fluxes will do it better and more economically. Write us today for sample. Address Dept. M.

Better jobbers everywhere  
carry the "FLUXINE" line.

**KREMBS AND COMPANY**  
Est. 1875  
669 W. Ohio Street—Chicago 10, Illinois

**FLUXINE**

TRADE MARK REGISTERED U. S. PAT. OFF.



**(Tractors) Continued**

Arthur D. Peterson Co., Inc.  
Towmotor Corp.

**TRAINING DEVICES**

Ballard Aircraft Div., The Walter M.  
Ballard Corp.  
Consolidated Vultee Aircraft Corp.  
G. Felsenthal & Sons  
Grand Central Airport Co.  
Link Aviation Devices, Inc.  
Spencer & Morris  
Variety Aircraft Corp.

**TUBE BENDING**

American Tube Bending Co.  
The Keeney Manufacturing Co.

**TUBING**

Air Cruisers Inc.  
Aircraft Welders, Inc.  
Aluminum Co. of America  
American Tube Bending Co., Inc.  
Atlantic India Rubber Works, Inc.  
Baker Steel & Tube Co.  
The Bowling Green Rubber Co.  
William Brand & Co.  
Breeze Corporations, Inc.  
Butler Manufacturing Co.  
Delco-Remy Div., General Motors  
Corp.  
Fibre Conduit Co.  
Flex-O-Tube Co.  
General Aircraft Supply Co.  
The General Tire & Rubber Co.  
Globe Steel Tubes Co.  
The B. F. Goodrich Co.  
Hope Webbing Co.  
Imperial Brass Manufacturing Co.  
Johns-Manville Corp.  
The Manhattan Rubber Mfg. Div.  
Raybestos-Manhattan, Inc.  
Michigan Seamless Tube Co.  
Otto Aviation Corp.  
Penn Brass & Copper Co., Inc.  
Perry Metal Products Co., Inc.  
Precision Tube Co.  
Resistoflex Corp.  
Revere Copper & Brass Inc.  
Reynolds Metals Co.  
Rodoc Rubber Corp.  
Saylor Electric Products Corp.  
Scovill Manufacturing Co.  
Shakespeare Products Co.

V. E. Sprouse Co.  
Superior Tube Co.  
The Timken Roller Bearing Co.  
United States Rubber Co.  
Wallace Supplies Manufacturing Co.  
R. D. Werner Co., Inc.  
Winchester Repeating Arms Co.

**TURRETS & PARTS**

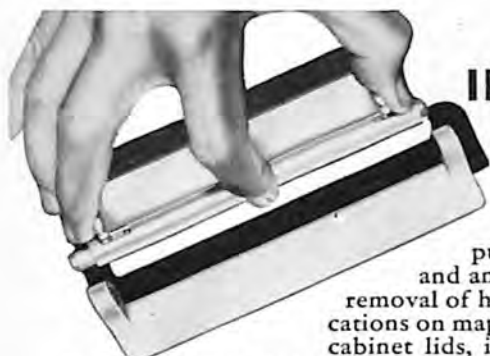
Air Transport Mfg. Co.  
The Electric Sprayit Co.  
The Emerson Electric Mfg. Co.  
Engineering & Research Corp.  
Firestone Aircraft Co.  
General Aircraft Equipment, Inc.  
General Aviation Equipment Co., Inc.  
General Electric Co.  
Goodyear Aircraft Corp.  
The Kawneer Co.  
Keystone Carbon Co.  
Marine-Air Research Corp.  
Glenn L. Martin  
The Murray Corp. of America  
Perry Metal Products Co., Inc.  
Plastic Manufacturers, Inc.  
Southern Aircraft Corp.  
Sperry Gyroscope Co., Inc.  
Vidal Research Corp.  
Ypsilanti Machine & Tool Co.

**UNIFORMS**

S. Appel & Co., Inc.  
Benray Products Co.  
The Duplan Corp.  
Roughwear Clothing Co.  
Russell Uniform Co.

**VALVES (CONTROL)**

Adel Precision Products Corp.  
Aerco Corp.  
Aerojet Engineering Corp.  
Aeronautical Manufacturing Corp.  
American Chain & Cable Co., Inc.,  
Reading-Pratt & Cady Div.  
The Deutsch Co.  
Durham Aircraft Service, Inc.  
Eclipse Fuel Engineering Co.  
The Electric Sprayit Co.  
General Controls Co.  
Harvill Corp.  
Huntington Precision Products Div. of  
Adel Precision Products Corp.  
Imperial Brass Manufacturing Co.



## BURKLYN INSTANT RELEASE HINGES

Four Standard Models  
Lengths—2" to 6"

These hinges serve the dual purposes of conventional hinges and an instant release device for hand removal of hinged parts. Adaptable to applications on map tables, folding seats, cowlings, cabinet lids, inspection doors, hatch covers, compartment divisions, hoods, housings on electrical equipment and on any other hinged surfaces. Available in several bracket designs, locking and non-locking types.

*First developed so that ammunition chutes could be removed instantly from aircraft machine guns.*

Also Manufacturers' Representatives and Jobbers for the West Coast with offices in:

Seattle  
Oakland  
Los Angeles  
Dallas

# BURKLYN

*Company*

3429 Glendale Boulevard Los Angeles 26, Calif.

Correct Uniforms Since 1856



**OFFICERS UNIFORMS**  
*for all*  
**AIR TRANSPORT**  
*Services*

**S. APPEL & CO.**

NEW YORK, N. Y. and MIAMI, FLA.  
18 Fulton Street 323 N.E. 1st St.

## *Clarke-Aero* HYDRAULIC COMPONENTS FOR AIRCRAFT

Gun Turret Control Valves  
Hydraulic Motors ● Fuel Transfer  
Pumps ● Restrictor Valves ● Re-  
lief Valves ● Rotary Valves ●  
Shuttle Valves ● Gun Elevator Cyl-  
inders ● Gill Cylinders.

**CLARKE AERO-HYDRAULICS INC.**  
PASADENA, CALIFORNIA

**(Valves). Continued**

Interstate Aircraft & Engineering Corp.  
 Jack & Heintz, Inc.  
 Kaiser Cargo, Inc., Fleetwings Div.  
 Kenyon Instrument Co., Inc.  
 Walter Kidde & Co., Inc.  
 Kohler Co.  
 A. Y. McDonald Mfg. Co.  
 Metropolitan Supply Co.  
 Otto Aviation Corp.  
 The Parker Appliance Co.  
 Peerless Machine Co.  
 Perry Metal Products Co., Inc.  
 Rohlm Manufacturing Co., Inc.  
 Rogers Products Co., Inc.  
 Scott Aviation Corp.  
 Stewart-Warner Corp.  
 Swift Lubricator Co., Inc.  
 United Aircraft Products, Inc.  
 Vard Inc.  
 Vickers Inc.  
 The Weatherhead Co.

**VENEERS**

Otto Aviation Corp.  
 Technical Ply-Woods  
 United States Plywood Corp.  
 Wood-Mosaic Co., Inc.

**VENTILATING & AIR  
CONDITIONING  
EQUIPMENT**

American Blower Corp.  
 American Foundry & Furnace Co.  
 American Machine & Metals, Inc.  
 Anemostat Corp. of America  
 Brunner Manufacturing Co.  
 Dietz Manufacturing Co.  
 Friez Instrument Div., Bendix Aviation Corp.  
 General Controls Co.  
 Harvey-Whipple Inc.  
 King Plastics Corp.  
 McQuay, Inc.  
 Perry Metal Products Co., Inc.  
 Pressed & Welded Steel Products Co. Inc.  
 Snapvent Co.  
 South Bend Air Products, Inc.  
 B. F. Sturtevant Co., Inc.  
 Surface Combustion  
 Utility Fan Corp.  
 Vapor Car Heating Co. Inc.  
 Variety Aircraft Corp.  
 Yates-American Machine Co.  
 Young Radiator Co.

**VIBRATION DAMPERS**

Adel Precision Products Corp.  
 Burklyn Co.  
 Connecticut Hard Rubber Co.  
 Firestone Aircraft Co.  
 The General Tire & Rubber Co.  
 The B. F. Goodrich Co.  
 Lord Manufacturing Co.  
 The Manhattan Rubber Mfg. Div.  
 Raybestos-Manhattan, Inc.  
 Perry Metal Products Co., Inc.  
 Rodic Rubber Corp.  
 United States Rubber Co.

**WELDING EQUIPMENT**

Allis-Chalmers Manufacturing Co.  
 Continental Machines Inc.  
 Dockson Corp.  
 General Aircraft Supply Co.  
 General Electric Co.  
 Glenn-Roberts Co.  
 Haynes Stellite Co.  
 W. F. Hebard Co.  
 Imperial Brass Manufacturing Co.  
 The Linde Air Products Co.  
 P. R. Mallory & Co., Inc.  
 The Alexander Milburn Co.  
 Pacific Engineering Corp.  
 Progressive Welder Co.  
 Sciaky Bros.  
 The Taylor-Winfield Corp.  
 Tube Turns, Inc.  
 Variety Aircraft Corp.  
 Weltronic Co.  
 Westinghouse Electric & Manufacturing Co.  
 White Aircraft Corp.  
 Whiting Corp.

**WHEELS**

Bendix Products Div., Bendix Aviation Corp.  
 Chicago Wheel & Manufacturing Co.  
 General Aircraft Supply Co.  
 The General Tire & Rubber Co.  
 Goodyear Aircraft Corp.  
 Hanson-Van Winkle-Munning Co.  
 Hayes Industries, Inc.  
 Otto Aviation Corp.  
 Scott Aviation Corp.  
 The Udyllite Corp.  
 Variety Aircraft Corp.  
 The Wellington Machine Co.

# Reliable Heating..



AT SEA LEVEL OR



AT 40,000 FEET

# Janitrol

## AIRCRAFT HEATERS

Janitrol Aircraft Heaters, based on the Whirling Flame principle, are now heating many types of Army, Navy and commercial planes in routine flights in the stratosphere, and at intermediate altitudes. In flight they operate on ram air or with fan. And for service in the coldest climates, these heaters can also be fan equipped for preflight ground heating.

These "all-altitude" heaters are lightweight and compact. They require a minimum weight of fuel tubing and

duct work. Standard models give capacities ranging from 15,000 to 125,000 Btu per hour output.

Surface Combustion engineers are ready to work with you and give you the benefit of their wide experience on the application and installation of various types of Janitrol heaters in all types of planes, boats, buses, trucks and other mobile equipment. For complete specification data, write Surface Combustion, Aircraft Heater Division, Toledo 1, Ohio.



This portable, self-contained ground heater furnishes reliable heat for engines, hangars, work shops, to dry out condensation and for many other purposes, will operate at temperatures as low as 40° below zero.



Janitrol Aircraft Heater with fan and combustion air regulator and compensator for atmospheric density. Heaters equipped with this regulator operate efficiently at highest flying altitudes.

**WINDSHIELD WIPERS**

Durham Aircraft Service, Inc.  
 Esso Aviation Products  
 The Marquette Metal Products Co.

**WIRE & CABLE —  
ELECTRICAL**

The Accurate Insulated Wire Corp.  
 Aluminum Co. of America  
 American Steel & Wire Co.  
 Belden Manufacturing Co.  
 Boston Insulated Wire & Cable Co.  
 The Crescent Co., Inc.  
 Crescent Insulated Wire & Cable Co.  
 Durham Aircraft Service, Inc.  
 General Aircraft Supply Co.  
 General Electric Co.  
 Kellogg Switchboard & Supply Co.  
 The Lewis Engineering Co.  
 Packard Electric Div., General Motors Corp.  
 Rockbestos Products Corp.  
 John A. Roebing's Sons Co.  
 Saylor Electric Products Corp.  
 United States Rubber Co.

**WIRE & CABLE —  
MECHANICAL &  
FLEXIBLE SHAFTS**

Aluminum Co. of America  
 American Chain & Cable Co., Inc.,  
 Automotive & Aircraft Div.  
 American Steel & Wire Co.  
 Arens Controls, Inc.  
 Bethlehem Steel Co.  
 General Aircraft Supply Co.  
 Kenyon Instrument Co., Inc.  
 Macwhyte Co.  
 Otto Aviation Corp.  
 Precision Tube Co.  
 John A. Roebing's Sons Co.  
 Saylor Electric Products Corp.  
 F. W. Stewart Mfg. Corp.  
 Western Electric Co., Inc., Radio Div.

**MISCELLANEOUS**

The Abbott Ball Co.  
 Abrams Instrument Co.  
 The Acromark Co.  
 Aerco Corp.  
 Aero Tool Co.  
 Aero Trades Co.  
 Air Cruisers Inc.

Airchox Co.  
 Aircraft Production Corp.  
 Ajax Electric Co., Inc.  
 Alten's Foundry & Machine Works  
 Amalgamated Steel Co.  
 American Chemical Paint Co.  
 American Plating Rack Co.  
 Associated Suppliers Co.  
 The Automatic Vise Sales Co.  
 Avery Adhesives  
 B. B. Chemical Co.  
 Baker & Co., Inc.  
 Benray Products Co.  
 Blackmer Pump Co.  
 Burdett Manufacturing Co.  
 Charles Manufacturing Co.  
 The Cleveland Automatic Machine Co.  
 Clifford Manufacturing Co.  
 Commonwealth Industries Inc.  
 Consolidated Vultee Aircraft Corp.  
 Del-Air Corp.  
 Detrex Corp.  
 The Dura-Products Manufacturing Co.  
 The Electric Sprayit Co.  
 Emmert Manufacturing Co.  
 Excello Corp.  
 G. Felsenthal & Sons  
 Firestone Aircraft Co.  
 The Flour City Ornamental Iron Co.  
 The General Tire & Rubber Co.  
 Goodyear Aircraft Corp.  
 The Guiberson Corp., Aircraft &  
 Heater Div.  
 The Hamilton Tool Co.  
 Hyster Co.  
 Interstate Aircraft & Engineering Corp.  
 The Kawneer Co.  
 Kenyon Instrument Co., Inc.  
 King Plastics Corp.  
 Krembs & Co.  
 Littelfuse Inc.  
 Major Aircraft Foundry  
 Markal Co.  
 Metal & Tool Reconditioning Corp.  
 Models, Inc.  
 North American Electric Lamp Co.  
 Olmsted Mfg. Div., Southwestern Development Co.  
 Otto Aviation Corp.  
 The Parker Appliance Co.  
 Perry Metal Products Co., Inc.  
 Arthur D. Peterson Co., Inc.  
 Pollak Manufacturing Co.  
 Poole Bros., Inc.  
 Reasor Manufacturing Co.  
 Rohlm Manufacturing Co., Inc.

LIGHTING CABLES • SYNTHETIC & FLAMEPROOF  
EVERY MAN, WOMAN & MACHINE

AT

# C R E S C E N T



IS WORKING 100% TO KEEP THE  
LIGHT OF FREEDOM BURNING

CRESCENT INSULATED WIRE & CABLE CO.  
TRENTON, N. J.

CRESFLEX NON-METALLIC SHEATHED CABLE • VARNISHED CAMBRIC • AIRCRAFT POWER &

INSULATION • RADIO WIRES • SIGNAL CABLE • FLEXIBLE CORDS • ARMORED CABLE

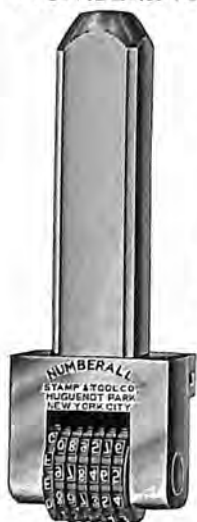
• IMPERIAL NEOPRENE JACKETED PORTABLE CABLE •

**(Miscellaneous) Continued**

Rohr Aircraft Corp.  
 Schweizer Aircraft Corp.  
 Scott Aviation Corp.  
 Screw Machine Products Co., Inc.  
 Sherman Paper Products Corp.  
 Spartan Aircraft Co.  
 Tal's Prestal Bender, Inc.  
 Thompson Products, Inc.  
 Turbo Engineering Co.  
 The Turner Brass Works

Union Aircraft Products Corp.  
 United Aircraft Products, Inc.  
 United Cinephone Corp.  
 Utility Fan Corp.  
 Vard Inc.  
 The Vimalert Co., Ltd.  
 Wayne Chemical Products Co.  
 Weems System of Navigation  
 White Aircraft Corp.  
 E. W. Wiggins Airways, Inc.

## NUMBER ALL NUMBERING MACHINES



For stamping  
 Figures and  
 Letters into  
 Metal, Fibre,  
 etc.  
**SPEED UP and  
 IMPROVE  
 MARKING**  
 Furnished in  
 Sizes  
 1/32" to 3/8"  
 With Three to  
 Twenty Wheels.

All the  
 Airplane  
 Manufacturers  
 use our  
 Machines for  
 marking  
 PARTS.

Write us for  
 Catalog.

**NUMBER ALL STAMP & TOOL CO., INC.**  
 Huguenot Park, Staten Island, N. Y.

## "WEEMS"

IS AN IMPORTANT NAME IN

## NAVIGATION

## TEXTS

## INSTRUMENTS

## INSTRUCTION

ENLARGED CLASS-ROOM  
 MODELS OF INSTRUMENTS



ANNAPOLIS, MARYLAND

**A Complete Range of  
HYDRAULIC SURFACE GRINDERS  
SPECIAL AIRCRAFT GRINDERS**

BROACH - SPLINE  
SLOT GRINDING AND  
MACHINE TOOL WAY GRINDERS



POWER ELEVATION  
FINGER TIP CONTROLS  
AUTOMATIC DOWN FEED  
AUTOMATIC WHEEL TRUING  
HYDRAULIC RAPID TRAVERSE  
AUTOMATIC SPARK-OUT CONTROL

SURFACE - 6 × 10 × 18 to 36 × 36 × 240  
BROACH - 6 × 48 to 12 × 72

Both for Flat and Round Broaches

**THE  
THOMPSON GRINDER COMPANY**  
West Main at Zischler St., Springfield, Ohio, U. S. A.



**AIRCRAFT  
TAPES AND FABRICS**

★A complete line of aircraft fabrics and tapes carries the famous Thurston Airwing label. These products include Army and Navy specification cloths, balloon fabrics, glider fabrics, utility cloths, and light-weight fabrics. Plus a distinguished group of aircraft tapes for all purposes.



**W. HARRIS THURSTON, Inc.**  
Div. of Reeves Brothers, Inc.

40 WORTH STREET, NEW YORK 13, N. Y.



Serving...

**WESTERN INDUSTRIES**

WITH  
CRANE AND PRODUCTION LINE  
SYSTEMS AND EQUIPMENT

•  
*Creators of...*

The **STABILIZED** Crane  
and  
**Gyro Float** Engine Test Stand

•  
**SPENCER & MORRIS**

ESTABLISHED 1919  
5649 Alhambra Ave. CLEVELAND TRAMRAIL SERVICE CASTERS & TRUCKS 580 Market St. San Francisco 4 SUITE 1715  
Los Angeles 32 Calif. Capital 5101

ENGINEERS — DESIGNERS — BUILDERS OF MATERIALS HANDLING SYSTEMS



# ALPHABETICAL DIRECTORY OF EQUIPMENT MANUFACTURERS AND SUPPLIERS OF BASIC MATERIALS AND FABRICATIONS

## A

**A. B. C. PRODUCTS, INC.**, 11952 Montana Ave., W. Los Angeles 24, Calif.

PERSONNEL: B. Wilson, Pres.; R. C. Hughes, V. Pres.; A. L. Wilson, Secy. & Chief Engr.

**THE ABBOTT BALL CO.**, Hartford 10, Conn.

PERSONNEL: J. W. Abbott, Pres.; D. V. Chapman, V. Pres.; H. K. Schwartz, Gen. Mgr.; J. Peta, Prod. Mgr.; J. H. Donahue, Sales Mgr. & Adv. Mgr.; R. F. Campbell, Pur. Dir.; N. Martinelli, Chief Engr.

**ABRAMS INSTRUMENT CO.**, 606 E. Shiawassee St., Lansing, Mich.

PERSONNEL: T. Abrams, Pres.; W. S. Karr, Gen. Mgr.; J. E. Meyer, Sales Mgr.; L. E. Davis, Pur. Dir.; H. L. Abrahamse, Chief Engr.

**ABRASIVE MACHINE TOOL CO.**, East Providence 14, R. I.

PERSONNEL: N. D. MacLeod, Pres. & Gen. Mgr.; M. E. Young, Secy.; E. S. Brackett, Jr., Treas.; E. S. Barton, Jr., Prod. Mgr.; W. P. R. Sceeles, Sales Mgr.; H. Hawksley, Pur. Dir.; H. A. Patenaude, Pers. Dir.; H. Hulme, Chief Engr.

**THE ACCURATE INSULATED WIRE CORP.**, P. O. Box 13, New Haven, Conn.

PERSONNEL: J. T. Whalen, Pres.; J. T. Whalen, Jr., V. Pres.; A. I. Whalen, Secy. & Treas.; L. W. Feldman, Gen. Mgr.; J. F. Kiggins, Prod. Mgr.; N. Sheehy, Pur. Dir. & Pers. Dir.

**ACME ALUMINUM ALLOYS INC.**, 323 N. Findlay St., Dayton, O.

PERSONNEL: K. A. Stein, Pres.; G. H. Stein, V. Pres.; W. C. Lewis, Secy. & Treas.; B. W. Burroughs, Sales Mgr.; A. F. Maish, Pur. Dir.; H. G. Hodges, Pers. Dir.; R. J. Stein, Adv. Mgr.; A. F. Leis, Chief Engr.

**ACME ELECTRIC HEATING CO.**, 1217 Washington St., Boston, Mass.

PERSONNEL: H. F. Price, Pres. & Treas.; G. A. Rice, V. Pres.

**THE ACROMARK CO.**

9-13 Morrell St., Elizabeth 4, N. J.  
PERSONNEL: H. O. Bates, Pres. & Pub. Dir.; A. D. Bates, Secy.; S. R. Rosenberg, Controller; W. A. Heine, Gen. Mgr. & Chief Engr.; W. A. Heine, Jr., Prod. Mgr. & Pers. Dir.; H. Karsten, Sales Mgr.; D. M. Shilo, Pur. Dir.; G. Martin, Adv. Mgr.

**ACTIVE SCREW & MANUFACTURING CO.**, 775 W. Jackson Blvd., Chicago 6, Ill.

PERSONNEL: E. Slutzky, A. Slutzky, Partners; E. Slutzky, Gen. Mgr. & Pers. Dir.; H. Jacobson, Sales Mgr.; A. Gramat, Pur. Dir.

**ACTUS PRODUCTS CO.**

10-14 N. Bleeker St., Mt. Vernon, N. Y.  
PERSONNEL: C. W. Prochaska, Gen. Mgr.; H. McCahan, Prod. Mgr.; J. D. Jackson, Sales Mgr.

**THE ADAMS CO.**

112 E. Fourth St., Dubuque, Ia.

**ADEL PRECISION PRODUCTS CORP.**

10800 Van Owen St., Burbank, Calif.  
1444 Washington Ave., Huntington, W. Va.

PERSONNEL: R. Ellinwood, Pres.; R. D. Cavanaugh, V. Pres. & Treas.; D. A. Schlosser, Gen. Mgr., Consumer Products & Line Support Div.; P. E. Prantz, Prod. Mgr., Aircraft & Trans. Div.; J. S. Garraway, Mgr., Engr. Service; R. L. Freeman, Pur. Dir.; K. F. Gleed, Pers. Dir.; C. H. Hollister, Jr., Pub. Rel. Dir.; J. W. Kelly, Chief Engr.

**ADHERE, INC.**, 1220 Maple Ave., Los Angeles 15, Calif.

PERSONNEL: D. F. Dreher, Pres. & Gen. Mgr.; I. A. Anderson, V. Pres., Sales Mgr. & Adv. Mgr.; W. W. Clarke, Secy. & Treas.; R. E. Heck, Prod. Mgr.; A. Austin, Pur. Dir.

**ADJUSTABLE CLAMP CO.**, 430 N. Ashland Ave., Chicago 22, Ill.

PERSONNEL: H. V. Holman, Pres.; D. V. Holman, Secy.

**ADVANCE ALUMINUM CASTINGS CORP.**, 2742 W. 36th Pl., Chicago 32, Ill.

PERSONNEL: R. W. Wilson, Pres.; N. Shoon, V. Pres. & Treas.; G. L. Hefner, Secy.; E. G. Grundstrom, Gen. Mgr.; A. J. Peterson, Sales Mgr.; G. J. Ries, Pur. Dir.; H. H. Brand, Chief Engr.

**ADVANCE PUMP CO.**, Ninth & Parker Sts., Berkeley, Calif.

PERSONNEL: J. N. Gilman, Exec. Mgr.; R. W. Sears, Prod. Mgr., Sales Mgr. & Pur. Dir.; J. E. Lindgren, Chief Engr.

**AERCO CORP.**

12024 Center St., Hollydale, Calif.  
PERSONNEL: T. E. Colvin, Pres. & Gen. Mgr.; L. A. Cole, Secy. & Treas.; C. B. Melone, Pur. Dir.; D. L. Story, Engr. in charge.

*Safe Landings*  
**ASSURED WITH AERCO  
 LANDING GEAR ASSEMBLIES**

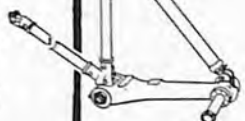


**TYPICAL AERCO PRODUCTS**

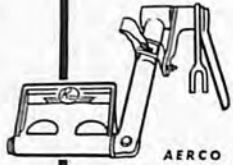
AERCO Tail Wheels  
 of the Fixed and Re-  
 tractable Types



AERCO Screw Jack  
 Actuator for Electric  
 or Hydraulic Motiva-  
 tion



AERCO Landing  
 Gear and Strut As-  
 sembly of the Fixed  
 Type



AERCO Rudder  
 Pedal and Brake  
 Actuator

*A*IRCRAFT manufacturers are invited to utilize Aerco's broad background of experience gained during the war, in the engineering of their landing gear assemblies—either conventional or tricycle types, fixed or retractable.

*Complete facilities for research  
 and large scale production.  
 Inquiries invited.*



H O L L Y D A L E , C A L I F O R N I A

**AERO-COUPLING CORP.,**

1051 N. Hollywood Way, Burbank, Calif.  
 PERSONNEL: A. A. Eisenman, Pres.; H. M. Davis, V. Pres., Treas., Sales Mgr., Adv. Mgr. & Chief Engr.; A. A. Burckle, Secy.; G. G. Bell, Prod. Mgr.; A. Ward, Pur. Dir.; G. E. Farmer, Pers. Dir.

**AERO SCREW CO.,**

19th Ave. & 12th St., Rockford, Ill.  
 PERSONNEL: F. L. Hill, Pres.; L. L. Barr, Gen. Mgr. & Adv. Mgr.; J. H. Cosell, Prod. Mgr.; S. H. Goranson, Sales Mgr.; H. Seebach, Pur. Dir.; H. Rosenthal, Pers. Dir.

**AERO SUPPLY MFG. CO., INC.,**

611 W. Main St., Corry, Pa.  
 PERSONNEL: S. J. Irvine, Pres. & Gen. Mgr.; L. E. Graham, V. Pres., Secy. & Treas.; F. H. Cameron, Prod. Mgr.; L. M. Kowalski, Sales Supervisor; H. W. Jewell, Pur. Dir.; H. O. Blount, Pers. Dir.; C. Rich, Pub. Dir. & Adv. Mgr.; G. T. Downey, Chief Engr.

**AERO TOOL CO., Burbank, Calif.**

PERSONNEL: L. Deutsch, Pres. & Gen. Mgr.; R. Sherwood, Prod. Mgr.; J. Henle, Sales Mgr.; T. C. Maxwell, Pur. Dir.; M. Waltz, Pers. Dir.; W. D. Wilson, Adv. Mgr.; L. Beebee, Chief Engr.

**AERO TRADES CO., Mineola, N. Y.**

PERSONNEL: E. Schiefele, J. G. McIntosh, Partners; J. Tallman, Gen. Mgr.

**AEROJET ENGINEERING CORP.,**

285 W. Colorado St., Pasadena 1, Calif.  
 PERSONNEL: A. G. Haley, Pres.; A. H. Rude, V. Pres. & Gen. Mgr.; T. E. Beehan, Secy. & Treas.; H. L. Robertson, Works Mgr.; J. P. Neal, Pur. Dir.; J. V. Hamilton, Pers. Dir.; H. W. Morgan, Adv. Mgr.

**AERONAUTICAL MANUFACTURING**

**CORP., 377 Fourth St., Niagara Falls, N. Y.**  
 PERSONNEL: A. M. Patterson, Pres.; G. C. Butler, V. Pres., Gen. Mgr. & Adv. Mgr.; J. D. Rumsey, Prod. Mgr.; R. Winship, Chief Engr.

**AERONAUTICAL PRODUCTS, INC.,**

18100 Ryan Rd., Detroit 12, Mich.  
 PERSONNEL: A. Jackson, Pres. & Gen. Mgr.; C. C. Layman, V. Pres. & Adv. Mgr.; M. J. Whitfield, Secy.; B. M. Layman, Treas.; E. P. Adamski, Prod. Mgr.; E. C. Jonke, Sales Mgr.; C. S. Sharpstein, Pur. Dir.; P. Heideman, Pers. Dir.; W. Schultz, Pub. Dir.

**AEROPRODUCTS DIV., GENERAL MOTORS CORP., Municipal Airport, Dayton 1, O.**

PERSONNEL: F. G. Wilson, Compt.; W. J. Blanchard, Gen. Mgr.; E. J. Parker, Prod. Mgr.; F. E. Lehman, Sales Mgr.; W. E. Kreitzer, Pur. Dir.; R. Daly, Pers. Dir.; C. J. Proud, Pub. Dir. & Adv. Mgr.

**AEROQUIP CORP.,**

300 South East Ave., Jackson, Mich.  
 PERSONNEL: D. T. McKone, Pres.; P. F. Hurst, V. Pres. & Gen. Mgr.; F. W. Corwin, Secy. & Treas.; E. Hurley, Prod. Mgr.; C. H. Field, Sales Mgr. & Adv. Mgr.; A. N. Snyder, Pur. Dir.; W. G. Howe, Pers. Dir.; M. W. Brandau, Chief Engr.

**AGAWAM AIRCRAFT PRODUCTS, INC.,**

Bay St., Sag Harbor, N. Y.  
 PERSONNEL: A. P. Loening, Pres. & Gen. Mgr.; G. A. Dippel, Factory Mgr.

**AIR CRUISERS INC.,**

330 Highland Ave., Clifton, N. J.  
 PERSONNEL: J. F. Boyle, Pres.; T. P. Vaughan, Exec. V. Pres., Treas. & Gen. Mgr.; H. A. Gerrish, V. Pres. & Secy.; W. H. Rauber, Prod. Mgr.; C. T. Blackburn, Sales Mgr., Pub. Dir. & Adv. Mgr.; E. D. Bastian, Pur. Dir.; C. Gosling, Pers. Dir.; J. J. Delainay, Chief Engr.

**AIR-PARTS, INC.,**

723 Sonora, Glendale 1, Calif.  
 PERSONNEL: W. B. Hawkins, Pres.; G. B. Hill, V. Pres.; N. K. Hawkins, Secy. & Treas.; A. C. Harvey, Gen. Mgr.; T. Henning, Sales Mgr.; D. K. Sowles, Pur. Dir.; H. A. Dawson, Chief Engr.

**AIR-SHIELDS INC.,**

County Line Rd., Hatboro, Pa.  
 PERSONNEL: S. Y. Gibbon, Pres.; B. C. Grieb, V. Pres., Treas. & Gen. Mgr.; J. B. McPherson, V. Pres. & Secy.; J. E. Lewis, Prod. Mgr.; E. R. March, Sales Mgr.

**AIR TRANSPORT MFG. CO.,**

Four Plants: 1114 N. Sycamore Ave., 1041 N. Sycamore Ave., 960 N. La Brea Ave., Los Angeles, Calif.; 614 W. Colorado Blvd., Glendale, Calif.  
 PERSONNEL: E. L. Hollywood, Pres., Gen. Mgr. & Chief Engr.; V. Bettin, V. Pres.; E. R. Hollywood, Secy.; P. J. Vandebosh, Treas.; W. G. Shields, Prod. Mgr.; F. A. Drumm, Sales Mgr.; R. W. Anderson, Pur. Dir.; M. L. Denton, Pers. Dir.; A. P. McKay, Pub. Dir. & Adv. Mgr.

**AIRADIO, INC., Melrose Ave. & Barry Pl., Stamford, Conn.**

PERSONNEL: J. B. Cobrain, Pres. & Treas.; L. Jacobson, H. L. Shortt, V. Pres.; E. C. Timmerman, Secy.; D. S. Basim, Dir. Engrg. & Research; J. R. Logan, Dir. Mfg.; H. G. Shea, Dir. Quality Control; W. L. Gustavson, Commercial Mgr.; W. J. Carroll, Controller.

**AIRCHOK CO.,**

8 S. Michigan Ave., Chicago 3, Ill.  
 PERSONNEL: G. L. Chapman, V. Pres.; L. M. Lewis, Secy.; E. A. Joyce, Treas. & Gen. Mgr.; F. G. Manson, Chief Engr.

**AIRCOOLED MOTORS CORP.,**

Liverpool Rd., Syracuse 8, N. Y.  
 PERSONNEL: L. E. Pierson, Jr., Pres.; C. T. Doman, V. Pres. & Chief Engr.; C. F. B. Roth, V. Pres., Gen. Sales Mgr. & Pub. Dir.; C. F. Carr, Secy. & Treas.; J. E. Babcock, Factory Mgr.; C. H. Bennum, Sales Mgr.; A. K. Stevens, Pur. Dir.; H. H. Severson, Pers. Dir.

**AIRCRAFT ACCESSORIES CORP., ELECTRONICS DIV., Fairfax & Funston Rd., Kansas City, Kans.**

PERSONNEL: R. C. Walker, Pres.; T. E. Colvin, Exec. V. Pres.; I. S. Wilson, V. Pres.-Finance; C. N. Kimball, V. Pres. & Exec. Engr.; O. R. Jones, Secy.; J. E. Nauman, Dir. of Pub. Rel.; H. Zimmerman, Dir. of Pur.

**AIRCRAFT ACCESSORIES CORP., POWER CONTROLS DIV., 166 W. Olive Ave., Burbank, Calif.**

PERSONNEL: R. C. Walker, Pres.; T. E. Colvin, Exec. V. Pres.; I. S. Wilson, V. Pres.-Finance; W. A. Cooke, V. Pres.-Ind. Rel.; O. R. Jones, Secy.; G. A. Rix, Service Mgr. & Control Engr.; R. E. Middleton, Chief Engr.; J. E. Nauman, Dir. of Pub. Rel.; J. Higbee, Dir. of Pur.

**AIRCRAFT ENGINEERING PRODUCTS, INC., 2 Ackerman Ave., Clifton, N. J.**

PERSONNEL: A. G. Roth, Pres., Secy. & Chief Engr.; G. Roth, V. Pres., Pers. Dir. & Pub. Dir.; L. E. Amann, Treas.; J. H. Reiter, Gen. Mgr.; E. T. Den Bleyker, Pur. Agt.



*"It sounds to me like  
a job for Aeronautical Products, Inc."*



If your precision parts program requires automatic screw machine work, grinding, thread grinding or milling, superfinishing, hyprolapping, heat treating, nitriding, plating, magnafluxing . . . at tolerances down to .0001 . . . we're equipped to do it faster . . . and better! In one organization with two great plants, *ALL* the facilities the most intricate production program requires. We were rated "tops" before the war began . . . we've *delivered the goods* in total war output . . . and we're staying at the top after Victory! We may have an open capacity now, on *your* parts problem . . . so why not play safe—write our Executive Sales Office now for booklet on complete plant equipment and facilities.

**AERONAUTICAL PRODUCTS, Inc.**

**DETROIT PLANT**  
and Administrative Offices:  
18100 Ryan Road, Detroit 12



**OHIO PLANT**  
Washington Court House  
Ohio

**AIRCRAFT HARDWARE MFG. CO.,**

1381 Lafayette Ave., New York 59, N. Y.  
 PERSONNEL: O. Mazzei, Partner & Gen. Mgr.;  
 S. Mazzei, Partner & Prod. Mgr.; F. Bohling,  
 Sales Mgr.; E. Kinsky, Pur. Dir.; R. Kovats,  
 Chief Engr.

**AIRCRAFT MECHANICS INC.,**

3200 N. Nevada, Colorado Springs, Colo.  
 PERSONNEL: P. W. Nichols, Pres. & Sales Mgr.;  
 E. E. Nichols, V. Pres.; M. A. Ohlander, Secy.  
 & Treas.; H. E. Jones, Prod. Supt.; G. C.  
 Woodard, Pur. Dir.; H. R. Elliott, Pers. Dir.  
 & Adv. Mgr.

**AIRCRAFT PRODUCTION CORP.,**

285 Madison Ave., New York, N. Y.  
 PERSONNEL: G. M. Curtis, Pres.; L. M. Law-  
 ton, Secy. & Treas.

**AIRCRAFT PRODUCTS CO.,**

West Chester, Pa.  
 PERSONNEL: J. H. Stephens, E. K. Gray, Part-  
 ners; F. K. McTyier, Gen. Mgr.; R. H. Bean,  
 Pur. Dir.; C. Fuller, Chief Engr.

**AIRCRAFT RADIO CORP., Boonton, N. J.**

PERSONNEL: L. M. Hull, Pres.; F. H. Drake,  
 V. Pres. & Chief Engr.; B. E. Holley, Treas.;  
 M. M. Eells, Sales Mgr.; H. M. Kingsland,  
 Pur. Dir.

**AIRCRAFT SCREW PRODUCTS CO., INC.,**

47-23 35th St., Long Island City, N. Y.  
 PERSONNEL: B. Sack, Pres. & Gen. Mgr.; H. W.  
 Cram, V. Pres. & Sales Mgr.; A. L. Salkin,  
 Secy.; C. L. Huisking, Jr., Treas.; E. M. Lang,  
 Prod. Mgr.; H. J. Wrigley, Pur. Dir.; C. G.  
 Thoma, Pub. Dir. & Adv. Mgr.; O. Haas, Chief  
 Engr.

**AIRCRAFT SPECIALTIES CO., 601 S. Ander-  
son St., Los Angeles 23, Calif.**

PERSONNEL: T. K. Temple, G. W. McChie, Jr.,  
 G. W. Potapenko, Partners.

**AIRCRAFT SPECIALTIES DIV., ZIMMER  
THOMSON CORP., 29-05 Review Ave.,  
Long Island City 1, N. Y.**

PERSONNEL: J. B. Thomson, Pres.; S. G. Thom-  
 son, Jr., V. Pres.; A. C. Stevens, Secy.; H. Scott,  
 Prod. Mgr.; J. O. Winberg, Pur. Dir.; S.  
 Kotula, Pub. Dir. & Adv. Mgr.; L. H. Leonard,  
 Chief Engr.

**AIRCRAFT STANDARD PARTS CO.,**

Rockford, Ill.  
 PERSONNEL: F. L. Hill, Pres.; G. Alden, Con-  
 troller; P. M. Stephenson, Gen. Mgr.; J.  
 Andrew, Sales Mgr.; J. Caulkins, Pur. Dir.;  
 H. Rosenthal, Pers. Dir.; K. Hill, Chief Engr.

**AIRCRAFT WELDERS, INC.,**

403 Beacon Bldg., Wichita, Kans.  
 PERSONNEL: O. A. Sutton, Pres.; W. L. Henry,  
 V. Pres. & Sales Mgr.; G. R. Carnahan, V.  
 Pres. & Prod. Mgr.; W. J. Lyons, Secy.; P. L.  
 Sutton, Treas.; E. M. Evans, Pur. Dir.; O. B.  
 Chandler, Pers. Dir.; G. E. Bange, Chief Engr.

**THE AIRCRAFTSMEN CO.,**

223 Hindry Ave., Inglewood, Calif.  
 PERSONNEL: A. C. Chester, Partner, Gen. Mgr.  
 & Chief Engr.; A. P. Clausen, Partner & Prod.  
 Mgr.; M. L. Lynch, Secy.; E. Armes, Pur. Dir.  
 & Pers. Dir.

**AIRESEARCH MANUFACTURING CO.,**

DIV. OF THE GARRETT CORP.,  
 9851 Sepulveda Blvd., Los Angeles 45,  
 Calif.

PERSONNEL: J. C. Garrett, Pres.; W. Brownlee,  
 V. Pres. & Gen. Mgr.; W. D. Morgan, Compt.;  
 M. Gelber, Asst. Compt.; S. Whitaker, Sales  
 Mgr.; J. B. Meyer, Pur. Agt.; W. R. Ramsaur,  
 Chief Engr.; C. W. Reynolds, Dir. Pub. & Ind.  
 Rel. & Adv. Dir.; J. Rosales, Works Mgr.

**AIRPLANE & MARINE INSTRUMENTS,  
INC., Clearfield, Pa.**

PERSONNEL: T. W. Stemmler, Pres.; E. S.  
 Little, V. Pres. & Sales Mgr.; W. Netherwood,  
 Secy. & Treas.; G. E. Pray, Gen. Mgr. & Chief  
 Engr.; W. F. Diehl, Prod. Mgr.; A. R.  
 McCauley, Pur. Dir.; G. E. Olewine, Pers. Dir.

**AJAX ELECTRIC CO., INC., Frankford Ave.**

at Delaware Ave., Philadelphia 23, Pa.  
 PERSONNEL: G. H. Clamer, Pres.; W. Adam,  
 Jr., V. Pres.; J. E. Haig, Secy.; L. B. Rousseau,  
 Sales Mgr.; W. W. Winters, Adv. Mgr.

**ALL AMERICAN AIRCRAFT PRODUCTS,  
INC., 1350 E. Anaheim, Long Beach,  
Calif.**

PERSONNEL: E. Adler, Pres.; G. R. Adler, V.  
 Pres.; P. E. Graham, Treas.; R. C. Adler, Chief  
 Engr.

**ALLIS-CHALMERS MFG. CO.,**

Milwaukee 1, Wisc.  
 PERSONNEL: W. Geist, Pres.; H. W. Story, J. A.  
 Keogh, W. A. Roberts, V. Pres.; J. M. White,  
 V. Pres. & Gen. Mgr.; W. C. Johnson, V. Pres.  
 & Sales Mgr.; L. H. Hill, V. Pres. & Pers. Dir.;  
 E. H. Brown, V. Pres. & Chief Engr.; W. E.  
 Hawkinson, Secy. & Treas.; A. J. Tank, Prod.  
 Mgr.; P. E. Haker, Pur. Dir.; G. J. Callos, Pub.  
 Dir. & Adv. Mgr.

**ALLISON DIV., GENERAL MOTORS CORP.,**

Indianapolis, Ind.  
 PERSONNEL: E. B. Newill, Gen. Mgr.; W. G.  
 Guthrie, Prod. Mgr.; R. C. Golt, Sales Mgr.;  
 R. E. Settle, Pur. Dir.; K. H. Hoffman, Pers.  
 Dir.; R. C. Fleming, Pub. Dir. & Adv. Mgr.;  
 R. M. Hazen, Chief Engr.

**ALOFS MANUFACTURING CO.,**

1615 Madison Ave. S. E., Grand Rapids  
 7, Mich.  
 PERSONNEL: H. G. Alofs, Gen. Mgr.; L.  
 Alkema, Pur. Dir.; J. D. Lindhout, Pers. Dir.

**ALTEN'S FOUNDRY & MACHINE WORKS,  
Lancaster, O.**

PERSONNEL: G. H. Alten, Pres.; H. K.  
 McGrath, V. Pres.; A. Cunix, Secy.; M. Smith,  
 Treas.; H. Ruff, Gen. Mgr.; W. Yost, Prod.  
 Mgr.; M. Winland, Sales Mgr.; D. Manson,  
 Pur. Dir.; B. Meyers, Pers. Dir.; J. Burghalter,  
 Adv. Mgr.; E. Mees, Asst. Chief Engr.

**ALUMINUM COMPANY OF AMERICA,**

Gulf Bldg., Pittsburgh 19, Pa.  
**ALUMINUM GOODS MFG. CO.,**  
 15th & Washington St., Manitowoc,  
 Wisc.

PERSONNEL: A. J. Vits, Pres.; E. O. Vits, V.  
 Pres.; H. L. Vits, V. Pres. & Pur. Dir.; W. F.  
 Bugenhagen, V. Pres. & Sales Mgr.; R. H.  
 Fulton, Secy. & Treas.; R. L. Pritchard, Adv.  
 Mgr.

**ALUMINUM LADDER CO.,**

Worthington, Pa.  
 PERSONNEL: S. H. Carbis, Pres., Gen. Mgr. &  
 Sales Mgr.; J. Cebula, V. Pres.; H. M. Cramer,  
 Secy. & Treas.; H. J. Mudd, Pur. Dir.

**AMALGAMATED STEEL CO.,**

7835 Broadway, Cleveland 5, O.  
 PERSONNEL: H. S. Meshorer, Pres.; L. B.  
 Edwards, Sales Mgr.

**AMERICAN AIRCRAFT MANUFACTURING**

CO., 704 N. Main St., Dayton, O.  
 PERSONNEL: R. A. Niekamp, Pres. & Gen.  
 Mgr.; D. L. Mills, V. Pres.; V. A. Niekamp,  
 Secy.; S. D. Mills, Prod. Mgr.; W. G. Hapner,  
 Sales Mgr.; J. M. Barber, Pur. Dir.; E. A.  
 Flynn, Pers. Dir.; P. B. Burrus, Chief Engr.



*Typical welded engine mount precision  
Welded by Aircraft Welders, Inc.*

Throughout the critical war years we at Aircraft Welders have been recognized for our ability to produce on schedule, quality Motor Mounts (Harness for winged horsepower).

We dedicate ourselves to continued ON SCHEDULE production and to the constant search for new and better processes.

Those who demand the best in welding and machining look to Aircraft Welders, Incorporated.



**AIRCRAFT WELDERS, INC.**

AIRFRAMES SPECIALISTS

OFFICE 403 BEACON BLDG  
WICHITA KANSAS

**AMERICAN ALUMINUM WARE CO.,**

366 Jelliff Ave., Newark 8, N. J.  
 PERSONNEL: H. Brucker, Ch. of Board & Prod. Mgr.; J. B. Klausmann, Pres., Sales Mgr., Pub. Dir. & Adv. Mgr.; M. H. Klausmann, V. Pres., Pur. Agt., Pers. Dir. & Chief Engr.; H. J. Brucker, V. Pres. & Chief Engr.; F. T. Blackeby, Secy. & Pur. Agt.; O. B. Brucker, Treas.

**AMERICAN BLOWER CORP.,**

Detroit 32, Mich.  
 PERSONNEL: C. T. Morse, Pres.; R. Vaile, V. Pres.; G. G. Polk, Secy.; H. E. Barth, Sales Mgr.

**AMERICAN BOSCH CORP.,**

3664 Main St., Springfield 7, Mass.  
 PERSONNEL: D. P. Hess, Pres.; W. K. Dow, V. Pres.; F. N. Perry, V. Pres.-Sales; E. H. Mill, V. Pres.-Mfg.; M. J. Berlyn, V. Pres.-Engrg.; J. R. Holden, Secy.; W. T. Barton, Pur. Dir.; H. J. McCormack, Pers. Dir.; R. J. Alden, Pub. Dir. & Adv. Mgr.; B. Loeffler, Chief Engr.

**AMERICAN CENTRAL MFG. CORP.,**

Connersville, Ind.  
 PERSONNEL: W. F. Valentin, Adv. Mgr.

**AMERICAN CHAIN & CABLE CO., INC.,**

929 Connecticut Ave., Bridgeport 2, Conn.  
 PERSONNEL: W. T. Morris, Pres.; W. F. Wheeler, Exec. V. Pres. & Treas.; C. N. Johns, V. Pres.-Operations; G. C. Moon, V. Pres.-Sales; W. D. Kirkpatrick, V. Pres.; A. C. Laske, Secy.; E. V. Creagh, Adv. Mgr.

American Chain Div.,  
 E. Princess & Charles, York, Pa.  
 PERSONNEL: W. D. Kirkpatrick, Sales Mgr.

Automotive & Aircraft Div.,  
 6-233 General Motors Bldg., Detroit 2, Mich.  
 PERSONNEL: H. Williams, Sales Mgr.; W. M. Lipps, Chief Engr.

Andrew C. Campbell Div.,  
 Bridgeport 2, Conn.  
 PERSONNEL: R. J. Southwell, Sales Mgr.; H. Robinson, Chief Engr.

Ford Chain Block Div.,  
 Second & Diamond Sts., Philadelphia 25, Pa.  
 PERSONNEL: C. B. Veit, Sales Mgr.; M. E. Silberger, Chief Engr.

Page Steel & Wire Div.,  
 Monessen, Pa.  
 PERSONNEL: W. H. Bleecker, Sales Mgr.

Reading-Pratt & Cady Div.,  
 Reading, Pa.  
 PERSONNEL: J. P. Ferguson, Sales Mgr.

Reading Steel Casting Div.,  
 Reading, Pa.  
 PERSONNEL: L. W. Hopkins, Sales Mgr.

Wright Manufacturing Div.,  
 E. Princess & Charles, York, Pa.  
 PERSONNEL: C. B. Veit, Sales Mgr.; M. E. Silberger, Chief Engr.

**AMERICAN CHEMICAL PAINT CO.,**

Ambler, Pa.  
 PERSONNEL: L. Chertsey, Pres. & Gen. Mgr.; F. P. Spruance, V. Pres. & Sales Mgr.; H. D. Steinbright, Secy., Prod. Mgr. & Pur. Dir.; E. H. Rishel, Treas.; W. B. Boyer, Adv. Mgr.

**AMERICAN FLANGE & MFG. CO., INC.,**

30 Rockefeller Plaza, New York 20, N.Y.  
 PERSONNEL: R. L. Parish, Pres.; J. Myers, V. Pres., Secy. & Gen. Mgr.; F. W. Sample, V. Pres. & Sales Mgr.; T. H. Chamberlain, Adv. Mgr.

**AMERICAN FOUNDRY & FURNACE CO.,**

Bloomington, Ill.  
 PERSONNEL: H. A. Soper, Pres., Gen. Mgr. & Sales Mgr.; L. G. Whitmer, V. Pres. & Treas.; R. P. Whitmer, Secy. & Pers. Dir.; W. G. Macy, Prod. Mgr.; E. L. Fox, Pur. Dir., Pub. Dir. & Adv. Mgr.; W. J. Klingberg, Chief Engr.

**AMERICAN GAUGE CO.,**

125 Bayard St., Dayton, O.

**AMERICAN HAIR & FELT CO.,**

1828 Merchandise Mart, Chicago 54, Ill.  
 PERSONNEL: N. S. McKay, Pres.; L. C. Scott, V. Pres.; W. W. Harmon, Prod. Mgr.; M. F. Norris, Sales Mgr.; W. A. Busch, Pur. Dir.; C. A. Conrad, Adv. Mgr.

**AMERICAN-LAFRANCE-FOAMITE CORP.,**

100 E. LaFrance St., Elmira, N. Y.  
 PERSONNEL: E. E. O'Neill, Pres.; C. F. Smith, V. Pres.; C. A. Pettyjohn, V. Pres. & Treas.; W. M. Cooper, V. Pres. & Secy.; J. O. Binford, Gen. Mgr.-Sales; A. G. Long, Prod. Mgr.; F. R. Baker, Pur. Dir.; L. C. Hogg, R. Rogers, Pers. Dir.; H. M. Messenger, H. Walker, Pub. Dir. & Adv. Mgr.; C. B. White, Chief Engr.

**AMERICAN MACHINE AND METALS, INC.,**

E. Moline, Ill.  
 PERSONNEL: P. G. Mumford, Pres.; J. C. Vander Pyl, V. Pres., Secy. & Gen. Mgr.; W. Mendell, V. Pres. & Sales Mgr.; H. T. McMeekin, Treas.; A. A. Carlson, Prod. Mgr.; S. H. Deicker, Pur. Dir.; J. Swennumson, Pers. Dir.; R. W. Denman, Adv. Mgr.; E. C. Miller, Chief Engr.

**AMERICAN PLATING RACK CO.,**

630 Parkview, Detroit 14, Mich.  
 PERSONNEL: D. W. Dyer, Pres.; L. E. Harris, Secy.; B. Martin, Chief Engr.

**AMERICAN PROPELLER CORP.,**

1333 Alexis Rd., Toledo 1, O.  
 PERSONNEL: W. F. Wise, Pres.; B. Conway, I. J. Snader, W. A. Mogensen, V. Pres.; R. S. Pruitt, Secy.; W. F. Kopp, Asst. Treas.; E. R. Isbell, Plant Mgr.; J. F. Howard, Factory Mgr.; R. J. Cowden, Sales Mgr.; D. T. Waltz, Pur. Dir.; D. H. Russ, Pers. Dir.; A. W. Gratop, Pub. Dir.; J. E. Wells, Adv. Mgr.; D. R. Woolf, Chief Engr.

**AMERICAN SCREW CO.,**

21 Stevens St., Providence 1, R. I.  
 PERSONNEL: E. E. Clark, Pres.; V. J. Roddy, V. Pres.; J. P. Doherty, Secy.; E. W. Lane, Treas.; G. A. Reama, Prod. Mgr.; C. O. Drayton, Sales Mgr.; W. A. Smedley, Pur. Dir.; J. A. Beauregard, Pers. Dir.; H. Mayoh, Pub. Dir. & Adv. Mgr.; F. E. Brown, Chief Engr.

**AMERICAN STEEL & WIRE CO.,**

Rockefeller Bldg., Cleveland 13, O.  
 PERSONNEL: C. F. Hood, Pres.; J. May, V. Pres. & Gen. Sales Mgr.; J. G. Nelson, Secy.; J. J. Farrell, Treas.; C. W. Meyers, Aviation Rep.; F. E. Chesney, Pur. Dir.; M. E. Nichols, Pers. Dir.; W. I. Ong, Pub. Dir.; W. H. Cordes, Adv. Mgr.; E. J. Reardon, Chief Engr.



Aviation  
Magnetos



Fuel Injection  
Equipment



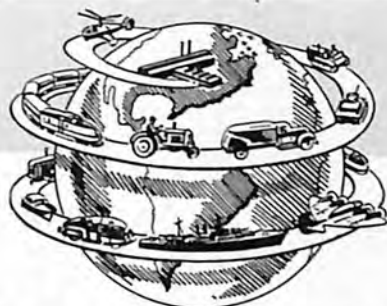
Commercial  
Magnetos



Generator  
Regulators



Ignition  
Condensers



## FOUR WORDS

and what they mean to the world

"Precision production for power."

Perhaps better than any other single phrase, those words describe American Bosch to the world.

Commerce, industry, mining, agriculture and construction have long known American Bosch as the source of precision ignition and fuel injection equipment and the facilities to maintain it.

Manufacturers of the world's engines have called upon American Bosch for specialized knowledge that has contributed vitally to the continued improvement of gasoline and Diesel engines.

The use of power in a world at peace will expand greatly. Then American Bosch Precision Production for Power will be available to all who will build or use the engines through which power will become the servant of mankind.



Starting  
Vibrators



Fuel Oil  
Filters



Generators



Windshield  
Wipers



Ignition  
Coils



AMERICAN BOSCH CORPORATION · SPRINGFIELD 7, MASS., U. S. A.

# AMERICAN BOSCH



**AMERICAN TUBE BENDING CO., INC.,**  
5 Lawrence St., New Haven 11,  
Conn.

PERSONNEL: H. W. Jones, Jr., Pres., Treas. & Gen. Mgr.; F. B. Kingsbury, V. Pres., Sales Mgr., Pub. Dir. & Adv. Mgr.; E. W. Stolz, Secy.; D. F. Bradley, Prod. Mgr.; A. F. Cewe, Pur. Dir.; R. Hanabury, Pers. Dir.; C. Von Allman, Chief Engr.

**B. C. AMES CO.,**  
12 Ames St., Waltham, Mass.

PERSONNEL: W. Ames, Pres.; I. R. Ames, V. Pres., Treas. & Sales Mgr.; H. G. Haynes, Secy.; H. B. Kruse, Prod. Mgr.

**ANCHOR POST FENCE CO.,**  
6500 Eastern Ave., Baltimore 24, Md.

PERSONNEL: W. F. Brannan, Pres.; R. D. Logee, V. Pres. & Sales Mgr.; T. H. Smoot, V. Pres. & Chief Engr.; G. B. Ferris, Secy.; C. W. Burton, Treas.; J. S. Case, Prod. Mgr.; C. A. Bishop, Pur. Dir.; C. J. Gross, Pers. Dir.; M. J. Donahue, Pub. Dir. & Adv. Mgr.

**ANDERSON AIRCRAFT INC.,**  
2630 Park Ave., New York 51, N. Y.

PERSONNEL: F. Anderson, Pres. & Chief Engr.; F. B. Woodworth, V. Pres.; I. Ratner, Secy. & Gen. Mgr.

**ANEMOSTAT CORP. OF AMERICA,**  
10 E. 39th St., New York 16, N. Y.

PERSONNEL: A. Rust-Oppenheim, Pres. & Gen. Mgr.; F. J. Kurth, V. Pres.; R. S. Fletcher, Secy.; J. C. Anderer, Treas.; W. Wander, Prod. Mgr.; J. B. Hewett, Sales Mgr.; R. E. Bassen, Pur. Dir.; F. X. Goette, Pers. Dir.; J. W. Molitor, Pub. Dir. & Adv. Mgr.; F. Honerkamp, Chief Engr.

**ANGIER CORP., Framingham, Mass.**

PERSONNEL: E. H. Angier, Pres.; A. J. Thiel, V. Pres. & Sales Mgr.; J. Angier, Treas. & Prod. Mgr.; O. Angier, Gen. Mgr.; F. Bowker, Pur. Dir.; A. B. Hall, Adv. Mgr.; E. R. Dearborn, Chief Engr.

**R. B. ANNIS CO., 1101 N. Delaware St., Indianapolis 2, Ind.**

PERSONNEL: R. B. Annis, Pres.; A. Anderson, Prod. Mgr.

**S. APPEL & CO. INC., 18 Fulton St., New York 7, N. Y.**

323 N. E. First St., Miami, Fla.  
PERSONNEL: G. I. Appel, Pres.; E. M. Bernstein, Secy.; H. Honeystein, Treas.

**ARCH ROOF CONSTRUCTION CO., INC.,**  
113 W. 42nd St., New York 18, N. Y.

PERSONNEL: L. Davidson, Pres., Treas. & Chief Engr.; L. Greenberg, Secy.

**ARENS CONTROLS INC.,**  
2253 S. Halsted St., Chicago 8, Ill.

PERSONNEL: C. Norton, Pres. & Gen. Mgr.; P. O. Hooker, V. Pres., Secy. & Sales Mgr.; R. E. Argast, Treas.; E. Sanders, Pur. Dir.

**ARNOLT MOTOR CO., Warsaw, Ind.**

PERSONNEL: S. H. Arnolt, Pres.; W. N. Brown, Prod. Mgr.; H. O. Gerard, Pur. Dir.; I. W. Martin, Pers. Dir.

**ARTER GRINDING MACHINE CO.,**  
15 Sagamore Rd., Worcester, Mass.

PERSONNEL: W. Arter, Sr., Pres.; H. Arter, V. Pres., Treas. & Pers. Dir.; H. Tattersall, Secy. & Pur. Dir.; W. Arter, Jr., Prod. Mgr.; A. B. O'Donnell, Sales Mgr., Pub. Dir. & Adv. Mgr.; W. F. Fraser, Chief Engr.

**ASSOCIATED FOUNDRIES & MFRS., INC.,**  
503-507 W. 56th St., New York 19, N. Y.

PERSONNEL: S. Norris, Pres.; A. Berger, V. Pres., Gen. Mgr. & Chief Engr.; C. Sliosberg, Secy.; I. Polakoff, Treas.; R. Nawratzki, Prod. Mgr.; L. Dobbins, Pur. Dir.

**ASSOCIATED SUPPLIERS CO.,**  
5610 Hollywood Blvd., Los Angeles,  
Calif.

PERSONNEL: W. M. Noe, Pres. & Gen. Mgr.; E. T. Stephens, V. Pres. & Treas.; H. V. Noe, Secy.; R. G. Machado, Prod. Mgr.; G. D. McLaughlin, Sales Mgr.; B. W. Beckmann, Pur. Dir.

**ATLANTIC DIESEL CORP., Codwise Ave., New Brunswick, N. J.**

PERSONNEL: J. S. Johnson, Pres.; O. S. Cabot, V. Pres.; J. J. Gibson, Jr., Secy.; F. A. Cosgrove, Treas.; J. E. Pakenham, Prod. Mgr.; R. F. Sturgis, Sales Mgr.; F. Mather, Pur. Dir.; W. A. Johns, Chief Engr.

**ATLANTIC INDIA RUBBER WORKS, INC.,**  
1453 W. Van Buren St., Chicago 7, Ill.

PERSONNEL: C. O. Moore, Pres.; M. E. Moore, Treas.; C. E. Chester, Prod. Mgr.; S. R. Flett, Sales Mgr.; W. G. Linard, Pur. Dir., Pub. Dir. & Adv. Mgr.; R. E. Powell, Chief Engr.

**ATLAS BRASS FOUNDRY, 1901 Santa Fe Ave., Los Angeles 21, Calif.**

PERSONNEL: F. Anderson, Pres.; N. C. Robinson, V. Pres.; M. M. Anderson, Secy.; S. V. Frase, Treas. & Pur. Dir.; R. F. Treuer, Gen. Mgr. & Sales Mgr.

**ATLAS METAL STAMPING CO.,**

3801 Castor Ave., Philadelphia 24, Pa.

PERSONNEL: J. A. Troup, Pres.; W. A. Lausterer, Works Mgr.; O. J. R. Troup, Treas. & Gen. Mgr.; E. Rexer, Prod. Mgr.; C. J. Meister, Sales Mgr. & Adv. Mgr.; J. J. Murphy, Pur. Dir.; E. G. Hughes, Pers. Dir.; E. H. Mather, Chief Engr.

**AUBURN BUTTON WORKS, INC.,**  
Auburn, N. Y.

PERSONNEL: D. Woodruff, Pres.; E. B. Crawford, V. Pres. & Gen. Mgr.; E. M. Woodruff, V. Pres.; H. Stewart, Secy.; W. A. Freyer, Treas. & Sales Mgr.

**AURORA EQUIPMENT CO., Aurora, Ill.**

PERSONNEL: J. C. Dunham, Pres.; F. D. Keck, V. Pres. & Treas.; M. L. Dunham, Secy.; A. P. Fauth, Pur. Dir.

**AUTOGROOM CO. INC.,**

68-02 38th Ave., Woodside, N. Y.

PERSONNEL: M. W. M. Devitt, Pres.; E. W. Lofgren, V. Pres.; R. Wolke, Treas.

**AUTOMATIC ELECTRIC CO.,**

1033 W. Van Buren St., Chicago 7, Ill.

PERSONNEL: P. W. Conrad, Pres.; W. J. Caverley, Exec. V. Pres.; T. S. Gary, Sales Mgr.; H. E. Clapham, Adv. Mgr.

**THE AUTOMATIC VISE SALES CO.,**

2845 Sunset Pl., Los Angeles 5, Calif.

PERSONNEL: R. C. Andrus, Pres. & Sales Mgr.

**AUTOMOTIVE RUBBER CO.,**

8601 Epworth Blvd., Detroit 4, Mich.

PERSONNEL: R. L. Redmond, Pres.; W. A. Swingle, Secy.; T. G. Meulenber, Gen. Mgr.; D. A. Koza, Prod. Mgr.; F. Kurt, Sales Mgr.; Aircraft Parts; F. D. Wressell, Pur. Dir.; G. C. Ludwig, Chief Engr.

**AVERY ADHESIVES, 451-453 E. Third St., Los Angeles 13, Calif.**

PERSONNEL: R. S. Avery, Gen. Mgr.; J. Arozena, Prod. Mgr.; M. McDougal, Sales Mgr.; R. W. Morris, Pur. Dir.



**We bend 'em—flare 'em—flange 'em and  
swage 'em with "micrometer" accuracy**

Yes, we have been working wonders bending TUBES, since 1910. Our smoothly working team of able engineers and highly skilled workmen make tubes squirm around in any direction like a pretzel to follow the most intricate designs, *with accurate precision*. Intake pipes, exhaust collectors and manifolds, oil lines, landing gear struts and forks, airplane seat frames, control sticks, oil slinger tubes for de-icing, ignition manifolds, etc.

We're doing a war job—with the same reliability, precision and custom-built accuracy for which American Tube Bending Company, Inc. has been known for 35 years to the airplane and automotive industries.

If you have problems in tube-bending put them up to us. Write for informative booklet about tube-bending at its best to American Tube Bending Co., Inc., 11 Lawrence St., New Haven 11, Conn.

**AMERICAN  
TUBE BENDING  
COMPANY, INC.**

**PRECISION to aircraft standards**

**AVONDALE CHEMICAL CO.**, 1030 N. Cleveland Ave., Chicago 10, Ill.  
**PERSONNEL:** H. N. Limback, Pres. & Chief Engr.; P. Kania, Gen. Mgr.

## B

**B. B. CHEMICAL CO.**, 784 Memorial Dr., Cambridge A, Mass.

**PERSONNEL:** H. W. Hyde, Pres.; E. N. Chase, Secy.; W. Kemp, Treas.; R. E. Stuart, Gen. Mgr. & Sales Mgr.; R. K. Nash, Prod. Mgr. & Chief Engr.; A. L. Weston, Pur. Dir.; J. M. Bradley, Pers. Dir.; E. D. Bement, Adv. Mgr.

**THE B G CORP.**, 136 W. 52nd St., New York 19, N. Y.

**PERSONNEL:** R. Goldsmith, Pres.

**B. H. AIRCRAFT CO., INC.**, 27-01 Bridge Plaza N., Long Island City 1, N. Y.

**PERSONNEL:** S. J. Baum, Pres.; E. Huck, V. Pres.; D. F. Baum, V. Pres. & Secy.; E. F. Devoy, Treas.; G. A. Schwobel, Prod. Mgr.

**B-W SUPERCHARGERS, INC.**, 3420 W. Capitol Dr., Milwaukee 9, Wisc.

**PERSONNEL:** R. J. Minshall, Pres.; D. M. Schuyler, Secy.; K. A. Freck, Treas.; J. P. Stewart, Asst. Gen. Mgr.; P. W. Brannon, Prod. Mgr.; D. A. Sutherland, Sales Mgr.; T. Adams, Pur. Dir.

**BAKER & CO., INC.**,

113 Astor St., Newark 5, N. J.

**PERSONNEL:** C. Engelhard, Pres., Treas. & Gen. Mgr.; A. M. Williams, V. Pres.; D. P. Fitzgerald, Pur. Dir.; W. A. Burnette, Adv. Mgr.

**BAKER INDUSTRIAL TRUCK DIV., THE BAKER-RAULANG CO.**, 2168 W. 25th St., Cleveland 13, O.

**PERSONNEL:** E. J. Bartlett, Pres.; E. J. Stahl, V. Pres.; J. W. Moran, Secy. & Treas.; D. L. Darnell, Sales Mgr.; E. W. Sankey, Pur. Dir.; F. Parsons, Pers. Dir.; M. W. McMillan, Pub. Dir. & Adv. Mgr.; B. F. Stoner, Chief Engr.

**BAKER STEEL & TUBE CO.**, P. O. Box 2096 Terminal Annex, Los Angeles 54, Calif.

**PERSONNEL:** R. Mulholland, Pres.; M. J. Baker, V. Pres.; W. F. Fahs, Secy. & Treas.; J. P. Boore, Gen. Mgr.; B. Ostlind, Chief Engr.

**BALLARD AIRCRAFT DIV. OF THE WALTER M. BALLARD CORP.**,

331 Madison Ave., New York 17, N. Y.

**PERSONNEL:** S. M. Revness, Pres.; J. F. Foster, V. Pres. & Gen. Mgr.; J. Baumann, Secy.; L. B. Bell, Treas.; D. B. Grossman, Prod. Mgr.; P. L. Bruce, Pur. Dir.; M. D. Rosenberg, Pers. Dir.; J. Landsberg, Pub. Dir.; D. P. Kurtz, Chief Engr.

**THE BARRETT DIV., ALLIED CHEMICAL & DYE CORP.**, 40 Rector St., New York 6, N. Y.

**PERSONNEL:** E. R. Snyder, Gen. Mgr.; L. F. Long, Prod. Mgr.; W. B. Alexander, Sales Mgr.; F. W. Warner, Pur. Dir.; J. W. Andrews, Pers. Dir.; A. G. Husen, Adv. Mgr.; M. P. Taylor, Chief Engr.

**BARTELT ENGINEERING CO.**,

1214 Partridge Ave., Beloit, Wisc.

**PERSONNEL:** M. Bartelt, Secy.; F. O. Bartelt, Gen. Mgr.; H. Bartelt, Chief Engr.

**REX BASSETT, INC.**, 500 S. E. Second St., Fort Lauderdale, Fla.

**PERSONNEL:** R. E. Bassett, Jr., Pres. Gen. Mgr. & Sales Mgr.; M. E. Bassett, V. Pres.; R. E. Bassett, Sr., Secy., Treas., Pur. Dir. & Pers. Dir.; G. A. Hemmel, Prod. Mgr.; A. Keil, Adv. Mgr.; W. I. Bohlen, Chief Engr.

**BASTIAN BROS. CO.**, 1600 N. Clinton Ave., Rochester 1, N. Y.

**PERSONNEL:** W. J. Wolf, Pres. & Gen. Mgr.; F. J. Brown, V. Pres. & Sales Mgr.; J. H. Mahoney, Secy.; F. J. Temmerman, Treas.; E. B. Bastian, Prod. Mgr.; L. W. Shanley, Pur. Dir.; M. F. Dummer, Pers. Dir.

**BAY STATE ABRASIVE PRODUCTS CO.**, 12 Union St., Westboro, Mass.

**PERSONNEL:** O. S. Buckner, Pres.; E. C. Hughes, Secy.; L. M. Krull, Treas.; D. B. Wilson, Gen. Mgr.; H. G. Clayton, Prod. Mgr.; A. G. Green, Sales Mgr.; G. Stockwell, Pur. Dir.; W. E. Moody, Pub. Dir.

**BEARIUM METALS CORP.**,

268 State St., Rochester 4, N. Y.

**PERSONNEL:** E. P. Langworthy, Pres.; G. P. Palma, V. Pres.

**BELDEN MANUFACTURING CO.**,

P. O. Box 5070A, Chicago 80, Ill.

**PERSONNEL:** W. Jacobs, Pres.; C. S. Craigmile, Exec. V. Pres.; H. W. Clough, V. Pres.; A. Beutler, Secy.; A. L. Wanner, Treas.; H. A. Neil, Ind. Sales Mgr.; B. Rogers, Adv. Mgr.; H. H. Wermine, Chief Engr.

**BELDING HEMINWAY CO.**,

119 W. 40th St., New York, N. Y.

**PERSONNEL:** J. P. T. Armstrong, Pres.; H. A. Johnston, A. A. Arnold, V. Pres.; F. L. Johnson, V. Pres. & Sales Mgr.; C. G. Heinrich, Secy. & Treas.; L. Seaver, Prod. Mgr.; H. Hancock, Adv. Mgr.; R. T. Kropf, Chief Engr.

**THE BELL CO., INC.**, 411 N. Wolcott Ave., Chicago 22, Ill.

**PERSONNEL:** J. M. Bell, Pres.; C. E. Allerdice, Jr., V. Pres. & Gen. Mgr.; C. J. Bell, Secy. & Treas.; J. D. Jacobs, Plant Supt.; H. E. Perrott, Pur. Dir.; J. H. Allerdice, Chief Engr.

**BELL & HOWELL CO.**,

7100 McCormick Rd., Chicago 45, Ill.

**PERSONNEL:** J. H. McNabb, Pres. & Treas.; J. H. Booth, V. Pres. & Sales Mgr.; C. V. Clark, Secy.; E. G. Mayer, Prod. Mgr.; C. E. Schreyer, Pur. Dir.; M. C. Keene, Pers. Dir.; M. H. Ostrom, Pub. Dir. & Adv. Mgr.; B. E. Stechbart, Chief Engr.

**BELMONT RADIO CORP.**,

5921 W. Dickens Ave., Chicago 39, Ill.

**PERSONNEL:** P. S. Billings, Pres.; H. C. Mattes, V. Pres. & Treas.; J. Robertson, Secy.; L. Boji, Prod. Mgr.; G. Neuhauser, Pur. Dir.; S. Freshman, Sales Mgr., Pub. Dir. & Adv. Mgr.; R. E. Schwertfeger, Pers. Dir.; W. L. Dunn, Chief Engr.

**BENCHMASTER MANUFACTURING CO.**,

2952 W. Pico Blvd., Los Angeles 6, Calif.

**PERSONNEL:** G. Florence, Pres.; P. S. Rosen, Gen. Mgr.

**BENDIX AVIATION CORP.**,

Fisher Bldg., Detroit 2, Mich.

30 Rockefeller Plaza, New York 20, N. Y.

**PERSONNEL:** E. R. Breech, Pres.; C. Marcus (N. Y.), V. Pres.-Engrg.; D. O. Thomas, V. Pres.-Mfg.; R. T. Hurley, A. E. Raabe (N. Y.), V. Pres.; H. A. Gossner, Secy.; W. H. Houghton, Treas.; C. Hummel, Compt.; A. A. Kucher, Dir. Research; H. L. Sharlock, Dir. Adv. & Pub. Rel.; M. A. Heidt, Dir. Ind. Rel.; L. A. Hyland, Exec. Engr.

# B-H

MANUFACTURERS  
OF SHEET METAL AND  
TUBULAR ACCESSORIES



- Cows
- Oars & Pumps
- Collector Rings
- Tubular Parts
- Manifolds
- Engine Mounts
- Aluminum Tanks
- Sheet Metal Fabrication
- Sheet Metal Stampings

CONTRACTORS TO ALL LEADING  
ENGINE AND PROPELLER MANUFACTURERS

**B. H. AIRCRAFT CO., Inc.**  
LONG ISLAND CITY 1, NEW YORK

**BENDIX PRODUCTS DIV., BENDIX AVIATION CORP.,** South Bend, Ind.

PERSONNEL: M. P. Ferguson, V. Pres.; G. E. Stoll, Asst. Gen. Mgr.; K. M. Wise, Dir. Engrg.; F. C. Mock, Aircraft Carburetor Mgr. Engrg. Sales; C. D. Manhart, Aircraft Carburetor Sales Mgr.; J. R. Cautley, Mgr. Aviation Undercarriage Sales; C. E. Budd, Pur. Agt.; F. C. Frank, Chief Engr., Airplane Wheel & Brake Div.; C. V. Johnson, Chief Engr., Aircraft Shock Struts Div.; G. W. Pontius, III, Chief Engr., Aircraft Armament & Hydraulic Div.

**BENDIX RADIO DIV., BENDIX AVIATION CORP.,** Baltimore 4, Md.

PERSONNEL: W. P. Hilliard, Gen. Mgr.; J. W. Hammond, Sales Mgr.; R. A. Anderson, Procurement Mgr.; E. K. Foster, Factory Mgr.; F. S. Gutekunst, Compt.; W. L. Webb, Chief Engr.

**BENRAY PRODUCTS CO.,** 10-65 Jackson Ave., Long Island City, N. Y.

PERSONNEL: B. C. Feman, Pres.

**THE BENWOOD-LINZE CO.,** 1811-19 Locust St., St. Louis 3, Mo.

PERSONNEL: H. J. Wrape, Pres.; C. E. Peters, V. Pres. & Chief Engr.; I. V. Veigel, Secy. & Treas.; J. C. Henning, Jr., Sales Mgr.; A. R. Keiffer, Jr., Pur. Agt.; V. P. Frey, Adv. Mgr.

**BERKEY & GAY FURNITURE CO.,** 900 Monroe Ave., N. W., Grand Rapids 2, Mich.

PERSONNEL: R. E. L. Graham, Pres.; M. J. Williams, V. Pres. & Prod. Dir.; A. W. Behnke, Asst. Secy.; M. T. Vanden Bosch, Treas.; C. P. Ulmer, Contract Mgr.; E. Hickman, Pur. Agt.; W. B. Baker, Pers. Dir.

**JACK BEST MFG. CO.,** 2128 S. Los Angeles St., Los Angeles 11, Calif.

PERSONNEL: G. J. Anderson, Gen. Mgr.

**BETHLEHEM STEEL CO.,** 701 E. Third St., Bethlehem, Pa.

PERSONNEL: E. G. Grace, Pres.; Q. Bent, V. Pres.; R. E. McMath, V. Pres. & Secy.; P. Mackall, V. Pres. & Sales Mgr.; C. R. Holton, V. Pres. & Pur. Dir.; J. P. Bender, Treas.; J. C. Long, Adv. Mgr.

**THE BILLINGS & SPENCER CO.,**

1 Laurel St., Hartford 6, Conn.

PERSONNEL: R. J. Ahern, Pres.; W. D. Endres, V. Pres.; H. E. Oberg, V. Pres. & Sales Mgr.-Contract Forgings; E. F. Cummings, Secy. & Treas.; R. W. Hoyt, Prod. Mgr.; K. B. Komp, Sales Mgr.-Field Tools; W. H. Blackburn, Pur. Dir.; B. F. Tolles, Pers. Dir.; R. H. Young, Pub. Dir. & Adv. Mgr.; M. N. Kincaid, Chief Engr.

**BLACK BEAR CO., INC.,** Aviation Div.,

620 Fifth Ave., New York 20, N. Y.

PERSONNEL: R. A. Schleicher, Pres. & Chief Engr.; F. Kacmer, Gen. Mgr.; S. Jamieson, Prod. Mgr.; S. R. Towles, Sales Mgr.; W. Richardson, Pur. Dir.; W. McCoy, Pers. Dir.; R. Miller, Pub. Dir.; M. O. Edwards, Adv. Mgr.

**THE BLACK & DECKER MFG. CO.,**

Towson 4, Md.

PERSONNEL: S. D. Black, Pres.; A. G. Decker, V. Pres. & Gen. Mgr.; R. D. Black, V. Pres. & Sales Mgr.; C. A. Sacra, Secy.; F. J. Nagell, Treas.; C. B. Mann, Pur. Dir.; H. J. Douglas, Pers. Dir.; J. F. Apsey, Jr., Adv. Mgr.; G. C. Wilhide, Chief Engr.

**BLACKMER PUMP CO.,**

Grand Rapids 9, Mich.

PERSONNEL: M. G. Klise, Pres.; H. C. Worfel, V. Pres.; J. Vande Bunte, Secy. & Treas.; F. T. Kennedy, Gen. Mgr.; D. N. Pangborn, Prod. Mgr.; J. B. Trotman, Sales Mgr., Pub. Dir. & Adv. Mgr.; V. Rhoades, Pur. Dir.; L. L. Rhoades, Pers. Dir.; E. W. Chapman, Chief Engr.

**BLANCHARD BROS. & LANE,**

408 Frelinghuysen Ave., Newark, N. J.

PERSONNEL: S. B. Gay, Pres.; K. W. Koeniger, V. Pres. & Prod. Mgr.; H. G. Crawford, Secy. & Treas.; N. C. Foss, Sales Mgr.

**BODINE ELECTRIC CO.,**

2254 W. Ohio St., Chicago 12, Ill.

PERSONNEL: C. D. Bodine, Pres.; E. W. Larson, V. Pres., Gen. Mgr. & Prod. Mgr.; P. J. Bodine, Secy. & Treas.; W. M. Yogerst, Sales Mgr.; W. Stern, Pers. Dir.

**THE W. W. BOES CO.,**

3001 Salem Ave., Dayton 1, O.

PERSONNEL: W. W. Boes, Pres.; W. E. Harbottle, Gen. Mgr.

**BOGUE ELECTRIC CO.,**

37 Kentucky Ave., Paterson, N. J.

PERSONNEL: E. P. Schinman, Pres.

**BOICE-CRANE CO.,**

930 W. Central Ave., Toledo 6, O.

PERSONNEL: J. E. Boice, Gen. Mgr.; W. B. Boice, Prod. Mgr.; M. H. Buehrer, Sales Mgr. & Adv. Mgr.; J. H. Luken, Pur. Dir.

**BOLTON MANUFACTURING CORP.,**

692 Campbell Ave., W. Haven 16, Conn.

PERSONNEL: W. H. Carney, Pres.; K. A. Kinsman, V. Pres. & Sales Mgr.; H. S. Elder, Secy. & Treas.; C. A. Brown, Gen. Mgr.; W. H. Riehl, Pur. Dir.; R. H. Howland, Pers. Dir.; O. S. Gill, Chief Engr.

**BONNEY FORGE & TOOL WORKS,**

Allentown, Pa.

PERSONNEL: F. S. Durham, Pres. & Gen. Mgr.; J. E. Durham, Jr., V. Pres.; A. J. Male, Secy., Treas. & Sales Mgr.; W. F. Herbst, Jr., Pur. Dir.; S. R. Robinson, Adv. Mgr.; L. J. MacGregor, Chief Engr.

**THE BOOTH FELT CO.,**

463 19th St., Brooklyn, N. Y.

PERSONNEL: E. W. Booth, Pres.; R. S. Stevens, Sales Mgr.

**BOOTH MANUFACTURING CORP.,**

3333 N. San Fernando Rd., Burbank, Calif.

PERSONNEL: N. M. Booth, Pres. & Gen. Mgr.; H. M. Roberts, V. Pres.; A. W. Booth, Secy.; W. A. Fort, Treas.; R. B. Campbell, Chief Engr.

**THE BOSTON AUTO GAGE CO.,**

70 West St., Pittsfield, Mass.

PERSONNEL: T. C. Nelson, Pres., Secy. & Sales Mgr.; H. Mackelvie, V. Pres.; H. J. Martin, Treas.; L. H. Foote, Prod. Mgr.; C. H. Hines, Pur. Dir.; J. H. Mattoon, Chief Engr.

**BOSTON INSULATED WIRE & CABLE CO.,**

75 Bay St., Dorchester, Mass.

PERSONNEL: H. B. Burley, Pres. & Treas.; J. C. Burley, V. Pres., Sales Mgr. & Chief Engr.; M. G. Fitzgerald, Secy.; H. B. Burley, Jr., Prod. Mgr.

**BOTANY WORSTED MILLS,**

Passaic, N. J.

PERSONNEL: C. F. H. Johnson, Pres.; C. F. H. Johnson, Jr., V. Pres.; A. de Liagre, Secy.; O. E. Kuhn, Treas.; R. S. Bartlett, Gen. Mgr.; W. Grose, Sales Mgr.; K. Rogers, Airplane Fabrics.

## Bendix Landing Gear Equipment Pneudraulic Shock Struts

Bendix Pneudraulic Shock Struts are continually being advanced in design to meet ever increasing landing impacts resulting from added plane weights and higher speeds.

The fact that Bendix has successfully met this challenge of increased performance standards is proved by the more than 200,000 shock struts *designed and built* by Bendix and the thousands of Bendix designed struts supplied the industry by other manufacturers.

To meet the industry's requirements shock struts cover a wide range of sizes and weights ranging from less than five pounds to over 900 pounds.



## Wheels and Brakes



Bendix Wheels and Brakes are designed with ample reserves of strength and exclusive features assuring fast smooth operation.

The new Bendix disc brake for example is recognized as a basic advancement in aircraft brakes. Maximum braking effectiveness is achieved through low hydraulic displacement and greater heat absorbing capacity—and at the same time the weight of brake and wheel assembly is considerably reduced.

BENDIX IS A TRADE-MARK OF BENDIX AVIATION CORPORATION

# Bendix

**PRODUCTS DIVISION**  
Bendix Aviation Corporation, South Bend 20, Ind.

*Landing Gears • Pneudraulic Shock Struts • Airplane Wheels • Brakes • Hydraulic Master Cylinders and Power Brake Valves*

**THE BOWLING GREEN RUBBER CO.,**

1222 Prospect Ave., Toledo 6, O.

PERSONNEL: S. Roberts, Pres.; R. Roberts, V. Pres. &amp; Prod. Mgr.; I. F. Zarobsky, Chief Engr.

**BOWSER, INC.,** 1302 E. Creighton Ave., Fort Wayne 2, Ind.

PERSONNEL: R. H. Damon, Pres.; E. D. Eggmann, V. Pres.; R. E. Middleton, V. Pres.-Production; C. P. Griffith, V. Pres.-Engr.; J. P. Bartels, Secy.; J. P. Orchard, Treas.; I. W. Baldwin, Mgr. Aviation Div.; F. S. Ehrman, Sales Mgr.; E. A. Steinhauer, Pur. Dir.; P. G. Liebmann, Pers. Dir.; H. J. Slack, Pub. Dir. &amp; Adv. Mgr.

**THE BRADY CONVEYORS CORP.,**

20 W. Jackson Blvd., Chicago 4, Ill.

PERSONNEL: H. H. Weiss, Pres.; A. J. Weiss, Secy. &amp; Sales Mgr.

**WILLIAM BRAND & CO.,**

276 Fourth Ave., New York 10, N. Y.

PERSONNEL: W. Brand, W. Naumburg, Partners.

**BRAND TOOL & SUPPLY CO.,**

500 W. Washington Blvd., Los Angeles 15, Calif.

PERSONNEL: J. Brand, Pres.

**BREEZE CORPORATIONS, INC.,**

24 S. Sixth St., Newark 7, N. J.

PERSONNEL: J. T. Mascuch, Pres.; J. F. Lucas, V. Pres.; F. G. Shupp, Treas.; G. Braumueller, Pur. Dir.; J. F. Keating, Pers. Dir.; K. G. Strunk, Chief Engr.

**THE BRIDGEPORT HARDWARE MFG. CORP.,** 461 Iranistan Ave., Bridgeport 5, Conn.

PERSONNEL: H. B. Curtis, Pres.; J. F. Windsor, Treas.

**THE BROWN INSTRUMENT CO.,**

Wayne &amp; Roberts Ave., Philadelphia 44, Pa.

PERSONNEL: C. B. Sweatt, Pres.; E. B. Evlieth, V. Pres. &amp; Gen. Mgr.; J. P. Goheen, Secy. &amp; Treas.; P. L. Goldstroom, Prod. Mgr.; L. M. Morley, Sales Mgr.; J. Weingartner, Pur. Dir.; H. Reisgen, Pers. Dir.; K. R. Knoblauch, Pub. Dir.; J. Sullivan, Adv. Mgr.; G. M. Muschamp, Chief Engr.

**BROWN LATHE & TOOL CO.,**

30 N. LaSalle St., Chicago 2, Ill.

PERSONNEL: L. R. Reis, Pres. &amp; Gen. Mgr.

**BROWN & SHARPE MFG. CO.,**

235 Promenade St., Providence 1, R. I.

PERSONNEL: H. D. Sharpe, Pres. &amp; Treas.; A. K. Brown, R. Viall, V. Pres.; J. A. Newton, Secy.; A. H. Bainton, Works Mgr.; C. W. Machon, Sales Mgr.; J. J. Hall, Pers. Dir.; J. P. Burdick, Adv. Mgr.; E. W. Freeman, Plant Engr.

**BRUNNER MANUFACTURING CO.,**

1821 Broad St., Utica 1, N. Y.

PERSONNEL: G. L. Brunner, Pres. &amp; Gen. Mgr.; G. L. Brunner, Jr., V. Pres. &amp; Secy.; A. G. Zumbun, Treas.; P. A. Lovegren, Prod. Mgr.; E. J. Scholl, Sales Mgr.; E. H. Schiller, Pur. Dir.; O. R. McDonald, Adv. Mgr.; S. R. Hirsch, Chief Engr.

**BRYANT CHUCKING GRINDER CO.,**

Springfield, Vt.

PERSONNEL: R. E. Flanders, Pres.; W. J. Bryant, Exec. V. Pres. &amp; Treas.; J. B. Johnson, Gen. Mgr. &amp; Sales Mgr.; J. L. Hronek, Factory Mgr.; E. R. Olney, Pur. Dir.; E. S. Dana, Employment Mgr.; J. K. Aiken, Adv. Dept.; M. H. Arms, Chief Engr.

**THE C. G. BUCHANAN CHEMICAL CO.,**

4640-60 Baker, Cincinnati 12, O.

PERSONNEL: C. G. Buchanan, Pres. &amp; Gen. Mgr.; G. R. Buchanan, V. Pres. &amp; Secy.; F. M. LaBeateaux, Prod. Mgr.; J. Netter, Sales Mgr.; H. N. Burns, Pur. Dir.; R. R. Buchanan, Chief Engr.

**BUCKEYE TOOLS CORP.,**

29 W. Apple St., Dayton 1, O.

PERSONNEL: M. J. McCombs, Pres. &amp; Gen. Mgr.; H. O. Gummere, Secy. &amp; Sales Mgr.; A. G. Lauzon, Treas.; E. E. Reeves, Pur. Dir.; S. J. Wood, Pers. Dir.; E. B. Hamilton, Chief Engr.

**BUHL MANUFACTURING CO.,**

2730 Scotten Ave., Detroit 10, Mich.

PERSONNEL: H. S. Finkenstaedt, Pres.; H. E. Ryan, V. Pres. &amp; Treas.; E. F. Rickelman, V. Pres., Sales Mgr., Pub. Dir. &amp; Adv. Mgr.; P. Fenz, Secy.; W. A. Burns, Factory Mgr.; A. Gies, Pur. Dir.; A. Spiriti, Pers. Dir.; C. D. LaFond, Chief Engr.

**BURD PISTON RING CO.,**

2401 10th St., Rockford, Ill.

PERSONNEL: P. M. White, Pres.; A. H. Bates, V. Pres.; M. E. Wahlstrom, Secy. &amp; Treas.; W. W. Beckett, Prod. Mgr.; E. F. Eiseman, Sales Mgr., Replacement Div.; G. H. Gruber, Sales Mgr., Original Equipment Div.; F. J. Erickson, Pur. Dir.; G. G. Stringer, Pers. Dir.; C. L. Haseman, Chief Engr.

**BURDETT MANUFACTURING CO.,**

19 N. Loomis St., Chicago 7, Ill.

PERSONNEL: J. H. Burdett, Pres.; E. B. McCormick, V. Pres.; J. E. Veihl, Secy., Treas. &amp; Gen. Mgr.; H. P. Egan, Prod. Mgr.; F. H. Olreich, Sales Mgr. &amp; Adv. Mgr.; W. H. Teemer, Chief Engr.

**BURGESS BATTERY CO.,** Freeport, Ill.

PERSONNEL: D. W. Hirtle, Pres.; A. M. Dobbs, V. Pres.; O. W. Storey, Secy.; D. J. Teare, Treas.; L. J. Lockwood, Gen. Supt.; J. A. McIlhenny, Sales Mgr.; C. A. Butcher, Pur. Dir.; W. C. Morse, Pers. Dir.; C. E. Balz, Adv. Mgr.; J. J. Coleman, Chief Engr.

**BURGESS-NORTON MFG. CO.,** Geneva, Ill.

PERSONNEL: C. M. Burgess, Pres. &amp; Treas.; F. E. Burgess, V. Pres.; C. F. Wohlhuter, Secy.; R. A. Anderson, Prod. Mgr.; C. B. Johnson, Sales Mgr.; G. W. Jansen, Pur. Dir.; G. M. Waller, Chief Engr.

**THE BURKE MACHINE TOOL CO.,**

Conneaut, O.

PERSONNEL: H. Rockwell, Pres., Treas. &amp; Gen. Mgr.; H. A. Gleason, Secy.

**BURKLYN CO.,** 3429 Glendale Blvd., Los Angeles, Calif.

PERSONNEL: T. Lynn, Owner; C. Caughron, Sales Mgr.; S. A. Martin, Pur. Dir.

**BURNDY ENGINEERING CO. INC.,**

107 Bruckner Blvd., New York 54, N. Y.

PERSONNEL: P. Fried, Pres.; B. Dibner, V. Pres.; M. Lee, Gen. Mgr.; F. E. L. Whitesell, Sales Mgr.; J. Rogoff, Chief Engr.

**BURTON-ROGERS CO.,**

857 Boylston St., Boston 16, Mass.

PERSONNEL: C. W. Burton, Pres., Treas. &amp; Sales Mgr.; E. L. Chase, V. Pres.; V. S. Church, Secy. &amp; Chief Engr.

**BUSSMANN MFG. CO.,** University at Jefferson, St. Louis 7, Mo.

PERSONNEL: A. B. Bussmann, Pres.; H. T. Bussmann, V. Pres. &amp; Chief Engr.; J. A. Bussmann, Secy. &amp; Treas.; L. J. Bussmann, Pur. Dir.; H. von P. Thomas, Adv. Mgr.



## **DEPENDABLE** Radio Ignition Shielding

Breeze Radio Ignition Shielding is now giving dependable service on America's fighting aircraft the world over, under the grueling conditions of wartime operation. Designed for use on hundreds of different types of engines, this shielding has been developed and perfected by Breeze over a period of many years. Such a background in the field has given Breeze

the "know-how" to design and manufacture Radio Ignition Shielding to meet any requirement. And in the world of tomorrow, Breeze experience in the engineering and production of Shielding Assemblies will be of great value in the continuing development of electronic and communications equipment for industry, transport, and the home.

**Breeze**



**CORPORATIONS, INC.** Newark, N. J.

PRODUCTION FOR VICTORY • PRODUCTS FOR PEACE



**BUTLER MANUFACTURING CO.,**  
13th & Eastern Ave., Kansas City, Mo.  
PERSONNEL: E. E. Norquist, Pres.; C. C. Crouch, V. Pres., Pub. Dir. & Adv. Mgr.; F. A. Ruff, Secy., Pur. Dir. & Pers. Dir.; O. D. Nelson, Treas. & Gen. Mgr.; C. G. Johnson, Prod. Mgr.; G. C. Speakman, Sales Mgr.; W. L. Smith, Chief Engr.

**BYRNE DOORS, INC.,**  
1150 Griswold St., Detroit 2, Mich.  
PERSONNEL: J. I. Byrne, Pres.; G. M. Bolton, V. Pres. & Gen. Mgr.; R. Ballantyne, V. Pres. & Treas.; B. C. Walsh, Secy.; D. H. Bracken, Prod. Mgr.; T. R. Wareham, Sales Mgr.; W. B. Lyons, Pur. Dir.; L. F. Zisler, Pub. Dir. & Adv. Mgr.; N. E. Colburn, Chief Engr.

## C

**C-O TWO FIRE EQUIPMENT CO.,**  
U.S. Highway #1, Newark 1, N. J.  
PERSONNEL: S. E. Allen, Pres.; M. A. Laswell, V. Pres. & Sales Mgr.; E. J. Waring, V. Pres.; R. F. Batch, Secy. & Pers. Dir.; B. S. MacCabe, Treas.; E. D. Wolf, Pur. Dir.; T. O. Young, Adv. Mgr.; F. B. Allen, Chief Engr.

**C-THRU RULER CO.,**  
385 Capitol Ave., Hartford, Conn.  
PERSONNEL: J. R. Zachs, Pres. & Treas.; E. Zachs, V. Pres.; A. H. Zachs, Secy.

**CALIFORNIA FLYERS, INC.,** Los Angeles  
Airport, Los Angeles 43, Calif.

**CAMBRIDGE INSTRUMENT CO., INC.,**  
3732 Grand Central Terminal, New York 17, N. Y.  
PERSONNEL: R. H. Kruse, Pres. & Gen. Mgr.; H. N. Packard, V. Pres. & Treas.; W. H. Jefferson, Secy. & Sales Mgr.; A. A. Clokey, Prod. Mgr.; L. Birdsall, Pur. Dir.; J. O. Hutton, Chief Engr.

**CAMLOC FASTENER CORP.,** 420 Lexington Ave., New York 17, N. Y.  
5410 Wilshire Blvd., Los Angeles 36, Calif.

PERSONNEL: J. M. Summers, Pres.; R. S. Wolff, Prod. Mgr.; A. F. Korman, Pur. Dir.; R. W. Allen, Adv. Mgr.; S. W. Hennessey, Jr., Chief Engr.

**CANNON ELECTRIC DEVELOPMENT CO.,**  
3209 Humboldt St., Los Angeles 31, Calif.

PERSONNEL: J. H. Cannon, Pres.; R. J. Cannon, V. Pres. & Gen. Mgr.; G. Taylor, Secy.; R. Rowan, Prod. Mgr.; W. V. Brainard, Sales Mgr.; E. Bixler, Pur. Dir.; A. Wilcox, Pers. Dir.; F. Hobart, Pub. Dir.; L. E. Baird, Catalogue Dir.; E. J. Neifing, Chief Engr.

**EUGENE CANTIN CO., INC.,**  
101 Park Ave., New York 17, N. Y.  
PERSONNEL: E. J. Cantin, Pres. & Gen. Mgr.; V. C. Shadgen, V. Pres. & Treas.

**CAPAC MANUFACTURING CO.,**  
Capac, Mich.  
PERSONNEL: T. J. Arbron, Pres.; R. W. Sinclair, V. Pres., Treas. & Sales Mgr.; J. K. Worley, Secy.; S. J. Ceranski, Asst. Gen. Mgr. & Pers. Dir.; B. Jackson, Prod. Mgr.; F. A. Hooper, Pur. Dir.; J. R. Wood, Chief Engr.

**CARNEY ENGINEERING CO.,**  
1819 Broadway, New York 23, N. Y.  
738 Empire Bldg., Syracuse, N. Y.  
PERSONNEL: H. C. Carney, Prop. & Gen. Mgr.; H. Stansfield, Asst. Gen. Mgr.; H. F. Wehrle, Prod. Mgr.; C. E. Dannheimer, Pers. Dir.; W. E. Beckjord, Chief Engr.

**CARTER MOTOR CO.,**  
1608 Milwaukee Ave., Chicago 47, Ill.

**CASEIN CO. OF AMERICA,**  
350 Madison Ave., New York 17, N. Y.  
PERSONNEL: W. F. Leicester, Pres.; B. B. Wadsworth, Sales Mgr.; A. M. Freeman, Adv. Mgr.

**THE CENTERLESS GRINDING CO., INC.,**  
19 Staples St., Bridgeport 1, Conn.  
PERSONNEL: W. Horberg, Pres. & Gen. Mgr.

**CENTRAL SCREW CO.,**  
3501 Shields Ave., Chicago 9, Ill.  
PERSONNEL: H. F. Kellogg, Pres. & Treas.; D. S. Jennings, V. Pres. & Secy.; G. Augustson, Prod. Mgr.; E. Payne, Sales Mgr.; W. Roche, Chief Engr.

**CESSNA AIRCRAFT CO.,** Wichita, Kans.  
PERSONNEL: D. L. Wallace, Pres. & Gen. Mgr.; D. S. Wallace, Exec. V. Pres. & Treas.; F. A. Boettger, Secy. & Controller; D. Flower, Sales Mgr.; T. Salter, Chief Engr.; D. Roskam, Prod. Mgr.; A. Sheldon, Factory Supt.; S. Graves, Chief Inspector; P. Elder, Pers. Dir.; A. E. Kansas, Service Mgr.; J. Rix, Plant Mfg. Engr.; W. S. Strobel, Plant Maintenance Engr.; C. P. Weisner, Pur. Dir.  
Hutchinson, Kans.

PERSONNEL: C. R. Larkin, Factory Mgr.; W. W. Moore, Prod. Mgr.; E. E. Rippey, Chief Inspector; J. B. Lindner, Factory Supt. L. O. Smith, Gen. Acct.; H. B. Houser, Pers. Dir.

**CHAMPION PNEUMATIC MACHINERY CO.,** 8166 S. Chicago Ave., Chicago 17, Ill.

PERSONNEL: G. T. Rayfield, Pres., Gen. Mgr. & Pur. Dir.; F. J. Rayfield, V. Pres., Treas. & Chief Engr.; C. H. Lee, Secy., Sales Mgr. & Adv. Mgr.

**CHAMPION SPARK PLUG CO.,**  
Upton Ave., Toledo 1, O.  
PERSONNEL: R. A. Stranahan, Pres.; D. Stranahan, V. Pres.; H. B. Speyer, Secy.; F. D. Stranahan, Treas.; B. H. Sibley, Gen. Mgr. & Prod. Mgr.; R. H. Rowland, Sales Mgr.; J. F. Lewis, Pur. Dir.; J. H. Beatty, Pers. Dir.; M. C. Dewitt, Pub. Dir. & Adv. Mgr.; H. H. Vogel, Chief Engr.

**CHANDLER-EVANS CORP.,** Evansville & Baker Aves., S. Meriden, Conn.  
PERSONNEL: C. W. Deeds, Pres.; B. H. Gilpin, V. Pres., Treas. & Gen. Mgr.; M. E. Chandler, V. Pres. & Chief Engr.; R. M. Swenson, Secy.; J. A. St. George, Prod. Mgr.; F. C. Gustafson, Sales Mgr.; E. F. Wiegand, Pur. Dir.; G. McDonough, Pers. Dir.

**CHARLES MANUFACTURING CO.,**  
1115 E. Hennepin Ave., Minneapolis, Minn.

PERSONNEL: S. Bronstien, Jr., Pres.; C. W. Bronstien, V. Pres. & Sales Mgr.; L. D. Horwitz, Secy.; E. Bronstien, Treas.; L. S. Sinykin, Gen. Mgr. & Pur. Dir.

**CHEMACO CORP.,** Berkeley Heights, N. J.  
PERSONNEL: H. W. Harding, Pres. & Treas.; W. J. A. Connor, V. Pres., Sales Mgr. & Adv. Mgr.; C. Burke, Secy.; K. M. Joehnick, Prod. Mgr. & Pur. Dir.

**CHICAGO AERIAL SURVEY CO.,**  
332 S. Michigan Ave., Chicago 4, Ill.  
PERSONNEL: E. W. Fuller, Pres.; F. T. Sonne, V. Pres.; J. L. Patzold, Pur. Dir.

for **AMERICA'S** *greatest* **WARPLANES**



**CECO** — carburetors  
 — fuel pumps  
 — protek-plugs



**CHANDLER-EVANS CORPORATION**  
**SOUTH MERIDEN • CONNECTICUT • U. S. A.**

*Makers of*

**Aerial Photographs and Maps of Superior Quality**  
 Since 1924

*Manufacturers of*

**SONNE Shutterless, Continuous Strip Aerial Cameras**  
 Black and White                      Color                      Stereoscopic

Especially adapted to rapid, large scale surveys of  
 Highways, Rivers, Railroads, Rights of Ways, etc.

**SONNE Automatic Continuous Photo Printer**

For rapid and accurate printing of commercial and  
 aerial negatives.

— Available After The War —

**CHICAGO AERIAL SURVEY COMPANY**

332 SOUTH MICHIGAN AVENUE, 4, CHICAGO

*Contractor to U. S. Army and Navy Air Forces*

**CHICAGO RIVET & MACHINE CO.,**

9600 W. Jackson Blvd., Bellwood, Ill.  
**PERSONNEL:** J. A. Morrissey, Pres. & Gen. Mgr.; H. J. Tonn, V. Pres.; E. J. Morrissey, Secy. & Sales Mgr.; E. P. O'Malley, Treas. & Prod. Mgr.; W. Bautz, Pur. Dir.; M. Pierce, Pers. Dir.; R. C. Hudson, Adv. Mgr.; W. Shineflug, Chief Engr.

**CHICAGO WHEEL & MANUFACTURING CO.,**

1101 W. Monroe St., Chicago 7, Ill.

**CHIKSAN TOOL CO.,**

330 N. Pomona Ave., Brea, Calif.  
**PERSONNEL:** W. E. Spear, Pres. & Gen. Mgr.; L. J. Laird, V. Pres., Sales Mgr. & Adv. Mgr.; F. Burrill, Secy. & Treas.; F. Ferguson, Prod. Mgr.; E. R. Vance, Pur. Dir.; M. A. Neely, Pers. Dir.; D. C. Warren, Chief Engr.

**CHRYSLER CORP., AMPLEX DIV.,**

6501 Harper Ave., Detroit, Mich.  
**PERSONNEL:** A. J. Langhammer, Pres.; L. Toulouse, Prod. Mgr.; R. H. Khuen, Sales Mgr.

**THE CINCINNATI LATHE & TOOL CO.,**

3207-11 Disney Ave., Cincinnati 9, O.  
**PERSONNEL:** W. C. Heindel, Pres.; M. E. Rogers, Secy.; D. Knies, Prod. Mgr.

**CIRCO PRODUCTS CO.,**

Cleveland 14, O.  
**PERSONNEL:** J. F. Black, Pres.; J. J. Skelly, V. Pres.; E. L. Feneshan, Treas.; W. Smith, Pur. Dir.; T. N. Thompson, Adv. Mgr.

**THE E. D. CLAPP MFG. CO.,**

Auburn, N. Y.  
**PERSONNEL:** E. D. Clapp, Pres., Pub. Dir. & Adv. Mgr.; H. W. Clapp, V. Pres.; W. R. Steele, Secy., Gen. Mgr. & Prod. Mgr.; J. D. Hutchinson, Treas. & Sales Mgr.; G. Vatter, Pur. Dir. & Pers. Dir.; G. Diehl, Chief Engr.

**C. P. CLARE & CO.,**

4719 Sunnyside Ave., Chicago, Ill.  
**PERSONNEL:** C. P. Clare, Pres.; J. E. Mossman, V. Pres.; J. I. McTaggart, Secy.

**CLAYBORNE MANUFACTURING CO.,**

4545 W. Lake St., Chicago 24, Ill.  
**PERSONNEL:** N. F. Clayborne, Owner.

**THE CLEVELAND AUTOMATIC MACHINE CO.,**

2269 Ashland Rd., Cleveland 3, O.  
**PERSONNEL:** H. R. LeBlond, Pres.; E. G. Schultz, V. Pres. & Treas.; J. Maezer, Prod. Mgr.; J. Prochaska, Gen. Sales Mgr.; H. E. Lemmerman, Pur. Dir.; R. Shrider, Pers. Dir.; A. F. Jelinek, Chief Engr.

**THE CLEVELAND GRAPHITE BRONZE CO.,**

1700 St. Clair Ave., Cleveland 10, O.

**PERSONNEL:** B. F. Hopkins, Pres.; J. L. Myers, Exec. V. Pres.; J. V. O. Palm, V. Pres.-Engrg.; G. O. Smith, Secy.; D. R. Schoales, Treas.; L. W. Christenson, Sales Mgr.; A. G. Mould, Pur. Dir.; H. E. Fuller, Pers. Dir.; E. D. Howard, Pub. Dir. & Adv. Mgr.

**THE CLEVELAND PNEUMATIC TOOL CO.,**

3781 E. 77th St., Cleveland 5, O.  
**PERSONNEL:** G. P. Torrence, Pres.; H. W. Foster, V. Pres.; F. B. Greve, V. Pres.-Adv.; J. S. Clark, Financial V. Pres. & Treas.; H. B. Collins, Secy.; E. J. Steger, Gen. Mgr. & Mgr. Appliances Div.; R. R. Morgan, Gen. Mgr., Rock Drill Div.; E. W. Krueger, Gen. Mgr., Aircraft & Automotive Div.; H. A. Lantz, Mgr., Automotive Sales; A. S. Telkins, Prod. Mgr.; W. C. Wehnes, Pur. Dir.; M. O. Halliwell, Pers. Dir.; J. E. Dillon, Pub. Dir.; E. L. Oldham, Adv. Mgr.; J. F. Wallace, Chief Engr., Aircraft & Automotive; L. L. Richardson, Chief Engr., Pneumatic Tools & Rock Drills.

**THE CLEVELAND TOOL ENGINEERING CO.,**

1255 W. Fourth St., Cleveland 13, O.

**PERSONNEL:** C. E. Walling, Owner.

**CLIFFORD MANUFACTURING CO.,**

564 E. First St., Boston, Mass.  
**PERSONNEL:** W. B. Clifford, Pres.; J. E. Woods, V. Pres.; F. J. Howe, Asst. Treas. & Compt.; J. J. McMahon, Gen. Supt.; E. F. Wilcox, Pur. Dir.; J. H. Howard, Chief Engr.

**COLONIAL BROACH CO.,**

Box 37, Harper Station, Detroit 13, Mich.  
**PERSONNEL:** C. J. Halborg, Pres.; A. Lundell, V. Pres.; G. McCracken, Prod. Mgr.; R. G. Lagerfeldt, Sales Mgr.; R. Hesser, Pur. Dir.; A. F. Denham, Adv. Mgr.; H. Gotberg, Chief Engr.

**COLUMBIA AIRCRAFT CORP.,**

Valley Stream, N. Y.  
**PERSONNEL:** J. W. Kenny, Pres. & Gen. Mgr.; L. D. Warrender, V. Pres.; J. T. King, Secy. & Treas.; P. S. Hubbard, Mfg. Dir.; D. J. Ryan, Pur. Dir.; P. J. Hickey, Pers. Dir.; J. Frogge, Pub. Dir.; G. D. Evans, Chief Engr.

**COLUMBIA AIRCRAFT PRODUCTS INC.,**

Haynes St., Somerville, N. J.  
**PERSONNEL:** A. W. Brooksbank, Sr., Pres. & Gen. Mgr.; E. H. Godfrey, V. Pres.; E. Alexander, V. Pres., Secy., Treas. & Pub. Dir.; J. Macko, Sales Mgr.; C. Rader, Pur. Agt.; W. E. Van Fleet, Pers. Dir.; F. W. Clewell, Chief Engr.

**COLUMBIAN STEEL TANK CO.,**

1509 W. 12th St., Kansas City 7, Mo.  
**PERSONNEL:** A. A. Kramer, Pres.; J. M. Kramer, Gen. Mgr.; E. L. Biersmith, Prod. Mgr.; W. M. Gadberrry, Sales Mgr.; J. M. Culver, Pur. Dir.; J. Lindquist, Pers. Dir.; R. S. Robinson, Pub. Dir. & Adv. Mgr.; H. Mullin, Chief Engr.

**COLUMBUS PLASTIC PRODUCTS, INC.,**

519 Dublin Ave., Columbus 15, O.  
**PERSONNEL:** G. W. Keny, Pres. & Gen. Mgr.; W. J. Braley, Secy. & Treas.; B. W. Hively, Sales Mgr., Pub. Dir. & Adv. Mgr.; N. W. Roop, Chief Engr.

**COMMONWEALTH INDUSTRIES INC.,**

5922 Commonwealth Ave., Detroit 8, Mich.  
**PERSONNEL:** C. G. Heilman, Pres. & Gen. Mgr.; H. W. Stark, V. Pres.; M. Hulett, Secy. & Treas.; R. M. Neff, Prod. Mgr. & Chief Engr.; D. M. Flemming, Sales Mgr.; L. C. Oldenburg, Pur. Dir. & Pers. Dir.

**THE COMTOR CO.,**

87 Rumford Ave., Waltham 54, Mass.  
**PERSONNEL:** R. G. Morse, Pres. & Treas.; R. M. Morse, V. Pres., Secy. & Gen. Mgr.; F. S. Snow, Prod. Mgr.

**CONNECTICUT HARD RUBBER CO.,**

407 East St., New Haven, Conn.  
**PERSONNEL:** J. A. Moffitt, Pres. & Treas.; C. M. Doede, V. Pres. & Secy.; E. H. Clohessy, Prod. Mgr.; J. V. Pulleyyn, Sales Mgr.; H. Nicholas, Pur. Dir.; B. J. Humphrey, Chief Engr.

**CONSOLIDATED VULTEE AIRCRAFT CORP.,**

San Diego, Calif.  
**PERSONNEL:** H. Woodhead, Pres.; I. M. Laddon, Exec. V. Pres.; F. A. Callery, V. Pres.-Finance; C. T. Leigh, V. Pres.; W. M. Shanahan, Secy. & Treas.; F. A. Learman, Sales Mgr.; A. W. Larsen, Pur. Dir.; F. A. Laureman, Ind. Rel. Dir.; E. A. Hoose, Jr., Pub. Rel. Dir. & Adv. Mgr.



**HANDEE**  
*Tool of 100 Uses*

READY FOR INSTANT ACTION—a Whole Shopful of Tools at your fingertips. The Handee is a real pal, not only for regular run-of-maintenance work in mobile or field shop, but for emergency repairs away from base.



More than 300 accessories, all interchangeable, are available for use with the Handee to grind, drill, cut, polish, sharpen, sand or saw.

Balanced to fit the hand and small enough to reach hard-to-get-at places.



Weighs only 12 ounces. Speed 25,000 r.p.m. AC or DC current. With 7 Accessories, \$18.50 postpaid in U. S. A., to all who have priority.



**HANDEE REPAIR KIT**

Every plane should have one. Strong case contains Handee Tool with 45 useful accessories, \$25.00 postpaid in U. S. A., to all who have priority.



**CHICAGO MOUNTED WHEELS\***—Little wheels that are doing a great big job. Custom built in any shape and size up to 3" diameter—a right one for every material.

**HI-POWER GRINDER**—A perfectly balanced 3-pound tool for constant service. Enough power to drive a 2½" diameter wheel. Speed 17,000 r.p.m. In case with accessories \$38.50, to all who have priority.

*Send Today for Complete Catalog of Tools, Mounted and Grinding Wheels.*

**CHICAGO WHEEL & MFG. CO.**

1101 W. Monroe St., Dept. AB, Chicago, 7, Ill.



\* Half a Century of Specialization has established our Reputation as the Small Wheel People of the Industry.

**CONTINENTAL MACHINES, INC.,**  
1301 Washington Ave., S. Minneapolis 4,  
Minn.

PERSONNEL: R. J. Wilkie, Pres.; J. W. Wilkie, V. Pres.; L. W. Haling, Secy.; R. Grosser, Prod. Mgr.; L. Rothenberger, Sales Mgr.; W. Homlett, Pur. Dir.; C. H. Rosene, Pub. Dir.; J. A. Harrington, Chief Engr.

**CONTINENTAL SCREW CO.,** 459 Mt.  
Pleasant St., New Bedford, Mass.

PERSONNEL: P. Sweeney, Pres. & Gen. Mgr.; D. D. Davis, V. Pres., Sales Mgr. & Pub. Dir.; M. Sweeney, Secy.; C. H. Wardwell, Treas.; B. Siwik, Prod. Mgr.; M. Hunt, Pur. Dir.; W. Gallant, Pers. Dir.; H. Phipard, Adv. Mgr.; F. Brown, Chief Engr.

**CONTINENTAL STEEL CORP.,**  
Kokomo, Ind.

PERSONNEL: D. A. Williams, Pres.; W. G. Harter, Secy.; U. K. Becker, Treas.; R. K. Clifford, Gen. Mgr.; J. L. Schueler, Prod. Mgr.; E. P. Severns, Sales Mgr.; G. L. Rathel, Pur. Dir.; R. A. Chaffin, Pers. Dir.; J. A. De Lo, Adv. Mgr.; L. E. Smith, Chief Engr.

**COPPERWELD STEEL CO.,** Warren, O.

PERSONNEL: S. E. Bramer, Pres.; S. D. Williams, V. Pres.; W. B. Klee, Jr., Asst. Secy.; M. H. Ronzone, Treas.; D. G. Baxter, Gen. Supt.; R. E. Wolf, Prod. Mgr.; R. S. Clingan, Sales Mgr. & Adv. Mgr.; D. R. Wilson, Pur. Dir.; F. H. Hodd, Pers. Dir.; D. B. Gallagher, Chief Engr.

**P. & F. CORBIN DIV., AMERICAN HARD-  
WARE CORP.,** New Britain, Conn.

PERSONNEL: C. B. Parsons, First V. Pres. & Gen. Mgr.; S. P. Morgen, Prod. Mgr.; W. F. Middlemass, Asst. Sales Mgr.; J. C. Andrews, Pur. Dir.; C. Mortenson, Pers. Dir.; E. L. Teich, Products Engr.

**THE CORBIN SCREW CORP.,** High, Myrtle  
& Grove Sts., New Britain, Conn.

PERSONNEL: G. T. Kimball, Pres.; J. B. Baldwin, V. Pres. & Gen. Mgr.; G. Hildebrandt, Secy.; W. J. Bunce, Treas.; E. C. Paddock, Sales Mgr.

**CORRY-JAMESTOWN MFG. CORP.,**  
32-40 N. First Ave., Corry, Pa.

PERSONNEL: D. A. Hillstrom, Pres. & Gen. Mgr.; R. C. Anderson, V. Pres.; D. Armour Hillstrom, Secy.; H. H. Keppel, Treas.; A. E. Rehnborg, Prod. Mgr.; R. E. Larson, Sales Mgr.; W. W. Windahl, Pur. Dir.; A. Lynch, Pers. Dir.; W. B. Ellsworth, Adv. Mgr.; M. N. Nelson, Chief Engr.

**S. H. COUCH CO., INC.,**  
North Quincy, Mass.

PERSONNEL: S. H. Couch, Pres.; J. E. Atkinson, V. Pres., Sales Mgr. & Adv. Mgr.; A. T. Morrison, V. Pres., Prod. Mgr. & Pur. Dir.; D. F. Cameron, Treas.; C. Johnson, Chief Engr.

**COWLES TOOL CO.,**  
2086 W. 110th St., Cleveland 2, O.

PERSONNEL: E. A. Cowles, Pres., Treas. & Gen. Mgr.; C. W. Sollenberger, V. Pres. & Secy.; W. MacPherson, Prod. Mgr.

**COX & STEVENS AIRCRAFT CORP.,**  
P. O. Box 30, Mineola, N. Y.

PERSONNEL: B. Sweeney, Pres.; A. L. Thurston, V. Pres. & Chief Engr.; W. A. Roseborough, V. Pres.; H. E. Ackerly, Secy.; R. D. Huntington, Treas.; K. C. Barse, Pur. Dir.; S. B. Crossman, Pers. Dir.

**THE CRESCENT CO., INC.,**  
Front St. & Central Ave., Pawtucket,  
R. I.

PERSONNEL: M. C. Sapinsley, Pres. & Treas.; A. R. Dahlstrom, V. Pres.; W. A. Demers, V. Pres. & Prod. Mgr.; J. L. Birch, V. Pres. & Sales Mgr.; O. E. O'Connell, Secy.; J. L. Sanek, Pur. Dir.; W. Birkit, Chief Engr.

**CRESCENT INSULATED WIRE & CABLE  
CO.,** N. Olden Ave., Trenton 5, N. J.

PERSONNEL: C. E. Murray, Jr., Pres.; E. L. Robinson, V. Pres. & Sales Mgr.; J. C. Murray, Jr., V. Pres.; A. H. Battye, Secy. & Pur. Dir.; J. C. Murray, Treas.; A. W. Staller, Factory Mgr.

**CRESCENT TRUCK CO.,** Lebanon, Pa.

PERSONNEL: J. Hunsicker, Pres.; C. D. Eiler, Secy., Treas. & Gen. Mgr.; J. G. Krause, Prod. Mgr. & Chief Engr.; R. E. Clark, Sales Mgr. & Adv. Mgr.; J. R. Baney, Pur. Dir.

**CRITERION MACHINE WORKS,**

403 N. Foothill Rd., Beverly Hills, Calif.

PERSONNEL: H. Brent, Partner, Pers. Dir., Pub. Dir. & Adv. Mgr.; M. DeGrace, Partner & Treas.; E. Montgomery, Secy., Gen. Mgr. & Pur. Dir.; H. R. Johnston, Prod. Mgr.; E. H. VanWissman, Sales Mgr.; D. Baker, Chief Engr.

**CROWE NAME PLATE & MFG. CO.,**

3701 Ravenswood Ave., Chicago 13, Ill.

PERSONNEL: E. C. Coolidge, Pres., Treas. & Gen. Mgr.; W. W. Barry, V. Pres.; M. Keagy, Secy.; E. L. Mabie, Prod. Mgr.; G. C. Hass, Pur. Dir.

**CUNNINGHAM-HALL AIRCRAFT CORP.,**  
Rochester 8, N. Y.

**CUNO ENGINEERING CORP.,**  
S. Vine St., Meriden, Conn.

PERSONNEL: C. H. Cuno, Pres. & Treas.; W. N. Guthrie, V. Pres. & Gen. Mgr.; S. L. Wolfson, V. Pres. & Plant Mgr.; W. A. Barnhart, Secy. & Controller; C. A. Lind, Sales Mgr.; R. A. Clark, Pur. Dir.; C. H. Winslow, Pers. Dir.; G. K. Thornton, Pub. Dir. & Adv. Mgr.; P. E. Ashton, Chief Engr.

**CURTIS PNEUMATIC MACHINERY DIV.  
OF CURTIS MANUFACTURING CO.,**  
1905 Kienlen Ave., St. Louis 20, Mo.

PERSONNEL: W. C. Hecker, Pres.; F. Ackerman, V. Pres. & Works Mgr.; C. W. Frees, Secy. & Treas.; J. D. Lodwick, Sales Mgr.; J. A. A. Hecker, Pur. Dir.; L. C. Blake, Adv. Mgr.

**CURTISS-WRIGHT CORP., PROPELLER  
DIV.,** Caldwell, N. J.

PERSONNEL: G. W. Vaughan, Pres.; R. L. Earle, V. Pres. & Gen. Mgr.; F. Crowe, Asst. Secy.; M. J. Smith, Asst. Treas. & Div. Controller; R. J. Schneider, General Plant Mgr.; R. E. Minton, Mgr.-Military Programs; H. H. Warden, Installations Mgr.; F. W. Moore, Pur. Agt.; N. A. Kirby, Pers. Mgr.; J. H. O'Connell, Pub. Rel.; G. W. Brady, Chief Engr.

---

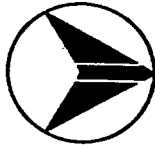
D

---

**DADE BROTHERS INC.,** Mineola, N. Y.

PERSONNEL: G. C. Dade, Pres. & Treas.; R. E. Dade, V. Pres.; J. B. Dailey, Jr., Gen. Mgr. & Sales Mgr.; C. E. Corsa, Pur. Dir.; J. T. Metz, Pers. Dir. & Pub. Dir.; J. B. Watterson, Chief Engr.

**COX & STEVENS AIRCRAFT CORP.**  
**MINEOLA, N.Y.**



DESIGNERS AND MANUFACTURERS  
OF  
SPECIALIZED AIRCRAFT COMPUTERS  
AND  
WEIGHING EQUIPMENT



*MODEL VW NAVIGATIONAL COMPUTER*  
*AIRCRAFT ELECTRIC WEIGHING KIT*  
*THE LOAD ADJUSTER*

**DAHLSTROM METALLIC DOOR CO.,**

Jamestown, N. Y.

PERSONNEL: P. N. Anderson, Pres. & Gen. Mgr.; C. T. Bergstrom, V. Pres. & Pur. Dir.; G. E. Johnson, Secy. & Treas.; A. G. Dawson, Prod. Mgr.; M. W. Wiesner, Sales Mgr.; H. Nicholson, Adv. Mgr.; C. Thierfeldt, Chief Engr.

**DARDELET THREADLOCK CORP.,**

2832 E. Grand Blvd., Detroit 11, Mich.

PERSONNEL: E. B. Jackson, Pres., Gen. Mgr. & Sales Mgr.; E. R. Evans, V. Pres., Treas. & Chief Engr.; D. H. Lundin, Secy.

**DAVIS & THOMPSON CO.,**

6411 W. Burnham St., Milwaukee 14, Wisc.

PERSONNEL: W. H. Weimer, Pres.; G. L. Otto, V. Pres. & Chief Engr.; S. C. Horwitz, Secy.; S. S. Sherman, Treas.; A. B. Py, Pur. Dir.; J. A. Hauser, Adv. Mgr.

**RICHARD M. DECKER CO., INC.,**

919 N. Michigan Ave., Chicago 11, Ill.

PERSONNEL: H. F. George, Pres.

**DEFIANCE MACHINE WORKS, INC.,**

Defiance, O.

PERSONNEL: D. W. Champlin, V. Pres. & Gen. Mgr.; O. Noffsinger, V. Pres. & Sales Mgr.

**DE LAVAL STEAM TURBINE CO.,**

Trenton 2, N. J.

PERSONNEL: H. L. Watson, Pres.; H. W. Johnson, V. Pres.; C. R. Waller, V. Pres. & Chief Engr.; G. C. Stoddard, Secy.; R. Stoddard, Treas.; H. V. Petersen, Sales Mgr.; T. E. Salmon, Pur. Agt.

**DEL-AIR CORP., De Land, Fla.**

PERSONNEL: W. A. Stone, Pres. & Gen. Mgr.; W. J. Deegan, Jr., V. Pres., Secy. & Prod. Mgr.; E. M. Porter, Treas.; J. G. Vilsack, Jr., Pur. Dir.; J. A. Kelley, Pers. Dir.

**DELCO-REMY DIV., GENERAL MOTORS CORP., Anderson, Ind.**

PERSONNEL: O. V. Badgley, Gen. Mgr.; H. D. Dawson, Factory, Mgr.; A. G. Phelps, Sales Mgr.; H. E. Nye, Pur. Dir.; A. G. Coburn, Pers. Dir.; F. Childers, Pub. Dir. & Adv. Mgr.; R. M. Critchfield, Chief Engr.

**THE DENISON ENGINEERING CO.,**

1160 Lublin Rd., Columbus, O.

**DETREX CORP., 13005 Hillview Ave.,**

Detroit 27, Mich.

PERSONNEL: R. A. Emmett, Pres.; W. W. Davidson, V. Pres.; C. F. Dinley, V. Pres., Prod. Mgr. & Sales Mgr.; A. O. Thalacker, Secy. & Gen. Mgr.; G. E. Powers, Treas.; W. G. Smith, Pur. Dir.; E. W. Allison, Pers. Dir.; G. W. Walter, Pub. Dir. & Adv. Mgr.; W. I. Tebo, Chief Engr.

**DETROIT GASKET & MFG. CO.,**

12640 Burt Rd., Detroit 23, Mich.

PERSONNEL: L. H. Diehl, Pres. & Gen. Mgr.; W. E. Ritter, V. Pres.; E. W. Diehl, Secy. & Treas.; H. F. Doolittle, Prod. Mgr.; B. S. Brown, Sales Mgr., Pub. Dir. & Adv. Mgr.; C. H. Strauss, Pur. Dir.; F. J. Brady, Pers. Dir.; G. T. Balfe, Chief Engr.

**DETROIT TAP & TOOL CO.,**

8432 Butler, Detroit 11, Mich.

PERSONNEL: S. B. Hellstrom, Pres.; F. R. Berquist, Treas.; H. Stedding, Prod. Mgr.; W. Laird, Pur. Dir.; D. W. Drury, Adv. Mgr.; A. E. Hogarth, Chief Engr.

**DEUTSCH CO.,**

7000 Avalon Blvd., Los Angeles, Calif.

PERSONNEL: A. Deutsch, Gen. Mgr.; R. Cumins, Prod. Mgr.; D. Herrington, Sales Mgr.; J. Jones, Pur. Dir.; H. Matlaf, Pers. Dir.; J. Manderbach, Adv. Mgr.; A. Bowlzer, Chief Engr.

**DIBBLE COLOR CO.,**

1497 E. Grand Blvd., Detroit 11, Mich.

PERSONNEL: R. A. Pulfer, Secy., Treas. & Gen. Mgr.

**DIETZ MANUFACTURING CO., 2310 S. La**

Cienega Blvd., Los Angeles 34, Calif.

PERSONNEL: F. G. Dietz, Pres.; C. K. Nigbor, Secy.; H. P. Higginson, Gen. Mgr.

**HENRY DISSTON & SONS, INC.,**

Unruh &amp; Milnor Sts., Philadelphia 35, Pa.

PERSONNEL: S. H. Disston, Pres.; W. S. Armstrong, V. Pres. & Secy.; R. T. Nalle, V. Pres.-Prod.; J. S. Disston, Jr., V. Pres.-Sales; W. D. Disston, V. Pres.-Pur. & Pub. Rel.; E. H. Biemuller, Treas.; C. P. Smith, Compt.; W. H. Gebhart, Gen. Dom. Sales Mgr.; C. D. Gerhart, Pur. Dir.; G. Jeffrey, Pers. Dir.; J. W. Jay, Adv. Mgr.; N. C. Bye, Chief Engr.

**DOCKSON CORP.,**

3839 Wabash Ave., Detroit 8, Mich.

PERSONNEL: C. J. Koller, Pres.; C. Collom, V. Pres. & Secy.; A. T. Reeve, Treas.; A. C. Tiedemann, Gen. Mgr.; A. Aikens, Sales Mgr.; H. E. Piggott, Pur. Dir.

**DOLLIN CORP.,**

600 S. 21st St., Irvington, N. J.

PERSONNEL: E. N. Dollin, Pres.; L. Turner, V. Pres., Treas. & Gen. Mgr.; J. L. Pinks, Secy.; B. Sachs, Prod. Mgr.; J. R. Schuchardt, Sales Mgr. & Chief Engr.; W. Cuozzi, Pur. Dir.; O. W. Nelson, Pers. Dir.

**THE DOW CHEMICAL CO., Midland, Mich.**

PERSONNEL: W. H. Dow, Pres.; L. I. Doan, V. Pres. & Secy.; E. W. Bennett, V. Pres. & Treas.; L. I. Doan, Gen. Mgr.; L. B. Grant, Sales Mgr.; J. E. LeFevre, Pur. Dir.; S. Crowther, III, Pub. Dir.; M. J. Hooker, Adv. Mgr.; L. G. Richards, Chief Engr.

**THE DUPLAN CORP., 512 Seventh Ave., New**

York 18, N. Y.

PERSONNEL: E. C. Geier, Pres.; L. B. Frieze, V. Pres. & Sales Mgr.; W. Neale, Secy. & Treas.; E. Rohr, Gen. Mgr.; W. H. Dietrich, Pur. Dir. & Chief Engr.; R. A. Lambert, Pers. Dir.

**DURA PLASTICS INC.,**

1 W. 34th St., New York, N. Y.

PERSONNEL: J. Layman, Pres., Treas. & Adv. Mgr.; M. J. Daub, Secy. & Sales Mgr.; K. Jensen, Prod. Mgr.; A. C. Caughey, Pur. Dir.

**THE DURA-PRODUCTS MANUFACTURING CO., 1407-21 Fifth St., S. W.,**

Canton 1, O.

PERSONNEL: C. C. Steiner, Pres., Gen. Mgr. & Pur. Dir.; S. A. Spilker, V. Pres.; E. E. George, Secy. & Treas.; R. B. McKinley, Prod. Mgr.; L. J. Bitter, Sales Mgr.; R. B. Bollman, Pers. Dir.; E. W. Schellhase, Pub. Dir. & Adv. Mgr.; C. C. Marshall, Chief Engr.

**DURAMOLD DIV. OF FAIRCHILD ENGINE & AIRPLANE CORP., Jamestown, N. Y.**

PERSONNEL: J. C. Ward, Jr., Pres.; A. P. Adams, V. Pres.; W. H. Schwebel, Secy.; W. Wilson, Treas.; T. K. Pierce, Gen. Mgr.; C. W. Deeds, Prod. Mgr.; W. D. Cross, Jr., Sales Mgr.; W. E. Lawrence, Pur. Dir.; B. A. Gorman, Pers. Dir.; G. B. Martin, Pub. Dir.; J. E. Lowes, Jr., Adv. Mgr.; A. W. Loerke, Chief Engr.

# HydrOILics — Aviation's Right Hand

So versatile are the applications of HydrOILic equipment, with its "oil-smooth" power and exact control of that power, that you will find it used in scores of ways in both the production and maintenance of aircraft. Only a few of the HydrOILic Test Stands, widely used in checking the flight per-

formance of aircraft on the ground, are shown here. And the unique new MULTIPRESS — industry's "production giant in midget form," is but one of many types of production machines, presses, and related oil-hydraulic equipment designed and built by Denison. Write for information.

## HydrOILic Test Stands



A



B



C



A: An electric-motor-driven unit for checking aircraft hydraulic systems using up to 3000 pound pressures. B: A test stand designed for the same purpose as the above, but powered by a gasoline engine.

C: A HydrOILic unit for testing aircraft spark plugs in conjunction with an auxiliary ignition tester.

D: Portable Magneto Test Stand for testing consistency of spark, coming-in speeds and magneto mechanical efficiency at speeds from 0 to 6000 rpm.

E: HydrOILic unit for testing aircraft distributor valves and the feathering action of Hydromatic Propellers.



D



E

## MULTIPRESS—A NEW kind of industrial tool!

A 4-ton, completely self-contained, bench-size oil hydraulic machine tool of amazing versatility. Downward ram pressures 300 to 8000 pounds. Upward pressures to 5000 pounds. Any stroke from 1/16 inch to 6 inches. Stroke speeds: 200 inches per minute downward; 300 upward. Numerous standard, ready-to-attach accessories broaden its scope to almost any type of pressure operation. Write for details.

**Special Machinery** Denison is one of the foremost designers and builders of special machinery and equipment featuring the smooth, flexible and exact control of oil-hydraulic power. Submit your requirements without obligation.



The Denison Engineering Co.  
1187 Dublin Road, Columbus 16, Ohio

**DENISON**  
EQUIPMENT & APPLIED  
*HydrOILics*



**DURHAM AIRCRAFT SERVICE, INC.,**  
Northern Blvd. at Prince St., Flushing,  
N. Y.

PERSONNEL: R. M. Durham, Pres.; G. W. Goble, V. Pres.; E. E. Heapy, Secy.; M. Leonard, Treas. & Parts Mgr.; J. E. Kling, Service Mgr.; E. Holmgren, Jr., Chief Engr.

**DURO METAL PRODUCTS CO.,**  
2649-59 W. Kildare Ave., Chicago 39, Ill.**DZUS FASTENER CO., INC.,**  
John St., Babylon, N. Y.

PERSONNEL: W. Dzus, Pres., Treas. & Gen. Mgr.; F. Wells, V. Pres.; T. Dzus, Secy.; C. Pfeife, Prod. Mgr.; L. F. Acker, Sales Mgr.; Pub. Dir. & Adv. Mgr.; G. H. Arnold, Pur. Dir.; R. VanBrunt, Pers. Dir.; J. Gunther, Chief Engr.

## E

**EAGLE OTTAWA LEATHER CO.,**  
Grand Haven, Mich.

PERSONNEL: E. O. Harbeck, Asst. Treas.

**EAGLE PARACHUTE CORP.,**

424 N. Queen St., Lancaster, Pa.  
PERSONNEL: C. J. Follmer, Pres.; R. E. Knoll, Secy. & Pur. Dir.; J. W. Van Buskirk, Prod. Mgr.

**EASTMAN KODAK CO., Rochester, N. Y.**

PERSONNEL: F. W. Lovejoy, Ch. of Board of Directors; T. J. Hargrave, Pres.; A. K. Chapman, V. Pres. & Gen. Mgr.; C. E. K. Mees, H. C. Sievers, C. K. Flint, A. Stuber, M. J. Hayes, V. Pres.; M. K. Robinson, Secy.; M. B. Folsom, Treas.; C. J. Van Niel, Gen. Compt.; J. E. McGhee, Gen. Sales Mgr.

**EATON MANUFACTURING CO.,**

739 E. 140th St., Cleveland 10, O.  
PERSONNEL: C. I. Ochs, Pres.; F. A. Buchda, W. H. Wallace, C. C. Bradford, H. J. McGinn, G. W. Veale, J. L. Dostal, D. H. Daisley, D. Dewey, V. Pres.; H. C. Stuessy, Secy. & Treas.; V. Cada, Pur. Dir.; P. Minsel, Pers. Dir.; M. Fenley, Pub. Dir. & Adv. Mgr.; V. Young, Chief Engr.

**ECLIPSE FUEL ENGINEERING CO.,**  
Rockford, Ill.**ECLIPSE-PIONEER DIV., BENDIX AVIATION CORP., Teterboro, N. J.**

PERSONNEL: K. MacGrath, Gen. Mgr.; A. Endlekofer, Factory Mgr.; R. H. Isaacs, Sales & Service Dir.; J. C. Harrower, Sales Mgr.; Eclipse Products; G. A. Lewthwaite, Sales Mgr.; Pioneer Instruments; R. H. Anderson, J. F. Smith, Pur. Dirs.; F. G. Muller, Pub. Dir.; J. E. Maczko, Adv. Mgr.; Eclipse Products; R. Lane, Adv. Mgr.; Pioneer Instruments; R. C. Sylvander, Dir. Engrg.

**THOMAS A. EDISON INC., INSTRUMENT DIV., West Orange, N. J.**

PERSONNEL: C. D. Geer, V. Pres. & Gen. Mgr.; C. H. Odell, Asst. Mgr.; W. T. Gray, Factory Mgr.; R. B. Lockhart, Gen. Pur. Agt.; H. S. Jones, Chief Engr.

**EDISON-SPLITDORF CORP.,**  
West Orange, N. J.

PERSONNEL: A. L. Walsh, Pres.; A. J. Clark, V. Pres., Gen. Mgr. & Sales Mgr.; F. C. Erwin, Secy.; H. H. Eckert, Treas.; J. Hoffman, Prod. Mgr.; R. B. Lockhart, Pur. Dir.; S. F. Larchar, Pers. Dir.; J. F. Coakley, Pub. Dir.; S. Schaeffer, Adv. Mgr.; G. D. Cerf, Chief Engr.

**EDO AIRCRAFT CORP.,**

405 Second St., College Point, N. Y.  
PERSONNEL: E. D. Osborn, Pres.; K. D. Vosler, V. Pres.-Prod.; G. B. Post, V. Pres.-Sales; B. V. Korvin-Kroukovsky, V. Pres.-Engrg.; W. P. Willetts, Secy.; S. E. Bostwick, Treas.; W. F. Konrad, Pur. Dir.; J. H. Burkett, Pers. Dir.; H. Y. Satterlee, Pub. Dir. & Adv. Mgr.

**EDWARDS CO., Sanford, N. C.**

PERSONNEL: R. B. Rogers, Pres.; H. K. Smyth, V. Pres. & Gen. Mgr.; C. Baker, Treas. & Chief Engr.; D. L. Satterfield, Prod. Mgr. & Sales Mgr.; Z. Z. Hadley, Pur. Dir.; D. C. White, Pers. Dir.; W. I. Glover, Jr., Pub. Dir. & Adv. Mgr.

**EICOR, INC.,**

1501 W. Congress St., Chicago 7, Ill.  
PERSONNEL: N. H. Wendell, Jr., Pres.; R. D. Wright, V. Pres.; W. R. Ward, Treas.; C. B. Fisher, Gen. Mgr.; B. J. Bradley, Prod. Mgr.; N. J. Viere, Sales Mgr.; I. Rud, Pur. Dir.; P. M. Paulson, Pers. Dir.; W. F. Beck, Adv. Mgr.; J. Nader, Chief Engr.

**EISEMANN CORP.,**

32 33rd St., Brooklyn 32, N. Y.  
PERSONNEL: J. A. Seubert, Pres.; H. R. Metz, V. Pres.-Operations; L. H. Scott, V. Pres.-Engrg.; G. O. Moyle, Secy.; O. H. Ashman, Treas.; J. L. McGara, Prod. Mgr.; E. J. Goggins, Sales Mgr.; M. W. Perrine, Pur. Dir.; E. S. Hackett, Pers. Dir.

**EKSTROM CARLSON & CO.,**

1439 R. R. Ave., Rockford, Ill.  
PERSONNEL: S. P. Ekstrom, Pres., Gen. Mgr., Sales Mgr., Pub. Dir. & Adv. Mgr.; G. H. Carlson, V. Pres. & Chief Engr.; H. E. Nelson, Acting Secy., Acting Treas. & Pers. Dir.; R. L. Olson, Prod. Mgr.; W. P. Anderson, Pur. Dir.

**ELECTRIC PRODUCTS CO.,**

1725 Clarkstone Rd., Cleveland 12, O.  
PERSONNEL: R. J. Berry, Pres.; F. K. Roope, V. Pres. & Sales Mgr.; G. J. Berry, V. Pres. & Adv. Mgr.; H. A. Parker, Secy.; E. D. Smith, Chief Engr.

**ELECTRIC SERVICE MANUFACTURING CO., 17th & Cambria Sts., Philadelphia 32, Pa.**

PERSONNEL: A. H. Englund, Pres. & Treas.; H. G. Lewis, V. Pres. & Gen. Mgr.; J. R. McFarlin, Secy.; E. A. Leinroth, Sales Mgr.; T. A. Waters, Pur. Dir.; L. B. Gawthrop, Adv. Mgr.; H. J. Graham, Chief Engr.

**THE ELECTRIC SPRAYIT CO., 1415-1425 Illinois Ave., Sheboygan, Wisc.**

PERSONNEL: S. Deusch, Pres. & Gen. Mgr.; M. B. Deusch, V. Pres., Prod. Mgr. & Sales Mgr.; C. A. MacDonald, Secy.; L. F. Smith, Treas.; K. H. Koch, Pur. Dir.; R. A. Sedlack, Pers. Dir.; R. J. Corrigan, Chief Engr.

**ELECTROL INC.,**

85 Grand St., Kingston, N. Y.  
PERSONNEL: R. B. Criddle, Pres.; B. N. Ashton, V. Pres. & Chief Engr.; F. I. Bertsch, Secy. & Treas.; E. Messerle, Factory Mgr.; G. D. Logan, Prod. Mgr.; E. B. Shumate, Sales Mgr., Pub. Dir. & Adv. Mgr.; L. Edwards, Pur. Dir.; J. Nutting, Pers. Dir.

**THE EMERSON ELECTRIC MFG. CO.,**

1824 Washington Ave., St. Louis 3, Mo.  
PERSONNEL: W. S. Symington, Pres.; O. C. Schmitt, Exec. V. Pres.; W. S. Sneed, V. Pres. & Treas.; J. A. Driy, V. Pres.-Prod.; R. H. McRoberts, Secy.; R. E. Otto, Sales Mgr.; J. A. Alles, Pur. Agt., Turret Div.; L. A. Dahlheimer, Pur. Agt., Elec. Div.; C. A. Swanlund, Adv. Mgr.; H. Leithiser, Chief Engr., Turret Div.; A. C. Dickson, Chief Engr., Elec. Div.

# There's a **DZUS\*** FASTENER For Every Requirement



Fastener Stud



Grommet



Spring



Complete assembly of the  
DZUS spiral cam fastener.

Dzus fasteners are the acme of simplicity—easy to install—rapid and positive in action (only a quarter turn to open or close) and completely dependable. If you have a fastening problem on a hinged or removable part, let us help you solve it.

\* The word DZUS is the Registered Trade Mark of the Dzus Fastener Co., Inc.

**DZUS FASTENER CO., Inc.**  
BABYLON NEW YORK

**EMMERT MANUFACTURING CO.,**

W. Main St., Waynesboro, Pa.  
 PERSONNEL: H. S. Kuhn, Pres., Treas., Gen. Mgr., Prod. Mgr. & Sales Mgr.; A. M. Kuhn, V. Pres. & Secy.

**ENDICOTT FORGING & MFG. CO., INC.,**

Endicott, N. Y.  
 PERSONNEL: A. W. Schaefer, Secy. & Sales Mgr.; C. A. Murray, Treas. & Pur. Dir.

**CHARLES ENGELHARD, INC.,** 233 New Jersey Railroad Ave., Newark 5, N. J.

PERSONNEL: C. Engelhard, Pres. & Treas.; C. B. Mitchell, V. Pres.; J. H. Laub, Secy.; A. W. Taber, Gen. Mgr., Pers. Dir. & Adv. Mgr.; O. Kunze, Pur. Dir.

**ENGINEERING & RESEARCH CORP.,**

Riverdale, Md.  
 PERSONNEL: L. A. Wells, Pres.; M. W. King, V. Pres. & Secy.; W. G. Carroll, Treas.; J. N. Dean, Gen. Mgr.; E. P. Scully, Pur. Agt.; J. E. Richardson, Pers. Dir.; P. C. Wright, Pub. Dir.; F. E. Weick, Chief Engr.

**ENGIS EQUIPMENT CO.,**

431 S. Dearborn, Chicago 5, Ill.  
 PERSONNEL: J. P. Steindler, Pres.; E. J. Schneider, V. Pres. & Secy.; M. Steindler, Treas.; J. S. Morton, Chief Engr.

**ERIE STEEL CONSTRUCTION CO.,**

Geist Rd. & Nickel Plate R. R., Erie, Pa.  
 PERSONNEL: G. H. Strayer, Pres. & Treas.; H. W. Strayer, V. Pres. & Gen. Mgr.; P. E. Bonnell, Secy. & Pur. Dir.; A. W. Reichert, E. F. Jones, Sales Mgrs.; J. A. Auld, Sales Mgr. & Chief Engr.

**ERTEL MACHINE CO.,**

2045 Martindale Ave., Indianapolis, Ind.  
 PERSONNEL: J. C. Ertel, Jr., Pres.; T. Woodard, Treas.; C. B. Enochs, Gen. Mgr.; J. C. Ertel, III, Sales Mgr.; C. Robertson, Pur. Dir.

**ESSO AVIATION PRODUCTS,**

26 Broadway, New York 4, N. Y.  
 PERSONNEL: R. C. Oertel, Sales Mgr.; B. F. Meglaughlin, Pub. Dir.; R. M. Gray, Adv. Mgr.; W. E. Lee, Chief Engr.

**THE ESTERLINE-ANGUS CO., INC.,**

P. O. Box 596, Indianapolis 6, Ind.  
 PERSONNEL: D. J. Angus, Pres.; A. J. Weber, V. Pres.; J. T. Casebourne, Secy.; R. J. Kryter, Treas.

**THE EXACT WEIGHT SCALE CO.,**

944 W. Fifth Ave., Columbus 8, O.  
 PERSONNEL: K. B. Neff, V. Pres. & Treas.; W. A. Scheurer, V. Pres.-Sales; S. L. Briggs, Secy.; T. H. Hamilton, Pur. Agt.; J. W. Sieverling, Adv. Mgr.; T. B. Flanagan, Chief Engr.

**EXCELLO CORP.,** Detroit, Mich.

PERSONNEL: P. Huber, Pres.; T. M. Olson, V. Pres.-Sales; J. K. Fulks, V. Pres.-Mfg.; H. G. Bixby, Secy. & Treas.; D. H. McIver, Asst. Sales Mgr.; J. Humphry, Adv. Mgr.

**EXECUTONE, INC.,**

415 Lexington Ave., New York 17, N. Y.  
 PERSONNEL: P. H. Seaman, Pres.; N. A. Karr, Gen. Mgr.; J. A. Richards, Sales Promotion Mgr.

## F

**FAHLIN MANUFACTURING CO.,**

Columbia, Mo.  
 PERSONNEL: O. Fahlin, Pres.; J. M. Allton, V. Pres.; H. G. Banks, Secy.; A. T. Driscoll, Gen. Mgr.

**FAIRBANKS, MORSE & CO.,**

600 S. Michigan Ave., Chicago 5, Ill.  
 PERSONNEL: R. H. Morse, Pres.; A. E. Ashcraft, V. Pres.-Mfg.; L. A. Keeler, V. Pres. & Compt.; S. T. Kiddoo, V. Pres. & Treas.; F. C. Dierks, Secy.; R. H. Morse, Jr., Gen. Sales Mgr.; F. J. Heaslip, Pur. Dir.; H. J. Barbour, Pub. Dir.; H. N. Baum, Adv. Mgr.; W. W. Schettler, Chief Engr.

**FAIRCHILD CAMERA AND INSTRUMENT CORP.,** 88-06 Van Wyck Blvd., Jamaica 1, N. Y.

PERSONNEL: J. S. Ogsbury, Pres.; E. Robinson, Exec. V. Pres. & Gen. Mgr.; C. L. Terrill, V. Pres. & Secy.; C. A. Harrison, V. Pres. & Sales Dir.; J. H. Dalton, Treas.; R. A. Draghi, Prod. Mgr.; J. Kaiser, Pur. Dir.; C. W. Miller, Pers. Dir.; R. H. Bailey, Pub. Dir.; H. K. Yulke, Adv. Mgr.; R. H. Lasche, Chief Engr.

**FARADAY ELECTRIC CORP.,**

Adrian, Mich.  
 PERSONNEL: E. Klienman, Pres.; J. S. Ackerman, J. M. Doroshaw, V. Pres.; L. J. Stern, V. Pres. & Gen. Mgr.; N. Cellentani, V. Pres. & Prod. Mgr.; P. H. Hill, V. Pres. & Sales Mgr.; F. Von Voigtlander, V. Pres. & Chief Engr.; J. S. Rodie, Secy., Treas. & Pers. Dir.; T. Smith, Pur. Dir.; H. W. Schild, Pub. Dir. & Adv. Mgr.

**FARNHAM MANUFACTURING CO.,**

1646-54 Seneca St., Buffalo 10, N. Y.  
 PERSONNEL: F. L. Boutet, Pres.; P. Duboscq, Chief Engr.

**THE FEDERAL BEARINGS CO., INC.,**

Poughkeepsie, N. Y.  
 PERSONNEL: G. R. Bennett, Jr., Pres.; V. W. Fichtel, Secy.; H. F. Petersen, Sales Mgr.

**FEDERAL PRODUCTS CORP.,**

1144 Eddy St., Providence 1, R. I.  
 PERSONNEL: L. C. Tingley, Pres.; F. C. Tanner, V. Pres. & Gen. Mgr.; L. B. Colt, V. Pres.-Sales; S. B. Reynolds, Secy.; C. N. Kingsford, Treas.; I. A. Hunt, Sales Prod. Mgr. & Adv. Mgr.; J. G. Gunderson, Pur. Agt.; V. McKivergan, Pers. Dir.; H. F. Joslin, Supt.

**FEDERAL TELEPHONE & RADIO CORP.,**

591 Broad St., Newark, N. J.  
 PERSONNEL: S. Behn, Pres.; H. M. Pease, Sr., V. Pres.; C. D. Hilles, Secy.; W. F. Cahir, Treas.; J. S. Jammer, Gen. Comm. Dir.; A. W. Rhinow, Adv. Mgr.

**G. FELSENTHAL & SONS,**

4110 W. Grand Ave., Chicago 51, Ill.  
 PERSONNEL: L. J. Felsenthal, I. G. Felsenthal, Partners; H. P. Slottag, Prod. Mgr.; B. W. Rau, Sales Mgr.; R. M. Shallcross, Pur. Dir.

**FERRACUTE MACHINE CO.,**

Bridgeton, N. J.  
 PERSONNEL: G. E. Bass, Pres.; J. B. Lawson, V. Pres. & Gen. Mgr.; P. Meyers, Secy.; L. Meyers, Treas. & Chief Engr.; H. Marsh, Prod. Mgr.; H. B. Harrison, Sales Mgr.; R. Nydick, Pur. Dir.; D. A. King, Pers. Dir.

**FIBRE CONDUIT CO.,** Orangeburg, N. Y.

PERSONNEL: H. J. Robertson, Jr., Pres.; J. R. Connell, V. Pres.; B. G. Le Mieux, Chief Engr.

**FIRESTONE AIRCRAFT CO.,**

1200 Firestone Parkway, Akron, O.  
 PERSONNEL: H. S. Firestone, Jr., Pres.; J. L. Cahill, V. Pres.; H. H. Hollinger, Secy.; J. J. Shea, Treas.; D. W. Anderson, Sales Mgr.

**FIRST AID SUPPLY CO.,**

32 W. 22nd St., New York 10, N. Y.  
 PERSONNEL: J. Maslan, Pres.; B. Maslan, Secy.; G. Wishny, Chief Engr.



*Measuring the weight distribution of an articulated rod for Wright Cyclone engine for the B-29 Superfortress. Wright Aeronautical Corporation, Paterson, N. J.*

## Precision Over Tokyo!

Far to the East are American Machines, many of them . . . keen, effective, destructive. They are the tools of free men who built them . . . who use them in their growing determined effort to free others oppressed, and they will not fail. Pictured here is an articulated rod in the act of being balanced on EXACT WEIGHT Scales. These rods are vital parts of the famous Superfortress, the B-29 for "Precision over Tokyo" . . . a sinister operation but one no less commonplace than the melting of plow shares into swords during the crusades. This is but a single, and we trust a temporary use for EXACT WEIGHT Scales. One of these days we will return to handling rods for huge passenger and cargo carrying aircraft used in worldwide peacetime pursuits.

**THE EXACT WEIGHT SCALE CO.**  
 557 W. Fifth Ave., Columbus 8, Ohio  
 Dept. X, 1104 Bay St., Toronto, Canada



SHADOWGRAPH, an electrically operated weighing unit of high accuracy for connecting rod balancing and selection.



SHADOWGRAPH, Type A, an electrically operated scale for piston selection and precision.

*Exact Weight Scales*

**FIRTH-STERLING STEEL CO.,**

McKeesport, Pa.  
**PERSONNEL:** L. G. Firth, Pres. & Gen. Mgr.; D. G. Clark, V. Pres. & Gen. Sales Mgr.; C. G. Krapf, Secy.; H. R. Huemme, Treas.; R. S. Stevick, Works Mgr.; H. K. Stern, Pur. Dir.; W. F. Rechter, Pers. Dir.; C. P. Hoffman, Adv. Mgr.; M. F. Judkins, Chief Engr., Design.

**GEO. J. FIX CO.,**

2413 Commerce St., Dallas 1, Tex.  
**PERSONNEL:** G. J. Fix, Sr., Owner & Gen. Mgr.; L. M. Dorman, Sales Mgr.; R. R. McLeRoy, Pur. Dir.; A. T. Schuler, Adv. Mgr.; G. J. Fix, Jr., Chief Engr.

**FLEX-O-TUBE CO.,**

750 14th St., Detroit, Mich.  
**PERSONNEL:** J. L. Ward, Pres.; R. De Tangle, V. Pres.; J. H. Conn, Secy. & Treas.; G. Monteith, Gen. Mgr.; E. H. Fitzpatrick, Prod. Mgr.; A. Wyka, Pur. Dir.; N. Couty, Chief Engr.

**FLIGHTEX FABRICS, INC.,**

93 Worth St., New York 13, N. Y.

**FLOOROLA PRODUCTS, INC.,**

560 Maryland Ave., York, Pa.  
**PERSONNEL:** E. J. Newcomer, Pres. & Gen. Mgr.; K. Busser, Secy. & Treas.; H. C. Feeser, Prod. Mgr. & Chief Engr.; W. L. Y. Davis, Sales Mgr.; H. S. Butler, Pur. Dir.

**FLOTTORP MFG. CO.,**

Airport, Grand Rapids, Mich.  
**PERSONNEL:** R. G. Taylor, Pres. & Gen. Mgr.; O. C. Hall, V. Pres.; J. Pierce, Treas.; H. Eitzen, Prod. Mgr.; H. W. Page, Sales Mgr.; G. McQuiston, Pur. Dir.; O. Flottorp, Chief Engr.

**THE FLOUR CITY ORNAMENTAL IRON CO.,**

2637 27th Ave., S., Minneapolis, Minn.  
**PERSONNEL:** W. Tetzlaff, Pres. & Gen. Mgr.; W. R. Westphal, V. Pres. & Sales Mgr.; W. Schorr, V. Pres. & Prod. Mgr.; H. J. Neils, Secy., Treas., Pub. Dir. & Adv. Mgr.; E. Feezer, Pur. Dir.; S. Thom, Pers. Dir.; C. R. Schuler, Chief Engr.

**THE FOLMER GRAFLEX CORP.,**

154 Clarissa St., Rochester 8, N. Y.  
**PERSONNEL:** N. L. Whitaker, Pres. & Gen. Mgr.; C. H. Harper, V. Pres. & Treas.; G. C. Whitaker, V. Pres.; H. A. Schumacher, V. Pres. & Sales Mgr.; J. E. B. Murphy, Secy.; C. H. Roth, Prod. Mgr.; C. J. Krembel, Pur. Dir.; J. B. Gibson, Pers. Dir.; R. E. Robischon, Adv. Mgr.; O. Steiner, Chief Engr.

**FOOTE BROS. GEAR & MACHINE CORP.,**

5225 S. Western Blvd., Chicago, Ill.  
**PERSONNEL:** W. A. Barr, Pres., Gen. Mgr. & Dir.; J. R. Fagan, Secy., Treas. & Dir.; L. F. Campbell, V. Pres.-Mfg., Precision Gear Div.; R. G. Davis, V. Pres. & Gen. Mgr., Industrial Gear Div.

**THE FORMICA INSULATION CO.,**

Spring Grove Ave., Cincinnati 32, O.  
**PERSONNEL:** D. J. O'Connor, Pres. & Gen. Mgr.; J. R. White, V. Pres., Sales Mgr., Pub. Dir. & Adv. Mgr.; W. Kruse, Secy.; W. Gebhart, Treas.; E. G. Williams, Prod. Mgr.; H. Heitbrink, Pur. Dir.; W. Fentress, Pers. Dir.; G. Clark, Chief Engr.

**FOX CO.,**

Fox Lane, Cincinnati 23, O.

**FRIEZ INSTRUMENT DIV., BENDIX AVIATION CORP.,**

Taylor Ave., Towson 4, Md.  
**PERSONNEL:** A. C. DeAngelis, Gen. Mgr.; D. P. Schrier, Prod. Mgr.; R. B. Stevenson, Sales Mgr.; T. Centracchio, Pur. Dir.; E. P. Loppacker, Pers. Dir.; V. D. Hauck, Chief Engr.

**THE FYR-FYTER CO.,**

221 Crane St., Dayton 1, O.  
**PERSONNEL:** R. C. Iddings, Pres. & Gen. Mgr.; A. S. Iddings, Secy. & Treas.; H. Williams, Prod. Mgr.; R. C. Hahn, Sales Mgr.; R. F. Thies, Pur. Dir.; G. Hewitt, Pers. Dir.; W. E. Hunt, Adv. Mgr.; E. Bork, Chief Engr.

## G

**G-M LABORATORIES INC.,**

4300 N. Knox Ave., Chicago 41, Ill.  
**PERSONNEL:** A. J. McMaster, Pres.; C. E. Parson, V. Pres.; A. G. Bradt, Sales Mgr.

**THE G & O MANUFACTURING CO.,**

138 Winchester Ave., New Haven 8, Conn.  
**PERSONNEL:** A. J. Verdi, Pres.; V. Carangelo, V. Pres.; F. I. Newton, Secy.; C. Oppe, Treas.; M. Wellman, Pur. Dir.; C. Eagan, Pers. Dir.

**GEORGE K. GARRETT CO., INC.,**

1421 Chestnut St., Philadelphia, Pa.  
**PERSONNEL:** A. G. Borowsky, Pres.; F. G. Borowsky, V. Pres., Secy. & Prod. Mgr.; K. Garrett, Treas.; G. Turner, Gen. Mgr.; F. J. Borowsky, Sales Mgr.; E. Garrett, Pur. Dir.; H. Miller, Pers. Dir.; G. T. Clay, Chief Engr.

**GARRISON MACHINE WORKS, INC.,**

9 Emily St., Dayton 7, O.  
**PERSONNEL:** J. R. Garrison, Pres.; R. P. Garrison, V. Pres.

**GAYBEX CORP.,**

388-A Franklin Ave., Nutley 10, N. J.  
**PERSONNEL:** J. B. Moore, Pres. & Gen. Mgr.; W. J. Camarata, Secy. & Treas.; R. C. Blodgett, Prod. Mgr.; F. T. Cafero, Pur. Dir.

**THE GEAR GRINDING MACHINE CO.,**

3901 Christopher, Detroit, Mich.  
**PERSONNEL:** C. N. MacDonald, Pres.; A. D. MacPherson, V. Pres.; M. Scheimer, Secy. & Treas.; A. W. Rudel, Sales Mgr. & Adv. Mgr.; M. R. King, Pur. Dir.; C. Stoner, Pers. Dir.; I. Gruenberg, Chief Engr.

**GENERAL ABRASIVE CO., INC.,**

College Ave. & Hyde Park Blvd., Niagara Falls, N. Y.  
**PERSONNEL:** A. V. Parker, Pres. & Gen. Mgr.; R. Macdonald, Jr., V. Pres.; H. A. Richmond, Treas.; A. J. Sandorff, Sales Mgr. & Adv. Mgr.; E. J. Nicholson, Pur. Agt.

**GENERAL AIRCRAFT EQUIPMENT, INC.,**

22 Elizabeth St., South Norwalk, Conn.  
**PERSONNEL:** C. M. Torrey, Pres.; P. R. Conery, V. Pres. & Treas.; J. C. Daninos, Gen. Mgr.; M. R. Wood, Dir. of Engrg. & Research; E. Mathiot, Prod. Mgr.

**GENERAL AIRCRAFT SUPPLY CORP.,**

Detroit City Airport, Detroit 5, Mich.  
**PERSONNEL:** L. F. Zygumt, Pres.; P. Altman, V. Pres.; H. L. Mitchell, Secy. & Treas.; C. A. Luma, Asst. Treas. & Gen. Mgr.; G. Reidy, Asst. Secy.

**FLEX-O-TUBE HOSE ASSEMBLIES**

*for*

Automatic Pilot Actuation • Bomb Door Controls • Control Surface Booster • Cowl Flap Controls • De-Icer Hose • Fuel and Oil Lines • Gun Mount Controls • Hydraulic Brakes • Hydraulic Gun Charger • Hydraulic Gun Turrets • Hydraulic Rudder Controls • Hydromatic Propeller Controls • Instrument Lines • Oxygen Feed Lines • Pump Connectors • Retractable Landing Gear • Retractable Landing Lights • Retractable Nose Wheel • Retractable Tail Wheel

**THE FLEX-O-TUBE COMPANY**

Lafayette at 14th Avenue • Detroit 14, Michigan

Offices at Chicago, Fort Worth, Los Angeles, New York and Toronto



**ENGINE COOLING RADIATORS**

•  
**OIL COOLERS**

**The G&O Manufacturing Co.**  
NEW HAVEN, CONNECTICUT



*for*  
Dimension Control

**It's Quicker to Use Dial Indicator Gages**

Dial indicator gages are visual, hence faster and more positive. Ask about new gage designs and catalog.

**FEDERAL PRODUCTS CORP.**  
Eddy St., Providence, R. I.



**GENERAL ARMATURE CORP.,**

Lock Haven, Pa.

PERSONNEL: J. F. Cullin, Pres. & Chief Engr.; A. C. Potratz, V. Pres., Gen. Mgr., Prod. Mgr. & Pur. Dir.; F. Kaplan, Secy.; L. Mervis, Sales Mgr.; J. Petrunak, Pers. Dir.; G. K. Warner, Pub. Dir. & Adv. Mgr.

**GENERAL AVIATION EQUIPMENT CO., INC.,** 69 Public Square, Wilkes Barre, Pa.

PERSONNEL: V. C. Bell, Pres. & Gen. Mgr.; A. R. Kerr, V. Pres. & Prod. Mgr.; C. A. Von Stein, Secy. & Treas.; G. D. Payne, J. C. Tracey, Sales Mgrs.; C. P. Elliott, Pur. Dir.; J. A. Esquirol, Pers. Dir.; R. Van Brunt, Chief Engr.

**GENERAL CONTROLS CO.,**

801 Allen Ave., Glendale 1, Calif.

PERSONNEL: W. A. Ray, Pres. & Chief Engr.; A. W. Ray, V. Pres., Gen. Mgr. & Prod. Mgr.; W. T. Doyle, Secy.; H. S. Nye, Treas.; J. P. Ray, Aircraft Sales Mgr.; J. H. Fudge, Pur. Dir.; B. Gorchakoff, Pers. Dir.; H. Schacht, Pub. Dir. & Adv. Mgr.

**THE GENERAL DETROIT CORP.,**

2272 E. Jefferson, Detroit, Mich.

PERSONNEL: R. L. Braden, Pres.; E. A. Warren, V. Pres. & Treas.; W. Bayliss, Secy. & Prod. Mgr.; F. D. Bacon, Gen. Mgr., Sales Mgr., Pub. Dir. & Adv. Mgr.; C. J. Thoman, Pur. Dir.; G. Herrscher, Pers. Dir.; L. Carroll, Chief Engr.

**GENERAL ELECTRIC CO.,**

1 River Rd., Schenectady 5, N. Y.

PERSONNEL: C. E. Wilson, Pres.; J. C. Miller, Sales Mgr.-Aviation; W. V. Merrihue, Adv. Mgr.

**THE GENERAL TIRE & RUBBER CO.,**

Englewood Ave., Akron, O.

PERSONNEL: W. O'Neil, Pres.; C. J. Jahant, S. S. Poor, W. E. Fouse, V. Pres.; L. A. McQueen, V. Pres. & Sales Mgr.; H. R. Jenkins, Secy.; T. S. Clark, Asst. Treas.; R. M. Graham, Pur. Dir.; W. H. Mason, Pub. Dir.; R. H. Harrington, Adv. Mgr.; R. Iredell, Chief Engr.

**GENESEE TOOL CO.,** Fenton, Mich.

PERSONNEL: A. M. Gruner, V. Pres.; L. W. Dahlberg, Secy.; E. Sjogren, Sales Mgr.; E. A. Sjogren, Pur. Dir.; A. F. Denham, Adv. Mgr.; W. N. Logan, Chief Engr.

**THE GEOMETRIC TOOL CO., DIV. OF GREENFIELD TAP & DIE CORP.,**

Blake &amp; Valley Sts., New Haven 15, Conn.

PERSONNEL: H. L. Bill, Pres.; A. S. Redway, Exec. V. Pres. & Gen. Mgr.; A. G. Kurtze, Prod. Mgr.; G. A. Denison, Sales Mgr.; J. H. H. Alden, Pur. Dir.; H. A. Paine, Pers. Dir.; G. S. Tracey, Adv. Mgr.; A. F. Breitenstein, Chief Engr.

**JOHN W. GILLETTE CO.,**

901 Stephenson Bldg., Detroit 2, Mich.

PERSONNEL: J. W. Gillette, Pres.

**GIRDLER CORP.,**

224 E. Broadway, Louisville 1, Ky.

PERSONNEL: W. H. Girdler, Sr., Pres.; G. O. Boomer, Exec. V. Pres.; C. J. Hodapp, V. Pres. & Gen. Mgr.; L. L. Dawson, V. Pres. & Div. Dir.; O. O. Funk, Secy. & Treas.; W. H. Girdler, Jr., Gen. Mgr.; E. H. Pferrer, Works Mgr.; C. C. Brumleve, Sales Mgr.; R. J. Dilger, Pur. Agt.; W. A. Willig, Ind. Rel. Dir.; G. V. Wedereit, Adv. Dir.; P. D. Zottu, Chief Engr.

**GLEASON WORKS,**

1000 University Ave., Rochester 3, N. Y.

PERSONNEL: J. E. Gleason, Pres.; E. B. Gleason, V. Pres., Treas. & Gen. Mgr.; N. A. Bullis, Secy.; D. Vandevate, Prod. Mgr.; B. H. Bickle, Sales Mgr.; M. Barker, Pur. Dir.; J. Williams, Pers. Dir.; H. L. Klein, Pub. Dir. & Adv. Mgr.; A. L. Stewart, Chief Engr.

**GLENN-ROBERTS CO.,**

3100 E. 10th St., Oakland 1, Calif.; 2107 Adams St., Indianapolis 1, Ind.

PERSONNEL: G. G. Glenn, Pres.; J. E. Vosburgh, Sales Mgr.; E. A. Bonfield, Adv. Mgr.; D. C. Girard, Chief Engr.

**GLOBE HOIST CO.,** 1000 E. Mermaid Lane, Philadelphia 18, Pa.

PERSONNEL: H. D. Smith, V. Pres. & Sales Mgr.; A. J. Bettendorf, V. Pres.-Mfg.; C. W. Brayton, Pur. Dir.; R. M. Bowling, Prod. Works Mgr. & Pers. Dir.

E. First and Court Ave., Des Moines, Ia.

PERSONNEL: F. W. Swanson, Pres., Acting Treas. & Gen. Mgr.; H. B. Harden, Secy.; E. W. Capwell, Adv. Mgr.; E. B. Thompson, Chief Engr.

**GLOBE STEEL TUBES CO.,**

3839 W. Burnham St., Milwaukee 4, Wisc.

PERSONNEL: W. C. Buchanan, Pres.; F. J. O'Brien, V. Pres.; G. O. Ross, Secy. & Treas.; A. Korsan, Pur. Dir.; A. C. Priss, Pers. Dir.; F. K. Krell, Pub. Dir. & Adv. Mgr.; E. Wrage, Chief Engr.

**THE B. F. GOODRICH CO.,**

500 S. Main St., Akron, O.

PERSONNEL: J. L. Collyer, Pres.; J. J. Newman, V. Pres.; T. G. Graham, V. Pres.-Factory Operations; W. F. Avery, Secy.; L. L. Smith, Treas.; G. E. Brunner, Gen. Sales Mgr.; J. S. Pedler, Aero. Sales Mgr.; A. D. Moss, Pur. Dir.; C. V. Molesworth, Pers. Dir.; H. W. Maxson, Pub. Dir.; F. T. Tucker, Adv. Dir.; H. E. Cook, Chief Engr.

**GOODYEAR AIRCRAFT CORP.,**

1210 Massillon Rd., Akron 15, O.

PERSONNEL: P. W. Litchfield, Pres.; H. E. Blythe, V. Pres. & Gen. Mgr.; P. E. H. Leroy, V. Pres. & Treas.; R. DeYoung, V. Pres.-Prod.; T. A. Knowles, V. Pres.-Sales; K. Arnstein, V. Pres.-Engrg.; H. L. Hyde, Secy.; L. A. Murphy, Pur. Dir.; F. A. Carter, Pers. Dir.; L. E. Judd, Pub. Dir.; J. K. Hough, Adv. Mgr.

**GEORGE GORTON MACHINE CO.,**

Racine, Wisc.

PERSONNEL: G. Gorton, Sr., Pres.; G. Gorton, III, V. Pres. & Sales Mgr.; W. B. Tomlinson, Secy. & Treas.; S. O. Larsen, Prod. Mgr.; E. W. Reitzel, Pur. Dir.; A. F. Olson, Pers. Dir.; F. C. Kinney, Pub. Dir. & Adv. Mgr.; P. M. Henkes, Chief Engr.

**GOULD STORAGE BATTERY CORP.,**

35 Neoga St., Depew, N. Y.

PERSONNEL: A. H. Daggett, Pres.; J. C. Sykora, V. Pres. & Sales Mgr.; J. L. Rupp, V. Pres. & Chief Engr.; C. R. Bachmann, Secy.; E. F. Cary, Treas.; R. H. Rowland, Gen. Mgr.; F. S. Keenan, Prod. Mgr.; E. J. Suttell, Pur. Dir.; L. R. Maxwell, Pers. Dir.; R. W. Hollingsworth, Sales Prom.

**GRAND CENTRAL AIRPORT CO.,**

1224 Air Way, Glendale 1, Calif.

PERSONNEL: C. C. Moseley, Pres. & Gen. Mgr.; E. Crowe, V. Pres.; R. Hart, Secy. & Treas.; O. D. McKenzie, Prod. Mgr. & Sales Mgr.; W. Clough, Pur. Dir.; J. W. Elliott, Pers. Dir.; F. B. Howe, Pub. Dir.; O. Nordin, Adv. Mgr.; L. L. Lollis, Chief Engr.



... ESSENTIAL MATERIAL IN  
THE CONSTRUCTION OF MODERN AIRCRAFT

**M**ORE than 83 different parts used in modern aircraft construction involve the use of Globe Steel Tubes — including Globe seamless carbon, alloy and stainless steel tubes, as well as Gloweld welded stainless steel tubing.

Great structural strength with minimum weight — adaptability and easy machine-ability — uniformity — qualify Globe steel tubes for applications ranging from small stator shells in fractional horsepower motors, as used aboard planes, to sturdy cylinders required for hydraulic landing gear.

<b>GLOBE</b>	
★ STAINLESS TUBES	★ CONDENSER AND HEAT EXCHANGER TUBES
★ BOILER TUBES	★ MECHANICAL TUBING
★ GLOBEIRON TUBING	
★ GLOWELD TUBES	

**GLOBE STEEL TUBES CO. MILWAUKEE, WIS., U. S. A.**



**GRAND RAPIDS VARNISH CORP.,**  
565 Godfrey Ave., S. W., Grand Rapids  
2, Mich.

PERSONNEL: H. C. Lawrence, Pres. & Gen. Mgr.; J. A. Hager, V. Pres., Sales Mgr.; Pub. Dir. & Adv. Mgr.; G. Kingston, Secy.; C. F. Anderson, Treas. & Pers. Dir.; M. S. Kruienza, Prod. Mgr.; J. VanFarowe, Pur. Dir.; W. R. Fuller, Chief Engr.

**THE G. A. GRAY CO.,**  
3611 Woodburn Ave., Cincinnati 7, O.

PERSONNEL: H. Marx, Pres. & Pub. Dir.; A. Marx, V. Pres., Gen. Mgr. & Adv. Mgr.; A. Zuest, Secy. & Treas.; E. Marx, Prod. Mgr.; J. E. Doran, Sales Mgr.; R. J. Jeggle, Pur. Dir.; E. G. Henke, Pers. Dir.; J. M. Walter, Chief Engr.

**GRAY RADIO CO., W. Palm Beach, Fla.**

PERSONNEL: F. E. Gray, Sr., Pres.; N. Trimble, Secy.; G. H. DeShazo, Gen. Mgr.; R. Thaxter, Prod. Mgr.; K. Hsu, Sales Mgr.; F. E. Gray, Jr., Chief Engr.

**GREENFIELD TAP AND DIE CORP.,**  
Greenfield, Mass.

PERSONNEL: D. G. Millar, Pres.; H. L. Bill, V. Pres. & Gen. Mgr.; J. B. Roys, Secy.; P. A. Yeaw, Treas.; E. A. Enderle, Prod. Mgr.; W. J. Eberlein, Sales Mgr.; J. W. Harrington, Pur. Dir.; G. W. Burre, Pers. Dir.; R. C. Helbig, Pub. Dir. & Adv. Mgr.; O. E. Koehler, Chief Engr.

**GRIMES MANUFACTURING CO.,**

515 N. Russell St., Urbana, O.  
PERSONNEL: W. G. Grimes, Pres.; N. Black, Secy.; C. Grimes, Treas.; L. B. Moore, Gen. Mgr. & Sales Mgr.; D. O. Printz, Prod. Mgr.; H. Hanna, Pur. Dir.; M. Wyant, Pers. Dir.

**THE GUIBERSON CORP., AIRCRAFT & HEATER DIV.,** 1000 Forest Ave., P. O. Box 1106, Dallas, Tex.

PERSONNEL: A. Guiberson, Pres.; W. W. Finlay, V. Pres. & Gen. Mgr.; R. D. Wallis, Secy. & Treas.; J. B. Story, Sales Mgr., Pub. Dir. & Adv. Mgr.; W. N. Rathbun, Pur. Dir.; M. B. Bogarte, Pers. Dir.

**GULF OIL CORP.,**  
Gulf Bldg., Pittsburgh 30, Pa.

W. & L. E. GURLEY, Troy, N. Y.  
PERSONNEL: C. I. Day, Pres.; E. H. Betts, V. Pres.; H. M. Dibert, Secy., Treas. & Sales Mgr.; H. R. Larsen, Chief Engr.

**THE GWILLIAM CO.,** 360 Furman St., Brooklyn 2, N. Y.

PERSONNEL: J. Gwilliam, Pres.; M. R. M. Gwilliam, V. Pres.; M. B. Welsh, Secy. & Treas.; J. E. Howay, Sales Mgr.

---

**H**

---

**H-B ELECTRIC CO., INC.,**  
6117 N. 21st St., Philadelphia 38, Pa.  
PERSONNEL: W. E. Girard, Pres.**HALL MFG. CO.,**

1600 Woodland Ave., Toledo 7, O.  
PERSONNEL: E. A. Hall, Pres.; R. P. Hall, V. Pres. & Gen. Mgr.; C. Musgrave, Secy.; K. Brock, Treas.; F. Lanzinger, Prod. Mgr.; G. Smith, Sales Mgr. & Adv. Mgr.; W. Kopflman, Pur. Dir.; W. Beard, Pers. Dir.; R. Beverlin, Chief Engr.

**THE HALLCRAFTERS CO.,**  
2611 S. Indiana Ave., Chicago, Ill.

PERSONNEL: W. J. Halligan, Pres.; R. W. Durst, V. Pres.; J. J. Frendreis, Secy.; R. L. Russell, Adm. Asst.; G. H. Hartley, Prod. Mgr.; J. G. Thompson, Sales Mgr.; E. J. Corcoran, Pur. Dir.; K. McClelland, Pers. Dir.; E. G. Brown, Adv. Mgr.; R. E. Samuelson, Chief Engr.

**HAMILTON STANDARD PROPELLERS, DIV. OF UNITED AIRCRAFT CORP.,**  
362 S. Main St., East Hartford 8, Conn.

PERSONNEL: S. A. Stewart, Gen. Mgr.; J. H. Cooper, Adm. Asst.; E. Martin, Engrg. Mgr.; C. F. Baker, Chief Engr.; A. Nelson, Factory Mgr.; S. P. Crago, Materials Mgr.; A. C. Wolz, Pur. Agt.; H. M. Ellis, Sales Mgr.; B. W. Whitten, Div. Acct.; H. W. Beh. Asst. Treas.; C. F. Schory, Service Mgr.; J. P. Jeffrey, Pers. Mgr.; G. B. Martin, Pub. Rep.

**THE HAMILTON TOOL CO.,**  
Ninth & Hanover Sts., Hamilton, O.

PERSONNEL: F. W. Schlichter, Pres.; W. H. Franzmann, C. W. Jung, V. Pres.; J. E. Grove, Secy., Sales Mgr. & Adv. Mgr.; O. E. Schlichter, Treas. & Gen. Mgr.; W. Delano, Prod. Mgr.; C. A. Lambert, Pur. Dir.; R. Kelly, Pers. Dir. & Pub. Dir.; R. Zihlman, Chief Engr.

**HAMILTON-WADE CO.,**  
52-62 Haverhill St., Brockton 62, Mass.

PERSONNEL: J. Christie, Pres. & Treas.; F. A. Fisher, V. Pres. & Sales Mgr.

**HANDY & HARMAN,**  
82 Fulton St., New York 7, N. Y.

PERSONNEL: G. H. Niemeyer, Pres.; R. H. Leach, J. C. Travis, V. Pres.; H. W. Boynton, Treas.; J. W. Colgan, Sales Mgr.; F. T. Van Syckel, Adv. Mgr.

**HANSON-VAN WINKLE-MUNNING CO.,**  
Matawan, N. J.

PERSONNEL: V. W. Todd, Pres.; C. W. Yerger, Exec. V. Pres.; L. M. Hague, V. Pres.-Sales; G. Todd, V. Pres.-Engrg.; N. Todd, Secy.; N. A. Munning, Asst. Treas.; H. G. Zucker, Prod. Mgr.; J. A. Bauer, Asst. Sales Mgr.; R. J. Maikmus, Pur. Dir.; R. V. Baylis, Pers. Dir.; G. K. Hammell, Adv. Dept.

**HARLOW AIRCRAFT CO.,**  
-620 E. Valley Blvd., Alhambra, Calif.

PERSONNEL: H. F. Keenan, Pres.; F. Der Yuen, V. Pres. & Gen. Mgr.; J. E. Addicott, Jr., V. Pres., Secy. & Sales Mgr.; E. L. McCreary, Treas.; M. J. Hoffman, Factory Mgr.; R. Kritzmire, Supt.; C. R. Howe, Pur. Agt.; M. H. Gray, Pers. Dir.; D. C. Mendenhall, Chief Engr.

**HARRIS-SEYBOLD-POTTER CO.,**  
SEYBOLD DIV., 819 Washington St., Dayton 77, O.

PERSONNEL: A. S. Harris, Pres.; F. Szuter, Secy.; R. L. Miller, Treas.; G. S. Dively, Gen. Mgr.; N. O. Scourfield, Mgr.; N. McGowan, Prod. Mgr.; H. A. Porter, J. C. Dabney, Sales Mgrs.; H. Irwin, Pur. Dir.; R. A. Kantner, Pers. Dir.; P. H. Schafer, Pub. Dir. & Adv. Mgr.; R. J. Neiderhauser, Adv. Mgr.; W. R. Spiller, Chief Engr.

**THE HART MANUFACTURING CO.,**  
110 Bartholomew Ave., Hartford 1, Conn.

PERSONNEL: G. H. Hart, Pres.; E. E. Legge, V. Pres. & Gen. Mgr.; R. B. Sturup, Secy. & Pur. Dir.; E. E. Norin, Treas.; J. Flannery, Prod. Mgr.; J. W. C. Price, Sales Mgr., Pub. Dir. & Adv. Mgr.; R. Keith, Pers. Dir.; S. C. Williams, Chief Engr.

# MORRISON

## WIRE STITCHING

*Approved for secondary structures  
and non-structural assembly  
by U. S. Government*

### FOR THE FACTS

*This fabrication method has been thoroughly tested by one of America's leading aircraft laboratories and an official report prepared. For information, write for Bulletin No. 55.*



# MORRISON

PRODUCTS OF THE SEYBOLD DIVISION  
HARRIS-SEYBOLD-POTTER COMPANY  
DAYTON 77, OHIO

# STITCHERS

Photograph, magnified, of cross section of stitch driven thru two sheets of 24ST .040 aluminum by Model SJR Morrison Aircraft Stitcher.

**THE HARTFORD MACHINE SCREW CO.,**

476 Capitol Ave., Hartford, Conn.  
 PERSONNEL: H. E. Penfield, Pres.; J. A. Taylor, V. Pres. & Gen. Mgr.; W. McCarrroll, Secy., Sales Mgr. & Adv. Mgr.; A. R. Grane, Treas.; T. E. Heineman, Prod. Mgr.; D. T. Bacon, Pur. Dir.; P. B. Fitzpatrick, Pers. Dir.; E. Grimmisen, Chief Engr.

**HARTWELL AVIATION SUPPLY CO.,**

3417 Crenshaw Blvd., Los Angeles 16, Calif.  
 PERSONNEL: C. Hartwell, Gen. Mgr.; A. Sapsworth, Pur. Dir.; T. Beck, Chief Engr.

**HARTZELL PROPELLER CO.,**

Piqua, O.  
 PERSONNEL: R. N. Hartzell, Pres.; R. I. Blayney, V. Pres.; R. B. Reck, Secy.; R. V. Hartzell, Treas.; C. F. Reed, Gen. Mgr.; R. E. Van De Grift, Sales Mgr.; M. C. Wright, Pur. Dir.; R. V. Grimes, Chief Engr.

**HARVEY RADIO LABORATORIES, INC.,**

447 Concord Ave., Cambridge 38, Mass.  
 PERSONNEL: E. Lyman, Jr., Pres.; J. E. McDonald, Sales Mgr.; C. L. Wright, Pur. Dir.; A. L. Quirk, Chief Engr.

**HARVEY-WELLS ELECTRONICS, INC.,**

Southbridge, Mass.  
 PERSONNEL: J. M. Wells, Pres. & Treas.; R. A. Mahler, V. Pres. & Gen. Mgr.; C. A. Harvey, V. Pres. & Chief Engr.; D. M. Dubreuil, Secy.; D. D. MacLeod, Prod. Mgr.; B. B. Pollett, Sales Mgr. & Adv. Mgr.; J. N. Kuzdzol, Pur. Dir.; M. H. Sichel, Pers. Dir.

**HARVEY-WHIPPLE INC.,**

Springfield 1, Mass.  
 PERSONNEL: W. O. Harvey, Pres.; F. R. Swayne, V. Pres.; L. F. Connor, Secy. & Pur. Dir.; R. G. Whipple, Treas. & Gen. Mgr.; A. A. Brunelle, Prod. Mgr.; T. A. Hodgdon, Sales Mgr., Pub. Dir. & Adv. Mgr.; G. I. Carter, Chief Engr.

**HARVILL CORP.,**

6251 W. Century Blvd., Los Angeles 45, Calif.  
 PERSONNEL: H. R. Gillett, Exec. V. Pres. & Treas.; F. Petit, Secy.; A. J. Hanlon, Prod. Mgr.; R. L. Neville, Sales Mgr. & Adv. Mgr.; E. T. Griffith, Pur. Dir.; R. Rhodes, Pers. Dir.

**THE HARWOOD CO., DIV. OF LOS**

**ANGELES CORP.,** 540 N. La Brea Ave., Los Angeles 36, Calif.  
 PERSONNEL: E. C. Simmons, Pres.; G. J. Levinston, V. Pres. & Gen. Mgr.; W. S. Hamby, Prod. Mgr.; L. D. O'Connell, Sales Mgr.; F. A. von Baum, Pur. Dir.; T. Wright, Pers. Dir.; A. C. Pearson, Chief Engr.

**HATHAWAY INSTRUMENT CO.,**

1315 S. Clarkson St., Denver 10, Colo.  
 PERSONNEL: C. M. Hathaway, Pres., Sales Mgr. & Chief Engr.; F. C. Webb, V. Pres., Gen. Mgr., Prod. Mgr., Pub. Dir. & Adv. Mgr.; H. V. Hathaway, Secy. & Treas.; H. L. Stowell, Pur. Dir.; A. E. Werner, Pers. Dir.

**HAYES INDUSTRIES, INC.,**

Jackson, Mich.  
 PERSONNEL: C. B. Hayes, Pres.; E. C. Hetherwick, V. Pres., Treas. & Gen. Mgr.; C. Hollelith, V. Pres.-Engr.; W. H. Donahue, Secy.; L. J. Bailey, Prod. Mgr.; H. H. Kerr, Sales Mgr.; G. B. Vass, Pur. Dir., Aircraft Div.; E. J. Peterson, Pers. Dir.; D. Mackie, Adv. Mgr.; F. H. LeJeune, Chief Engr.

**HAYES MANUFACTURING CORP.,**

551 Seventh St., N. W., Grand Rapids, Mich.  
 PERSONNEL: R. W. Clark, Pres. & Gen. Mgr.; A. A. Anderson, V. Pres.; T. E. Dean, Secy.; J. H. Lee, Treas.; F. P. Bettiger, Factory Mgr.; L. A. Pinkowske, Pur. Dir.; F. R. Schriber, Pers. Dir.

**HAYNES STELLITE CO.,**

Kokomo, Ind.  
 PERSONNEL: J. W. Todd, Adv. Mgr.

**HEATH CO.,**

Benton Harbor, Mich.  
 PERSONNEL: H. E. Anthony, Pres.; J. E. Ballard, Jr., Sales Mgr.; W. C. Gard, Pur. Dir.; C. M. Edwards, Adv. Mgr.; G. D. Woods, Chief Engr.

**W. F. HEBARD & CO.,**

2433 S. State St., Chicago 16, Ill.  
 PERSONNEL: W. F. Hebard, Pres. & Gen. Mgr.; W. A. Hensel, V. Pres. & Chief Engr.; J. Green, Secy. & Treas.; H. Guy, Prod. Mgr.; E. Virden, Sales Mgr.; A. Grossman, Pur. Dir.; O. E. Tronnes, Pub. Dir. & Adv. Mgr.

**A. W. HECKER,**

1976 E. 66th St., Cleveland 3, O.  
 PERSONNEL: A. W. Hecker, Owner & Sales Mgr.; S. C. Johns, Asst. to Owner; C. A. Nichol, Treas.; R. B. Denison, Prod. Mgr.; P. O. Semon, Pur. Dir.; J. E. Hines, Pers. Dir.; W. F. Barge, Chief Engr.

**THE HEIM CO.,**

46 Sanford St., Fairfield, Conn.  
 PERSONNEL: L. R. Heim, Pres. & Chief Engr.; A. E. Heim, V. Pres.; C. C. Van Etten, Secy. & Pur. Dir.; C. R. Heim, Treas. & Gen. Mgr.; E. Dardani, Prod. Mgr.; E. Hildes-Heim, Sales Mgr.; M. Schollin, Pers. Dir.

**HEINEMANN CIRCUIT BREAKER CO.,**

Trenton, N. J.  
 PERSONNEL: B. S. Berlin, Pres.; E. Bromberg, Sales Mgr.; K. W. Wilckens, Chief Engr.

**ROBERT HETHERINGTON & SON, INC.,**

Sharon Hill, Pa.  
 PERSONNEL: C. F. Benzel, Pres. & Treas.; R. K. Hetherington, V. Pres.-Sales; J. D. Cox, V. Pres.-Prod.; O. Pyle, Secy.; J. F. White, Pur. Dir.; J. H. Schellman, Chief Engr.

**HEWITT RUBBER CORP.,**

240 Kensington Ave., Buffalo 5, N. Y.  
 PERSONNEL: T. Robins, Jr., Pres.; F. G. Cooban, V. Pres. & Gen. Mgr.; J. H. Hayden, Secy.; E. K. Twombly, Treas.; L. D. Bigelow, Prod. Mgr.; C. W. Mackett, Sales Mgr.; H. B. Urtel, Pur. Dir.; C. G. Travers, Pers. Dir.; G. Ennes, Adv. Mgr.; F. W. Blanchard, Chief Engr.

**HEYER PRODUCTS CO., INC.,**

451 Cortlandt St., Belleville, N. J.  
 PERSONNEL: B. F. W. Heyer, Pres.; R. L. Gray, V. Pres. & Gen. Mgr.; L. Heyer, Secy.; N. P. Weed, Treas.; A. C. Warner, Prod. Mgr.; S. R. Milburn, Sales Mgr., Pub. Dir. & Adv. Mgr.; G. G. Schneider, Pur. Dir.; E. W. Steele, Pers. Dir.; C. W. Dalzell, Chief Engr.

**HEYMAN MFG. CO.,**

Kenilworth, N. J.  
 PERSONNEL: H. W. Heyman, Pres.; F. Klumpp, Jr., V. Pres. & Chief Engr.; H. Klumpp, Secy.; K. E. Fahnestock, Treas.

**THE HILLIARD CORP.,**

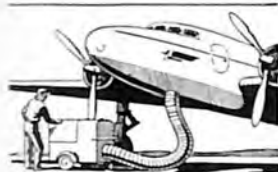
85 W. Fourth St., Elmira, N. Y.  
 PERSONNEL: A. M. Bovier, Pres.; E. A. Mooers, V. Pres. & Gen. Mgr.; R. E. Slayton, Prod. Mgr.; T. A. Labrecque, J. H. Fassett, Sales Mgrs.; C. Bauer, Pur. Dir.; J. V. Stowell, Pub. Dir. & Adv. Mgr.; E. H. Proulx, J. Schuckers, Chief Engrs.

**R. M. HOLLINGSHEAD CORP.,**

840 Cooper St., Camden, N. J.  
 PERSONNEL: R. M. Hollingshead, Pres.; R. M. Hollingshead, Jr., S. Hollingshead, V. Pres.; W. Mitchell, Treas.; O. J. Blank, Prod. Mgr.; L. M. Olson, Sales Mgr.; J. P. Scully, Pur. Dir.; L. R. Wallack, Pers. Dir.; R. E. Conley, Adv. Mgr.; T. J. Bagley, Chief Engr.



The **Master Kraft** Portable Heater  
 Puts the heat where you want it . . .  
When you want it



Preheating aircraft  
cabins



Melting ice off wings



Supplying emergency  
heat to buildings

Here is a portable heater especially designed for aircraft and airport use. Originally developed and manufactured for the U. S. armed forces, it is now available on high priority for civilian use. It is entirely self-contained and self-powered, carries enough fuel for 8 hours continuous heat delivery. DOES NOT require a level base for operation, and the flame is lighted automatically by electric ignition. Uses either furnace oil or gasoline. Heat delivery is by flexible ducts as shown. Available either with electric or gas engine power, in two sizes, 300,000 and 150,000 B.T.U. This portable heater is ideal for preheating aircraft engines, aircraft cabins, melting ice off wings, supplying temporary heat to hangars, shops, and other buildings. A few applications are shown at left.

For your oil heating requirements—either portable or permanent, consult your nearest Master Kraft Oil Heating Dealer or write to the factory, address below.

MANUFACTURED BY  
**HARVEY-WHIPPLE INC.**  
 Springfield, Mass.

**HOLO-KROME SCREW CORP.,**  
Brook St., Elmwood, Hartford 10, Conn.  
PERSONNEL: W. A. Purtell, Pres. & Treas.;  
W. C. Stauble, Exec. V. Pres. & Secy.; P. W.  
Klooz, V. Pres. & Prod. Mgr.

**HOPE WEBBING CO.,** Providence 1, R. I.  
PERSONNEL: C. A. Horton, Pres. & Gen. Mgr.;  
A. A. Turner, V. Pres., Treas. & Pur. Dir.;  
H. W. Horton, V. Pres., Prod. Mgr. & Pers.  
Dir.; C. A. Pray, Secy.; H. S. Smith, Sales Mgr.,  
Pub. Dir. & Adv. Mgr.; A. L. Davis, Chief  
Engr.

**HOUE ENGINEERING DIV.,**  
**HOUDAILLE-HERSHEY CORP.,**  
537 E. Delavan Ave., Buffalo 11, N. Y.  
PERSONNEL: C. Getler, Pres.; R. P. Peo, V.  
Pres.; M. C. Mason, Secy.; G. C. Phelps,  
Treas.; V. E. Walters, Gen. Mgr.; E. F.  
McPherson, Prod. Mgr.; A. C. Ryan, Dir.-  
Sales; C. J. Butler, Pur. Agt.; H. C. Thornton,  
Pers. Dir.; C. F. Lautz, Chief Engr.

**E. F. HOUGHTON & CO.,** 303 W. Lehigh Ave.,  
Philadelphia 33, Pa.  
PERSONNEL: A. E. Carpenter, Pres.; G. W.  
Pressell, Exec. V. Pres.; E. A. Carpenter, Secy.;  
W. F. MacDonald, Treas.; D. J. Richards,  
Asst. Dir. of Sales; H. B. Fox, Pur. Agt.; A. R.  
Boyd, Pers. Dir.; D. C. Miner, Adv. Mgr.;  
W. A. Bohne, Chief Engr.

**THE HOWE SCALE CO.,** Rutland, Vt.  
PERSONNEL: F. G. Riehl, Pres.; L. J. Colen-  
back, V. Pres. & Gen. Mgr.; H. McK. Dodge,  
Secy. & Treas.; J. G. Fenton, Prod. Mgr.; R. F.  
Straw, Sales Mgr.; N. Gron, Pur. Dir.; E. J.  
Fallon, Pers. Dir.; O. T. Baxter, Pub. Dir. &  
Adv. Mgr.; T. A. Yager, Chief Engr.

**HUB INDUSTRIES INC.,**  
38-04 48th St., Long Island City, N. Y.  
PERSONNEL: A. E. Ulmann, Pres.; W. A. De  
Lamater, V. Pres. & Secy.; T. F. Hanley, V.  
Pres. & Treas.; J. J. Buckley, Prod. Mgr.; R. F.  
Horton, Sales Mgr.; J. Splain, Pur. Dir.

**THE HUGHES KEENAN CO.,**  
Mansfield, O.  
PERSONNEL: G. W. Way, Pres.; W. E. Post,  
V. Pres., Gen. Mgr., Sales Mgr. & Adv. Mgr.;  
M. Jacot, Secy.; O. Schaller, Treas. & Pur. Dir.;  
P. A. Wrasse, Prod. Mgr. & Pers. Dir.; W. H.  
Martin, Chief Engr.

**HUNTINGTON PRECISION PRODUCTS**  
**DIV., ADEL PRECISION PRODUCTS**  
**CORP.,** P. O. Box 2046, Huntington,  
W. Va.

PERSONNEL: H. R. Ellinwood, Pres.; R. D.  
Cavanaugh, V. Pres.; S. Amdisen, Secy. &  
Treas.; R. S. Ellinwood, Gen. Mgr.; A. M.  
Starling, Prod. Mgr.; J. H. Bourdon, Sales  
Mgr., Line Supports; J. H. Reisman, Sales Mgr.,  
Hydraulics; C. C. Cole, Pur. Dir.; W. W. Good-  
win, Pers. Dir. & Pub. Dir.; O. K. Fagan, Adv.  
Mgr.; R. D. Terrell, Chief Engr.

**THE HYDRAULIC PRESS MFG. CO.,**  
Mount Gilead, O.  
PERSONNEL: H. F. MacMillin, Pres. & Gen.  
Mgr.; P. C. Pockock, V. Pres.; W. C. Batchelor,  
Secy. & Treas.; R. J. Whiting, Works Mgr.;  
H. J. Miller, Sales Mgr.; A. L. Boggs, Pur. Dir.;  
R. W. Powell, Adv. Mgr.; W. Ernst, Chief  
Engr.

**HYLAND MACHINE CO.,** 40 Potomac St.,  
P. O. Box 992, Dayton 5, O.  
PERSONNEL: F. Hyland, Pres.; H. Greth, Gen.  
Mgr.; R. P. White, Pur. Dir.

**HYSTER CO.,** 2902 N. E. Clackamas, Portland  
8, Ore.  
PERSONNEL: E. G. Swigert, Pres.; F. Ross,  
V. Pres.; H. Black, Secy. & Treas.; E. Cald-  
well, Gen. Mgr.; M. Hooft, Prod. Mgr.; P. Hill,  
Sales Mgr.; C. Bamberg, Pur. Dir.; C. Dunham,  
Pers. Dir.; D. Johnson, Pub. Dir. & Adv. Mgr.;  
A. Zwald, Chief Engr.

## I

**IDEAL COMMUTATOR DRESSER CO.,**  
Park & Borden Ave., Sycamore, Ill.  
PERSONNEL: J. W. Becker, Gen. Mgr.; B. E.  
Holub, Sales Mgr.

**IMPERIAL BRASS MANUFACTURING CO.,**  
1200 W. Harrison St., Chicago 7, Ill.  
PERSONNEL: F. McNellis, Pres. & Treas.; F. C.  
Shafer, V. Pres.; A. Dobrick, V. Pres. & Secy.;  
J. X. Allman, Sales Mgr.-Aviation Div.; W. B.  
Burnet, Pur. Dir.; E. F. Todd, Adv. Mgr.;  
R. D. McIntosh, Chief Engr.

**INDEPENDENT PNEUMATIC TOOL CO.,**  
600 W. Jackson Blvd., Chicago 6, Ill.  
PERSONNEL: N. C. Hurley, Jr., Pres.; W. A.  
Nugent, V. Pres. & Sales Mgr.; E. G. Gustaf-  
son, Treas.; E. N. Haas, Gen. Mgr.; F. Pelletier,  
Prod. Mgr.; T. Tess, Pur. Dir.; M. Shultz, Pers.  
Dir.; C. N. Kirchner, Pub. Dir. & Adv. Mgr.;  
W. G. Mitchell, Chief Engr.

**INDIANA GEAR WORKS,**  
1458 E. 19th St., Indianapolis 7, Ind.  
PERSONNEL: L. C. Buehler, Gen. Mgr.; J. L.  
Buehler, Works Mgr. & Pers. Dir.; M. Hogan,  
Plant Supt.; W. A. Groat, Jr., Pur. Dir.; C. D.  
Eagle, Chief Engr.

**INDUSTRIAL SOUND CONTROL,**  
45 Granby St., Hartford, Conn.  
PERSONNEL: C. W. Lemmerman, Pres.; G. E.  
Wood, Secy.; C. G. Keirstead, Treas.

**INLAND MFG. DIV., GENERAL MOTORS**  
**CORP.,** P. O. Box 1050, Dayton 1, O.  
PERSONNEL: J. D. O'Brien, Gen. Mgr.; H. J.  
Raiff, Prod. Mgr.; H. C. Berkeley, Sales Mgr. &  
Adv. Mgr.; D. Hagans, E. J. Dill, Pur. Dirs.;  
C. K. Haas, Pers. Dir.; F. W. Sampson, Chief  
Engr.

**INTERCONTINENTAL ENGINEERS, INC.,**  
176 W. Adams St., Chicago 3, Ill.  
PERSONNEL: W. A. Darrah, Pres. & Gen. Mgr.;  
E. B. Jones, V. Pres. & Chief Engr.; L. S.  
Reilly, Secy. & Treas.; R. A. Hastings, Sales  
Mgr.; C. P. Masure, Pur. Dir., Pub. Dir. &  
Adv. Mgr.

**INTERNATIONAL DERRICK & EQUIP-**  
**MENT CO.,** 875 Michigan Ave.,  
Columbus 8, O.  
PERSONNEL: O. M. Havekotte, Pres.; R. B.  
McCleery, Treas.; J. E. Muirhead, Prod. Mgr.;  
F. Barnes, Sales Mgr.; J. T. Dunlap, Pur. Dir.;  
C. White, Pers. Mgr.

**INTERNATIONAL FLARE SIGNAL DIV.,**  
(See Kilgore Manufacturing Co.)

**INTERSTATE AIRCRAFT AND ENGINEER-**  
**ING CORP.,** 2600 W. Imperial High-  
way, El Segundo, Calif.  
PERSONNEL: D. P. Smith, Pres.; W. E. Hirten-  
steiner, L. J. Lay, F. L. Holser, V. Pres.; R. W.  
Limacher, Ass't to Exec. V. Pres.; L. A.  
Kavanagh, Secy.; W. C. Barnett, Treas.; C. O.  
Durrett, Prod. Mgr.; W. F. Jones, Sales Mgr.;  
J. E. Koster, Pur. Dir.; F. H. Smith, Pers. Dir.;  
D. Adams, Pub. Dir.

# SOUND *Stone*

A HIGHLY EFFICIENT SOUND ABSORBING MASONRY PRODUCT

## INDUSTRIAL SOUND CONTROL

**H** *omestead*

ENGINEERS AND CONTRACTORS FOR SOUND INSULATIONS  
HARTFORD, CONN.

# SOUND *Metal*

A HIGHLY EFFICIENT ACOUSTICAL METAL BAFFLE

### SPECIALISTS in fabricating small parts for aircraft

THE COMPLETENESS of Hyland manufacturing facilities and experience in exclusive aircraft parts manufacture since 1928 are important reasons for use of Hyland parts by leading aircraft manufacturers. Parts include: handle releases; impulse units; clevises, fork ends, eye-bolts; rod ends; clamps; and scores of special parts. Many times, rush orders can be quickly handled from stock . . . so check Hyland first. Write for details.

**HYLAND MACHINE COMPANY**  
DAYTON, OHIO

**H  
M  
C**

**INTERSTATE DROP FORGE CO.,**

4051 N. 27th St., Milwaukee, Wis.  
**PERSONNEL:** C. E. Stone, Pres. & Gen. Mgr.; H. C. Osborn, V. Pres.; C. C. Bremer, Secy. & Treas.; J. H. Plischke, Prod. Mgr.; B. E. Weiss, Sales Mgr.; J. A. Webber, Chief Engr.

**J****JACK & HEINTZ, INC.,** Cleveland 1, O.

**PERSONNEL:** W. S. Jack, Pres., Gen. Mgr. & Sales Mgr.; R. M. Heintz, V. Pres. & Secy.; W. R. Jack, V. Pres. & Treas.; W. E. Tabb, Prod. Mgr.; R. C. Hodge, Pur. Dir.; F. L. Schultz, Pers. Dir.; A. E. Hanson, Pub. Dir.; D. R. Fairchilds, Adv. Mgr.; P. F. Scofield, Chief Engr.

**JACOEL CABLE SPLICING EQUIPMENT CO.,** 1514-18 Main St., Buffalo 9, N. Y.

**PERSONNEL:** I. Jacoel, Owner.

**JEFFERSON-TRAVIS RADIO MFG. CORP.,** 245 E. 23rd St., New York 10, N. Y.

**PERSONNEL:** I. M. Felt, Pres.; E. Ellinger, Jr., V. Pres.; F. Baron, Secy.; J. C. Harris, Treas.; A. Brown, Prod. Mgr.; P. Nichols, Pur. Dir.; M. Baron, Pers. Dir.; W. Wilkens, Chief Engr.

**JOHNS-MANVILLE CORP.,** 22 E. 40th St., New York 16, N. Y.

**PERSONNEL:** J. H. Trent, L. A. Baldwin, V. Pres.; J. A. O'Brien, Gen. Sales Mgr.; W. S. Hough, Sales Mgr.; N. O. Aeby, Pur. Dir.; J. P. Syme, Pers. Dir.; H. W. Allen, Pub. Dir.; H. T. Bain, Adv. Mgr.

**JOYCE AVIATION, INC.,**  
(See Airchox Co.)**K****KAISER CARGO, INC., FLEETWINGS DIV.,** Bristol, Pa.

**PERSONNEL:** E. E. Trefethen, Jr., Pres.; S. D. Hackley, V. Pres. & Gen. Mgr.; R. E. Knight, Asst. Secy. & Gen. Mgr., Aircraft Div.; F. R. Browning, Asst. Treas. & Exec. Asst. to V. Pres.; J. L. McClane, Asst. Mgr.; W. E. Lucie, Controller; L. J. Kelly, Prod. Budget Mgr.; W. E. Strang, Ind. Rel. Mgr. & Pers. Dir.; J. E. Birdsall, Resident Counsel; G. G. Cudhea, Chief Engr.; C. de Ganahl, Research Engr.; W. H. Engle, Ch. Test Pilot.

**KATO ENGINEERING CO.,** 530 N. Front St., Mankato, Minn.

**PERSONNEL:** C. H. Jones, Pres., Gen. Mgr. & Prod. Mgr.; J. P. Habinger, V. Pres. & Pur. Dir.; W. A. Cliff, Secy. & Sales Mgr.; W. M. Reed, Treas.; C. H. Jones, Gen. Mgr. & Prod. Mgr.; C. B. Chapman, Pers. Dir.; E. Pennington, Pub. Dir. & Adv. Mgr.; S. Neubert, M. L. Nelson, Chief Engrs.

**THE KAWNEER CO.,** Niles, Mich.

**PERSONNEL:** L. J. Plym, Pres.; F. R. Eaglesfield, V. Pres. & Sales Mgr.; E. H. Bigelow, Secy.; H. W. Zimmer, Treas.; A. M. Simpson, Gen. Mgr.; E. H. Wickstead, Prod. Mgr.; E. C. Witwer, Pur. Dir.; D. D. Dunning, Pers. Dir.; J. B. Carse, Adv. Mgr.; K. E. Knott, Chief Engr.

**THE KEENEY MFG. CO.,** 1170 Main St., Newington, Conn.

**PERSONNEL:** W. A. Keeney, Pres.; B. M. Hanna, Secy. & Treas.; J. D. Hanna, Gen. Mgr.; E. O. Sturtervant, Pur. Dir.; R. F. Young, Pub. Dir.; W. Wilcox, Chief Engr.

**KELLETT AIRCRAFT CORP.,** Lansdowne

Ave. & State Rd., Upper Darby, Pa.  
**PERSONNEL:** W. W. Kellett, Pres.; R. G. Kellett, Exec. V. Pres.; W. L. Wilson, V. Pres.; R. H. Prewitt, V. Pres.-Engrg.; W. R. Yarnall, Secy. & Treas.; S. W. Frick, Asst. Secy. & Gen. Counsel; T. S. Ryan, Asst. Treas.; W. V. Trelease, Factory Mgr.

**KELLOGG SWITCHBOARD & SUPPLY CO.,** 6650 S. Cicero Ave., Chicago 38, Ill.

**PERSONNEL:** J. G. Kellogg, Pres.; J. H. Kellogg, Exec. V. Pres. & Secy.; H. C. McCluskey, Treas.; V. Flood, Prod. Control Mgr.; F. M. Parsons, Sales Mgr.; J. Geiger, Pur. Dir.; J. A. Petrick, Pers. Dir.; R. C. Krueger, Pub. Dir. & Adv. Mgr.; R. M. Kaib, Chief Engr.

**KENNAMETAL INC.,** Latrobe, Pa.

**PERSONNEL:** P. M. McKenna, Pres.; D. C. McKenna, A. G. McKenna, V. Pres.; R. M. Zacharias, Secy.; G. T. Kearns, Treas.; R. J. Flickinger, Pur. Agt.; F. W. Pennington, Adv. Mgr.; W. L. Kennicott, Chief Engr.

**KENT-MOORE ORGANIZATION, INC.,** 485 W. Milwaukee Ave., Detroit 2, Mich.

**PERSONNEL:** W. A. Kent, Pres.; J. E. Moore, V. Pres.; F. C. Bowles, Secy.; H. L. Faust, Sales Mgr.; A. W. Bacon, Adv. Mgr.; G. M. Graham, Chief Engr.

**KENYON INSTRUMENT CO., INC.,**

1345 New York Ave., Huntington Station, N. Y.

**PERSONNEL:** A. T. Newell, Pres., Gen. Mgr. & Chief Engr.; H. R. Talbot, V. Pres., Treas. & Pur. Dir.; D. W. Newell, Secy.; T. S. Hall, Jr., Prod. Mgr. & Sales Mgr.; A. T. Valentine, Pers. Dir. & Adv. Mgr.

**KEYSTONE CARBON CO.,**

1935 State St., St. Marys, Pa.  
**PERSONNEL:** B. R. Reuscher, Pres. & Gen. Mgr.; F. A. Krellner, V. Pres. & Sales Mgr.; C. N. Klausman, Secy. & Treas.; A. F. Meyer, Prod. Mgr.; C. A. Sorg, Prod. Engr.; L. H. Schaut, Pur. Dir.; H. P. Sorg, Pers. Dir.; A. A. Gleixner, Mechanical Engr.; R. R. Hoffman, Electrical Engr.

**WALTER KIDDE & CO., INC.,** 675 Main St., Belleville, N. J.

**PERSONNEL:** J. F. Kidde, Pres.; C. L. Griffin, V. Pres., Aviation Sales; D. Mapes, V. Pres.-Engrg.; J. Hammill, Aviation Sales Mgr.; N. Vuyosevich, Pur. Dir.; G. F. Ives, Adv. Mgr.

**KILGEN AIRCRAFT, DIV. OF THE KILGEN ORGAN CO.,** 4632 W. Florissant Ave., St. Louis 15, Mo.

**PERSONNEL:** E. R. Kilgen, Pres. & Treas.; M. Hess, V. Pres.; E. J. Maruska, Secy.; P. Garvey, Prod. Mgr.; J. A. Weber, Pur. Dir. & Pers. Dir.; M. Bronson, Pub. Dir. & Adv. Mgr.; G. McCandless, Chief Engr.

**THE KILGORE MANUFACTURING CO., INTERNATIONAL FLARE-SIGNAL DIV.,** Tipp City, O.

**PERSONNEL:** H. B. Watkins, Pres. & Treas.; A. F. Hubbard, V. Pres. & Gen. Mgr.; D. L. Reed, Secy.; R. D. Wiley, Prod. Mgr. & Chief Engr.; R. W. Putterbaugh, Pur. Dir.; J. F. Mains, Pers. Dir.

**KING PLASTICS CORP.,**

101 E. Speer Blvd., Denver 3, Colo.  
**PERSONNEL:** E. K. Krueger, Pres. & Gen. Mgr.; J. C. Gadd, V. Pres.; D. G. Wells, Secy.; D. O. Ormsbee, Treas.; R. P. McClung, Prod. Mgr.; E. D. Warde, Sales Mgr.; D. W. Cluff, Pur. Dir.; E. L. Michael, Pub. Dir. & Adv. Mgr.; H. E. Cole, Chief Engr.



## Precision TUBE BENDING

Close tolerance in tubular bending requires highly developed skills. From design through production our engineered manufacturing methods, coupled with experienced supervision, assure KEENEY products of meeting the most exacting test requirements.

Manufacturing ranges from  $\frac{1}{8}$ " to 3" I.D. in brass, copper, mild and stainless steel and aluminum.

Modern methods and equipment for precision tubular bending, stamping, soldering and brazing and finishing; also, a department of sufficient size to handle large continuous runs of assemblies.

*A Quarter of a Century of  
Tube Bending Experience.*

**THE KEENEY MANUFACTURING CO.**  
NEWINGTON - CONNECTICUT

*Aircraft  
Assemblies*



- ★
- ★ Our modern plant, built
- ★ 1943, is equipped with
- ★ the latest refinements
- ★ for plywood fabrication,
- ★ glider assemblies, tail
- ★ sections, seats, wings.
- ★ Controlled humidity—
- ★ electronic aging and
- ★ bonding.
- ★ PLUS expert craftsmen
- ★ with 25 years' plywood
- ★ experience.
- ★ AAF preferential rating
- ★ for the past 2½ years.
- ★
- ★

**Kilgen Aircraft**  
4632 W. Florissant Ave. St. Louis 15, Missouri

★ ★ ★

## JACOEL Cable SPLICER



Cables from  $\frac{1}{16}$  to 1" diameter for Thimbles, Bushings, Spacers, now quicker and better handled by Jacoel Cable Splicing Equipment. U. S. Govt., Aircraft Factories, Schools, Repair Stations, all are enthusiastic users.

JACOEL CABLE SPLICING  
EQUIP. CO., 1514 Main St., Buffalo 9, N. Y.



**KIRSCH CO., Sturgis, Mich.**

PERSONNEL: G. W. Kirsch, Pres. & Gen. Mgr.; J. N. Kirsch, V. Pres.; A. W. Evers, Secy.; Pub. Dir. & Adv. Mgr.; D. W. Hoxic, Treas.; L. Barnell, Prod. Mgr.; P. B. Stratton, Sales Mgr.; H. E. Davis, Pur. Dir.; J. A. McCormick, Pers. Dir.; F. Stutz, Chief Engr.

**KOEHLER AIRCRAFT PRODUCTS CO.,**

814 Vermont Ave., Dayton 4, O.

PERSONNEL: G. J. Koehler, Pres.; G. T. Koehler, V. Pres. & Factory Mgr.; J. J. Koehler, Secy. & Treas.; A. W. Kuhner, Sales Mgr. & Adv. Mgr.; C. J. Korte, Pur. Agt.; A. P. Barcus, Chief Engr.

**KOHLER CO., Kohler, Wisc.**

PERSONNEL: H. V. Kohler, Pres.; O. A. Kroos, Exec. V. Pres.; W. J. Kohler, Jr., Secy.; J. M. Kohler, Treas.; F. G. Brotz, Prod. Mgr.; A. G. Zibell, Sales Mgr.; A. G. Kroos, Pur. Dir.

**KOLLSMAN INSTRUMENT DIV. OF SQUARE D CO., 80-08 45th Ave., Elmhurst, N. Y.**

PERSONNEL: F. W. Magin, Pres.; P. Kollsman, V. Pres.; V. Carbonara, V. Pres. & Gen. Mgr.; G. Adolph, Secy.; L. Bolster, Treas.; W. C. Bonn, Sales Mgr.; J. Goodrich, Pur. Dir.; J. Niederhofer, Pers. Dir.; J. C. Carr, Pub. Dir. & Adv. Mgr.; W. Angst, Chief Engr.

**KOPP GLASS, INC.,**

Swissvale, Pittsburgh 18, Pa.

PERSONNEL: C. H. Curry, Pres. & Treas.; C. J. Huot, V. Pres. & Gen. Mgr.; G. D. Hammond, Secy.; F. S. Huot, Prod. Mgr.; H. P. Thorne, Sales Mgr.; C. E. Leberknight, Research Dir.

**KOPPERS CO., INC., BARTLETT HAYWARD DIV., 200 Scott St., Baltimore 3, Md.**

PERSONNEL: W. F. Perkins, V. Pres. & Gen. Mgr.; J. E. Tellman, Asst. Secy. & Treas.; J. Jones, Test & Service Chief; S. H. Fedan, Exec. Engr. & Adv. Mgr.; S. W. Randolph, Prod. Mgr.; J. D. Andrew, Sales Engr.; B. K. Shaner, Pur. Dir.; W. Ortman, Pers. Dir.; R. Karey, Project Engr.; P. F. Hackethal, Chief Engr.

**KREMBS & CO.,**

669 W. Ohio St., Chicago, Ill.

PERSONNEL: O. M. Krembs, Prop.

**KROPP FORGE AVIATION CO.,**

5301 W. Roosevelt Rd., Chicago, Ill.

PERSONNEL: R. A. Kropp, Pres.; R. B. Kropp, V. Pres. & Treas.; J. H. Lund, V. Pres. & Sales Mgr.; C. F. Johnson, Secy.; B. H. Gebhardt, Prod. Mgr.; P. C. Patch, Pur. Dir.; R. T. O'Keefe, Jr., Pers. Dir.; D. Bennett, Chief Engr.

**L****L. G. S. SPRING CLUTCH CORP., SUBSIDIARY OF CURTISS-WRIGHT CORP., 398 Division St., Indianapolis 6, Ind.**

PERSONNEL: G. W. Vaughan, Pres.; W. W. Gleeson, V. Pres. & Gen. Mgr.; E. S. Cramer, Secy.; C. W. Cady, Treas.

**L & J PRESS CORP., Elkhart, Ind.**

PERSONNEL: D. R. Grossman, Pres. & Gen. Mgr.; G. Snyder, Secy.; M. B. Lockwood, Pur. Dir.

**THE LACKAWANNA LEATHER CO.,**

740 Grand Ave., Hackettstown, N. J.

PERSONNEL: D. S. Good, Pres., Gen. Mgr. & Adv. Mgr.; D. H. McCree, V. Pres.; C. F. Good, Secy.; J. D. Woodward, Treas.; R. S. Bailey, Chief Engr.

**THE LAISTER-KAUFFMANN AIRCRAFT CORP., 6376 Clayton Rd., St. Louis 17, Mo.**

PERSONNEL: J. W. Laister, Pres. & Gen. Mgr.; M. N. Whitehead, V. Pres., Pub. Dir. & Adv. Mgr.; J. R. Kauffmann, Secy. & Treas.; A. Vedders, Prod. Mgr.; W. F. Nesbit, Asst. Secy.; F. R. Kaiser, Pur. Dir.; E. Wagner, Pers. Dir.; R. N. Chapman, Chief Engr.

**LAKE ERIE ENGINEERING CORP.,**

P. O. Box 68, Kenmore Station, Buffalo 17, N. Y.

PERSONNEL: R. E. Dillon, Pres. & Gen. Mgr.; H. D. Thweatt, Sales Mgr.; O. Hoffman, Chief Engr.

**LAMSON CORP., Syracuse 1, N. Y.**

PERSONNEL: C. F. Dietz, Pres.; F. D. Weeks, V. Pres. & Treas.; R. I. Hicks, V. Pres. & Gen. Works Mgr.; C. A. Burton, Gen. Sales Mgr.; S. H. Munro, Comm. Sales Mgr.; A. J. Cole, Ind. Sales Mgr.; C. S. Jennings, Sales Promotion Mgr. & Adv. Mgr.; H. C. Keller, Engr. Mgr.; B. Skalton, Pur. Agt.; W. M. Paff, Installation Mgr.; A. F. Pascall, Traffic Mgr.

**THE LAMSON & SESSIONS CO.,**

1971 W. 85th St., Cleveland, O.

PERSONNEL: R. H. Smith, Pres.; J. P. Donahue, V. Pres.; H. H. Winterberg, Secy.; G. S. Case, Jr., Treas.; H. J. McMahon, Gen. Mgr.; E. H. Werner, Prod. Mgr.; R. G. Patterson, Sales Mgr.; G. Hines, Pur. Dir.; H. L. Judd, Pers. Dir.; C. L. Harvey, Chief Engr.

**LANDERS CORP., P. O. Box 911, Toledo, O.**

PERSONNEL: R. G. Landers, Pres. & Gen. Mgr.; J. P. Howland, V. Pres. & Secy.; P. E. Roper, Treas.; F. W. Baker, Prod. Mgr.; C. M. Keiser, W. M. Brown, Sales Mgrs.; J. C. Siegmann, Pur. Dir.; W. Chenny, Pers. Dir.; H. Coffey, Pub. Dir. & Adv. Mgr.; C. E. Denoon, Chief Engr.

**LANSING STAMPING CO.,**

S. Pennsylvania Ave., Lansing 2, Mich.

PERSONNEL: G. F. Conway, Pres.; G. L. Robinson, V. Pres.; L. S. Reese, Secy.; M. W. Jackfin, Sales Mgr.; I. W. Swift, Pur. Dir.

**LASALCO, INC.,**

2818 LaSalle St., St. Louis, Mo.

PERSONNEL: B. G. Daw, Pres. & Treas.; H. J. Struckhoff, V. Pres., Sales Mgr. & Adv. Mgr.; C. H. Pinkerton, Secy.; J. C. Bessonette, Pur. Dir.; N. K. House, Chief Engr.

**I. F. LAUCKS, INC.,**

911 Western Ave., Seattle 4, Wash.

PERSONNEL: H. P. Banks, Pres. & Gen. Mgr.; L. W. Eilertsen, V. Pres. & Sales Mgr.; D. M. Williamson, Secy. & Prod. Mgr.; J. T. Lively, Treas.; R. G. Frederick, Pur. Dir.; F. G. Galer, Adv. Mgr.; W. D. Lawshe, Chief Engr.

**LAVELLE AIRCRAFT CORP.,**

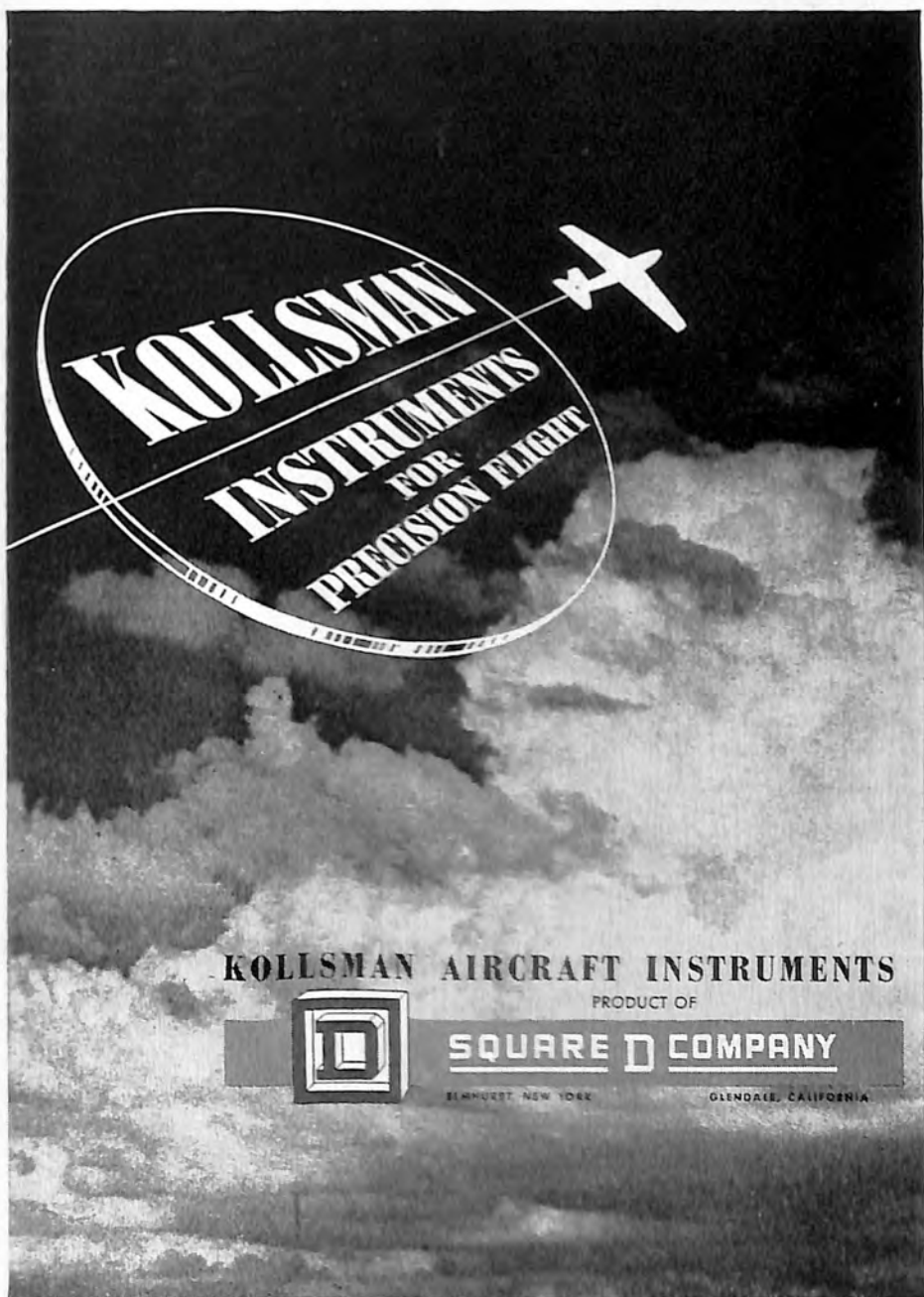
Sterling St., Newtown, Bucks County, Pa.

PERSONNEL: T. Lavelle, Pres. & Gen. Mgr.; H. A. Liese, V. Pres. & Pur. Dir.; S. Van Artsdalen, Secy. & Prod. Mgr.; A. Herzog, Chief Engr.

**LAWRANCE AERONAUTICAL CORP.,**

N. Stiles St., Linden, N. J.

PERSONNEL: R. Burnstan, Pres. & Gen. Mgr.; A. J. Gariepy, Asst. to Pres.; A. Marshall, V. Pres.; W. A. Bowers, V. Pres. & Treas.; C. L. Lawrance, Engine Research Dir.; L. W. Kelley, Contracts & Service Mgr.; R. E. Davis, Pur. Dir.; A. Unsworth, Pers. Dir.; L. McClerman, Adv. Coordinator; S. C. Bennett, Chief Engr.



**KOLLSMAN  
INSTRUMENTS  
FOR  
PRECISION FLIGHT**



**KOLLSMAN AIRCRAFT INSTRUMENTS**

PRODUCT OF



**SQUARE D COMPANY**

ELMHURST, NEW YORK

GLENDALE, CALIFORNIA

**THE LEA MANUFACTURING CO.,**

16 Cherry Ave., Waterbury 86, Conn.  
 PERSONNEL: R. S. Leather, Pres.; R. P. Crane, V. Pres., Sales Mgr. & Adv. Mgr.; H. L. Kellner, Secy.; E. W. Couch, Treas. & Gen. Mgr.; W. D. Starr, Prod. Mgr. & Pur. Dir.

**LEACH RELAY CO., INC.,**

5915 Avalon Blvd., Los Angeles 3, Calif.  
 PERSONNEL: R. Monroe, Pres.; E. K. Neale, V. Pres. & Sales Mgr.; D. C. Moore, Secy. & Treas.; L. E. Baldrige, Pur. Dir.; E. Baker, Chief Engr.

**THE LEECE-NEVILLE CO.,**

5363 Hamilton Ave., Cleveland 14, O.  
 PERSONNEL: B. M. Leece, Pres., Treas. & Gen. Mgr.; P. H. Neville, V. Pres.; J. P. Johnston, Secy.; K. C. Gano, Sales Mgr.; D. M. Evans, Pur. Dir.; R. D. Williamson, Jr., Pers. Dir.; S. F. Stewart, Chief Engr.

**THE LELAND ELECTRIC CO.,**

1501 Webster St., Dayton, O.  
 PERSONNEL: W. F. Lisman, Pres. & Gen. Mgr.; G. R. Gaskell, V. Pres., Secy. & Treas.; E. B. George, V. Pres. & Chief Engr.; J. H. Sampson, Prod. Mgr.; P. D. Dale, Sales Mgr.; H. E. Snider, Pur. Dir.; C. J. Phillips, Pers. Dir.; R. S. Ferguson, Adv. Mgr.

**LEMPCO PRODUCTS, INC., Bedford, O.**

PERSONNEL: J. F. Strand, Pres.; J. Y. Blazek, V. Pres. & Secy.; F. J. Schwab, V. Pres.-Sales; P. F. Hronek, Treas.; D. J. Martell, Ind. Sales Mgr.; J. H. Gulick, Pur. Dir.; O. Chaffin, Pers. Dir.; V. Roy, Chief Engr.

**G. B. LEWIS CO.,**

426 Montgomery St., Watertown, Wisc.  
 PERSONNEL: L. W. Parks, Pres., Treas. & Gen. Mgr.; G. C. Lewis, Secy.; G. G. Prater, Prod. Mgr.; K. Hawkins, Sales Mgr., Pub. Dir. & Adv. Mgr.; A. Killion, Pur. Dir.; R. Merville, F. Cramer, Chief Engrs.

**THE LEWIS ENGINEERING CO.,**

52 Rubber Ave., Naugatuck, Conn.

**LIBERTY AIRCRAFT PRODUCTS CORP.,**

Farmingdale, N. Y.  
 PERSONNEL: R. Simon, Pres.; G. H. Hauser, V. Pres.; W. G. Holman, Secy. & Treas.; E. A. Matzen, Pur. Dir.; H. Prime, Pers. Dir.; W. Ochse, Chief Engr.

**LIGHTS, INC.,**

1111 S. Fremont Ave., Alhambra, Calif.  
 PERSONNEL: T. Thorndike, Pres.; H. S. Kimball, Managing Dir.; M. Hurley, Secy.; M. L. Thorndike, Treas.; O. E. Harvey, Mgr., Aircraft & Marine Fittings Div.; G. W. Turman, Mgr., Aircraft Lighting Div.; F. C. Soderberg, Mgr., Ordnance Div.; W. G. Palmer, Dir., M. R. C. Div.; M. G. Davis, Pur. Dir.; J. W. Peckham, Pers. Dir.; C. D. Cooper, Pub. Dir.; C. R. Erickson, Adv. Mgr.; E. B. Williams, Chief Engr.

**LINCOLN ENGINEERING CO.,**

5701 Natural Bridge Ave., St. Louis, Mo.  
 PERSONNEL: A. P. Fox, Pres. & Treas.; F. Holmes, J. L. Kludt, V. Pres.; T. L. Perrine, Secy.; J. L. Carmitchal, Sales Mgr.; D. K. Howell, Jr., Pur. Dir.; R. W. Thomas, Pers. Dir.; W. B. Gordon, Adv. Mgr.; L. C. Rotter, Chief Engr.

**LINCOLN-SCHLUETER FLOOR MACHINERY CO., INC.,**

512-532 S. Peoria St., Chicago 7, Ill.  
 PERSONNEL: G. S. Ehle, Pres.; H. P. Ehle, V. Pres., Treas. & Gen. Mgr.; A. R. Poster, Secy.; J. A. Backlund, Prod. Mgr. & Chief Engr.; L. C. Johnson, Sales Mgr.; E. J. Zajac, Pur. Dir.

**THE LINDE AIR PRODUCTS CO.,**

30 E. 42nd St., New York 17, N. Y.

**LINK AVIATION DEVICES, INC.**

Nowlan Rd., Hillcrest, Binghamton, N. Y.

PERSONNEL: E. A. Link, Pres.; G. W. Emerson, P. S. Hopkins, V. Pres.; G. T. Link, V. Pres. & Treas.; G. Lowkrantz, V. Pres. & Chief Engr.; F. A. Spencer, Secy.; F. R. Perier, Works Mgr.; B. MacDougall, Prod. Mgr.; E. H. Allen, Pur. Dir.; T. E. Mulford, Pub. Dir. & Adv. Mgr.

**THE LIQUIDOMETER CORP.,**

Skullman Ave. & 36th St., Long Island City, N. Y.

PERSONNEL: C. A. deGiers, Pres. & Gen. Mgr.; H. T. Cullinan, V. Pres. & Sales Mgr.; H. A. Kurowaki, Secy. & Treas.; R. H. Hogan, Pur. Dir.; A. Wickesser, Asst. Chief Engr.

**LISLE CORP., Clarinda, Ia.**

PERSONNEL: C. V. Lisle, Pres. & Gen. Mgr.; J. R. Arthur, V. Pres.; T. E. Brooks, Secy. & Chief Engr.; A. A. Cambre, Treas. & Adv. Mgr.; E. G. Thompson, Prod. Mgr.; E. Lisle, Sales Mgr.

**LITTELFUSE INC., 4757 Ravenswood Ave.,**

Chicago 40, Ill., El Monte, Calif.  
 PERSONNEL: E. V. Sundt, Pres. & Chief Engr.; T. M. Blake, V. Pres., Secy. & Treas.; W. A. Foote, Dir. of Sales; D. Breen, Sales Mgr., Western Div.; R. G. Akin, Sales Mgr., Mid-western Div.; J. D. Hughes, Sales Mgr., Eastern Div.; M. Symonds, Adv. Mgr.

**LORD MANUFACTURING CO.,**

1635 W. 12th St., Erie, Pa.  
 PERSONNEL: H. C. Lord, Pres.; T. Lord, V. Pres. & Gen. Mgr.; B. H. Hartman, Secy. & Treas.; A. E. Weingard, Prod. Mgr.; C. E. Beavan, Sales Mgr.; F. J. Kuhn, Pur. Dir.; D. R. Coddington, Pers. Dir.; R. C. Henshaw, Chief Engr.

**LOS ANGELES STAMP AND STATIONERY**

CO., 1500 S. Los Angeles St., Los Angeles 15, Calif.

PERSONNEL: A. C. Davidson, Pres.; W. M. Knapp, V. Pres. & Gen. Mgr.; W. V. McRoberts, Secy. & Treas.; G. W. Garvin, Prod. Mgr.; S. C. Bullock, Pur. Dir.; R. Gannon, Chief Engr.

**THE LOWE BROTHERS CO.,**

424 E. Third St., Dayton, O.  
 PERSONNEL: D. A. Kohr, Pres.; C. W. Parrott, V. Pres.; P. H. Harn, Treas.; E. W. Fasig, Gen. Mgr.; E. F. Teyber, Sales Mgr.; W. T. Loges, Pur. Dir.; G. L. Clark, Pers. Dir.; P. B. Willis, Adv. Mgr.

**LUBRIPLATE DIV., FISCHE BROTHERS**

REFINING CO., 129 Lockwood St., Newark 5, N. J.

PERSONNEL: F. J. Snyder, Pres.; L. A. Ryan, V. Pres.; F. W. Edwards, Secy. & Treas.; G. E. Merkle, Gen. Mgr. & Prod. Mgr.; R. L. Watts, Adv. Mgr. & Mgr.-Lubriplate Div.

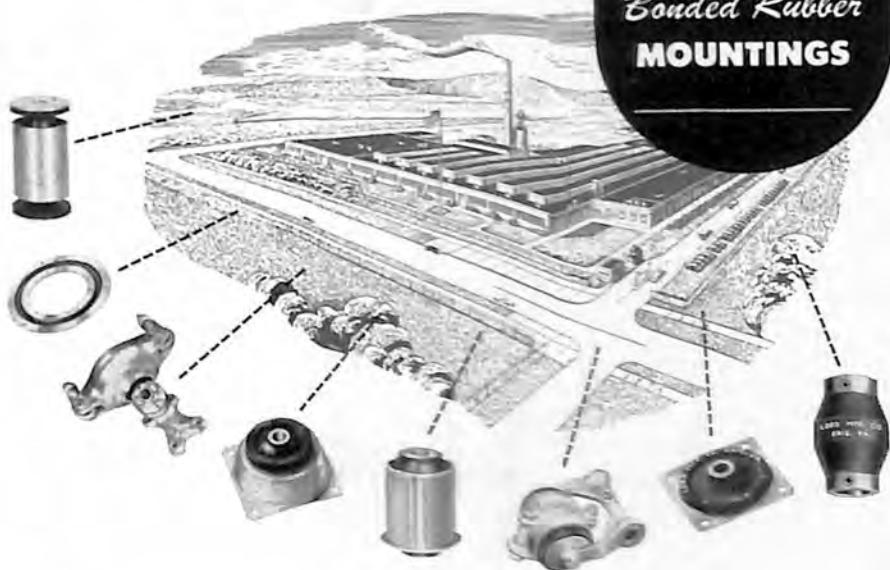
**THE LUFKIN RULE CO., Saginaw, Mich.**

PERSONNEL: R. G. Thompson, Pres.; E. Russell, V. Pres.; H. P. Krauss, Secy.; G. C. McBeth, Sales Mgr.; W. Zoellner, Pur. Dir.; R. Andrus, Pers. Dir.; N. A. Ellis, Adv. Mgr.

**LUSCOMBE AIRPLANE CORP.,**

Trenton 7, N. J.  
 PERSONNEL: L. H. P. Klotz, Pres.; F. J. Knack, V. Pres.-Engr.; C. L. Riegel, Secy. & Treas.; R. D. Clamptett, Sales Mgr.; F. Peberdy, Pur. Dir.; L. P. Taylor, Pers. Dir.; H. H. Booth, Sales Prom. Mgr.; J. Cunningham, Factory Supt.

**The Plant Behind  
The Product . . .**



**AN** idea that was born over twenty years ago; an idea that was painstakingly developed on reams of paper covered with engineering formulas, drawings and mathematical computations; an idea that was proven in countless laboratory tests. That idea accounts for the fact that Lord has had to make three additions in as many years, to take care of the war-time demand for the best in vibration control mountings for airplanes, ships, tanks, and a hundred other tools of war.

The idea was that a Shear Type Mounting, properly designed, is vastly superior in vibration control to compression or tension type mountings. The work on paper and in the laboratory has continued; it has

included designs for thousands of different jobs; it has included methods of bonding rubber to practically every industrial metal; it has included exhaustive tests of natural rubber and synthetic rubber of varying compositions and degrees of stiffness.

It has all resulted in Lord being the authority on vibration control and isolation. When a tough vibration problem comes up, the typical expression heard from the designer, the engineer, the shop superintendent is, "Send it to Lord".

Because Lord knows, there is a solution to your vibration problem. Perhaps it's in our free literature; perhaps you would do well to call in a Lord Vibration Engineer. No obligation attached to either service.

**Do More Than Before—Buy EXTRA War Bonds**

IT TAKES BONDED RUBBER *In Shear* TO ABSORB VIBRATION

**LORD MANUFACTURING COMPANY**  
ERIE, PENNSYLVANIA



**Originators of Shear Type Bonded Rubber Mountings**

**LUSCOMBE ENGINEERING CO.,**

North Wales, Pa.

PERSONNEL: D. A. Luscombe, Owner; K. G. Funk, Treas.; B. B. Melcher, Factory Mgr.; H. P. Greene, Prod. Mgr.; W. E. Reiff, Pur. Dir.; W. B. Shepard, Chief Engr.

**LYCOMING DIV., THE AVIATION CORP.,**  
Williamsport, Pa.

PERSONNEL: V. Emanuel, Ch. of Board; I. Babcock, Pres.; W. F. Wise, L. I. Hartmeyer, B. Conway, I. J. Snader, V. Pres.; R. S. Pruitt, V. Pres. & Secy.; W. A. Mogenssen, V. Pres. & Treas.; G. G. Johnson, Plant Mgr.; H. J. Glasby, Factory Mgr.; E. L. Wilkinson, Prod. Mgr.; R. E. Posthauer, Sales Mgr.; J. J. Elliott, Pur. Dir.; C. Bishop, Pers. Dir.; A. W. Gratop, Pub. Dir.; S. K. Hoffman, Chief Engr.

**LYNCH MANUFACTURING CORP.,**

Defiance, O.

PERSONNEL: M. H. Pendergast, Pres.; F. K. Zimmerman, Treas.; J. P. McCarthy, Prod. Mgr.; R. L. Sears, Sales Mgr.; R. J. Carroll, Pur. Dir.

**LYON METAL PRODUCTS, INC.,** Aurora, Ill.

PERSONNEL: E. D. Power, Pres.; E. W. Nix, Secy. & Treas.; C. E. Gerberich, V. Pres.-Prod.; H. B. Spackman, V. Pres.-Sales; K. C. Walkey, V. Pres.-Dev. & Engrg.; J. T. Hillenbrand, Pur. Dir.; N. Ormand, Pers. Dir.; L. B. Rhodes, Pub. Dir. & Adv. Mgr.; J. B. O'Connor, Chief Engr.

**LYON-RAYMOND CORP.,** Greene, N. Y.

PERSONNEL: G. G. Raymond, Pres.

**M****MCCAULEY STEEL PROPELLER CO.,**

1840 Howell Ave., Dayton 7, O.

PERSONNEL: E. G. McCauley, Pres. & Gen. Mgr.; K. C. Long, V. Pres.; C. P. Pfarrer, Secy.; B. C. Taylor, Treas.; C. E. Adams, Pur. Dir.

**MCCOLPIN-CHRISTIE CORP., LTD.,**

4922 S. Figueroa St., Los Angeles 37, Calif.

PERSONNEL: S. L. Christie, Pres., Gen. Mgr. & Chief Engr.; H. L. Christie, V. Pres.; D. G. Dinsmore, Secy. & Treas.; H. R. Jaenecke, Prod. Mgr.; E. E. Hughes, Sales Mgr.; R. E. Sanderson, Pur. Dir. & Adv. Mgr.

**A Y. McDONALD MFG. CO.,**

12th &amp; Pine St., Dubuque, Ia.

PERSONNEL: D. L. McDonald, Pres.; J. M. McDonald, Jr., Secy.; H. M. McDonald, Treas.; E. Ruh, Prod. Mgr.; C. L. Reeder, Sales Mgr.; J. G. Schuller, Pur. Dir.; A. M. Meyers, Pers. Dir.; E. A. Falkenberg, Factory Mgr.; C. Groen, Chief Engr.

**MCDONNELL AIRCRAFT CORP.,**

St. Louis, Mo.

Memphis, Tenn.

PERSONNEL: J. S. McDonnell, Pres., Sales Mgr., Pub. Dir. & Adv. Mgr.; G. W. Carr, Exec. V. Pres.; L. A. Smith, V. Pres., Secy. & Treas.; C. W. Drake, Factory Mgr.; N. L. Stetsen, Prod. Mgr.; J. M. Lipscomb, Pur. Dir.; F. H. Eyler, Pers. Dir.; G. C. Covington, Chief Engr.

**THE MCGONEGAL MFG. CO.,**

Railroad Ave. &amp; Mozart St., E. Rutherford, N. J.

PERSONNEL: M. E. Vogel, Treas.; Err S. McGonegal, Gen. Mgr. & Adv. Mgr.; Elton S. McGonegal, Prod. Mgr.; R. W. McGonegal, Sales Mgr.; H. C. Renz, Pur. Dir.

**MCGRATH ST. PAUL CO.,**

242 E. Fifth St., St. Paul 1, Minn.

PERSONNEL: J. B. McGrath, Pres.; E. J. McGrath, V. Pres. & Secy.; H. R. Gilden, Gen. Mgr.; W. R. Kuehn, Chief Engr.

**MCQUAY, INC.,** 1600 Broadway N. E.,  
Minneapolis, Minn.

PERSONNEL: R. J. Resch, Pres.; G. Kelting, V. Pres.; E. H. Seelert, Secy., Treas. & Gen. Mgr.; D. P. Wilson, Prod. Mgr.; R. C. Colman, Sales Mgr.; E. M. Fox, Pur. Dir., Pub. Dir. & Adv. Mgr.; W. Carroll, Pers. Dir.; C. L. Bensen, Chief Engr., Aircraft Div.

**MACWHYTE CO.,**

2901 14th Ave., Kenosha, Wisc.

PERSONNEL: J. S. Whyte, Pres. & Gen. Mgr.; R. B. Whyte, V. Pres. & Prod. Mgr.; H. E. Sawyer, V. Pres. & Treas.; M. A. Buntrock, Asst. Secy.; R. G. Diehl, Sales Mgr.-Aircraft; C. F. Lamich, Pur. Dir.; E. G. Knoedler, Pers. Dir.; F. J. Nelson, Pub. Dir. & Adv. Mgr.; H. G. Kinder, Chief Engr.

**MAGNETIC ENGINEERING & MFG. CO.,**

848 Van Houten Ave., Clifton, N. J.

PERSONNEL: J. J. Ferris, Pres., Gen. Mgr. & Sales Mgr.; J. L. Hope, V. Pres. & Prod. Mgr.; F. E. Ferris, Secy., Treas. & Pur. Dir.

**MAGNUM CHEMICAL CO., INC.,**

Garwood, N. J.

PERSONNEL: W. M. Campbell, Pres.; D. Blanchard, V. Pres.-Sales; W. M. Garbe, Secy.; R. W. Mitchell, Prod. Mgr.; R. D. Kreie, Adv. Mgr.; M. Zinty, Chief Engr.

**MAJOR AIRCRAFT FOUNDRY, Puente, Calif.**

PERSONNEL: L. Crosby, Pres., Pub. Dir. & Adv. Mgr.; A. J. Leonard, V. Pres., Gen. Mgr. & Prod. Mgr.; V. Hicks, Secy. & Pers. Dir.; J. Leonard, Treas.; H. Bryan, Sales Mgr. & Pur. Dir.; C. Woods, Chief Engr.

**MALABAR MACHINE CO.,** 5722 Santa Fe  
Ave., Los Angeles 11, Calif.

PERSONNEL: E. P. Grime, Co-Owner & Chief Engr.; G. H. Hutchins, Gen. Mgr.; J. Steele, Prod. Mgr.; B. Matheson, Pur. Dir.; E. Grady, Pers. Dir.; C. Crank, Adv. Mgr.

**P. R. MALLORY & CO., INC.,**3029 E. Washington St., Indianapolis 6,  
Ind.

PERSONNEL: P. R. Mallory, Pres.; J. E. Cain, V. Pres. & Gen. Mgr.; M. E. Hamilton, V. Pres. & Treas.; J. M. Smith, V. Pres.-Mfg.; R. F. Sparrow, V. Pres.-Sales; L. Robbin, V. Pres.-Engrg.; G. Fotheringham, Secy.; H. W. Sams, Sales Mgr.; G. C. Mercer, Pur. Dir.; A. E. Sinclair, Pers. Dir.; R. B. Roberts, Adv. Mgr.

**EDWARD D. MALTBY CO.,**

1718 S. Flower, Los Angeles 15, Calif.

PERSONNEL: E. D. Maltby, Pres. & Gen. Mgr.; C. Russell, Secy. & Treas.; D. D. Gildersleeve, Sales Mgr. & Pers. Dir.; F. C. Warren, Chief Engr.

**THE MANHATTAN RUBBER MFG. DIV.,**  
**RAYBESTOS-MANHATTAN, INC.,**

61 Willett St., Passaic, N. J.

PERSONNEL: J. J. DeMario, Adv. Mgr.

**MANUFACTURERS SCREW PRODUCTS,**

216-222 W. Hubbard St., Chicago 10, Ill.

PERSONNEL: B. J. Sackheim, Pres.; R. M. LeGlaire, Sales Mgr.; F. King, Pur. Dir.; R. S. Weisler, Pers. Dir.; R. Gale, Adv. Mgr.; W. A. Mosow, Chief Engr.

**MARINE-AIR RESEARCH CORP.,**

Annapolis, Md.

PERSONNEL: F. M. Weir, Pres.; P. M. Dolan, V. Pres.; R. E. Bell, V. Pres. & Treas.; W. J. McWilliams, Secy.

**Used on America's Leading Aircraft!**



NO. 732R-A

**MACWHYTE COMPANY**

2901 FOURTEENTH AVENUE      KENOSHA, WISCONSIN

*Manufacturers of "Hi-Fatigue" Aircraft Cable,  
 "Safe-Lock" Cable Terminals, Aircraft  
 Tie-Rods, Braided Wire Rope Slings, Monel Metal and  
 Stainless Steel Wire Rope, and wire rope for all requirements*

**MARKAL CO.,**

607 N. Western Ave., Chicago 12, Ill.  
PERSONNEL: L. Aronberg, Pres.; B. Lytton, Gen. Mgr.

**THE MARQUETTE METAL PRODUCTS CO.,**

1145 Galewood Dr., Cleveland 10, O.  
PERSONNEL: H. Gleitz, Pres.; J. S. Kustin, Secy. & Treas.; C. E. Miller, Sales Mgr.; W. O. Yohe, Pur. Dir.; E. D. Jackson, Mgr. Aircraft Accessories Dept.

**THE GLENN L. MARTIN CO.,**

Baltimore 3, Md.  
PERSONNEL: G. L. Martin, Pres.; J. T. Hartson, H. F. Vollmer, W. K. Ebel, H. T. Rowland, V. Pres.; T. H. Jones, Secy.; M. G. Shook, Treas.; W. C. Miles, Prod. Supt.; T. J. Dunning, Procurement Dir.; D. W. Siemon, Pers. Dir.; A. McBea, Pub. Rel. Dir.; R. Young, Factory Mgr.

**THE MARYLAND BOLT & NUT CO.,**

Mt. Washington 9, Baltimore, Md.  
PERSONNEL: C. S. Duvall, Pres.; W. F. Wheeler, V. Pres.; A. C. Lasko, Secy.; S. S. Spielman, Treas.; E. V. Creagh, Adv. Mgr.

**J. H. MATTHEWS & CO.,**

3942 Forbes St., Pittsburgh 13, Pa.  
PERSONNEL: A. L. Fox, Pres. & Gen. Mgr.; W. Witte, V. Pres. & Prod. Mgr.; T. J. Miers, Secy. & Treas.; R. E. Ginn, Sales Mgr.; G. Gray, Pur. Dir.; H. E. McDonald, Pers. Dir. & Adv. Mgr.; A. M. Brown, Chief Engr.

**MEAD SPECIALTIES CO.,**

4114 N. Knox Ave., Chicago 41, Ill.  
PERSONNEL: T. E. Mead, Gen. Partner & Gen. Mgr.; F. R. Kirchner, Secy.; M. J. Lieser, Prod. Mgr.; E. G. Case, Sales Mgr.; S. F. Streicker, Pur. Dir. & Pers. Dir.; J. E. Mead, Pub. Dir. & Adv. Mgr.; C. E. Lindstedt, Chief Engr.

**MECHANICAL HANDLING SYSTEMS, INC.,**

4600 Nancy Ave., Detroit 12, Mich.  
PERSONNEL: W. V. Casgrain, Pres., Treas., Gen. Mgr. & Adv. Mgr.; L. J. Bishop, V. Pres. & Sales Mgr.; C. H. Haberkorn, Secy.; J. F. O'Donnell, Prod. Mgr.; W. E. Bennett, Pur. Dir.; W. H. Mitchell, Pers. Dir.; H. T. Bourne, Pub. Dir.; A. E. Grann, Chief Engr.

**MELFLEX PRODUCTS CO.,**

415 Wheeler Lane, Akron 8, O.  
PERSONNEL: L. E. Warford, Pres.; H. L. Warford, V. Pres.; M. Houghlan, Prod. Mgr.; W. C. Brooks, Sales Mgr.; J. Peik, Pur. Dir.

**MENASCO MANUFACTURING CO.,**

805 S. San Fernando Blvd., Burbank, Calif.  
PERSONNEL: J. E. Royall, Pres.; R. R. Miller, V. Pres. & Secy.; E. V. Carlson, Treas.; J. E. I'Anson, Works Mgr.; E. B. Challenor, Prod. Mgr.; J. H. Smith, Sales Mgr.; D. E. Erickson, Pur. Dir.; C. H. Alfred, Pers. Dir.; W. G. Wood, Chief Engr.

**MENAUGH-DUTTERER CO.,**

549 Washington Blvd., Chicago 6, Ill.  
PERSONNEL: J. E. Menaugh, Pres.; R. J. L. Dutterer, V. Pres. & Chief Engr.

**MERCURY AIRCRAFT INC.,**

Hammondsport, N. Y.  
PERSONNEL: J. F. Meade, Pres. & Gen. Mgr.; E. M. Meade, V. Pres.; M. C. Close, Secy.; S. Singer, Treas.; R. F. Moore, Sales Mgr. & Adv. Mgr.; C. F. Guthy, Pur. Dir.; M. D. Linehan, Pers. Dir.; R. W. Heffer, Chief Engr.

**MERRILL ENGINEERING LABORATORIES,**

1240 Lincoln St., Denver 3, Colo.  
PERSONNEL: M. S. Merrill, Owner, Gen. Mgr. & Adv. Mgr.; R. W. Becker, Prod. Mgr., Sales Mgr. & Chief Engr.; F. Duncanson, Pur. Dir. & Pers. Dir.

**MERZ ENGINEERING CO.,**

200 S. Harding St., Indianapolis, Ind.  
PERSONNEL: C. C. Merz, Pres.; B. Dingley, V. Pres.; W. P. Nottingham, Secy.; E. J. Breech, Treas. & Gen. Mgr.; H. Bose, Prod. Mgr.; G. Stassus, Sales Mgr.; R. G. Butcher, Pur. Dir.; J. C. Clark, Pers. Dir.; C. A. Campbell, Pub. Dir. & Adv. Mgr.; W. Powell, Chief Engr.

**METAL & TOOL RECONDITIONING CORP.,**

250 W. 54th St., New York, N. Y.  
PERSONNEL: S. M. Cleja, Pres. & Treas.; H. Esquette, V. Pres.; B. R. Payn, Secy.; E. J. Herman, Gen. Mgr. & Pur. Dir.; M. Becht, Prod. Mgr.; A. E. Benfield, Sales Mgr.; S. Kata, Pers. Dir.; R. Messinger, Pub. Dir.; F. Becht, Chief Engr.

**METROPOLITAN SUPPLY CO.,**

353 E. Second St., Los Angeles 12, Calif.  
PERSONNEL: J. H. Leeds, Owner; H. C. Brister, Sales Mgr., Aviation Specialties.

**MEYERS AIRCRAFT CO.,**

Box 721 Tecumseh, Mich.  
PERSONNEL: A. H. Meyers, Pres., Sales Mgr., Pub. Dir., Adv. Mgr. & Chief Engr.; C. F. Sage, V. Pres.; B. W. Hoffman, Secy., Treas. & Pur. Dir.; O. Meier, Gen. Mgr. & Prod. Mgr.

**MEYERS & MARTIN MACHINE CO.,**

6920 S. Central Ave., Los Angeles 1, Calif.  
PERSONNEL: M. M. Martin, Gen. Mgr.; A. Schmitz, Prod. Mgr.; J. Evans, H. P. Vanderpool, R. W. Reach, Sales; D. H. Jones, Office Mgr.

**MICA INSULATOR CO.,**

200 Varick St., New York 14, N. Y.  
PERSONNEL: M. A. Chapman, Pres.; C. P. Mills, V. Pres.; E. Nelson, Secy. & Treas.; G. C. Jetter, Gen. Mgr., Pers. Dir. & Adv. Mgr.; L. L. Hartle, Sales Mgr.; Q. F. Jardine, Pur. Dir.

**MICHIGAN SEAMLESS TUBE CO.,**

S. Lyon, Mich.  
PERSONNEL: W. A. McHattie, Pres. & Gen. Mgr.; M. D. Bullard, V. Pres. & Pur. Dir.; J. L. Faber, Secy. & Treas.; M. M. Weiss, Prod. Mgr.; R. A. Armstrong, Sales Mgr. & Adv. Mgr.; R. E. Rash, Pers. Dir.; J. A. Findlay, Pub. Dir.; T. C. Moran, Chief Engr.

**MICHIGAN TOOL CO.,**

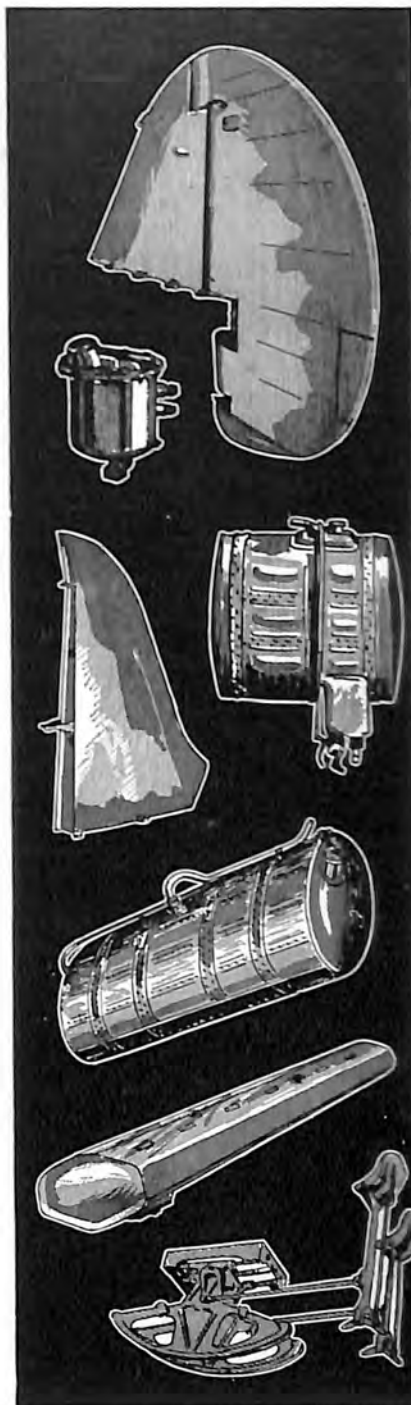
7171 E. McNichols Rd., Detroit 12, Mich.  
PERSONNEL: O. L. Bard, Pres.; M. R. Anderson, V. Pres.; J. C. Drader, Gen. Mgr. & Prod. Mgr.; P. P. Zerke, Sales Mgr.; P. Norman, Pur. Dir.; A. F. Denham, Adv. Mgr.; C. R. Staub, F. L. Birch, Chief Engrs.

**MICRO SWITCH DIV., FIRST INDUSTRIAL CORP.,**

Freeport, Ill.  
PERSONNEL: W. B. Schulte, Pres. & Adv. Mgr.; A. L. Riche, V. Pres. & Gen. Mgr.; W. W. Gilmore, V. Pres. & Prod. Mgr.; M. W. Eaton, Asst. Secy.; C. J. Slater, Asst. Treas.; F. E. Wiley, Sales Mgr.; W. L. Young, Pur. Dir.; P. A. Celandar, Chief Engr.

**THE ALEXANDER MILBURN CO.,**

1416-28 W. Baltimore St., Baltimore 23, Md.  
PERSONNEL: A. F. Jenkins, Pres. & Treas.; W. L. Lawrence, V. Pres., Gen. Mgr. & Sales Mgr.; M. D. Maguire, Secy.



... for 25 years,  
 the Mercury Mark  
 has stood for pre-  
 cision and skill in  
 craftsmanship, plus  
 a sixth sense which  
 can be acquired only  
 through experience  
 ... the *know how* to  
 do a job right . . .

aluminum fuel and oil  
 tanks • ailerons, fins,  
 rudders and similar  
 surfaces • aircraft parts  
 and accessories.

AT *The Cradle of Aviation*





**THE MILFORD RIVET & MACHINE CO.,**

857 Bridgeport Ave., Milford, Conn.  
 PERSONNEL: F. H. Merwin, Pres. & Gen. Mgr.; S. Simpson, V. Pres.; R. B. Davis, Secy.; A. R. Knight, Treas. & Prod. Mgr.; A. M. Birks, Sales Mgr. & Adv. Mgr.; H. P. Brewer, Pur. Dir.; J. Lockwood, Pers. Dir.; V. M. Caltham, Chief Engr.

**MILERS FALLS CO., Greenfield, Mass.**

PERSONNEL: P. Rogers, Pres. & Gen. Mgr.; G. U. Hatch, V. Pres. & Sales Mgr.; E. D. Holtby, Secy. & Treas.; D. B. Swain, Prod. Mgr.; C. W. Parsons, Pur. Dir.; K. Y. Taylor, Adv. Mgr.; W. J. Parsons, Chief Engr.

**MILWAUKEE ELECTRIC TOOL CORP.,**

106-8 N. Water St., Milwaukee 2, Wisc.  
 PERSONNEL: A. F. Siebert, Pres. & Gen. Mgr.; W. K. Beckwith, V. Pres.; A. E. Lange, Secy. & Pers. Dir.; R. L. Siebert, Treas. & Pur. Dir.; A. R. Buchholz, Prod. Mgr.; L. T. Morand, Sales Mgr.; H. W. Welch, Pub. Dir. & Adv. Mgr.; E. W. Ristow, Chief Engr.

**MILWAUKEE METAL SPINNING CO.,**

1325 S. 43rd St., Milwaukee 14, Wisc.  
 PERSONNEL: T. J. Salow, Sr., Pres.; T. J. Salow, Jr., V. Pres. & Gen. Mgr.; K. Salow, Secy. & Treas.; G. A. Mast, Prod. Mgr.; G. P. Farley, Sales Mgr.; R. W. Fink, Pur. Dir. & Pers. Dir.; H. Kupter, Adv. Mgr.; E. Weiss, Chief Engr.

**MODELS, INC.,**

1112 12th St., N. Bergen, N. J.  
 PERSONNEL: L. F. Werner, Pres. & Gen. Mgr.; A. Zinsser, Jr., V. Pres. & Chief Engr.; C. Meyle, Secy., Treas. & Pur. Dir.

**MONITE WATERPROOF GLUE CO.,**

1628 N. Second St., Minneapolis 11, Minn.  
 PERSONNEL: H. L. Prestholdt, Pres.; H. W. Mattison, V. Pres.; L. F. Prestholdt, Secy.

**MONOGRAM MANUFACTURING CO.,**

3406 W. Washington Blvd., Los Angeles 16, Calif.  
 PERSONNEL: H. H. Helbush, Pres.; E. R. Livingston, V. Pres.; L. T. Hutter, Secy.; W. F. Hauser, Sales Mgr.

**MONSANTO CHEMICAL CO., MERRIMAC**

DIV., Everett Station, Everett 49, Mass.  
 PERSONNEL: C. Belknap, Pres.; W. M. Rand, V. Pres.; D. S. Dinsmoor, Gen. Mgr.; A. L. Gardner, Prod. Mgr.; R. O. Fernandez, Sales Mgr.; E. Hathaway, Pur. Dir.; E. R. Chapin, Adv. Mgr.

**MOOG INDUSTRIES, INC.,**

6650 Easton Ave., St. Louis 14, Mo.  
 PERSONNEL: H. P. Moog, Pres., Treas. & Gen. Mgr.; A. A. Apple, V. Pres. & Sales Mgr.; A. M. Goetz, Secy.; G. E. Baumgartner, Prod. Mgr.; P. J. Percich, Pur. Dir.; E. Paine, Pers. Dir.; J. A. Maxwell, Pub. Dir. & Adv. Mgr.; H. Paine, Chief Engr.

**MOORE-EASTWOOD & CO.,**

537 E. Monument Ave., Dayton 2, O.  
 PERSONNEL: H. C. Moore, Owner & Gen. Mgr.; V. Augspurger, Treas.; F. Schrotberger, Prod. Mgr.; L. Scheid, Sales Mgr. & Pur. Dir.; R. C. Moore, Chief Engr.

**MURPHY FINISHES CORP.,**

224 McWhorter St., Newark 1, N. J.  
 PERSONNEL: C. J. Roh, Pres.; P. S. Kennedy, V. Pres.; Z. Belcher, Secy. & Pers. Dir.; R. H. Sommer, Sales Mgr. & Adv. Mgr.; T. I. Savage, Pur. Dir.; A. Anderson, Chief Engr.

**THE MURRAY CORP. OF AMERICA,**

7700 Russell St., Detroit 11, Mich.  
 PERSONNEL: C. W. Avery, Pres.; B. C. Gould, V. Pres.-Operations; C. D. Widman, V. Pres.-Finance; J. H. Barrett, Secy. & Treas.; C. H. Menge, Sales Mgr.; M. B. Lindquist, Pur. Dir.; F. W. Hall, Pers. Dir.; J. P. Sexton, Pub. Dir.; O. F. Graebner, Chief Engr.

**MUSKOGON PISTON RING CO.,**

Sixth & Alpha Sts., Muskegon, Mich.  
 PERSONNEL: T. E. McFall, Pres.; H. G. Vaughan, G. W. Lundeen, V. Pres.; G. Fifield, Secy.; G. D. Abbott, Treas.; J. A. Nadeau, Pur. Dir.; W. A. DeVette, Pers. Dir.; P. S. Lane, Chief Research Engr.

## N

**NATIONAL LEAD CO.,**

111 Broadway, New York 6, N. Y.  
 PERSONNEL: F. W. Rockwell, Pres.; H. O. Bates, Secy.; C. Simon, Treas.; F. J. Shirley, Prod. Mgr.; W. Knust, Adv. Mgr.; A. Mayer, Chief Engr.

**NATIONAL MACHINE PRODUCTS,**

150 W. Slauson Ave., Los Angeles 3, Calif.  
 PERSONNEL: R. F. Sopris, Pres. & Gen. Mgr.; L. H. Scagrave, V. Pres.; H. E. Vorhis, Secy. & Treas.; C. A. Dickinson, Prod. Mgr.; R. H. Spitznas, Sales Mgr.; W. E. Griffin, Pur. Dir.; G. P. Bristow, Pers. Dir.; J. Lampl, Chief Engr.

**NEW DEPARTURE, DIV. OF GENERAL MOTORS CORP.,**

Bristol, Conn.  
 PERSONNEL: F. G. Hughes, Gen. Mgr.; N. C. Branch, Prod. Mgr.; L. G. Sigourney, Gen. Sales Mgr.; J. A. Ashwell, Pur. Dir.; C. B. Greene, Pers. Dir.; C. B. Beckwith, Adv. Mgr.; T. C. D. Crow, Chief Engr.

**NICE BALL BEARING CO., 30th & Hunting**

Park Ave., Philadelphia 40, Pa.  
 PERSONNEL: G. Carleton, Jr., Exec. V. Pres.; W. O. Schirmer, Pur. Dir.; T. E. Spilker, Adv. Mgr.

**NORMA-HOFFMANN BEARINGS CORP.,**

Hamilton Ave., Stamford, Conn.  
 PERSONNEL: O. P. Wilson, Pres. & Treas.; F. W. Mesinger, V. Pres.-Sales; C. E. Stevens, V. Pres.-Plant Operations; D. E. Batesole, V. Pres. & Chief Engr.; C. A. Wattson, Pur. Agt.; P. Osterby, Pers. Dir.

**NORTH AMERICAN ELECTRIC LAMP CO.,**

1014 Tyler St., St. Louis 6, Mo.  
 PERSONNEL: C. M. Rice, Pres.; E. O. Cohn, V. Pres.; L. Lander, Secy., Treas. & Gen. Mgr.; H. N. Adelstein, Prod. Mgr. & Pur. Dir.

**NORTHERN AIRCRAFT PRODUCTS DIV., THE AVIATION CORP.,**

Adams & 14th Sts., Toledo, O.  
 PERSONNEL: V. Emanuel, Ch. of Board; I. Babcock, Pres.; W. F. Wise, L. I. Hartmeyer, B. Conway, I. J. Snader, V. Pres.; R. S. Pruitt, V. Pres. & Secy.; W. A. Mogensen, V. Pres. & Treas.; H. C. Deckard, Plant Mgr.; J. O. LaTulip, Prod. Mgr.; R. Luallen, Pur. Dir.; S. Lashley, Pers. Dir.; A. W. Gratop, Pub. Dir.; J. E. Wells, Adv. Mgr.

**NORTHWEST AIR SERVICE, INC.,**

Boeing Field, Seattle 8, Wash.  
 PERSONNEL: C. H. Babb, Pres.; J. E. Crosson, V. Pres.; N. Wien, Treas.

**"NORMA-HOFFMANN"**

**PRECISION BEARINGS**

BALL, ROLLER AND THRUST

Norma-Hoffmann is devoting all its resources and its 33 years' experience to the production of Precision Bearings for Army, Navy and Air Corps units.



NORMA-HOFFMANN BEARINGS CORP'N., STAMFORD, CONN., U. S. A.—FOUNDED 1911

**MOORE EASTWOOD & CO.**

**DAYTON**

**OHIO.**

**Manufacturers of Airplane Parts,  
Especially Armament Equipment  
for past 21 years — Contractors  
For Army, Navy, and Leading  
Airplane Companies.**

**NUKRAFT MANUFACTURING CO.,**Shelbyville, Ind.  
PERSONNEL: R. R. Gross, Gen. Mgr.**NUMBERALL STAMP & TOOL CO.,**Huguenot Park, Staten Island, N. Y.  
PERSONNEL: M. Bayerdorffer, Pres.; C. Zeitler, V. Pres.

## O

**THE OHIO ELECTRIC MFG. CO.,**5901 Bellford Ave., Cleveland 4, O.  
PERSONNEL: J. W. Jessop, Pres.**THE OHIO PISTON CO.,**5340 Hamilton Ave., Cleveland 14, O.  
PERSONNEL: C. Birnbaum, Pres.; E. J. Gutman, V. Pres.; D. P. Shaw, Secy., Gen. Mgr., Prod. Mgr., Sales Mgr. & Adv. Mgr.; R. G. Horsburgh, Treas.; G. Svetcoff, Chief Engr.**OHMITE MANUFACTURING CO.,**4835 W. Flornoy St., Chicago 44, Ill.  
PERSONNEL: D. T. Siegel, Pres.; R. S. Laird, V. Pres.-Sales; J. S. Howe, V. Pres.-Prod.; W. B. Hills, Treas.; A. Stolzenfeldt, Pur. Dir.; J. H. Smale, Pers. Dir.; L. H. Ritzma, Adv. Mgr.; H. Levy, Chief Engr.**OLDS ALLOYS CO.,**8686 Rheem Ave., South Gate, Calif.  
PERSONNEL: R. B. Olds, Pres.; P. S. Rattle, V. Pres., Secy. & Sales Mgr.; M. E. Greenhow, V. Pres. & Gen. Mgr.; R. D. Madsen, Treas. & Pur. Dir.**OLMSTED MANUFACTURING DIV.,  
SOUTHWESTERN DEVELOPMENT  
CO.,** 511 S. Redondo Blvd., Inglewood,  
Calif.

PERSONNEL: A. B. Ruddock, Pres.; L. W. Olmstead, V. Pres. &amp; Gen. Mgr.; E. Neuhoft, Secy.; B. Johnson, Sales Mgr.; J. H. Henderson, Pur. Dir.; B. W. Grothe, Chief Engr.

**ONSRUD MACHINE WORKS, INC.,**3900 W. Palmer St., Chicago 47, Ill.  
PERSONNEL: R. F. Onsrud, Pres.; J. Knox, Secy. & Pur. Dir.; R. C. Reinhartsen, Sales Mgr. & Adv. Mgr.; H. Grondahl, Chief Engr.**OPERADIO MANUFACTURING CO.,**St. Charles, Ill.  
PERSONNEL: J. M. Stone, Pres.; G. R. Haase, V. Pres.; L. A. King, Secy. & Treas.; F. D. Wilson, Sales Mgr.; E. E. Swick, Pur. Dir.; A. F. Hunecke, Pers. Dir.**OTTO AVIATION CORP.,**256 Liberty St., Bloomfield, N. J.  
PERSONNEL: B. R. Otto, Pres. & Gen. Mgr.; W. D. Dayton, V. Pres., Prod. Mgr. & Chief Engr.; F. Amato, Treas.; J. C. Kerr, Sales Mgr.; C. O. Pühlblad, Pur. Dir.; B. Mason, Pers. Dir.**OZALID, DIV. GENERAL ANILINE & FILM  
CORP.,** Johnson City, N. Y.

PERSONNEL: J. W. Coffman, Gen. Mgr.; W. Beebe, Prod. Mgr.; S. Orth, Sales Mgr.; N. Cihivsky, Pur. Dir.; E. Wagner, Pers. Dir.; E. J. Shelley, Pub. Dir. &amp; Adv. Mgr.; F. O. Trump, Chief Engr.

## P

**PAASCHE AIRBRUSH CO.,**1909-1929 Diversey Pkwy., Chicago 14,  
Ill.

PERSONNEL: J. A. Paasche, Pres.; H. F. Reck, V. Pres.; C. H. Smith, Adv. Mgr.; E. W. Berg, Chief Engr.

**PACIFIC CAR & FOUNDRY CO.,**Renton, Seattle, Wash.  
Billings, Mont.  
PERSONNEL: P. Pigott, Pres.; H. Curd, V. Pres. & Gen. Mgr.; F. Schmitz, V. Pres.; J. LeBlanc, Secy. & Treas.; F. Stewart, Prod. Mgr.; T. Monson, Sales Mgr.; D. Newell, Sales Mgr., Aviation Div.; H. Ridalls, Pur. Dir.; C. Bailey, Pers. Dir.; J. L. Hamilton, Pub. Dir. & Adv. Mgr.; T. Hendrickson, Chief Engr.**PACIFIC DIV., BENDIX AVIATION CORP.,**  
11600 Sherman Way, N. Hollywood,  
Calif.

PERSONNEL: P. Nicholls, Gen. Mgr.; M. M. Burns, Asst. Gen. Mgr.; J. Hannum, Pur. Agt.; A. Malmquist, Pers. Mgr.; J. B. Shaw, Adv. Mgr.; W. C. Trautman, Chief Development Engr., Hydraulic; H. Winchel, Chief Development Engr., Radio.

**PACIFIC ENGINEERING CORP.,**3123 San Fernando Rd., Los Angeles,  
Calif.

PERSONNEL: R. Swaisgood, Pres.; H. Steinberger, V. Pres.; J. S. Spence, Secy. &amp; Treas.; C. E. Swift, Sales Mgr. &amp; Adv. Mgr.; C. Roth, Pur. Dir.; M. Hanson, Chief Engr.

**PACIFIC FIRE EXTINGUISHER CO.,**142 Ninth St., San Francisco 3, Calif.  
PERSONNEL: B. L. Davis, Pres.; S. H. Hardin, V. Pres. & Gen. Mgr.; J. F. Pugh, Secy. & Treas.; F. A. Briggs, Sales Mgr.; A. Johnson, Pur. Dir.; J. Snow, Chief Engr.**PACIFIC PUMPS INC.,**5715 Bickett St., Huntington Park, Calif.  
PERSONNEL: A. R. Weis, Pres.; E. J. Weis, V. Pres.; D. P. Brush, Gen. Mgr.; A. A. Christainsen, Prod. Mgr.; D. B. Wait, Sales Mgr.; G. W. Thompson, Pur. Dir.; C. F. Connelly, Pers. Dir.; L. J. Cleveland, Chief Engr.**PACKARD ELECTRIC DIV., GENERAL  
MOTORS CORP.,** Warren, O.

PERSONNEL: B. N. MacGregor, Gen. Mgr.; R. E. Hatch, Prod. Mgr.; R. J. Montgomery, Sales Mgr.; E. E. DeBolt, Pur. Dir.; J. Blair, Pers. Dir.; R. I. Williams, Pub. Dir.; H. C. Mohr, Adv. Mgr.; L. C. Wolcott, Chief Engr.

**THE PARKER APPLIANCE CO.,**17325 Euclid Ave., Cleveland 12, O.  
PERSONNEL: H. I. Markham, Pres.; C. H. Wagner, Secy.; F. A. Rolls, Treas.; R. L. Hous, Gen. Mgr.; R. E. Felix, Prod. Mgr.; F. E. Amon, Sales Mgr.; H. H. Krause, Pur. Dir.; W. R. Meredith, Pers. Dir.; R. A. Nelson, Adv. Mgr.; L. H. Schmolh, Chief Engr.**THE PARKER STAMP WORKS, INC.,**650 Franklin Ave., Hartford, Conn.  
PERSONNEL: H. L. Bitter, Pres. & Treas.; H. C. Bitter, V. Pres.; J. T. F. Bitter, Secy., Gen. Mgr., Sales Mgr. & Adv. Mgr.; T. H. Daley, Pur. Dir.; E. Wild, Chief Engr.**THE PAULSON TOOLS INC.,**  
Wallingford, Conn.

PERSONNEL: C. H. Loucks, Pres. &amp; Gen. Mgr.; E. W. Thompson, V. Pres.; J. E. Wrinn, Secy.; J. J. Brosnan, Treas.

**PEERLESS MACHINE CO.,**1600 Junction Ave., Racine, Wisc.  
PERSONNEL: J. R. McDonald, Pres.; C. O. Wanvig, V. Pres. & Treas.; J. R. Duncan, Secy., Gen. Mgr. & Sales Mgr.; A. Mainland, Prod. Mgr.; O. H. Geschke, Pur. Dir.; J. O. Ferch, Pub. Dir. & Adv. Mgr.; O. M. Jensen, Chief Engr.

# Parker Products

PRECISION - BUILT

## TUBE COUPLINGS

Parker patented precision tube couplings . . . aircraft and industrial . . . are designed and built to withstand both high pressures and extreme temperatures. The basic Parker design is incorporated in Army-Navy specifications for all aircraft fittings.



## VALVES

Parker precision valves function perfectly over a wide range of temperatures and pressures. Designed and built to meet specific needs, Parker valves are recognized by all industry as quality products backed by sound engineering development.



\* \* \*

Offset globe, ball check, needle, high-pressure check, shuttle, relief, fuel selector (manual and motor-driven), swing check, engine primer, and special valves.

*Catalog 50B gives complete information.*

The **PARKER APPLIANCE** Company  
 17325 Euclid Avenue • Cleveland 12, Ohio

**PEIGER, McCAW & CO.,**

318-320 First Ave., Pittsburgh 22, Pa.  
PERSONNEL: J. J. Peiger, Pres.; R. T. McCaw, V. Pres.

**PENN BRASS & COPPER CO., INC.,**

20th and Powell Ave., Erie, Pa.  
PERSONNEL: K. W. Wilks, Pres. & Gen. Mgr.; A. E. Halstead, Secy.; J. H. Roach, Treas.; L. Gehrlein, Prod. Mgr.; R. K. Wilks, Sales Mgr. & Adv. Mgr.; A. T. Anderson, Pur. Dir.

**THE PENNZOIL CO.,** Oil City, Pa.

PERSONNEL: W. S. Zehrung, Pres. & Gen. Mgr.; M. A. Brewster, V. Pres. & Treas.; D. W. Grant, V. Pres.; R. A. Browne, Secy.; J. M. Hinman, Prod. Mgr.; V. Benson, Sales Mgr.-Lubrication; J. G. Miller, Sales Mgr.-Gasoline; A. W. Clinger, Pur. Dir.; J. F. Vandeventer, Pers. Dir.; E. F. Johnson, Pub. Dir. & Adv. Mgr.; D. G. Proudfoot, Chief Engr.

**PERMOFLUX CORP.,**

4900 W. Grand Ave., Chicago 39, Ill.  
PERSONNEL: L. M. Heineman, Pres.; W. E. Gilman, V. Pres.; M. F. Heineman, Treas.

**THE PERMOLD CO.,**

P. O. Box 70, Medina, O.  
PERSONNEL: E. G. Fahlman, Pres., Treas. & Gen. Mgr.; L. E. DeGroat, V. Pres., Sales Mgr. & Adv. Mgr.; H. R. Doswell, Secy. & Prod. Mgr.; A. Eble, Pur. Dir.; H. D. MacCullough, Pers. Dir.; S. W. Jackson, Chief Engr.

**PERRY METAL PRODUCTS CO., INC.,**

Atlantic Ave., Brooklyn 16, N. Y.  
PERSONNEL: S. Sack, Pres., Treas., Sales Mgr., Pub. Dir. & Adv. Mgr.; E. R. Elliott, V. Pres.; M. Rubinson, Secy.; O. R. Gischow, Gen. Mgr.; F. Wagner, Prod. Mgr.; B. Cooper, Pur. Dir.; P. Lannert, Pers. Dir.; C. Holinger, Chief Engr.

**PESCO PRODUCTS CO.,**

11610 Euclid Ave., Cleveland 6, O.  
PERSONNEL: R. J. Minshall, Pres. & Gen. Mgr.; N. M. Forsythe, V. Pres.; C. Bissell, Secy.; J. L. Menart, Treas.; E. M. Whalley, Prod. Mgr.; E. S. Moreland, Sales Mgr.; J. A. Pittner, Pur. Dir.; A. H. Brown, Pers. Dir.; S. E. Voran, Pub. Dir. & Adv. Mgr.; J. A. Lauck, Chief Engr.

**ARTHUR D. PETERSON CO., INC.,**

420 Lexington Ave., New York, N. Y.  
PERSONNEL: A. D. Peterson, Pres.; A. H. Tull, V. Pres. & Sales Mgr.; J. M. Finlayson, V. Pres.; A. F. Keefe, Secy. & Treas.

**PETROLEUM SOLVENTS CORP.,**

331 Madison Ave., New York 17, N. Y.  
PERSONNEL: L. A. Staff, Pres.; S. V. Hirschman, Secy. & Treas.; B. H. Jacoby, Adv. Mgr.

**PHEOLL MANUFACTURING CO.,**

5700 W. Roosevelt Rd., Chicago 50, Ill.  
PERSONNEL: M. Phelps, Pres.; E. M. Whiting, V. Pres. & Gen. Mgr.; J. J. Schwander, Secy. & Treas.; A. J. MacDonald, Prod. Mgr.; J. A. Perry, Sales Mgr.; A. A. Schmid, Pur. Dir.; M. Jensen, Pers. Dir.; N. L. Marvin, Adv. Mgr.; F. P. Tisch, Chief Engr.

**PHILLIPS AVIATION CO.,**

1525 Monterey Rd., S. Pasadena, Calif.  
PERSONNEL: J. A. Phillips, Jr., Pres. & Gen. Mgr.; D. B. Morgan, V. Pres.; L. M. Phillips, Secy. & Treas.; O. A. Phillips, Prod. Mgr. & Chief Engr.; C. A. Mason, Pur. Dir.; B. Swartz, Pers. Dir.

**PHILLIPS MFG. CO.,**

3475 Touhy Ave., Chicago 45, Ill.  
PERSONNEL: M. B. Phillips, Pres.; J. M. Bash, Gen. Mgr.; I. Concell, Pur. Dir.; J. Hanley, Pub. Dir. & Adv. Mgr.; J. Holbrook, B. Ticha, Engrs.

**PIONEER ENGINEERING & MFG. CO.,**

19669 John R. St., Detroit, Mich.  
PERSONNEL: A. M. Sargent, Pres., Gen. Mgr., Sales Mgr. & Adv. Mgr.; E. M. Beyma, V. Pres.; P. C. Querry, Secy. & Treas.; D. J. Lowe, Pur. Dir.; H. C. French, Chief Engr.

**PIONEER PARACHUTE CO., INC.,**

Manchester, Conn.  
PERSONNEL: H. R. Mallory, Pres. & Treas.; S. H. Ford, V. Pres.; C. D. Cheney, Secy.

**PLASTIC MANUFACTURERS, INC.,**

280 Fairfield Ave., Stamford, Conn.  
PERSONNEL: M. A. Wick, Pres.; H. Wick, V. Pres.-Operations; M. Farmer, V. Pres. & Gen. Mgr.; G. C. Bovaird, V. Pres. & Sales Mgr.; K. D. Browne, Secy. & Treas.; G. P. Bohrer, Prod. Mgr.; J. C. Harre, Pur. Dir.; R. Whale, Pers. Dir.; J. C. Prior, Chief Engr.

**PLASTIC & RUBBER PRODUCTS CO.,**

2100 Hyde Park Blvd., Los Angeles 44, Calif.

PERSONNEL: N. O. Hulsey, M. Pierce, Co-Owners; J. L. Nece, Prod. Mgr.; J. S. Reid, Pur. Dir.; K. M. Rogers, Pers. Dir.; T. B. Keenan, Chief Engr.

**POLLAK MANUFACTURING CO.,**

Arlington, N. J.  
PERSONNEL: L. L. Pollak, Pres.; C. Schlesinger, Exec. V. Pres.; P. Calabro, V. Pres.; S. Tischler, Secy.; G. A. King, Treas.; C. D. Koch, Sales Engr.; R. D. Heebner, Pur. Dir.; C. A. Wood, Pers. Dir.; D. N. Conklin, Pub. Dir. & Adv. Mgr.; H. E. Davies, Chief Engr.

**POOLE BROS. INC.,**

85 W. Harrison St., Chicago 5, Ill.  
PERSONNEL: G. A. Poole, Pres.; G. A. Poole, Jr., V. Pres. & Treas.; M. S. McGurn, Secy.; P. A. Johnston, Sales Mgr.; A. Reinhardt, Pur. Dir.

**THE PORCUPINE CO.,**

200 Eliot St., Fairfield, Conn.  
PERSONNEL: R. L. Alvey, Asst. Treas.

**PRECISION TUBE CO., 3824-26-28 Terrace St., Philadelphia 28, Pa.**

PERSONNEL: N. H. Jack, Pres. & Treas.; N. H. Jack, Jr., V. Pres. & Gen. Mgr.; F. Castleman, Secy. & Pur. Dir.; G. Swint, Prod. Mgr.; G. Turney, Sales Mgr. & Adv. Mgr.

**PRECO INC.,**

960 E. 61st St., Los Angeles 1, Calif.  
PERSONNEL: C. T. Hill, Pres.; H. J. Wieden, V. Pres. & Gen. Mgr.; C. R. Nissen, Secy. & Treas.; L. F. Etter, Prod. Control; E. Zuchelli, Sales Mgr.; E. R. Davis, Pur. Dir.; E. F. Stoner, Chief Engr.

**PRESSED & WELDED STEEL PRODUCTS CO., INC., 38-61 11th St., Long Island City 1, N. Y.**

PERSONNEL: W. E. Haskin, Pres.; W. C. Foster, V. Pres. & Treas.; W. J. Carnes, Secy. & Sales Mgr.; E. Schanzer, Prod. Mgr. & Chief Engr.; R. J. Dealy, Pur. Dir.; C. R. Thomas, Pers. Dir.; C. B. Chisholm, Pub. Dir. & Adv. Mgr.

**PRINTLOID, INC.,**

93 Mercer St., New York 12, N. Y.  
PERSONNEL: G. Margolish, Pres. & Treas.; M. Margolish, V. Pres.; S. Helfman, Secy.; C. Legler, Prod. Mgr.; L. Green, Pur. Dir.; M. Lome, Chief Engr.

**PIONEER PARACHUTES**  
**THE VANGUARD OF VICTORY**

**PIONEER PARACHUTE COMPANY, INC.**  
 MANCHESTER, CONNECTICUT, U. S. A.

CHENEY fabrics ARMY U.S. ARMY U.S. ARMY

CABLE ADDRESS: PIPAR, TELEPHONE: Manchester 4157

WEST COAST FACTORY BRANCH, 109 SOUTH CENTRAL AVENUE, GLENDALE 4, CALIFORNIA

## ARTHUR D. PETERSON COMPANY INC.

WORTHINGTON MOWER CO.

GRASS BLITZERS & TRACTORS

J. I. CASE COMPANY, INC.

INDUSTRIAL TRACTORS

MATHER MANUFACTURING COMPANY, INC.

MATERIAL HANDLING EQUIPMENT

BUCKNER MANUFACTURING CO.

IRRIGATION EQUIPMENT

### Grass Seed & Fertilizers

TURF PRODUCTION BY CONTRACT

420 Lexington Ave., New York 17, N. Y.  
 Mohawk 4-4151

**PROCUNIER SAFETY CHUCK CO.,**

18 S. Clinton St., Chicago 6, Ill.  
PERSONNEL: H. G. Procunier, Pres.; J. A. McConnell, Secy.

**PRODUCTS ENGINEERING CO.,**

9045 Wilshire Blvd., Beverly Hills, Calif.  
PERSONNEL: L. A. Spievak, Pres.; J. P. Vogel, Gen. Mgr.; L. T. Adams, Prod. Mgr.; E. C. Babbitt, Sales Mgr. & Adv. Mgr.; P. Stein, Pur. Dir.; J. Pensack, Pers. Dir.; W. Walker, Chief Engr.

**PROGRESSIVE WELDER CO.,**

3050 E. Outer Dr., Detroit 12, Mich.  
PERSONNEL: F. H. Johnson, Pres.; L. M. Benkert, Gen. Mgr. & Prod. Mgr.; J. D. Gordon, Sales Mgr.; W. D. Nixon, Pur. Dir.; D. W. Drury, Pub. Dir.; A. F. Denham, Adv. Mgr.; K. Swanson, Chief Engr.

**PURITAN COMPRESSED GAS CORP.,**

2012 Grand Ave., Kansas City 8, Mo.  
PERSONNEL: P. P. Francia, Pres.; R. E. Stone, Prod. Mgr.; R. E. Koons, Sales Mgr.; E. P. Muller, Adv. Mgr.; C. H. Welty, Chief Engr.

**PURULATOR PRODUCTS, INC.,**

365 Frelinghuysen Ave., Newark 5, N. J.  
PERSONNEL: R. R. Layte, Pres. & Gen. Mgr.; F. P. Herman, V. Pres. & Sales Mgr.; E. B. Headden, V. Pres.; H. W. Thogode, Treas.; R. L. Irvine, Prod. Mgr.; L. E. Welch, Pur. Dir.; M. H. Hartwell, Pers. Dir.; J. P. Kovacs, Chief Engr.

**PYRENE MANUFACTURING CO.,**

560 Belmont Ave., Newark 8, N. J.  
PERSONNEL: E. J. Waring, Pres.; E. G. Weed, Exec. V. Pres.; G. H. Boucher, J. E. Fitz-Simons, V. Pres.; E. A. Clapp, Secy. & Treas.; D. R. Gamble, Prod. Mgr.; H. L. Friedauf, Pur. Dir.; G. H. Phillips, Pers. Dir.; T. O. Young, Adv. Mgr.; F. A. Dodelin, Chief Engr.

**PYROXYLIN PRODUCTS, INC.,**

4851 S. St. Louis Ave., Chicago 32, Ill.  
PERSONNEL: P. S. Fawkes, Pres.; W. C. Wilson, V. Pres., Treas. & Gen. Mgr.; C. E. Fawkes, Secy. & Sales Mgr.; L. C. Powell, Prod. Mgr.; I. Erhardt, Pur. Dir.; E. W. Trolander, Pub. Dir.; P. H. Yoder, Adv. Mgr.; W. S. Ashley, Chief Engr.

---

**R**

---

**R C A VICTOR DIV., RADIO CORP. OF AMERICA,**

Front and Cooper Sts., Camden, N. J.  
PERSONNEL: D. Sarnoff, Pres.; F. M. Folsom, V. Pres.; L. MacConnach, Secy.; G. S. DeSousa, Treas.; R. R. Shannon, Gen. Mgr.; J. A. Milling, Prod. Mgr.; H. M. Hucke, Aviation Sales Mgr.; F. D. Wilson, Pur. Dir.; F. H. Kirkpatrick, Pers. Dir.; J. Haber, Pub. Dir.; J. P. Taylor, Adv. Mgr.; R. R. Welsh, Aviation Chief Engr.

**RADIOPLANE CO.,**

Metropolitan Airport, Van Nuys, Calif.  
PERSONNEL: W. C. Collins, Pres.; H. H. Powell, V. Pres.; R. Denny, V. Pres. & Secy.; F. Smith, V. Pres. & Chief Engr.; W. Larrabee, Treas. & Gen. Mgr.; C. L. Lang, Prod. Mgr.; S. L. Bollenger, Pur. Dir.

**RANDALL GRAPHITE PRODUCTS CORP.,**

609-613 W. Lake St., Chicago 6, Ill.  
PERSONNEL: R. H. Whiteley, Pres., Treas. & Gen. Mgr.; E. A. Zimmerman, V. Pres.; W. P. Thacher, Secy.; H. C. Whiteley, Prod. Mgr.; M. E. Clark, Sales Mgr. & Adv. Mgr.; W. E. Dickerson, Pur. Dir.; R. C. Jamison, Pers. Dir.; H. B. Hostettler, Chief Engr.

**RAYMOND MFG. CO., DIV. ASSOCIATED SPRING CORP.,**

S. Center St., Corry, Pa.  
PERSONNEL: F. F. Barnes, Pres.; E. W. Feldt, V. Pres. & Gen. Mgr.; P. E. Whittlesey, Secy. & Treas.; H. H. Herlein, Prod. Mgr.; J. E. Mount, Sales Mgr. & Chief Engr.; C. H. Holden, Pur. Dir.; H. Wheeler, Pers. Dir.; W. M. Young, Adv. Mgr.

**RAYTHEON MANUFACTURING CO.,**

Foundry Ave., Waltham, Mass.  
55 Chapel St., Newton, Mass.  
PERSONNEL: L. K. Marshall, Pres.; D. T. Schultz, V. Pres. & Treas.; D. L. Trouant, Secy.; J. Pierson, Gen. Mgr., Communications Div.; H. F. Argento, Sales Mgr., Power Tube Div.; W. Knott, Sales Mgr., Communications Div.

**THE READY TOOL CO.,**

Bridgeport, Conn.  
PERSONNEL: T. Fish, Pres.

**REASOR MANUFACTURING CO.,**

13th & Indiana, St. Charles, Ill.  
PERSONNEL: J. A. Crum, Gen. Mgr.; D. C. Putnam, Pur. Dir.; F. W. Zwiger, Chief Engr.

**REBSTOCK CONVEYOR CO.,**

1439 N. 19th St., St. Louis 6, Mo.  
PERSONNEL: A. J. Rebstock, Gen. Mgr.

**RECORDGRAPH DIV., FREDERICK HART & CO., INC.,**

350 Madison Ave., New York 17, N. Y.  
PERSONNEL: C. R. D'Olive, Pres.; C. P. Galloway, V. Pres. & Gen. Mgr.; A. D. Stern, V. Pres. & Sales Mgr.

**REED-PRENTICE CORP.,**

677 Cambridge St., Worcester 4, Mass.  
PERSONNEL: F. W. McIntyre, Pres.; C. S. Payson, V. Pres. & Treas.; E. T. Connolly, Secy.; E. J. Keyes, Plant Mgr.; V. Rosenlund, Prod. Mgr.; C. W. Gallagher, Sales Mgr.; R. P. Harrington, Pur. Dir.; R. L. Rougemont, Chief Engr.

**REPUBLIC AIRCRAFT PRODUCTS DIV., THE AVIATION CORP.,**

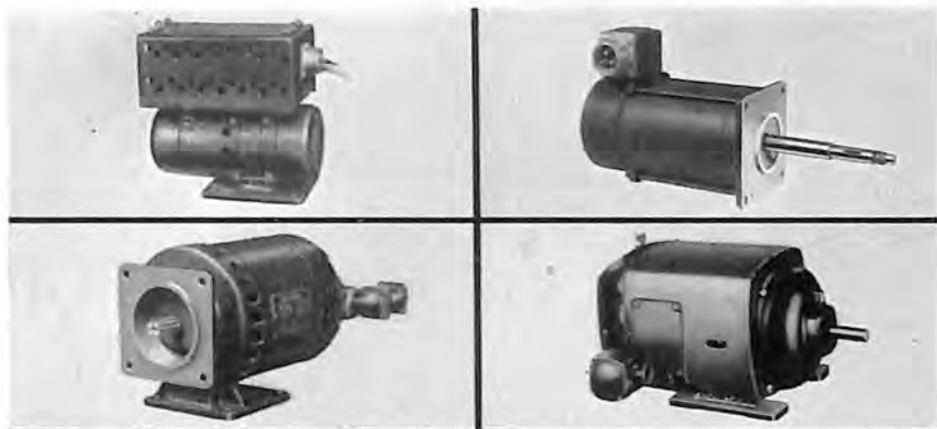
5914 Federal St., Detroit 9, Mich.  
PERSONNEL: V. Emanuel, Ch. of Board; I. Babcock, Pres.; W. F. Wise, L. I. Hartmeyer, B. Conway, I. J. Snader, V. Pres.; R. S. Pruitt, V. Pres. & Secy.; W. A. Mogensen, V. Pres. & Treas.; D. H. McRae, Plant Mgr.; B. J. Doyler, Prod. Mgr.; J. E. Wells, Sales Mgr. & Adv. Mgr.; M. R. Underwood, Pur. Dir.; S. Zelinsky, Pers. Dir.; A. W. Gratop, Pub. Dir.

**REPUBLIC STEEL CORP., BERGER MFG. DIV.,**

Canton 5, O.  
PERSONNEL: E. T. Causer, Works Mgr.; R. W. Helms, Sales Mgr.; K. Foutz, Pur. Dir.; W. R. Lauffer, Pers. Dir.; L. J. Hahn, Pub. Dir.; N. W. Sutmaier, Adv. Mgr.; P. Vignos, Chief Engr.

**RESISTOFLEX CORP.,**

Belleville 9, N. J.  
PERSONNEL: E. S. Peierls, Pres.; H. E. Krebs, V. Pres., Sales Mgr., Pub. Dir. & Adv. Mgr.; C. E. Stretton, Secy. & Pur. Dir.; W. W. Brooks, Treas.; S. W. Sinding, Prod. Mgr. & Pers. Dir.; W. M. McWilliam, Chief Engr.



## Motors and Power Generators

Leland designs and builds a wide range of motors for aeronautical applications, in sizes 1/6 to 3 HP singlephase and 1/6 to 5 HP polyphase. The four units here shown are typical and should suggest Leland as a logical source for many of your requirements. As motor design problems arise consult *Leland*.

*Is the name Leland in your file of motor sources? Make sure.*

*The Leland Electric Company, Dayton, 1, Ohio*

1. Aircraft high frequency motor alternator set for operating radio equipment.
2. Aircraft type DC motor to operate landing gear.
3. General purpose Aircraft type motor.
4. Continuous duty explosion proof gasoline pump motor.

# LELAND



SELENIUM



COPPER  
SULPHIDE

### ELECTRICAL RECTIFYING EQUIPMENT

Because of our experience and "know how", many of America's leading manufacturers depend on

### B-L RECTIFIER TRANSFORMER ASSEMBLIES

*For Aircraft Power Rectification . . . Including*

- Aircraft Power Rectifiers
- DC Power Supplies for testing radio receivers and transmitters
- Battery Chargers for 6, 12 and 24 volt batteries
- DC Power Supplies or Packs for practically any requirement or classification

*Check with B-L for any Rectifier Requirement*

### THE BENWOOD-LINZE COMPANY

1815 Locust Street • Telephone: Central 5830 • Saint Louis 3, Mo.

*Designers and manufacturers of Selenium and Copper Sulphide Rectifiers, Battery Chargers, and DC Power Supplies for practically every application.*



**REVERE COPPER & BRASS CORP.,**

230 Park Ave., New York 17, N. Y.

PERSONNEL: C. D. Dallas, Pres.; J. J. Russell, V. Pres., Secy. &amp; Treas.; N. A. Schuele, Adv. Mgr.

**REVOLVATOR CO., 86th St. at Bergen Turnpike, N. Bergen, N. J.**

PERSONNEL: H. S. Germond, Pres.; A. D. Germond, V. Pres.; P. D. Germond, Secy. &amp; Chief Engr.; H. S. Germond, III, Treas.; J. F. Taylor, Pur. Dir.; R. Burnham, Adv. Mgr.

**REYNOLDS METALS CO.,**

Reynolds Metals Bldg., Richmond 19, Va.

PERSONNEL: R. S. Reynolds, Pres.; R. S. Reynolds, Jr., V. Pres. &amp; Treas.; C. D. Blackwelder, V. Pres. &amp; Chief Engr.; C. E. Manning, Secy.; M. W. Henry, Pur. Dir.; J. D. Reynolds, Pers. Dir.

**Aluminum Div.,**

2500 S. Third St., Louisville 1, Ky.

PERSONNEL: W. G. Folden, V. Pres. &amp; Gen. Mgr.; D. P. Reynolds, V. Pres., Sales Mgr. &amp; Dir. Adv. &amp; Pub. Rel.

**RICHMOND RING CO.,**

Washington &amp; Lawn Aves., Souderton, Pa.

PERSONNEL: E. Tranier, Pres.; E. H. Burk, Gen. Mgr.

**RIEKER INSTRUMENT CO.,**

1919 Fairmount Ave., Philadelphia 30, Pa.

PERSONNEL: M. A. Rieker, Gen. Mgr.; R. Dunbar, Prod. Mgr.; E. Rieker, Chief Engr.

**RIGID-TEX CORP.,**

658 Ohio St., Buffalo 3, N. Y.

PERSONNEL: R. S. Smith, Pres.; H. L. Perry, Secy. &amp; Treas.; W. J. McArdle, Sales Mgr.

**RITTER CO., INC., Rochester 3, N. Y.**

PERSONNEL: E. J. Ries, Pres.; W. S. Hermon, V. Pres.; F. R. Shumway, V. Pres., Secy. &amp; Treas.; A. Gray, Gen. Mgr.; H. Miller, Prod. Mgr.; V. A. Noel, Sales Mgr.; R. J. Rosa, Pur. Dir.; H. Brownlee, Pers. Dir.; E. Hurlburt, Adv. Mgr.; E. Beebe, Chief Engr.

**ROBERTSON AIRCRAFT CORP., Lambert-St. Louis Municipal Airport, Robertson 21, Mo.**

PERSONNEL: N. Schuyler, Pres.; J. C. Thompson, V. Pres.; W. B. Robertson, Secy.; P. L. McMahon, Treas.; R. N. Rioux, Gen. Mgr.; A. Overy, Prod. Mgr.; W. B. Russell, Sales Mgr. &amp; Pub. Dir.; R. E. Laing, Pur. Dir.; J. M. Johannes, Pers. Dir.; V. W. Payne, Chief Engr.

**ROCHESTER MANUFACTURING CO., INC.,**

51 Rockwood St., Rochester, N. Y.

PERSONNEL: W. Mulcahy, Pres., Treas. &amp; Gen. Mgr.; C. L. Hastings, V. Pres., Sales Mgr. &amp; Pub. Dir.; W. W. Hastings, Secy. &amp; Prod. Mgr.; L. A. Mumford, Pur. Dir.; C. A. Babbitt, Pers. Dir.; J. S. Lynch, Adv. Mgr.; G. E. Ford, Chief Engr.

**ROCKBESTOS PRODUCTS CORP.,**

50 Mitchell Rd., P. O. Box 1102, New Haven 4, Conn.

PERSONNEL: A. G. Newton, Pres.; B. H. Reeves, V. Pres. &amp; Gen. Mgr.; W. C. Armstrong, Secy. &amp; Treas.; S. S. Nichols, Factory Supt.; H. O. Anderson, Sales Mgr.; E. L. Anderson, Pur. Dir.; T. R. Bailey, Pers. Dir.; E. M. Heery, Adv. Mgr.; H. S. Moore, Chief Engr.

**ROCKFORD DRILLING MACHINE DIV., BORG-WARNER CORP., Rockford, Ill.**

PERSONNEL: A. A. Warner, Pres. &amp; Gen. Mgr.; E. C. Shields, V. Pres.; F. M. Palmquist, Secy. &amp; Treas.; G. L. Christianson, Sales Mgr. &amp; Adv. Mgr.; M. E. Carlson, Pur. Dir.; H. Lundberg, Pers. Dir.

**ROCKFORD SCREW PRODUCTS CO.,**

2501 Ninth St., Rockford, Ill.

PERSONNEL: O. G. Nelson, Pres.; S. Hillman, V. Pres.; E. A. Miller, Secy. &amp; Treas.; D. E. Johnson, Gen. Mgr.; E. L. Stonefield, Sales Mgr.

**ROCKY MOUNTAIN STEEL PRODUCTS, INC., 1360 Wall St., Los Angeles 15, Calif.**

PERSONNEL: E. C. LeMunyon, Pres. &amp; Gen. Mgr.; G. L. LeMunyon, V. Pres.; L. E. Hurley, Secy. &amp; Treas.; A. L. Robb, Chief Engr.

**RODIC RUBBER CORP., Garwood, N. J.**

PERSONNEL: W. C. Godsey, Jr., Pres. &amp; Gen. Mgr.; J. G. Groendyk, V. Pres. &amp; Sales Mgr.; L. Edland, V. Pres.; W. J. Carson, Treas.; C. C. Dickey, Prod. Mgr.

**JOHN A. ROEBLING'S SONS CO.,**

640 S. Broad St., Trenton, N. J.

PERSONNEL: C. R. Tyson, Pres. &amp; Gen. Mgr.; F. W. Roebling, III, V. Pres.; H. L. Rathbun, Secy.; A. W. Brown, Treas.; E. C. Low, Gen. Mgr.-Sales; J. D. Thompson, Prod. Mgr.; F. S. Burtch, Sales Mgr., Aircord Div.; L. H. Van Dike, Pur. Dir.; F. J. Maple, Adv. Mgr.; A. J. Morgan, Chief Engr., Aircord Div.

**ROGERS PRODUCTS CO., INC.,**

3711 Hudson Blvd., Jersey City 7, N. J.

PERSONNEL: C. L. Zabriskie, Pres.; H. Albertine, V. Pres.; J. A. Miller, Secy. &amp; Treas.; C. S. Gill, Sales Mgr.

**ROHLM MANUFACTURING CO., INC.,**

561 E. 18th St., Erie, Pa.

PERSONNEL: J. R. Dunnihoo, Pres., Gen. Mgr. &amp; Sales Mgr.; M. H. Adams, V. Pres.; H. N. Dunnihoo, Secy. &amp; Pur. Dir.; S. Licklider, Treas.; L. M. Bisbee, Prod. Mgr.; J. W. Hellwege, Pur. Dir.; E. M. Sarver, Chief Engr.

**ROHM & HAAS CO., 222 W. Washington Sq., Philadelphia 5, Pa.**

PERSONNEL: O. Haas, Pres.; D. S. Frederick, L. W. Covert, E. L. Helwig, V. Pres.; S. C. Kelton, Secy.; D. Merriwether, Treas.; D. A. Rothrock, Sales Mgr., Plastics Div.; P. J. Clarke, Pur. Dir.; H. H. Hey, Pers. Dir.; E. Greene, Adv. Mgr., Plastics Div.

**ROHR AIRCRAFT CORP., Chula Vista, Calif.**

PERSONNEL: F. H. Rohr, Pres. &amp; Gen. Mgr.; J. E. Rheim, Exec. V. Pres.; B. P. Lester, V. Pres.-Finance; F. H. Nottbusch, V. Pres., Secy. &amp; Gen. Counsel; G. M. Harrington, Treas.; E. M. Lacey, Asst. to Gen. Mgr.; E. J. Beauregard, Employment Mgr.; H. R. Wiseman, Ind. Rel. Mgr.; F. E. McCreery, Chief Engr.; K. W. Maynard, Gen. Works Mgr.; J. H. Stromberg, Pur. Agt.; B. F. Raynes, Chief Inspector.

**ROMEC PUMP CO., Abbey Rd., Elyria, O.**

PERSONNEL: H. D. Stecher, Pres. &amp; Gen. Mgr.; H. H. Newell, V. Pres. &amp; Treas.; K. Fauver, Secy.; A. A. Anderson, Prod. Mgr.; R. B. Clymer, Sales Mgr. &amp; Adv. Mgr.; L. D. Acheson, Pur. Dir.; M. L. Matthews, Pers. Dir.; G. Carpenter, Pub. Dir.; H. F. Enyeart, Chief Engr.

# ROEBLING

*means Control in the Air!*



**Cord and Terminal Assemblies  
Aircraft Terminals  
Cords and Strands  
Engineered Slings**

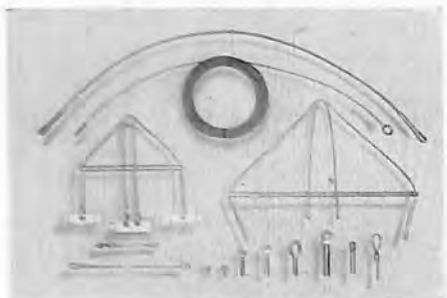
THE COMPLETE Roebling line has made this name a byword in the control shops of the entire industry.

Illustrated, various types of Roebling Cord and Strand, including 7x7, 19 wire strand, 7x19, and 6x7 with cotton center. Also a section of Lock-Clad control cord and several types of swaged terminals. Wide range of diameters, stainless or galvanized, pre-formed or non-pre-formed. Roebling Slings and Sling Fittings available in sizes and fitting types to meet your specifications.

*Aircord Division*

**JOHN A. ROEBLING'S SONS COMPANY**  
TRENTON 2, NEW JERSEY

*Branches and Warehouses in Principal Cities*



**G. D. ROPER CORP., Rockford, Ill.**  
**PERSONNEL:** S. H. Hobson, Pres.; F. K. Lawson, Exec. V. Pres. & Treas.; J. P. Curtin, Secy.; H. N. Morse, Prod. Mgr.; A. E. Jacobs, Sales Mgr.; S. C. Cochran, Pur. Dir.; W. Otto, Pers. Dir.; C. Edwards, Adv. Mgr.; A. C. Durdin, Chief Engr.

**ROSEMAN TRACTOR MOWER CO.,**  
 Central & Ridge, Evanston, Ill.  
**PERSONNEL:** F. T. Roseman, Owner; J. E. Hoffman, Gen. Mgr., Prod. Mgr., Sales Mgr. & Adv. Mgr.

**THE ROTOR TOOL CO.,**  
 17325 Euclid Ave., Cleveland 12, O.  
**PERSONNEL:** H. P. Bailey, Pres. Gen. Mgr., Pub. Dir. & Adv. Mgr.; F. B. Engeln, V. Pres.; J. J. Goodwin, Secy. & Pur. Dir.; D. S. Linton, Treas. & Prod. Mgr.; R. C. Manning, Sales Mgr.; L. Dwors, Pers. Dir.; F. J. Hejduk, Chief Engr.

**ROUGHWEAR CLOTHING CO.,**  
 93 Worth St., New York 13, N. Y.  
**PERSONNEL:** I. Kirschenbaum, Pres., Treas. & Pur. Dir.; H. Sander, V. Pres.; M. S. Jacobs, V. Pres., Secy., Gen. Mgr. & Sales Mgr.; S. Kirschenbaum, Prod. Mgr.

**ROYAL ENGINEERING CO.,**  
 East Hanover, N. J.

**ROXALIN FLEXIBLE FINISHES, INC.,**  
 800 Magnolia Ave., Elizabeth, N. J.  
**PERSONNEL:** L. Roan, Pres.; A. Miesem, Exec. V. Pres.; R. V. Kirk, Secy.; E. D. Horgan, Sales Mgr.; A. B. Marsh, Chief Engr., Aircraft Products.

**RUSSELL UNIFORM CO.,**  
 1600 Broadway, New York, N. Y.  
**PERSONNEL:** J. A. Russell, Pres., Treas., Gen. Mgr. & Adv. Mgr.; A. Russell, V. Pres., Secy. & Pur. Dir.; C. White, Prod. Mgr. & Sales Mgr.

**THE RUTHMAN MACHINERY CO.,**  
 1809-1823 Reading Rd., Cincinnati 2, O.  
**PERSONNEL:** E. J. Ruthman, Pres. & Gen. Mgr.; A. H. Ruthman, V. Pres. & Sales Mgr.; J. Ruthman, Secy. & Treas.; E. J. Lehnhoff, Prod. Mgr.

**RYAN AERONAUTICAL CO.,**  
 Lindbergh Field, San Diego, Calif.  
**PERSONNEL:** T. C. Ryan, Pres. & Treas.; O. L. Woodson, V. Pres. & Gen. Mgr.; G. C. Woodard, V. Pres. & Secy.; E. D. Prudden, V. Pres.; G. E. Barton, Works Mgr.; S. C. Breder, Sales Mgr.; O. F. Rigley, Pur. Dir.; W. F. Persons, Pers. Dir.; W. Wagner, Pub. Dir. & Adv. Mgr.; B. T. Salmon, Chief Engr.

---

**S**

---

**SKF INDUSTRIES, INC.,**  
 Front St. & Erie Ave., Philadelphia, Pa.  
**PERSONNEL:** W. L. Batt, Pres.; S. F. Wollmar, Exec. V. Pres.; T. W. Dinlocker, Secy. & Treas.; R. H. DeMott, Gen. Sales Mgr.; H. J. Lance, Pur. Agt.; H. S. Langdon, Pers. Dir.; R. C. Byler, Pub. Dir.; G. Palmgren, Chief Engr.

**S & M LAMP CO.,**  
 119 W. 36th Pl., Los Angeles 54, Calif.  
**PERSONNEL:** J. Shirreffs, Pres. & Gen. Mgr.; W. G. Shirreffs, V. Pres. & Chief Engr.; A. L. Varenhorst, Secy.; S. Friedman, Treas.; E. Westlund, Prod. Mgr.; B. DeRamus, Sales Mgr. & Adv. Mgr.; H. S. Gardner, Pur. Dir.

**ST. LOUIS TOOL & MFG. CO.,**  
 6100 Prescott, St. Louis 15, Mo.  
**PERSONNEL:** G. A. Coolidge, Pres. & Treas.; B. B. Coolidge, V. Pres.; A. Jeski, Secy. & Pers. Dir.; D. J. Ludden, Prod. Mgr.; W. Jeski, Pub. Dir.; J. T. Bratton, Chief Engr.

**ST. PIERRE CHAIN CORP.,**  
 50 Frank St., Worcester, Mass.  
**PERSONNEL:** H. St. Pierre, Pres. & Treas.; T. St. Pierre, V. Pres. & Pur. Dir.; B. Durell, Secy.; R. D. Moore, Gen. Mgr., Sales Mgr. & Adv. Mgr.; C. Fay, Pers. Dir.; H. Perreault, Chief Engr.

**W. J. SAVAGE CO., Knoxville 2, Tenn.**  
**PERSONNEL:** J. H. Murrian, Pres.; J. A. Murrian, V. Pres. & Gen. Mgr.; W. M. Fulton, Secy. & Treas.; W. A. Stern, Prod. Mgr.; F. C. Astley, Sales Mgr.; C. M. Rawlings, Pur. Dir.; J. O. Tayler, Adv. Mgr.; H. F. Leonhard, Chief Engr.

**SAYLOR ELECTRIC PRODUCTS CORP.,**  
 1014 Lynn St., Detroit 11, Mich.  
**PERSONNEL:** W. L. Saylor, Pres.; C. C. Saylor, V. Pres. & Treas.; C. J. Saylor, V. Pres. & Prod. Mgr.; W. R. Saylor, V. Pres. & Sales Mgr.; J. M. Sharkey, Secy.

**THE SCHATZ MANUFACTURING CO.,**  
 Poughkeepsie, N. Y.  
**PERSONNEL:** G. R. Bennett, Jr., Pres. & Treas.; F. W. Recknagel, Secy. & Chief Engr.; W. J. Bennett, Prod. Mgr.; H. F. Petersen, Sales Mgr.; V. W. Richtel, Pur. Dir.; D. G. Richter, Pers. Dir.; E. C. Sweeney, Dir. Sales Promotion.

**GEORGE SCHERR CO., INC.,**  
 200 Lafayette St., New York 12, N. Y.  
**PERSONNEL:** G. Scherr, Pres.; F. Koenig, V. Pres.; K. F. Kirchofer, Gen. Mgr.

**W. A. SCHUYLER,**  
 250 W. 57th St., New York 19, N. Y.

**SCHWEIZER AIRCRAFT CORP.,**  
 Chemung County Airport, Elmira, N. Y.  
**PERSONNEL:** E. Schweizer, Pres. & Chief Engr.; P. A. Schweizer, V. Pres., Treas., Gen. Mgr. & Sales Mgr.; R. P. McDowell, Secy.; W. Schweizer, Prod. Mgr.; W. I. Brown, Pur. Dir.; E. S. Bardwell, Pers. Dir. & Pub. Dir.; F. Hurrst, Adv. Mgr.

**SCIAKY BROS., 4915 W. 67th St., Chicago, Ill.**  
**PERSONNEL:** D. Sciaky, Partner & Chief Engr.; S. Sciaky, Treas.; Maurice Sciaky, Gen. Mgr.; Mario Sciaky, Prod. Mgr.; W. R. Bernardi, Sales Mgr.; J. Bilik, Pur. Dir.; B. Stults, Pers. Dir.; J. W. Newhall, Adv. Mgr.

**SCINTILLA MAGNETO DIV., BENDIX AVIATION CORP.,** Sidney, N. Y.  
**PERSONNEL:** E. R. Breech, Pres.; G. E. Steiner, Div. Compt.; H. Hanni, Gen. Mgr.; T. Z. Fagan, Sales Mgr.; A. Bekker, Pur. Agt.; E. M. Van Name, Pers. Dir.; W. J. Spengler, Exec. Engr.; L. W. Trees, Service Mgr.

**HENRY L. SCOTT CO.,**  
 130 Blackstone St., Providence, R. I.

**O. M. SCOTT & SONS, INC.,**  
 Marysville, O.

**SCOTT AVIATION CORP.,**  
 207 Erie St., Lancaster, N. Y.  
**PERSONNEL:** E. M. Scott, Pres.; H. A. Benzel, V. Pres. & Chief Engr.; E. M. Prior, Secy.; R. D. Pollock, Treas.; A. S. Brown, Sales Mgr.; E. J. Allein, Pur. Dir.; L. M. Crans, Pers. Dir.

YOU SHOULD HAVE *Scotts Turf*  
ON YOUR AIRFIELD



Scott turf is best able to stand the punishment of man and machine. Its ancestry is in good seed of the hardiest varieties and most dependable quality. Ask for prices, seeding suggestions and a FREE copy of the booklet "Airfields of the Future"

**O. M. SCOTT & SONS COMPANY**  
101 Main St., Marysville, Ohio

---

---

**ROYCO  
PRODUCTS**

ENGINEERING SERVICE  
FOR ALL MOVING PARTS

*Royal Engineering Co.*  
EAST HANOVER NEW JERSEY

---

---

**SINCLAIR  
AIRCRAFT  
Oils & Greases**



SINCLAIR  
REFINING COMPANY  
630 FIFTH AVENUE  
NEW YORK 20, N. Y.

**SCOVILL MANUFACTURING CO.,**

P. O. Box 1820, Waterbury 91, Conn.  
**PERSONNEL:** L. P. Sperry, Pres., Treas. & Gen. Mgr.; W. M. Goss, Exec. V. Pres.; A. P. Hickcox, V. Pres. & Pur. Dir.; P. E. Penton, Asst. V. Pres. & Sales Mgr.; F. T. Reeves, Secy.; A. M. Rogers, Adv. Mgr.

**SCREW MACHINE PRODUCTS CO., INC.,**

1012 Eddy St., Providence 5, R. I.  
**PERSONNEL:** G. Briggs, Pres.; S. E. Lummis, Treas.; D. Q. Williams, Sales Mgr.; M. W. Seymour, Adv. Mgr.

**SEAMAN PAPER CO.,**

222 W. Adams St., Chicago, Ill.  
**PERSONNEL:** D. R. Seaman, Pres.; C. Seaman, V. Pres.; L. Springer, Secy.; A. J. Drusch, Treas. & Gen. Mgr.; A. J. Drusch, Jr., Chief Engr.

**SENSENICH BROTHERS, Lancaster, Pa.**

**PERSONNEL:** H. M. Sensenich, M. M. Sensenich, Partners; C. H. Brubaker, Prod. Mgr.; R. N. Bomberger, Sales Mgr. & Adv. Mgr.; M. S. Erb, Pur. Dir.; L. K. Witmer, Pers. Dir.; H. R. Uhrich, Chief Engr.

**SHAKEPROOF INC.,**

2501 N. Keeler Ave., Chicago 39, Ill.  
**PERSONNEL:** H. B. Smith, Pres. & Treas.; C. L. Johnson, V. Pres. & Secy.; C. G. Olson, V. Pres.-Engrg.; F. W. England, V. Pres. & Gen. Mgr.; C. J. Irwin, Prod. Mgr.; E. E. Vally, Sales Mgr.; W. R. Smith, Pur. Dir.; J. Tomlin, Pers. Dir.; R. M. Wall, Adv. Mgr.; F. Bohle, Chief Engr.

**SHAKESPEARE PRODUCTS CO.,**

241 E. Kalamazoo Ave., Kalamazoo, Mich.  
**PERSONNEL:** H. G. Shakespeare, Pres.; D. E. Wallace, V. Pres.; M. Shakespeare, Secy. & Gen. Mgr.; W. J. Harrison, Treas.; C. W. Davis, Prod. Mgr. & Adv. Mgr.; M. Balch, Sales Mgr.; H. Barron, Pur. Dir.; E. W. Batterson, Chief Engr.

**SHELL OIL CO., INC., AVIATION DEPT.,**

50 W. 50th St., New York, N. Y.  
**PERSONNEL:** R. T. Goodwin, Mgr.; J. W. Freeman, J. L. Wheeler, Aviation Supervisors.

**SHERMAN PAPER PRODUCTS CORP.,**

156 Oak St., Newton Upper Falls 64, Mass.  
**PERSONNEL:** G. Sherman, Pres.; G. M. Setliff, Gen. Mgr.; R. V. Manning, Prod. Mgr.; G. H. Stucke, Sales Mgr.; H. B. Donovan, Pur. Dir.; H. T. Pillsbury, Pers. Dir.; P. Thompson, Adv. Mgr.

**SIMMONDS AEROCESSORIES, INC.,**

30 Rockefeller Plaza, New York 20, N. Y.  
**PERSONNEL:** W. R. Enyart, Pres.; C. H. Tomkinson, Prod. Mgr.; H. Holmes, Sales Mgr.; F. J. Umstatter, Pur. Dir.; R. Newcomb, Adv. Mgr.; W. J. Morrison, Chief Engr.

**SINCLAIR REFINING CO.,**

630 Fifth Ave., New York, N. Y.  
**PERSONNEL:** G. H. Taber, Jr., Pres.; J. E. Dyer, V. Pres. & Gen. Sales Mgr.; L. P. Lochridge, Mgr. Domestic Lub. Sales; D. S. Bixler, Asst. Mgr. Aviation; C. M. Larson, Chief Consulting Engr.; C. W. McAllister, Aviation Engr.; District Sales Mgrs.: J. M. Woodruff, 10 W. 51st St., New York, N. Y.; A. H. Sus, 2540 W. Cermak Rd., Chicago, Ill.; A. F. Buck, Fair Bldg., Seventh & Throckmorton Sts., Forth Worth, Tex.; H. D. Kline, 573 W. Peachtree St., Atlanta, Ga.; J. V. Dippel, Ninth & Grand Ave., Kansas City, Mo.

**SKALLA MANUFACTURING CO.,**

1175 E. Green St., Pasadena 5, Calif.  
**PERSONNEL:** J. B. Pearman, Gen. Mgr.; R. C. Davis, Prod. Mgr.; C. G. Thiene, Chief Engr.

**SKINNER PURIFIERS INC.,**

1500 Trombly, Detroit 11, Mich.  
**PERSONNEL:** R. L. Skinner, Pres. & Gen. Mgr.; R. T. Skinner, V. Pres.; R. J. Daly, Secy. & Treas.; W. W. Sanford, Prod. Mgr.; J. H. Skinner, Sales Mgr. & Adv. Mgr.; O. P. Dameron, Pur. Dir.; J. P. Campbell, Pers. Dir.; W. Kasten, Chief Engr.

**SKYDYNE, INC.,**

River Road, Port Jervis, N. Y.  
**PERSONNEL:** M. K. Weill, Pres. & Treas.; R. L. Weill, V. Pres.; S. E. Mautner, V. Pres. & Chief Engr.; R. J. Strauss, Secy.; M. P. Williams, Pur. Dir.; J. Szomor, Pers. Dir.

**SKYVIEW CAMERA CO., Olmsted Falls, O.**

**PERSONNEL:** D. Worster, Gen. Mgr.

**H. B. SMITH MACHINE CO.,**

Smithville, N. J.  
**PERSONNEL:** E. J. Smith, Pres.; A. H. Howe, V. Pres.; H. E. Willitts, Gen. Mgr.

**F. A. SMITH MANUFACTURING CO., INC.,**

Rochester 2, N. Y.  
**PERSONNEL:** H. P. Toppin, Pres.; H. M. Sylvester, Secy. & Treas.; H. A. Ketchum, Compt.; C. B. Mahan, Prod. Mgr.; G. E. Sundre, Sales Mgr.; G. J. Andres, Pur. Dir.; F. W. O'Grady, Pers. Dir.; W. T. Jensen, Pub. Dir. & Adv. Mgr.; E. I. Rusk, Chief Engr.

**SMITH METER CO., 5743 Smithway St.,**

Los Angeles 22, Calif.  
**PERSONNEL:** H. P. Detrick, Pres.; W. W. Brown, V. Pres.; H. W. Hatch, Secy.; H. P. Strickler, Treas.; H. G. Smith, Sales Mgr.; A. Modjeski, Pur. Dir.; D. O. Newton, Pers. Dir.; W. E. Steen, Chief Engr.

**SNAP-ON TOOLS CORP.,**

8028 28th Ave., Kenosha, Wisc.  
**PERSONNEL:** J. Johnson, Pres.; W. A. Swide-mann, V. Pres., Secy. & Prod. Mgr.; R. Palmer, V. Pres. & Sales Mgr.; W. Nernitz, Treas.; F. A. Tetzlaff, Pur. Dir.; C. L. Holderness, Pers. Dir.; W. F. Holz, Pub. Dir.; G. A. Smith, Adv. Mgr.; G. Walraven, Chief Engr.

**SNAPVENT CO.,**

521 W. Cumberland Ave., Knoxville 1, Tenn.  
**PERSONNEL:** B. B. Simcox, Pres.; M. P. Simcox, V. Pres.

**SNOW REMOVAL EQUIPMENT CO.,**

400 Seventh St., San Francisco 3, Calif.  
**PERSONNEL:** N. K. Davis, Pres.; A. E. Mason, V. Pres., Gen. Mgr., Prod. Mgr., Sales Mgr., Pub. Dir., Adv. Mgr. & Chief Engr.; J. M. Azevedo, Secy., Treas., Pur. Dir. & Pers. Dir.

**SO-CAL FOUNDRY,**

1985 E. 16th St., Los Angeles, Calif.  
**PERSONNEL:** F. E. Gaines, Pres.; A. L. Barker, Secy. & Treas.; B. Averett, Gen. Mgr.; C. D. Perriguy, Prod. Mgr.

**SOCONY-VACUUM OIL CO., INC.,**

26 Broadway, New York 4, N. Y.  
**PERSONNEL:** B. B. Jennings, Pres.; F. E. Powell, Jr., Gen. Mgr., Marine & Aviation; W. L. Baker, Domestic Mgr., Aviation; A. E. Smith, Mgr., Technical Div., Aviation Dept.

*Acoustical and Thermal  
Insulation for Aircraft*

**SEAMAN PAPER COMPANY**

(AIRCRAFT DIVISION)

Organized 1902

Insulating Aircraft since 1932.

- General fabricators of Aircraft Insulation Materials to order.
- Specializing in constructions with adhesives, including spot, strip and entire surface, and sewing of all designs in lockstitch, etc.
- Materials we fabricate include Insulating Felts and Batts, Aircraft Fiberglas Batts, etc.
- Manufacturers and Fabricators of products trade-named.

SEAPAK . . . KWILKO . . . SKYFELT

- Manufacturers of Insulated Rug Combinations for Aircraft.
- Suppliers of Interior Fabrics.
- Samples of Special Constructions you require furnished without charge.

*Main Office*

222 West Adams Street, Chicago 6, Illinois

*Branch Offices*

1051 N. Hollywood Way, Burbank, California

122 E. 42nd Street, New York, N. Y.

4455 Williams Ave., Detroit 8, Michigan

**SOLA ELECTRIC CO.,**

2525 Clybourn Ave., Chicago 14, Ill.  
 PERSONNEL: A. R. Johnson, Pres.; J. G. Sola, V. Pres. & Gen. Mgr.; J. R. Fischer, Secy. & Treas.; R. R. Nickell, Prod. Mgr.; L. C. Marschall, Sales Mgr.; R. L. Slater, Pur. Dir.; H. F. Schlacks, Pers. Dir.; H. L. Hardy, Adv. Mgr.; M. A. Tennyson, Chief Engr.

**SOLAR AIRCRAFT CO., 2200 Pacific Highway, San Diego 12, Calif.**

PERSONNEL: E. T. Price, Pres. & Gen. Mgr.; R. E. Craig, V. Pres.; J. L. Oatman, Secy.; A. W. Briggs, Treas.; P. S. Seitz, Sales Mgr.; W. L. Wilkinson, F. W. Ford, Pur. Dir.; E. E. Binger, Pers. Dir.; V. Wyatt, Pub. Dir.; W. C. Heath, Chief Engr.

**THE SOUNDSCRIBNER CORP.,**

82 Audubon St., New Haven 11, Conn.  
 PERSONNEL: L. Thompson, Pres.; H. Gfroerer, Exec. V. Pres. & Gen. Mgr.; H. K. Greer, Secy.; F. Scoville, Pur. Dir.; E. W. Gross, Adv. Mgr.; R. L. Stone, Chief Engr.

**SOUTH BEND AIR PRODUCTS, INC.,**

322 E. Colfax Ave., South Bend 22, Ind.  
 PERSONNEL: M. A. Smith, Jr., Pres., Treas., Gen. Mgr. & Chief Engr.; J. R. Cox, V. Pres.; J. E. Lejeune, Secy. & Prod. Mgr.

**SOUTH SHORE MACHINE & TOOL WORKS, INC., Merrick Rd., Seaford, N. Y.**

PERSONNEL: G. A. Bauer, Pres.; J. A. Sullivan, Secy. & Treas.; A. G. Bauer, Prod. Mgr.

**SOUTHERN AIRCRAFT CORP.,**

Garland, Dallas County, Tex.  
 PERSONNEL: J. R. McLean, Ch. of Board; W. C. Brown, Pres.; A. E. Pattison, V. Pres. & Treas.; F. H. Brown, Secy.; A. E. Worley, Prod. Mgr.; L. D. Barnhill, Pur. Dir.; T. A. Gentle, Jr., Pers. Dir.; W. M. Mullings, Chief Engr.

**SPARTAN AIRCRAFT CO.,**

1900 N. Sheridan Rd., Tulsa, Okla.  
 PERSONNEL: J. P. Getty, Pres.; G. F. Shortess, Asst. to Pres.; M. W. Balfour, V. Pres.; F. T. Hopp, Secy. & Treas.; A. Reitherman, Exec. Engr.; H. S. Nubemyer, Pur. Dir.; C. H. Story, Pers. Dir.; A. B. Barnett, Plant Supt.; W. F. Stewart, Chief Engr.

**SPAULDING FIBRE CO., INC.,**

310 Wheeler St., Tonawanda, N. Y.  
 PERSONNEL: C. C. Steck, Pres. & Gen. Mgr.; H. W. Grieser, V. Pres.; C. M. Pike, Secy.; S. E. Clow, Treas.; A. P. Hardleben, Pur. Dir.; R. B. Green, Adv. Mgr.

**SPECIALTIES INC.,**

Skunks Misery Rd., Syosset, N. Y.  
 PERSONNEL: S. A. McClellan, Pres.; M. C. McClellan, Secy. & Treas.; H. G. Sanborn, Plant Mgr.; L. Magilligan, Pur. Dir.; W. A. Parker, Pers. Dir.; R. Alkan, Chief Engr.

**SPENCER LENS CO.,**

19 Doat St., Buffalo 11, N. Y.  
 PERSONNEL: H. Fox, Pres.; H. D. Rhyndance, W. G. Buckley, V. Pres.; C. W. Barton, Secy.; B. Glenny, Treas.; W. A. Kerr, Sales Mgr.; J. Williams, Pers. Dir.; K. G. Niblack, Adv. Mgr.

**SPENCER & MORRIS,**

5649 Alhambra Ave., Los Angeles 32, Calif.  
 580 Market St., San Francisco 4, Calif.  
 PERSONNEL: E. B. Spencer, G. B. Morris, Partners; E. B. Spencer, Gen. Mgr. & Pers. Dir.; L. Barton, Prod. Mgr.; S. E. Morris, Sales Mgr.; J. Bartholomew, Pur. Dir.; P. A. Stember, Pub. Dir. & Adv. Mgr.; G. V. Migula, Chief Engr.

**SPERRY GYROSCOPE CO., INC.,**

Great Neck, N. Y.  
 PERSONNEL: R. E. Gillmor, Pres.; R. B. Lea, V. Pres.; P. R. Bassett, V. Pres.-Engrg. & Gen. Mgr.; H. H. Willis, V. Pres.-Sales; J. B. Wilson, Secy.; F. W. Kilduff, Treas.; C. L. Rice, Pur. Dir.; A. J. Percival, Pers. Dir.; J. H. Fountain, Pub. Dir.; J. A. Fitz, Adv. Mgr.; E. C. Sparling, Chief Engr.

**SPERRY PRODUCTS, INC.,**

1505 Willow Ave., Hoboken, N. J.  
 PERSONNEL: J. B. Farwell, Pres. & Gen. Mgr.; E. G. Sperry, V. Pres. & Treas.; J. H. Lipschutz, Secy.; M. F. Sproul, Sales Mgr.; L. C. Wohlberg, Pur. Agt.; E. P. Dodge, Pers. Dir.; P. E. Moreton, Pub. Dir.; E. A. Crawford, Chief Engr.

**SPIEGEL SALES CO.,**

405 Boulevard Bldg., Detroit 2, Mich.  
 PERSONNEL: H. W. Spiegel, Pres.; S. N. Lawson, V. Pres.

**THE SPOOL COTTON CO., CROWN FASTENER DIV., 745 Fifth Ave., New York, N. Y.**

PERSONNEL: H. Grandage, V. Pres.; J. S. Campbell, Sales Mgr.; C. H. Neuer, Pur. Dir.; D. P. Sullivan, Adv. Mgr.

**V. E. SPROUSE CO., Columbus, Ind.****STANDARD AIRCRAFT PRODUCTS, INC.,**

121 Franklin St., Dayton 2, O.  
 PERSONNEL: R. N. Webster, Pres.; J. Golob, V. Pres. & Chief Engr.; L. G. Zarbock, V. Pres. & Sales Mgr.; A. H. Ellinger, Secy. & Treas.; R. Casey, Gen. Mgr.; F. Abercrombie, Prod. Mgr.; W. Ruetz, Pur. Dir.; D. E. Stauffer, Pers. Dir.; V. Sheffield, Pub. Dir.; V. L. Hansen, Adv. Mgr.

**STANDARD ELECTRIC CO., INC.,**

Route 3, Box 121-B, San Antonio 2, Tex.  
 PERSONNEL: B. Dubinski, Pres.; L. Dubinski, Secy. & Gen. Mgr.

**THE STANDARD ELECTRICAL TOOL CO.,**

2488 River Rd., Cincinnati, O.  
 PERSONNEL: W. A. Ferguson, Pres. & Treas.; L. A. Hauck, V. Pres.; R. A. Huhn, Secy. & Gen. Mgr.; J. J. Falls, Prod. Mgr.; J. J. Klopp, Pur. Dir.

**STANDARD FELT CO., DIV. OF HUNTING-**

**TON LAND & IMPROVEMENT CO.,**  
 29-115 S. Palm Ave., Alhambra, Calif.  
 PERSONNEL: H. S. Cook, V. Pres. & Gen. Mgr.; J. S. Murray, Prod. Engr. & Sales Mgr.; J. S. Roome, Pur. Agt.; C. M. O'Donnell, Pers. Dir.

**STANDARD MACHINERY CO.,**

351 Indiana Ave., N.W., Grand Rapids 4, Mich.  
 PERSONNEL: J. Monahan, Owner.

**STANDARD OIL CO. OF CALIFORNIA,**

225 Bush St., San Francisco, Calif.  
 PERSONNEL: R. F. Bradley, Mgr., Aviation Div.; L. W. Aubry, Asst. Mgr., Aviation Div.

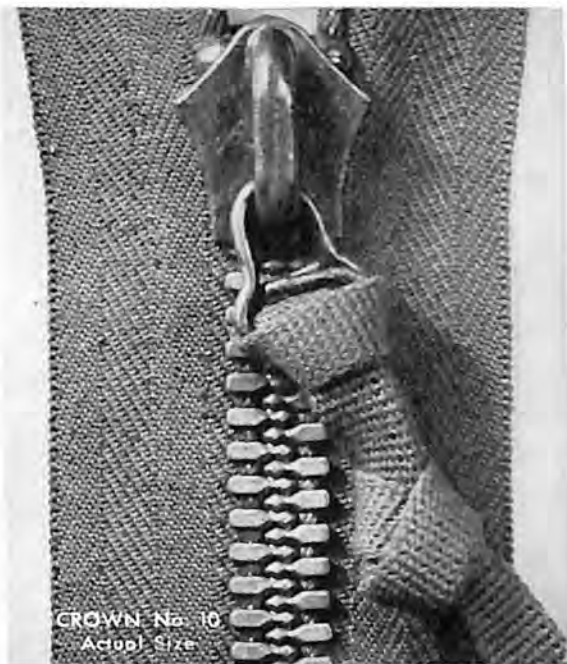
**THE STEEL PRODUCTS ENGINEERING CO., 1205 W. Columbia St., Springfield, O.**

PERSONNEL: J. E. McAdams, Pres.; S. L. Tatum, V. Pres.; W. C. Jordan, V. Pres. & Gen. Mgr.; I. W. Clark, Secy.; D. Applegate, Pur. Agt.; A. W. Endter, Pers. Dir.; E. F. Fowle, Chief Engr.

**STERLING TOOL PRODUCTS CO.,**

155 E. Ohio St., Chicago 11, Ill.  
 PERSONNEL: S. A. Crosby, Pres. & Gen. Mgr.; J. A. Proven, V. Pres. & Sales Mgr.; F. W. Walters, Compt. & Pers. Dir.; W. D. Hughes, Pur. Dir.; R. D. Wyly, Pub. Dir. & Adv. Mgr.; P. Zasadny, Chief Engr.

Choose your own opening  
with Crown Zippers



**NEW!**

Double-acting feature allows multiple slider assemblies (some military jobs developed by Crown have as high as 10 sliders to a single track)—enables you to choose your opening at any given point along zipper track.

Crown No. 10 Jumbo Zippers for better engine covers, now used on leading types of military planes — use Crown No. 7 for Gunner's Windbreaks, Boots for Tail Wheels, Torque Tubes and Central Columns, Flying Boots.

The Services of Crown's Engineering Division are at your command to assist in installation or design problems.

SEND FOR SAMPLES



Test Crown's easy, smooth action  
Write or wire: The Spool Cotton Company  
Crown Fastener Division  
745 Fifth Avenue, New York 22, N. Y.

Use **CROWN ZIPPERS**  
FOR ALL AVIATION NEEDS



**M. C. STEWART, Ashburnham, Mass.**  
PERSONNEL: M. C. Stewart, Pres.

**F. W. STEWART MFG. CORP.,**  
4311 N. Ravenswood Ave., Chicago 13,  
Ill.

PERSONNEL: F. W. Stewart, Pres.; D. Stewart,  
V. Pres.; O. C. Koch, Secy. & Gen. Mgr.;  
J. Gorski, Prod. Mgr.; F. V. Epperson, Sales  
Mgr.; J. H. Jacobsen, Pur. Dir.; R. A. Thies,  
Adv. Mgr.; J. Hrouda, Chief Engr.

**STEWART-WARNER CORP.,**  
1826 W. Diversey Pkwy., Chicago 14, Ill.  
PERSONNEL: J. S. Knowlson, Pres.; L. A.  
Williams, Jr., V. Pres.; J. A. Fabrie, Sales Mgr.;  
F. R. Cross, Adv. Mgr.; J. H. Leslie, Chief  
Engr.

**STUMPP & WALTER CO.,**  
132-138 Church St., New York 8, N. Y.  
PERSONNEL: G. O. Stumpp, Pres.; W. A.  
Spurling, V. Pres.; T. F. Kearney, Secy.; W. L.  
Isaacs, Treas.

**B. F. STURTEVANT CO., INC.,**  
18 Damon St., Hyde Park 36, Mass.  
PERSONNEL: E. B. Freeman, Pres.; E. B.  
Williams, V. Pres.; J. H. Melzard, Secy.; B. S.  
Foss, Treas.; R. M. Fullerton, Prod. Mgr.;  
J. C. Thompson, Sales Mgr.; H. D. Orrok, Pur.  
Dir.; E. W. Andros, Adv. Mgr.; H. E. Morton,  
Chief Engr.

**P. A. STURTEVANT CO., Addison, Ill.**  
PERSONNEL: P. A. Sturtevant, Pres.; H. E.  
Nusperle, Gen. Mgr.; C. Nusperle, Prod. Mgr.;  
H. G. Rudd, Sales Mgr. & Adv. Mgr.; J. H.  
Pilkington, Pur. Dir.; H. R. Benson, Chief  
Engr.

**SUPERIOR TUBE CO., Norristown, Pa.**  
PERSONNEL: C. A. Warden, Pres.; C. A. War-  
den, Jr., Exec. V. Pres. & Secy.; R. H. Gabel,  
V. Pres.-Engr.; P. E. Kelly, Treas. & Asst.  
Secy.; C. E. Pugh, Asst. Treas.; S. L. Gabel,  
Gen. Mgr.; H. B. Brown, Jr., Sales Mgr.; J. J.  
Bowe, Asst. Gen. Mgr.; C. W. Buler, Plant  
Supt.; D. L. Buckwalter, Pur. Agt.; W. J.  
McFarland, Pers. Dir.

**SURFACE COMBUSTION,**  
2375 Dorr St., Toledo, O.  
PERSONNEL: F. H. Adams, Gen. Mgr.; A. M.  
Degner, Works Mgr.; C. B. Phillips, Gen. Sales  
Mgr.; M. Goodman, Pur. Dir.; J. Merrill, Pers.  
Dir.; W. J. Grover, Adv. Mgr.; W. M. Hep-  
burn, Chief Engr.

**SWIFT LUBRICATOR CO., INC.,**  
Elmira, N. Y.  
PERSONNEL: C. T. Burke, Pres. & Gen. Mgr.;  
C. W. Swift, Jr., V. Pres., Sales Mgr. & Adv.  
Mgr.; J. L. Burke, Secy. & Treas.; D. H.  
Hughes, Prod. Mgr.; L. Beuter, Chief Engr.

**SWITLIK PARACHUTE CO.,**  
Lalor & Hancock Sts., Trenton 7, N. J.  
PERSONNEL: S. Switlik, W. Switlik, R. Switlik,  
L. Switlik, Partners; E. F. Connelly, Pub. Dir.  
& Adv. Mgr.

---

T

---

**C. J. TAGLIABUE MFG. CO.,**  
550 Park Ave., Brooklyn 5, N. Y.  
PERSONNEL: J. H. Nichols, Pur. Dir.; G. A.  
Terhune, Adv. Mgr.

**THE TAKK CORP., Newark, O.**  
PERSONNEL: F. W. Atkinson, Pres.; W. E.  
Krause, V. Pres.-Mfg.; R. B. Taylor, V. Pres.-  
Research; D. Kleist, Secy. & Treas.; D. C.  
Leidy, Pur. Agt.

**TAL'S PRESTAL BENDER, INC.,**  
225-227 N. Water St., Milwaukee 2,  
Wisc.

PERSONNEL: E. T. Tal, Pres., Gen. Mgr., Sales  
Mgr. & Adv. Mgr.; H. Mueller, V. Pres.; J. S.  
Elsby, Secy.; A. B. Doyle, Treas. & Prod. Mgr.;  
C. Tal, Pur. Dir.

**TAYLOR FIBRE CO., Norristown, Pa.**  
PERSONNEL: J. M. Taylor, Pres.; L. T.  
McCloskey, V. Pres. & Sales Mgr.; C. N.  
Jacobs, V. Pres. & Pur. Dir.; W. H. Taylor,  
Secy. & Treas.; D. W. Shaw, Pers. Dir.; G.  
Miller, Adv. Mgr.; G. J. Muller, Chief Engr.

**THE TAYLOR-WINFIELD CORP.,**  
1052 Mahoning Ave., N. W., Warren, O.  
PERSONNEL: J. A. Anderson, Pres.; T. S. Long,  
V. Pres. & Gen. Mgr.; J. D. Anderson, Secy. &  
Treas.; E. L. Prust, Supervisor-Prod. Control;  
J. H. Cooper, Chief Sales Engr.; C. E. Tripp,  
Pur. Agt.; E. E. Steigler, Supervisor-Pers.  
Dept.; M. M. Seeloff, Chief Engr.

**TAYLORCRAFT AVIATION CORP.,**  
Alliance, O.  
PERSONNEL: J. C. Hart, Pres.; R. G. King,  
Asst. to Pres.; R. H. Wendt, V. Pres.-Engr.;  
K. W. Tibbits, V. Pres.-Mfg.; M. W. Third,  
Secy. & Treas.; R. E. Iden, Asst. Sales Mgr.;  
O. M. Bell, Pur. Dir.; G. A. Bennett, Pers. Dir.;  
J. F. Masterson, Pub. Dir. & Adv. Mgr.

**TECHNICAL PLY-WOODS,**  
228 N. LaSalle St., Chicago 10, Ill.  
PERSONNEL: J. R. Fitzpatrick, Dir. & Sales  
Mgr.; A. N. Carstens, Associate; M. B. Gris-  
wold, Treas. & Pur. Dir.; H. J. Hansen, Chief  
Engr. & Res. Dept.

**TEMPLETON, KENLY & CO.,**  
1020 S. Central Ave., Chicago 44, Ill.  
PERSONNEL: J. B. Templeton, Pres., Gen. Mgr.,  
Pub. Dir. & Adv. Mgr.; A. C. Lewis, V. Pres. &  
Sales Mgr.; F. W. Krickhan, Secy.; P. R.  
Jeffries, Treas.; C. A. Crane, Prod. Mgr.; R. H.  
Webb, Pur. Dir.; C. Stewart, Pers. Dir.; F. J.  
Jakoubek, Chief Engr.

**TENNESSEE EASTMAN CORP.,**  
Kingsport, Tenn.  
PERSONNEL: P. S. Wilcox, Pres.; J. C. White,  
V. Pres. & Gen. Mgr.; M. K. Robinson, Secy.;  
J. C. Stone, Treas.; S. E. Palmer, Sales Mgr.,  
Cellulose Products Div.

**GEORGE A. TERRY CO.,**  
356 S. Elmwood Ave., Buffalo 1, N. Y.  
PERSONNEL: G. A. Terry, Pres. & Gen. Mgr.;  
A. M. Dodge, Asst. Mgr.

**THE TEXAS CO.,**  
135 E. 42nd St., New York 17, N. Y.  
PERSONNEL: H. T. Klein, Pres.; H. W. Dodge,  
V. Pres.; R. L. Saunders, Secy.; L. H. Linde-  
man, Treas.; M. Halpern, Prod. Mgr.; R. T.  
Herndon, Sales Mgr.; G. W. Orton, Pur. Dir.;  
C. O. Strahley, Pers. Dir.; P. C. Humphrey,  
Pub. Dir.; S. M. Birch, Adv. Mgr.; D. W.  
Carswell, Chief Engr.; A. Kief, Aviation Mgr.;  
R. J. Hall, Asst. Mgr.-Aviation.

**THIOKOL CORP.,**  
780 N. Clinton Ave., Trenton, N. J.  
PERSONNEL: J. W. Crosby, Pres.; H. R. Fer-  
guson, V. Pres. & Prod. Mgr.; S. M. Martin,  
Jr., Secy. & Sales Mgr.; E. P. Roll, Jr., Treas. &  
Pur. Dir.

# SUPERIOR TUBE COMPANY

Norristown, Pennsylvania

METAL TUBING MANUFACTURERS

## SEAMLESS TUBING



Steel  
 Alloy Steels  
 Stainless Steels  
 Composite (Steel  
 and Copper)  
 Nickel  
 "Monel"  
 "Inconel"  
 Copper  
 Beryllium Copper  
 Aluminum

## \*WELDRAWN TUBING

(welded, then drawn)

Stainless Steels  
 Low Carbon Steel  
 "Monel"  
 "Inconel"



## FABRICATED PRODUCTS

Alloy Steel Valve Push Rods for Aircraft and Tank Engines  
 Antennas in Weldrawn Monel and Stainless for Aircraft, Marine  
 and other Installations  
 Tubing in a great variety of Metals for instruments for Surgical applications  
 Tubing and fabricated parts for the Electronic Industry

\*Trade-marked

**THE THOMPSON GRINDER CO.,**

1534 W. Main St., Springfield, O.  
 PERSONNEL: C. Baldenhofer, Pres., Treas. & Gen. Mgr.; W. G. Baldenhofer, V. Pres.; R. M. McDonough, Secy.; J. C. Wilson, Sales Mgr., Pub. Dir. & Chief Engr.; R. L. Powers, Pur. Agt. & Pers. Dir.

**THOMPSON PRODUCTS, INC.,**

8354 Wilcox Ave., Bell, Calif.  
 PERSONNEL: F. C. Crowford, Pres.; L. M. Clegg, Exec. V. Pres.; J. D. Wright, V. Pres. & Secy.; J. H. Coolidge, V. Pres. & Treas.; P. D. Hileman, Gen. Mgr.; R. S. Orchard, Prod. Mgr.; W. H. Carhart, Sales Mgr. & Adv. Mgr.; S. A. Richards, Pur. Dir.; K. O. Howie, Pers. Dir.; R. M. Rogers, Chief Engr.

**THOMPSON PRODUCTS, INC.,**

2196 Clarkwood Rd., Cleveland 3, O.  
 PERSONNEL: P. C. Crawford, Pres.; L. M. Clegg, Exec. V. Pres.; A. T. Colwell, V. Pres.; J. H. Coolidge, V. Pres. & Treas.; J. D. Wright, V. Pres. & Secy.; R. S. Livingstone, V. Pres.-Pers.; T. O. Duggan, V. Pres.-Service Div.; G. V. Sevald, Sales Mgr.; G. H. Hackett, Pur. Dir.; G. H. Malone, Pers. Dir.; F. R. Witt, Pub. Dir. & Adv. Mgr.; H. D. Bubb, Jr., Chief Engr.

**J. H. THORP & CO., INC.,**

250 Park Ave., New York 17, N. Y.  
 PERSONNEL: G. A. Bomann, Sr., Pres.; G. A. Bomann, Jr., V. Pres.; D. Bomann, Secy. & Sales Mgr.; T. E. Jahn, Treas.

**W. HARRIS THURSTON, INC.,**

40 Worth St., New York 13, N. Y.  
 PERSONNEL: H. J. Meyer, V. Pres.; J. G. Bausher, Sales Mgr., Airwing Aviation Fabrics and Tapes.

**THE TIMKEN ROLLER BEARING CO.,**

1835 Dueber Ave., S. W., Canton 6, O.  
 PERSONNEL: W. E. Umstadt, Pres.; L. M. Klinedinst, V. Pres.; R. C. Brower, Secy. & Treas.; W. B. Moore, Sales Mgr.; P. J. Reeves, Adv. Mgr.

**THE TOBRIN TOOL CO.,**

Plantsville, Conn.  
 PERSONNEL: W. F. Thomson, Pres., Treas., Gen. Mgr. & Pur. Dir.; D. S. Blakeslee, V. Pres.; R. H. Brannin, Secy.; E. L. Barlow, Sales Mgr.

**TOLEDO SCALE CO.,**

1050 Telegraph Rd., Toledo 12, O.  
 PERSONNEL: H. D. Bennett, Pres.; C. O. Marshall, Secy.; W. A. Fink, Treas. & Sales Mgr.; G. S. Yost, Pur. Dir.; R. H. Herron, Pers. Dir.; H. Ellingwood, Pub. Dir. & Adv. Mgr.; F. W. Gilchrist, Chief Engr.

**THE TOMKINS-JOHNSON CO.,**

Jackson, Mich.  
 PERSONNEL: A. R. Johnson, Pres.; D. M. J. Tracey, V. Pres. & Gen. Mgr.; B. O. Ludwig, Prod. Mgr.; W. J. Remund, Sales Mgr.; C. B. Cranor, Chief Engr.

**TOWMOTOR CORP.,**

1226 E. 152nd St., Cleveland 10, O.  
 PERSONNEL: L. M. Sears, Pres.; C. E. Smith, V. Pres. & Sales Mgr.; C. H. Hubbard, Prod. Mgr.; H. W. Neff, Pur. Dir.; E. Southworth, Adv. Mgr.; W. R. Westphal, Chief Engr.

**THE TRIPLETT ELECTRICAL INSTRUMENT CO.,**

Harmond Rd., Bluffton, O.  
 PERSONNEL: R. L. Triplett, Pres. & Gen. Mgr.; C. A. Biery, V. Pres.; N. A. Triplett, Secy. & Sales Mgr.; L. E. Fenn, Prod. Mgr.; G. W. Linden, Pur. Dir.; A. R. Baker, Pers. Dir. & Adv. Mgr.; F. J. Lingel, Chief Engr.

**TRUSCON STEEL CO.,**

Youngstown 1, O.  
 PERSONNEL: R. J. Wysor, Pres.; W. V. Peters, V. Pres. & Sales Mgr.; A. C. Ruhley, Secy. & Treas.; R. W. Sutton, Pur. Dir.; H. V. Golle, Pers. Dir.; P. L. Callahan, Adv. Mgr.; R. D. Snodgrass, Chief Engr.

**TUBE TURNS, INC.,**

224 E. Broadway, Louisville 1, Ky.  
 PERSONNEL: W. H. Girdler, Sr., Pres.; G. O. Boomer, Exec. V. Pres.; C. J. Hodapp, V. Pres. & Gen. Mgr.; J. G. Seiler, V. Pres. & Sales Mgr.-Fittings; R. E. Fritsch, V. Pres. & Sales Mgr.-Forgings; O. O. Funk, Secy. & Treas.; W. H. Girdler, Jr., Acting Gen. Mgr.; N. C. Dooley, Works Mgr.; R. J. Dülger, Pur. Agt.; W. A. Willig, Ind. Rel. Dir.; G. V. Wedereit, Adv. Dir.; H. C. Bell, Engrg. Dir.

**TURBO ENGINEERING CORP.,**

Hancock & Lalor Sts., Trenton, N. J.  
 PERSONNEL: D. L. Derron, Pres.; H. White, Asst. to Pres.; A. Gaetgens, Secy.; W. Schwab, Treas.; W. P. McCarthy, Prod. Mgr.; E. Schwarz, Pur. Dir.; J. Paluskiwicz, Pers. Dir.; J. Williams, Chief Engr.

**THE TURNER BRASS WORKS,**

Sycamore, Ill.  
 PERSONNEL: J. Slezak, Pres.; N. O. Hanks, Secy.; W. M. McAllister, Treas.; J. H. Joseph, Prod. Mgr.; J. W. Mock, Sales Mgr.; R. C. Carney, Pur. Dir.

---

 U
 

---

**U. S. TOOL CO., INC.,**

255 N. 18th St., East Orange, N. J.  
 PERSONNEL: C. Todd, Pres. & Treas.; F. Koch, V. Pres.; W. P. Powers, Secy.; J. Armour, Gen. Mgr.; T. Hill, Prod. Mgr.; P. E. McKeith, Sales Mgr. & Adv. Mgr.; W. W. Downey, Pur. Dir.; R. G. Bliss, Pers. Dir.; A. E. Borton, Chief Engr.

**THE UDYLITE CORP.,**

1651 E. Grand Blvd., Detroit 11, Mich.  
 PERSONNEL: L. K. Lindahl, Pres.; C. H. Reeme, V. Pres. & Treas.; H. S. Maynard, Secy.; G. Drury, Prod. Mgr.; L. V. Nagle, Sales Mgr.; V. Zobel, Pur. Dir.; A. L. Barak, Pers. Dir.; R. C. Trees, Adv. Mgr.; L. Pianowski, Chief Engr.

**UNIFORM HOOD LACE CO.,**

1530 Carrollton Ave., Indianapolis, Ind.  
 PERSONNEL: J. L. Anthony, Pres. & Gen. Mgr.; L. M. Anthony, Secy.; J. Thompson, Treas.; C. Jacks, Prod. Mgr.; J. R. Brown, Sales Mgr.; H. Noel, Pur. Dir., Pers. Dir. & Pub. Dir.; J. B. Given, Chief Engr.

**UNION AIRCRAFT PRODUCTS CORP.,**

245 E. 23rd St., New York 10, N. Y.  
 PERSONNEL: I. M. Felt, Pres.; E. Ellinger, Jr., V. Pres.; S. C. Jones, Secy. & Treas.; D. Fordsman, Gen. Mgr. & Prod. Mgr.; H. H. Hutt, Sales Mgr., Pub. Dir. & Adv. Mgr.; L. Zamarin, Pur. Dir.; M. Baron, Pers. Dir.; J. Tuomey, Chief Engr.

**UNION DRAWN STEEL DIV., REPUBLIC**

STEEL CORP., Massillon, O.  
 PERSONNEL: R. J. Wysor, Pres.; N. J. Clarke, V. Pres.; W. W. Hancock, Secy. & Treas.; D. D. Buchanan, Gen. Mgr.; J. B. McClain, Prod. Mgr.; F. C. Young, Sales Mgr.; C. A. Ilgenfritz, Pur. Dir.; J. A. Voss, Pers. Dir.; C. W. Ruth, Adv. Mgr.; R. W. Worle, Chief Engr.

# FORGINGS



*of steel, aluminum  
and other alloys!*

For over fifteen years, the Tube Turns organization has been recognized for its ability to originate and employ new forging methods that handle difficult operations with accuracy and speed that were impossible under older forging procedures. Your inquiry on any forgings of a contract nature, for war-time production or future plans, will be accepted in confidence and have our immediate attention. Simply write TUBE TURNS (Inc.) Louisville, Ky.

## **TUBE TURNS**

*Forgings for Industry*

## V

**UNION MFG. CO.,**

296 Church St., New Britain, Conn.  
 PERSONNEL: C. S. Newmann, Pres. & Sales  
 Mgr.; C. S. Mueller, Secy.; H. H. Wheeler,  
 Treas. & Pur. Dir.; E. I. Stevens, Adv. Mgr.

**UNITED AIRCRAFT PRODUCTS, INC.,**

Dayton 1, O.  
 PERSONNEL: F. G. Sorensen, Pres.; F. W. Wil-  
 kins, P. Christensen, V. Pres.; J. Shotwell, Secy.  
 & Treas.; W. W. Cowan, Gen. Mgr.; E. M.  
 Rogers, Prod. Mgr.; E. C. Hartlieb, Sales Mgr.  
 & Adv. Mgr.; J. A. Connolly, Pur. Dir.; L. K.  
 Sherrill, Pers. Dir.; A. C. Hoffman, Chief Engr.

**UNITED-CARR FASTENER CORP.,**

31 Ames St., Cambridge 42, Mass.  
 PERSONNEL: A. W. Kimbell, Pres. & Gen. Mgr.;  
 G. S. Maynard, V. Pres. & Sales Mgr.; L. S.  
 Boynton, Secy.; J. Ellsworth, Treas.; F. J.  
 Ross, Pur. Dir.; N. A. Dill, Adv. Mgr.; R. A.  
 Chaffee, Chief Engr.

**UNITED CINEPHONE CORP.,**

65 New  
 Litchfield St., Torrington, Conn.  
 PERSONNEL: L. R. Ripley, Pres.; L. B. Corn-  
 well, V. Pres., Secy. & Gen. Mgr.; R. J. Pugh,  
 Sales Mgr., Pub. Dir. & Adv. Mgr.; W. O.  
 Charnley, Pur. Dir.; J. M. Miller, Jr., Chief  
 Engr.

**UNITED STATES PLYWOOD CORP.,**

616 W.  
 46th St., New York 19, N. Y.  
 PERSONNEL: L. Ottinger, Pres.; J. J. Dunne, V.  
 Pres.; S. Ottinger, Secy.; W. A. Leary, Treas.;  
 C. Brown, Gen. Mgr.; S. W. Antoville, Sales  
 Mgr.; R. C. Wilcox, Pur. Dir.; J. G. Berens,  
 Pub. Dir.; R. S. Lowell, Adv. Mgr.; O. S.  
 Tuttle, Chief Engr.

**UNITED STATES RADIUM CORP.,**

535 Pearl St., New York, N. Y.  
 PERSONNEL: C. B. Lee, Pres.; J. E. Paul, V.  
 Pres. & Prod. Mgr.; E. B. Fisher, V. Pres. &  
 Sales Mgr.; G. C. Becket, Secy.; H. A. Whiting,  
 Treas.; D. R. Ely, Pur. Dir.; L. V. Moore, Jr.,  
 Pers. Dir.

**UNITED STATES RUBBER CO.,**

1230 Sixth Ave., New York 20, N. Y.  
 PERSONNEL: H. E. Smith, Pres.; E. Burkman,  
 Secy.; A. Surkamp, Treas.; S. MacKenzie, Pur.  
 Dir.; T. H. Young, Adv. Mgr.; C. A. Ostling,  
 Chief Engr.

**UNITED STATES TESTING CO., INC.,**

1415 Park Ave., Hoboken, N. J.  
 PERSONNEL: D. E. Douty, Pres.; A. L.  
 Brassell, V. Pres.; S. B. Walker, Secy., Sales  
 Mgr. & Adv. Mgr.; E. C. Brown, Treas. & Pur.  
 Dir.; H. S. Wyckoff, Chief Engr.

**UNITED STATES VARNISH CO.,**

Hasbrouck Heights, N. J.  
 PERSONNEL: H. G. Hose, Pres.

**UTICA DROP FORGE & TOOL CORP.,**

2415 Whitesboro St., Utica 4, N. Y.  
 PERSONNEL: E. Norris, Pres.; W. V. Daugherty,  
 F. P. Tenney, V. Pres.

**UTILITY FAN CORP.,**

4851 S. Alameda St.,  
 Los Angeles 11, Calif.  
 PERSONNEL: B. B. Breslow, Pres., Gen. Mgr. &  
 Prod. Mgr.; M. Breslow, V. Pres. & Adv. Mgr.;  
 B. Harris, Secy. & Sales Mgr.; H. A. Goldman,  
 Treas.; T. Northcote, Pur. Dir.; A. Silver, Pers.  
 Dir.; E. A. Guenther, Pur. Dir.; H. Leo, Chief  
 Engr.

**VAN NORMAN CO.,**

3640 Main St., Springfield 7, Mass.  
 PERSONNEL: J. V. Scott, Pres. & Gen. Mgr.;  
 L. F. Hunderup, V. Pres. & Prod. Mgr.; H. G.  
 Hoglund, V. Pres., Sales Mgr. & Adv. Mgr.;  
 F. D. VanNorman, Secy.; R. W. Porter, Treas.;  
 C. A. Thompson, Pur. Dir.; L. H. Hutchins,  
 Pers. Dir.; A. W. Todd, Chief Engr.

**VAPOR CAR HEATING CO., INC.,**

80 E. Jackson Blvd., Chicago, Ill.  
 PERSONNEL: W. L. Conwell, Pres.; A. D. Bruce,  
 V. Pres.; O. A. Rosboro, Secy. & Treas.; L. H.  
 Gillick, Sales Mgr.; C. E. Krupp, Pub. Dir.;  
 E. A. Russell, Chief Engr.

**VARD, INC.,**

2961 E. Colorado, Pasadena 8, Calif.  
 PERSONNEL: V. B. Wallace, Pres.; H. E.  
 Robinson, V. Pres. & Prod. Mgr.; H. M. Bray,  
 Secy., Treas. & Sales Mgr. & Adv. Mgr.; P. H.  
 Ford, Gen. Mgr.; N. O. Nelson, Pur. Dir.; J. C.  
 Partsch, Pers. Dir.; G. B. Wilshire, Chief Engr.

**VARIETY AIRCRAFT CORP.,**

2901 W. Third St., Dayton, O.  
 PERSONNEL: I. M. Coppock, Pres., Gen. Mgr. &  
 Prod. Mgr.; C. A. Coppock, Secy., Treas. &  
 Pur. Dir.; F. D. Paine, Sales Mgr., Adv. Mgr.  
 & Chief Engr.; A. King, Pers. Dir.

**THE VELLUMOID CO.,**

54 Rockdale St., Worcester 6, Mass.  
 PERSONNEL: R. D. Seamans, Pres.; C. S.  
 Livingstone, V. Pres., Sales Mgr. & Adv. Mgr.;  
 W. W. Webster, Treas.; L. Wald, Gen. Mgr. &  
 Pur. Dir.

**VICKERS INC.,**

1400 Oakman Blvd., Detroit 32, Mich.  
 PERSONNEL: H. F. Vickers, Pres.; K. R. Her-  
 man, V. Pres. & Gen. Mgr.; F. T. Harrington,  
 V. Pres. & Sales Mgr.; J. F. Forster, Treas.;  
 R. M. McCabe, Pur. Dir.

**VIDAL RESEARCH CORP.,**

Central Airport, Camden, N. J.  
 PERSONNEL: E. L. Vidal, Pres.; T. Epprecht,  
 V. Pres.; R. L. Reed, Secy.; H. K. Hardie,  
 Treas.; S. Goodman, Gen. Mgr.; F. W. Ken-  
 line, Prod. Mgr.; T. Carroll, Sales Mgr.; A. R.  
 Halbert, Pur. Dir. & Pers. Dir.; F. Waltman,  
 Pub. Dir. & Adv. Mgr.; N. W. Perdew, Chief  
 Engr.

**THE VIMALERT CO., LTD.,**

90 Forrest St., Jersey City 4, N. J.  
 PERSONNEL: R. Cuse, Pres.; H. Shapiro, Secy.;  
 H. A. Schaufelberger, Treas. & Pur. Dir.; H.  
 Butler, Prod. Mgr.; R. H. Clarke, Chief Engr.

**VIRGINIA RUBATEX DIV., GREAT AMERI-  
CAN INDUSTRIES, INC.,**

Bedford, Va.  
 PERSONNEL: H. W. Harwell, Pres.; W. L.  
 Smith, V. Pres. & Gen. Mgr.; G. H. Cornelius,  
 Sales Mgr.

**VITA-VAR CORP.,**

46 Albert Ave., Newark, N. J.  
 PERSONNEL: C. J. Robison, Pres.; E. G. Robi-  
 son, V. Pres.; A. O. Allen, V. Pres.-Mfg. &  
 Research; T. H. Gibson, Sales Mgr.; W. H.  
 Jackson, Pur. Dir.

**THE VOGES MANUFACTURING CO.,**

98th St. & 103rd Ave., Ozone Park 17,  
 N. Y.  
 PERSONNEL: F. Voges, F. W. Voges, Partners;  
 A. Rosenberg, Prod. Mgr.; J. K. Weickel, Pers.  
 Dir.; C. A. Aifeen, Chief Engr.

*For Intelligent  
Co-operation in*



**R E S E A R C H  
D E V E L O P M E N T  
M A N U F A C T U R E**

- Oil Temperature Regulators • Pumps
- Hydraulic Operating Valves • Fuel Cocks
- Oil Dilution Controllers • Fuel Pumps
- Oil Dilution Valves • Fuel Strainers
- Thermostatic Valves • Control Assemblies
- Glycol Radiators • Pressure Regulators
- Y Drain Valves • Actuating Cylinders
- Accumulators • Landing Gear Struts
- Fuses; Hydraulic, Air, Oil
- Nose and Tail Wheel Assemblies



**UNITED AIRCRAFT PRODUCTS, Inc.**

**Main Office: DAYTON 1, OHIO**

*Plants: Dayton, Ohio • Los Angeles, Calif.*



## W

**WAILES DOVE-HERMISTON CORP.,**

Westfield, N. J.

PERSONNEL: L. Stuart, Pres.; W. H. T. Thornhill, R. C. Stromquist, V. Pres.; L. deBeauchamp, Treas.

**WALDES KOH-I-NOOR INC.,**

47-52 27th St., Long Island City 1, N. Y.  
PERSONNEL: S. Waldes, Pres.; H. Axthelm, V. Pres. & Gen. Mgr.; H. J. Cooke, Secy. & Sales Mgr.; M. M. Miller, Treas.; L. Wolf, Pur. Dir.; L. Amsterdam, Pers. Dir.; H. T. Wines, Chief Engr.

**WALES-STRIPPIT CORP., 345 Payne Ave.,**

North Tonawanda, N. Y.

PERSONNEL: A. F. Wales, Pres.; H. Osmondson, V. Pres. & Gen. Mgr.; C. Michel, Secy. & Treas.; A. Wasserman, Prod. Mgr.; J. Hayes, Sales Mgr.; L. A. Scott, Pur. Dir.; H. Rook, Pers. Dir.; H. Laney, Pub. Dir. & Adv. Mgr.; J. Andrews, Chief Engr.

**WALLACE ENGINEERING CO.,**

3640 W. 135th St., Hawthorne, Calif.

PERSONNEL: F. Wallace, Pres.; D. L. Wallace, Secy.; A. E. Thompson, Chief Engr.

**WALLACE SUPPLIES MANUFACTURING CO., 1300 Diversey Parkway, Chicago 14, Ill.**

PERSONNEL: E. Metterhausen, Pres. & Sales Mgr.; E. J. De Witt, V. Pres. & Gen. Mgr.; F. J. Lammers, Secy.; W. Hannan, Pur. Dir.; K. Longley, Pers. Dir.; H. O. Newlin, Chief Engr.

**WALLS SALES CORP., 96 Warren St., New York 7, N. Y.**

PERSONNEL: S. Grossman, Pres.; L. N. Grossman, Gen. Mgr.

**THE WALTON CO.,**

94 Allyn St., Hartford 3, Conn.

PERSONNEL: K. W. Weeks, Pres. & Treas.; B. L. Woodward, V. Pres.; H. S. Weeks, Secy.; C. P. Manning, Prod. Mgr.; R. A. Trask, Pur. Dir.

**THE WARNER AIRCRAFT CORP.,**

20263 Hoover Ave., Detroit 5, Mich.

PERSONNEL: W. O. Warner, Pres. & Gen. Mgr.; L. A. Faunce, V. Pres., Sales Mgr. & Adv. Mgr.; L. A. Majneri, V. Pres. & Chief Engr.; W. J. Jarvie, Secy. & Treas.; G. A. Dahlquist, Prod. Mgr.; G. Whetter, Pur. Dir.; K. Symington, Pers. Dir.

**WAYNE CHEMICAL PRODUCTS CO.,**

Copeland &amp; M. C. R., Detroit 17, Mich.

PERSONNEL: E. G. Behr, Pres. & Gen. Mgr.; K. G. Behr, V. Pres.; W. L. Behr, Secy. & Treas.; W. C. Dilloway, Prod. Mgr.; R. T. Reynolds, Sales Mgr.

**THE WEATHERHEAD CO.,**

300 E. 131st St., Cleveland 8, O.

PERSONNEL: A. J. Weatherhead, Jr., Pres.; H. Church, V. Pres.-Sales; H. F. Bailey, V. Pres.-Finance; R. F. Gibson, V. Pres.-Automotive Sales; G. Hufferd, V. Pres.-Engrg.; J. W. Reavis, Secy.; E. L. Ferguson, Treas.; J. D. Smetzer, Works Mgr.; J. F. Knobloch, Plant Supt.; L. J. Henderson, Asst. Gen. Sales Mgr.; G. R. Young, Pur. Dir.; C. S. Mattoon, Pers. Dir.; P. M. Gaffney, Pub. Dir.; G. P. Robers, Sales Promotion Mgr.; C. H. Crawley, Chief Engr.

**WEBER SHOWCASE AND FIXTURE CO., INC., 5700 Avalon Blvd., Los Angeles 54, Calif.**

PERSONNEL: K. Weber, Pres.; F. Weber, V. Pres. & Treas.; I. S. Summerfield, Secy.; A. Johnson, Gen. Mgr.; K. Chase, Prod. Mgr.; C. Norby, Sales Mgr.; J. Hoffman, Pur. Dir.; J. Kaufhold, Pers. Dir.; D. Mack, Pub. Dir. & Adv. Mgr.; H. Johnson, Chief Engr.

**WEEMS SYSTEM OF NAVIGATION,**

Annapolis, Md.

PERSONNEL: P. V. H. Weems, M. T. Weems, G. T. Weems, C. R. Dodds, A. A. Illyne, R. M. Thackray, Partners; R. M. Thackray, Sales Mgr.; R. G. Willis, Chief Engr.

**JOSEPH WEIDENHOFF, INC.,**

4340 W. Roosevelt Rd., Chicago 24, Ill.

PERSONNEL: E. N. Webber, Pres.; W. H. Yenni, V. Pres.; B. Hoban, Secy.; C. K. Hunter, Treas.; C. J. Boesch, Asst. Gen. Mgr.; G. A. Bauer, Prod. Mgr. & Pers. Dir.; P. F. Jones, Sales Mgr. & Adv. Mgr.; C. J. Haas, Pur. Dir.; R. E. Lee, Pub. Dir.; V. L. Gunder, Chief Engr.

**WELDON ROBERTS RUBBER CO.,**

BRIGHTBOY INDUSTRIAL DIV.,

93-99 N. 13th St., Newark 7, N. J.

PERSONNEL: W. Roberts, Pres.; C. Roberts, V. Pres.; G. Roberts, Secy., Treas. & Gen. Mgr.; R. S. Henderson, Prod. Mgr.

**THE WELLINGTON MACHINE CO.,**

Wellington, O.

PERSONNEL: R. E. Clisby, Pres.; P. J. Clisby, Secy. & Treas.; C. W. Gannett, Prod. Mgr. & Chief Engr.; C. A. Glass, Sales Mgr.

**THE WELLMAN BRONZE & ALUMINUM CO., 2525 E. 93rd St., Cleveland, O.**

PERSONNEL: F. S. Wellman, Pres. & Treas.; H. G. Wellman, V. Pres. & Secy.; H. Alchin, V. Pres. & Sales Mgr.; D. Smith, Mgr., Peerless Magnesium Foundry; E. Metzger, Mgr., Superior Non Ferrous Foundry; J. H. Wellman, Pur. Dir.; I. Gundling, Pers. Dir.

**WELLS AIRCRAFT PARTS CO.,**

4154 Whiteside St., Los Angeles 33, Calif.

PERSONNEL: R. B. Wells, Partner & Bus. Mgr.; E. J. Wells, Partner & Factory Mgr.; R. V. Skarda, Supt.; C. A. Hoffman, Sales Mgr.; N. V. Robinson, Pur. Dir.; K. L. Wells, Pers. Dir.

**WELTRONIC CO.,**

19500 W. Eight Mile Rd., Detroit, Mich.

PERSONNEL: C. J. Collom, Pres. & Chief Engr.; R. Berndt, Treas.; J. J. Bourassa, Gen. Mgr.; R. Klees, Prod. Mgr.; F. X. Busche, Sales Mgr.; P. Cummings, Pur. Dir.; V. Kaye, Adv. Mgr.

**R. D. WERNER CO., INC.,**

295 Fifth Ave., New York 16, N. Y.

PERSONNEL: R. D. Werner, Pres.; V. C. Petersen, V. Pres. & Sales Mgr.; L. L. Werner, Treas.; N. L. Sheiner, Pur. Dir.; J. P. Felton, Adv. Mgr.

**WESLEY LACQUER CO.,**

95 Fourth St., Brooklyn, N. Y.

PERSONNEL: F. J. Wesley, Pres.

**WESSON CO., 1220 Woodward Heights Blvd.,**

Ferndale 20, Mich.

PERSONNEL: R. Garrett, Pres.; W. B. Duncan, V. Pres. & Gen. Mgr.; M. F. Diaz, Secy.; B. S. Naven, Treas.; E. Mortensen, Prod. Mgr.; F. W. Archer, Sales Mgr.; J. Shover, Pur. Dir.; L. Archer, Adv. Mgr.; B. K. Stuber, Chief Engr.



# WALDES TRUARC RETAINING RING

U. S. PATENT  
RE 10144

Waldes Truarc presents a significant advance in retaining rings.

It spreads or contracts without distortion; retaining its perfectly fitting circular contour.

For thrust-load fixing, shaft and housing applications, Waldes Truarc provides dis-

tinct advantages over nuts and bolts or wedges and washers. It reduces dimension and weight, saves material, cuts manufacturing time...simplifies assembly and dis-assembly.

On request, we will gladly furnish samples and full data for your tests.

SOLE MANUFACTURERS AND LICENSEES IN U. S. A.

WALDES KOH-I-NOOR-INC • LONG ISLAND CITY, N. Y.





**WEST BEND EQUIPMENT CORP.,**

West Bend, Wisc.

PERSONNEL: A. H. Klumb, Pres. &amp; Gen. Mgr.; G. W. Ball, V. Pres. &amp; Sales Mgr.; C. E. Klumb, Secy., Prod. Mgr. &amp; Chief Engr.

**WESTCOTT CHUCK CO.,**

312-326 E. Walnut St., Oneida, N. Y.

PERSONNEL: E. G. Baker, Pres.; J. L. Wheaton, V. Pres.; A. F. Barnaskey, Secy.; A. P. Barnaskey, Treas. &amp; Gen. Mgr.; J. C. Harvey, Prod. Mgr.; L. M. Carhart, Sales Mgr.

**WESTERN AUTOMATIC MACHINE SCREW CO.,** Elyria, O.

PERSONNEL: H. E. Penfield, Pres.; B. C. Franklin, V. Pres. &amp; Gen. Mgr.; F. H. Bryant, Secy.; A. T. Rosenau, Treas.; G. J. Hillmer, Prod. Mgr.; R. D. Oldfield, Sales Mgr.; A. F. Steller, Pur. Dir.; R. D. Buol, Pers. Dir.; W. J. Cox, Adv. Mgr.; R. A. Green, Chief Engr.

**WESTERN ELECTRIC CO., INC., RADIO DIV.,** 195 Broadway, New York 7, N. Y.

PERSONNEL: C. G. Stoll, Pres.; F. R. Lack, V. Pres.; N. R. Frame, Secy.; G. B. Proud, Treas.; H. N. Willets, Sales Mgr.; D. F. G. Eliot, Pur. Dir.; A. B. Goetz, Pers. Dir.; F. B. Wright, Pub. Dir.; H. W. Forster, Adv. Mgr.

**WESTINGHOUSE ELECTRIC & MANUFACTURING CO.,** E. Pittsburgh, Pa.

PERSONNEL: G. H. Bucher, Pres.; R. A. Neal, V. Pres.; C. B. Stainback, Sales Mgr.; G. E. Pendray, Adv. Mgr.

**WESTON ELECTRICAL INSTRUMENT CORP.,** 614 Frelinghuysen Ave., Newark 5, N. J.

PERSONNEL: C. Brown, Pres.; E. R. Mellen, V. Pres. &amp; Treas.; H. L. Gerstenberger, V. Pres. &amp; Sales Mgr.; R. Nichols, Secy.; H. Hartkopf, Prod. Mgr.; A. R. Briggs, Pur. Dir.; J. R. Abrams, Pers. Dir.; S. Cassey, Adv. Mgr.; J. Miller, Chief Engr.

**WHITE AIRCRAFT CORP.,** Palmer, Mass.

PERSONNEL: D. G. White, Pres., Treas. &amp; Sales Mgr.; R. Turner, V. Pres.; M. H. Lawrence, Secy.; C. A. Killmeyer, Factory Mgr.; R. W. Goodell, Compt.; S. E. Shaw, Pur. Dir.; R. M. Collat, Pers. Dir.

**THE WHITE & BAGLEY CO.,**

100 Foster St., Worcester, Mass.

PERSONNEL: H. P. Bagley, Pres.; E. G. Bagley, Secy., Treas. &amp; Pur. Dir.; G. J. Nurse, Automotive Sales Mgr.; H. P. Fleming, Eastern District Mgr.; K. White, Western District Mgr.; M. T. Holland, Adv. Mgr.

**WHITEHEAD STAMPING CO.,**

1661 W. Lafayette Blvd., Detroit 16, Mich.

PERSONNEL: J. F. Whitehead, Pres. &amp; Treas.; T. C. Whitehead, V. Pres.; G. W. Schreck, Secy.

**WHITING CORP.,** Harvey, Ill.

PERSONNEL: T. S. Hammond, Pres.; S. H. Hammond, V. Pres.; R. A. Pascoe, Secy.; J. C. Thomas, Treas.; J. Munro, Gen. Mgr.; D. Polderman, Sales Mgr.; H. E. Eaton, Pur. Dir.; M. P. Miller, Pers. Dir.; A. DeYoung, Adv. Mgr.

**WICKES BROS.,** 515 N. Washington Ave., Saginaw, Mich.

PERSONNEL: H. R. Wickes, Pres.; C. Bintz, V. Pres. &amp; Gen. Mgr.; C. G. Morrell, Secy. &amp; Treas.

**WICO ELECTRIC CO.,**

Phelon Ave., West Springfield, Mass.

PERSONNEL: E. L. Stoughton, Pres. &amp; Gen. Mgr.; K. A. Harmon, V. Pres. &amp; Chief Engr.; H. J. Bock, Treas. &amp; Clerk; E. H. Voorhees, Works Mgr.; H. M. Sauers, Gen. Sales Mgr.; D. B. Sistare, Pur. Dir.; W. F. Nye, Pers. Dir.; M. F. Allen, Pub. Dir. &amp; Adv. Mgr.

**E. W. WIGGINS AIRWAYS, INC.,**

Metropolitan Airport, Norwood, Mass.

PERSONNEL: J. Garside, Pres. &amp; Gen. Mgr.; H. E. Shaw, C. S. Cowan, V. Pres.; C. H. Scott, V. Pres. &amp; Plant Mgr.; E. W. Wiggins, Treas.; A. R. Leo, Prod. Mgr.; F. S. Tobey, Sales Mgr.; H. E. Martin, Pur. Dir.

**WILKENING MANUFACTURING CO.,**

2000 S. 71st St., Philadelphia 42, Pa.

PERSONNEL: F. W. Wilkening, Pres.; D. A. Cowhig, H. E. Gerstley, W. S. Loeb, C. Wilkening, V. Pres.; F. Solis-Cohen, Secy. &amp; Pur. Agt.; H. E. Gerstly, Treas.; W. K. Lee, Factory Mgr.; A. Kraft, Foundry Mgr.; S. S. Evans, Sales Mgr., Replacement Div.; W. E. Wilkening, Sales Mgr., Ind. Div.; H. E. Day, Pers. Mgr.; W. A. Kirkpatrick, Pub. Dir. &amp; Adv. Mgr.; H. Braendel, Chief Engr.

**J. H. WILLIAMS & CO.,**

400 Vulcan St., Buffalo 7, N. Y.

PERSONNEL: A. D. Armitage, Pres.; W. C. Kress, V. Pres.; C. M. Fleming, Secy. &amp; Treas.; E. J. Wilcox, Sales Mgr.; H. M. Robins, Pub. Dir. &amp; Adv. Mgr.

**WILLIAMS, WHITE & CO.,** Moline, Ill.

PERSONNEL: H. W. Getz, Pres.; H. H. Rogers, V. Pres.; W. A. Thorngren, Secy.; A. B. Lindburg, Pur. Dir.; E. C. Case, Adv. Mgr.; D. F. Green, Chief Engr.

**WILMINGTON FIBRE SPECIALTY CO.,**

P. O. Drawer 1028, Wilmington 99, Del.

PERSONNEL: J. W. Morris, Pres.; F. L. Gerhauser, V. Pres.; H. W. McHinch, Secy.; M. L. K. Armstrong, Treas.; H. N. Romig, Sales Mgr.; J. R. Quinn, Pur. Dir.

**K. R. WILSON,**

215 Main St., Buffalo 3, N. Y.

PERSONNEL: K. R. Wilson, Pres. &amp; Sales Mgr.; F. W. Amo, V. Pres., Pur. Dir. &amp; Adv. Mgr.; G. L. Lambert, Treas. &amp; Pers. Dir.; M. C. Newman, Gen. Mgr.; F. C. Wilson, Prod. Mgr.; G. K. Silliman, Chief Engr.

**WINCHESTER REPEATING ARMS CO.,**

DIV. OF WESTERN CARTRIDGE CO.,

275 Winchester Ave., New Haven, Conn.

PERSONNEL: I. W. Olin, Pres.; J. M. Olin, V. Pres.; R. R. Casteel, Secy.; E. W. Taft, Treas.; T. I. S. Boak, Works Mgr. &amp; Chief Engr.; H. E. Jenkins, Sales Mgr., Radiator Div.; R. C. Swanton, Pur. Dir.; A. F. Snyder, Pers. Dir.; D. E. Whitelam, Pub. Dir.; C. S. Hutt, Adv. Mgr.

**J. WISS & SONS CO.,**

33 Littleton Ave., Newark, N. J.

PERSONNEL: J. R. Wiss, Pres. &amp; Prod. Mgr.; N. F. Wiss, V. Pres. &amp; Treas.; B. E. Bostwick, Sales Mgr.; P. Voelker, Pur. Dir.; G. H. Botton, Adv. Mgr.; C. A. Thober, Chief Engr.

**WOLF'S HEAD OIL REFINING CO., INC.,**

P. O. Box 56, Oil City, Pa.

PERSONNEL: A. W. Scott, Pres. &amp; Secy.; E. W. Chase, V. Pres. &amp; Chairman of Board; E. E. Bellen, Treas.; W. J. Scott, Pur. Agt.




**BARR**  
SERVICE

*30 Years* OF CONTINUOUS SERVICE  
TO THE AIRPLANE EXPORT TRADE  
\* \* \* \* \*  
INTERNATIONAL SHIPPING AGENTS  
\* \* \* \* \*  
*Complete Facilities Arranging, Dismantling, Boxing,  
Forwarding, All Risk Insurance*



**BARR SHIPPING COMPANY**  
HARRY K. BARR, *President*  
25 BROADWAY NEW YORK  
Cable Address: BARRSHIPCO



*The largest producer  
of aircraft forgings in  
the world.*

**WYMAN-GORDON**

**WORCESTER, MASS.**

**HARVEY, ILL.**

**DETROIT, MICH.**

**WOOD-MOSAIC CO., INC.,**  
Louisville 9, Ky.

PERSONNEL: A. D. MacLean, Pres.; C. S. MacLean, V. Pres.; J. J. Egan, V. Pres. & Gen. Mgr.; W. F. Franket, Secy. & Sales Mgr.; P. R. MacLean, Treas.; E. V. Bulleit, Pur. Dir.; R. W. Hutchinson, Pers. Dir.; C. M. Kreider, Chief Engr.

**WOODWARD GOVERNOR CO.,**  
5001 N. Second St., Rockford, Ill.

PERSONNEL: I. C. Martin, Pres. & Gen. Mgr.; H. W. Thorell, V. Pres. & Prod. Mgr.; R. W. Estell, V. Pres., Sales Mgr. & Pub. Dir.; D. Sandell, Secy.; W. A. Ring, Treas. & Pur. Dir.; F. Crawford, Pers. Dir.; G. F. Drake, Engr. Mgr.

**N. A. WOODWORTH CO., 1300 E. Nine Mile Rd., Detroit 20, Mich.**

PERSONNEL: N. S. Woodworth, Pres.; V. L. Anderson, Secy. & Treas.; W. L. Mullen, Prod. Mgr.; R. E. Kramer, Sales Mgr. & Adv. Mgr.; E. P. Gallagher, Pur. Dir.; C. Dusenberry, Pers. Dir.; A. R. Gloster, Pub. Dir.; G. Hohwart, Chief Engr.

**WORTHINGTON MOWER CO.,**  
Stroudsburg, Pa.

PERSONNEL: E. R. Sawtelle, Pres. & Gen. Mgr.; J. J. Blair, V. Pres. & Chief Engr.; W. U. Routlette, 2nd V. Pres.; C. R. Bensinger, Secy.; J. C. Rodewald, Treas.

**WORTHINGTON PUMP & MACHINERY CORP., Harrison, N. J.**

PERSONNEL: H. C. Beaver, Pres.; C. E. Searle, V. Pres.; C. N. Barney, V. Pres. & Secy.; H. C. Ramsay, V. Pres.-Operations & Gen. Mgr.; H. A. Bellows, Treas.; J. J. Summersby, Gen. Sales Mgr.; C. Reynell, Pur. Dir.; A. L. Davis, Adv. Mgr.

**WYANDOTTE CHEMICALS CORP.,**  
Wyandotte, Mich.

PERSONNEL: E. M. Ford, Pres.; W. F. Torrey, F. S. Ford, V. Pres.; F. Ballantyne, Secy. & Treas.; C. B. Robinson, Sales Mgr.; J. B. Ford Div.; A. D. Harris, Pur. Dir.; R. Raine, Adv. Mgr.

**WYMAN-GORDON CO.,**  
105 Madison St., Worcester 1, Mass.

PERSONNEL: H. G. Stoddard, Pres.; R. W. Stoddard, V. Pres.; C. C. Winn, Treas.; G. W. Motherwell, Works Mgr.; F. E. Wellington, District Sales Mgr.; H. Layport, Pur. Dir.

**X****X. L. RADIO LABORATORIES,**  
420 W. Chicago Ave., Chicago 10, Ill.

PERSONNEL: F. Michaelis, Owner & Gen. Mgr.

**Y****YATES AMERICAN MACHINE CO.,**  
Beloit, Wis.

PERSONNEL: A. Haas, Pres. & Gen. Mgr.; F. J. Oberlander, C. H. Kelly, V. Pres.; A. H. Woekel, Secy.; J. W. Bussler, Treas.; E. F. Saberson, Prod. Mgr.; J. B. Edwards, Sales Mgr.; K. J. Richter, Pur. Dir.; H. E. Hall, Pers. Dir.; G. C. Mueller, Pub. Dir.; W. P. Heidemann, Adv. Mgr.; W. D. Johnson, Chief Engr.

**YORK TOOL SALES CO.,**  
52 S. Duke St., York, Pa.

PERSONNEL: Erwin Huber, E. B. Huber, Owners; Ethelyn Huber, Secy.; P. West, Gen. Mgr. & Sales Mgr.; C. H. Krout, Prod. Mgr.; Pur. Dir. & Chief Engr.; F. Huber, Pub. Dir.; O. Young, Adv. Mgr.

**YOUNG RADIATOR CO.,**  
709 S. Marquette St., Racine, Wis.

PERSONNEL: F. M. Young, Pres. & Gen. Mgr.; J. J. Hilt, V. Pres.; W. H. Schleck, Secy. & Treas.; K. E. Yeager, Prod. Mgr.; G. J. Haismaier, Sales Mgr.; R. W. Baggott, Pur. Dir.; L. B. Dahlin, Pers. Dir.; W. V. Astrup, Chief Engr.

**YPSILANTI MACHINE & TOOL CO.,**  
110 N. Park St., Ypsilanti, Mich.

PERSONNEL: P. J. O'Connor, V. Pres.; A. Henwood, Secy. & Treas.; P. Tucker, Sr., Gen. Mgr.; F. Glatt, Pur. Dir.

**Z****ZAPON DIV., ATLAS POWDER CO.,**  
Stamford, Conn.

PERSONNEL: J. K. Weidig, Gen. Mgr.; F. Paight, Prod. Mgr.; J. M. Howard, Sales Mgr.

**DEALERS, DISTRIBUTORS, EXPORTERS AND SHIPPERS****EDWIN D. ALLMENDINGER,**  
15 Moore St., New York, N. Y.**AIRCRAFT EXPORT CORP.,**  
30 Rockefeller Plaza, New York, N. Y.**AMERICAN EASTERN CORP.,**  
30 Rockefeller Plaza, New York, N. Y.**AVIATION EQUIPMENT & EXPORT, INC.,**  
25 Beaver St., New York, N. Y.**AVIQUIPO, INC.,**  
25 Beaver St., New York, N. Y.**CHARLES H. BABB CO.,**  
Grand Central Air Terminal, Glendale, Calif.**BARR SHIPPING CORP.,**  
25 Broadway, New York, N. Y.**BENDIX EXPORT DIV. OF BENDIX AVIATION CORP.,** 30 Rockefeller Plaza, New York, N. Y.**BLUEFRIES-NEW YORK, INC.,**  
44 Whitehall St., New York, N. Y.**CHINA AIRMOTIVE CO.,**  
444 Madison Ave., New York, N. Y.**CURTISS EXPORTS DIV. OF CURTISS-WRIGHT CORP.,** 30 Rockefeller Plaza, New York, N. Y.**J. V. W. CORP.,**  
1100 Raymond Bldg., Newark, N. J.**MIRANDA BROTHERS, INC.,**  
6 E. 45th St., New York, N. Y.**ROYAL SHIPPING CO.,**  
21 Pearl St., New York, N. Y.**TRI-AMERICAN AIRCRAFT CORP.,**  
Graybar Bldg., New York, N. Y.**UNITED AIRCRAFT EXPORT DIV. OF UNITED AIRCRAFT CORP.,** E. Hartford, Conn.

## RIVET REMOVER

This rivet remover will extract faulty rivets without damage. Re-drilling and re-dimpling not necessary. New rivet can be inserted in same hole.

Removal of damaged or faulty rivet does not alter or damage sheet in any way.

Removing rivets with this new Topflight Tool saves time and labor. Priced at \$12.00 it saves its cost in one day's use.

## PRINTED TAPE

Cellulose-Pressure Sensitive Laminated Tape printed to your order. Special AN codes and specifications. Wire and Cable Markers. Overseas Labels.

Overnight Service—Phone your new codes, numeral and letter combinations—Printed roll of tape will be airmailed same day. Printed specially for you on famous Topflight Tape Printer.

## BROKEN DRILLS

Topflight Broken Drill Adapters and Flute Key Collet-Chucks save time and labor. Made to fit any standard size fluted drill. Stop wasting fine, expensive drills! Break them and use them again and again. Small pieces of drills may be used immediately, without soldering or set screws. Precision and concentricity guaranteed.

## FASTENER AIRPLIERS

This clever new Topflight Tool will install and remove any standard skin fastener, easier, quicker, and with less fatigue than any other tool. Actual stop-watch test on production lines revealed savings of 50% in time.

Operators like it because they do a better job without tiring. At \$18.50, it quickly pays for itself.

# TOPFLIGHT TOOL CO.

TOWSON 4, MARYLAND—YORK, PENNSYLVANIA

Cable Address—"Bluefries" New York  
Telephone—Bowling Green 9-6395

## BLUEFRIES-NEW YORK, Inc.

INTERNATIONAL SHIPPING AGENTS

44 WHITEHALL STREET  
NEW YORK

Specializing in Preparing, Boxing,  
Processing of Airplanes and Spare  
Parts for Shipment Overseas.

*Our Activities Include:*

EXPORT-IMPORT SHIPPING  
CUSTOMS BROKERAGE  
SUPERINTENDENCE  
WEIGHING  
SURVEYING  
SAMPLING

Packing · Distribution, Splitting of  
Carloads · Warehousing · Trucking

Combined Freight Service  
to Various Countries

## W E L L M A N NON-FERROUS C A S T I N G S

ALUMINUM—HEAT TREATED  
MAGNESIUM  
AMPCO BRONZE  
BRONZE  
BRASS

### FACILITIES

1. Two modern plants; well-equipped pattern shop (wood or metal); new heat-treating equipment.
2. Precision workmanship; rigid production and inspection standards.
3. Experienced personnel—35 years in brass and aluminum; 15 years in magnesium.
4. Modern laboratory, including X-ray equipment, for quality checking.

THE WELLMAN BRONZE  
& ALUMINUM CO.

General Offices  
2531 E. 93rd Street, Cleveland 4, Ohio

## INDEX OF ADVERTISERS

- Academy of Aeronautics, 429  
 Acme Aluminum Alloys, Inc., 503  
 Adel Precision Products Corp., 489  
 Aerco Corp., 599  
 Aero Supply Mfg. Co., Inc., 453  
 Aeronautical Products Inc., 601  
 AeroProducts Div., General Motors Corp., 575  
 Aeroquip Corp., 461  
 Aircraft Engineering Products, Inc., 513  
 Aircraft Hardware Mfg. Co., 543  
 Aircraft Mechanics, Inc., 509  
 Aircraft Radio Corp., 457  
 Aircraft Screw Products Co., Inc., 589  
 Aircraft Welders, Inc., 603  
 Allison Div., General Motors Corp., 499  
 Aluminum Company of America, 507  
 American Bosch Corp., 605  
 American Chemical Paint Co., 485  
 American Flange & Manufacturing Co., Inc., 529  
 American Gauge Co., 453  
 American Tube Bending Co., 607  
 Appel, S. & Co., 591  
 Atlantic India Rubber Works, Inc., 437  
 B G Corp., 583  
 B. H. Aircraft Co., Inc., 609  
 Babb, Charles H., Co., 463  
 Barr Shipping Co., 671  
 Beech Aircraft Corp., 403, 411  
 Bell Aircraft Corp., 405  
 Bell Co., Inc., 561  
 Bellanca Aircraft Corp., 433  
 Belmont Radio Corp., 477  
 Bendix Products Div., Bendix Aviation Corp., 525, 611  
 Benwood Linze Co., 653  
 Bluefries-New York, Inc., 673  
 Boeing Airplane Co., 417  
 Bolton Manufacturing Corp., 537  
 Boston Insulated Wire & Cable Co., 587  
 Botany Worsted Mills, 545  
 Breeze Corporations, Inc., 613  
 Burkllyn Co., 591  
 Cal-Aero Technical Institute, 397  
 Cannon Electric Development Co., 487  
 Carney Engineering Co., 439  
 Champion Spark Plug Co., 483  
 Chandler-Evans Corp., 615  
 Chicago Aerial Survey Co., 615  
 Chicago Wheel & Mfg. Co., 617  
 Clare, C. P., & Co., 538  
 Clarke Aero-Hydraulics Inc., 591  
 Cleveland Pneumatic Tool Co., 580  
 Clifford Manufacturing Co., 558  
 Climax Molybdenum Co., 441  
 Consolidated Vultee Aircraft Corp., 389  
 Continental Motors Corp., 449  
 Cox & Stevens Aircraft Corp., 619  
 Crescent Insulated Wire & Cable Co., 595  
 Curtiss-Wright Corp., Airplane Div., 415  
 Curtiss-Wright Corp., Propeller Div., 407  
 Denison Engineering Co., 621  
 Douglas Aircraft Co., 395  
 Dow Chemical Co., 509  
 Duramold Div., Fairchild Engine & Airplane Corp., 419  
 Durham Aircraft Service, Inc., 555  
 Dzus Fastener Co., Inc., 623  
 Eagle Parachute Corp., 457  
 Eastman Kodak Co., 473  
 Eaton Manufacturing Co., 465  
 Eclipse-Pioneer Div., Bendix Aviation Corp., 451, 533  
 Edison, Thomas A., Inc., 535  
 Edo Aircraft Corp., 447  
 Engineering & Research Corp., 442  
 Exact Weight Scale Co., 625  
 Fairchild Aircraft Div., Fairchild Engine & Airplane Corp., 419  
 Fairchild Engine & Airplane Corp., 419  
 Federal Products Corp., 627  
 Federal Telephone & Radio Corp., 523  
 Firestone Aircraft Co., 515  
 Flex-O-Tube Co., 627  
 Flightex Fabrics, Inc., 497  
 Foote Bros. Gear & Machine Corp., 526  
 Formica Insulation Co., 565  
 G & O Manufacturing Co., 627  
 General Controls Co., 543  
 General Electric Co., 504-505  
 Globe Steel Tubes Co., 629  
 Grimes Manufacturing Co., 568  
 Grumman Aircraft Engineering Corp., 391  
 Guiberson Diesel Engine Co., 527  
 Gulf Oil Corp., 461  
 Hall Manufacturing Co., 581  
 Hallcrafters Co., 579  
 Hamilton Standard Propellers Div. of United Aircraft Corp., 413  
 Harris-Seybold-Potter Co., 631  
 Hartzell Propeller Co., 473  
 Harvey-Whipple, Inc., 633  
 Hilliard Corp., 486  
 Hub Industries, Inc., 561  
 Hyland Machine Co., 635  
 Industrial Sound Control, 635  
 International Flare-Signal Div. of Kilgore Manufacturing Co., 551  
 J. V. W. Corp., 399  
 Jack & Heintz, Inc., 541  
 Jacobs Aircraft Engine Co., 491  
 Jacoel Cable Splicing Equipment Co., 637  
 Jones, Casey, School of Aeronautics, 429  
 Joyce Aviation, Inc., 481  
 K. L. M. Royal Dutch Airlines, 485  
 Keeny Manufacturing Co., 637  
 Kellogg Switchboard & Supply Co., 531  
 Kennametal Inc., 550  
 Kilgen Aircraft Div. of The Kilgen Organ Co., 637  
 Koehler Aircraft Products Co., 455  
 Kollsman Instrument Co., 639  
 Krembs & Co., 589  
 Kropp Forge Aviation Co., 459  
 Leach Relay Co., 455  
 Leece-Neville Co., 473  
 Leland Electric Co., 653  
 Liberty Aircraft Products Corp., 520  
 Lights, Inc., 567  
 Link Aviation Devices, Inc., 399  
 Liquidometer Corp., 561  
 Lockheed Aircraft Corp., 409

- Lord Manufacturing Co., 641  
 Luscombe Airplane Corp., 435  
  
 McDonnell Aircraft Corp., 495  
 Macwhyte Co., 643  
 Martin, Glenn L., Co., 423  
 Material Distributors Inc., Div. of Beech  
 Aircraft Corp., 471  
 Mercury Aircraft, Inc., 645  
 Merz Engineering Co., 507  
 Micro Switch Div. of First Industrial Corp.,  
 539  
 Moore-Eastwood & Co., 647  
  
 Norma-Hoffmann Bearings Corp., 647  
 North American Aviation, Inc., 387  
 Northrop Aircraft, Inc., 393  
 Northwest Air Service, Inc., 429  
 Numberall Stamp & Tool Co., 596  
  
 Onsrud Machine Works, Inc., 571  
  
 Pacific Engineering Corp., 543  
 Parker Appliance Co., 649  
 Parks Air College, Inc., 437  
 Peterson, Arthur D., Co., 651  
 Pioneer Parachute Co., Inc., 651  
 Piper Aircraft Corp., 427  
 Pratt & Whitney Aircraft Div. of United  
 Aircraft Corp., 413  
  
 Ranger Aircraft Engines Div., Fairchild En-  
 gine & Airplane Corp., 419  
 Republic Aviation Corp., 401  
 Roebling's, John A., Sons Co., 655  
 Rohr Aircraft Corp., 585  
 Roseman Tractor Mower Co., 517  
 Roxalin Flexible Finishes, Inc., 549  
 Royal Engineering Co., 657  
 Ryan Aeronautical Co., 493  
  
 S K F Industries, Inc., 519  
 Scintilla Magneto Div., Bendix Aviation  
 Corp., 469  
 Scott, Henry L., Co., 587  
 Scott, O. M., & Sons Co., 657  
 Seaman Paper Co., 659  
 Seybold Div., Harris-Seybold-Potter Co., 631  
  
 Sikorsky Aircraft Div. of United Aircraft  
 Corp., 413  
 Simmonds Aerocessories, Inc., 500  
 Sinclair Refining Co., 657  
 Skydyne, Inc., 437  
 Socony-Vacuum Oil Co., Inc., 429  
 Solar Aircraft Co., 573  
 Spencer & Morris, 597  
 Sperry Gyroscope Co., Inc., 563  
 Spool Cotton Co., 661  
 Sprouse, V. E., Co., 557  
 Standard Aircraft Products, Inc., 553  
 Standard Oil Company of California, 425  
 Stewart Technical School, 475  
 Stumpp & Walter Co., 555  
 Superior Tube Co., 663  
 Surface Combustion, Aircraft Heater Div.,  
 593  
 Switlik Parachute Co., 475  
  
 Thompson Grinder Co., 597  
 Thompson Products, Inc., 479  
 Thurston, W. Harris, Inc., 597  
 Timken Roller Bearing Co., 521  
 Tomkins-Johnson Co., 569  
 Topflight Tool Co., 673  
 Tube Turns, Inc., 665  
  
 United Aircraft Corp., 413  
 United Aircraft Products, Inc., 667  
 United-Carr Fastener Corp., 547  
 United States Plywood Corp., 511  
 United States Rubber Co., 421  
 Utica Drop Forge & Tool Corp., 475  
  
 Vickers, Inc., 559  
 Vought, Chance, Aircraft Div. of United  
 Aircraft Corp., 413  
  
 Waco Aircraft Co., 497  
 Waldes Koh-I-Noor, Inc., 669  
 Weems System of Navigation, 596  
 Wellman Bronze & Aluminum Co., 673  
 Western Electric Co., 577  
 Worthington Mower Co., 431  
 Wright Aeronautical Corp., 501  
 Wyman-Gordon Co., 671  
  
 Zimmer-Thomson Corp., 467

## INDEX

### A

- Abrahamsen, O., 109  
Abrasives, 502  
Acme Aluminum Alloys, Inc., 311  
Adams, R. R., 474  
Adel Precision Products Corp., 311-312  
Adhesives, 554  
Aerco Corp., 312  
Aerial campaigns, 29-31, 32, 34-37, 38-42, 45-46, 48, 50-52, 53, 58-66, 66-68, 69, 80, 82; against Germany, 29-31, 32, 34-37, 45-46; against Japan, 48, 50, 66-68, 70  
Aero Digest, publication, 480  
Aero Supply Manufacturing Co., 312  
Aerodynamics, 153-155, 209, 210, 232-233, 234  
Aeronautical Chamber of Commerce of America, Inc., 202-203; airport plan, 177-180; roster, 458; work of, 189-192  
Aeronautical organizations, 189-206  
Aeronautical Products, Inc., 210-212  
Aeronautical Review, publication, 480  
Aeronca Aircraft Corp., 212  
Aeroproducts Div., General Motors Corp., 312  
Aeroquip Corp., 312  
Air attacks, 34-37, 46, 50-52, 54-56, 60-61, 63, 65-66, 70, 76, 77, 86, 87  
Air compressors, 502  
Air conditioning equipment, 592  
Air express, 107-108  
Air Facts, publication, 480  
Air Law Review, publication, 480  
Air Line Mechanic, publication, 480  
Air Line Pilot, publication, 480  
Air lines, *see* Air Transport  
Air News, publication, 480  
Air power, 12, 15-16, 18  
Air Research Manufacturing Co., 115  
Air Tech, publication, 480  
Air Trails, publication, 480  
Air transport, 93-128; domestic routes, 117-128; expansion of, 94-95; international routes, 108-117; modification work, 113, 114, 121; operations, 416; routes, 95-96, 418-424; safety, 95, 436; status of, 414; summary, 414  
Air Transport, publication, 480  
Air Transport Association of America, 95, 96; roster, 476; work of, 199-200  
Air war, 11-26  
Aircooled Motors Corp., 301  
Aircraft Accessories Corp., 312  
Aircraft armament and equipment, 321-323, 502  
Aircraft Engineering Products, 313  
Aircraft Hardware Manufacturing Co., Inc., 313  
Aircraft manufacturing industry, 207-383; employees earnings, 440; employment of women, 214, 287, 308, 318, 361; increased manufacturing efficiency, 234, 242-246, 281-282, 291-293, 298-300, 304-305, 307-308; industrial relations, 214, 241, 283, 290-291, 300; manpower, 158, 214, 224, 232, 233, 290, 294-295, 308, 312; mass production methods, 234, 237, 307-308; number of employees, 438; production, 25, 157-158, 233, 239, 241, 250-251, 263, 268, 275, 288, 412; subcontracting, 213, 233, 258, 260-261, 262, 274, 294, 300, 305, 358, 359, 360, 365-366; training, 268, 287  
Aircraft Owners and Pilots Association, roster, 476; work of, 205-206  
Aircraft Production Board, 156-158  
Aircraft Resources Control Office, 156-158  
Aircraft Screw Products Co., 313  
Aircraft War Production Council, East Coast, 194; committees, 466-472; work of, 196-199  
Aircraft War Production Council, West Coast, committees, 462-464; members, 194; work of, 194-196  
Aircraft War Production Councils, 194-199  
Aircraft Welders, Inc., 313  
Aircraft Year Book, 480  
Airlanes, publication, 480  
Airplanes, in war service, 392, 408-409; manufacturers, 212-300; number produced, 157, 195, 207, 234, 241, 400, 402; performance, 24; production by types, 404; production by weight, 402  
Airport construction equipment, 516  
Airport designers and builders, 516

- Airport equipment, 516-518  
 Airport fuel systems, 552  
 Airport maintenance equipment, 363.  
     366, 382, 516  
 Airport operating equipment, 516-518  
 Airport Reference, publication, 480  
 Airports, 169-180, 202-203; in operation,  
     170; number of, 430; number  
     proposed, 170, 172  
 Airways, 169-180  
 Al-Fin Corp., 313  
 All American Aviation, 96, 119  
 Allen, Edmund T., Memorial Aero-  
     nautical Laboratories, 232-233  
 Allied Expeditionary Air Forces, 28  
 Allison Div., General Motors Corp.,  
     301, 370  
 Almen, J. O., 205  
 Aluminum Co. of America, 313-314  
 American Airlines, 93, 96, 118-119  
 American Aviation, publication, 480  
 American Aviation Daily, publication,  
     480  
 American Chemical Paint Co., 314-315  
 American Export Airlines, 103, 117-  
     119  
 American Flange & Manufacturing  
     Co., 315  
 American Gauge Co., 315-316  
 American Propeller Corp., 196, 316  
 American Society of Mechanical En-  
     gineers, roster, 458  
 American Tube Bending Co., 316  
 Ames Aeronautical Laboratory, 154  
 Ammunition Boxes and counters, 518  
 Anderson, F., 445  
 Anderson, W. L., 474  
 Andrews, F. M., 68  
 Andrews, H. J., 456  
 Andrews, P., 460  
 Armament, 344-345  
 Armer, J. C., 478  
 Army Air Forces, 14, 18, 23, 27-68,  
     123, 160, 173, 181, 182, 213, 218, 227,  
     235, 238, 240, 246, 257, 264, 268, 275,  
     276, 286, 288, 290, 294, 307, 312, 338,  
     340, 345, 346, 355, 356, 357, 360, 369;  
     Air Transport Command, 58-59, 93,  
     96-100, 109, 118, 120, 126, 128, 230,  
     252, 254, 394; bombs dropped, 12,  
     18, 23, 27, 50, 31, 33, 38, 45, 46, 50,  
     53, 58, 388; combat record, 18, 28,  
     30, 33-34, 38, 385; combat sorties,  
     28, 31, 38, 40, 45, 50, 53, 58, 64, 386;  
     equipment, 392; growth of, 27; or-  
     ganization, 28; personnel, 27, 396;  
     Personnel Distribution Command,  
     132-134; personnel trained, 129-130;  
     psychological testing procedures,  
     130-132; Redistribution Center, 132-  
     134; roster, 444-445; survival train-  
     ing, 132; training, 129, 396; Train-  
     ing Command, 129-130; Troop Car-  
     rier Command, 62, 68, 252, 254  
 Arnold, H. H., 27, 50, 52, 56, 57, 58,  
     61, 66, 97, 130, 183, 250, 444, 445,  
     448  
 Ashley, T., 460  
 Asiatic theater, 18-26, 48-68, 69-84  
 Atlantic India Rubber Works, Inc., 316  
 Atwood, J. L., 478  
 Autogiros, 262  
 Automotive and Aviation Industries,  
     publication, 480  
 Automotive Council for War Produc-  
     tion, 194  
 Auxiliary motors, 534-536  
 Auxiliary power plants, 518  
 Aviation, publication, 480  
 Aviation Corp., 196  
 Aviation Division, Department of  
     State, work of, 166-168  
 Aviation Equipment, publication, 480  
 Aviation News, publication, 480  
 Aviation Writers Association, roster,  
     460
- B
- B G Corp., 316  
 B. H. Aircraft Co., 316  
 Bachman, B. B., 478  
 Bailey, A. D., 458  
 Bailey, E. L., 476  
 Bane, Thurman H., 201  
 Barnes, I. R., 448  
 Barrett, J. L., 478  
 Basic materials and fabrications, 518  
 Bassett, P. R., 472  
 Batteries, 518  
 Battles, 18, 21, 22, 39-42, 44, 46-48, 58-  
     60, 62-63, 71-73, 76, 78, 80  
 Bearings, 518-522; roller, 361  
 Beech Aircraft Corp., 213-216  
 Beer, K. V., 112  
 Beisel, R. B., 466, 472  
 Belgium, battle of, 47-48  
 Bell, L. D., 205, 219, 458, 466  
 Bell Aircraft Corp., 196, 205, 217-224,  
     291; Ordnance Div., 325  
 Bell Co., Inc., 316



- Bell Telephone Laboratories, 380  
 Bellamy, J. C., 201  
 Bellanca Aircraft Corp., 224-225, 286  
 Bellinger, P. N. L., 446  
 Belmont Radio Corp., 317  
 Bendix Aviation Corp., Bendix Products Div., 317-320; Eclipse-Pioneer Div., 333-338; Pacific Div., 317; Scintilla Magneto Div., 366-367  
 Benwood Linze Co., 320-321  
 Bergin, J., 474, 476  
 Black, L., 460  
 Blakeslee, D., 278  
 Blickman, S., & Co., 325  
 Blind landing systems, 522  
 Boeing Aircraft Co., 194, 225-233, 267, 286, 347  
 Boelter, L. M. K., 458  
 Bolts, 544-546  
 Bomb racks, 522  
 Bombs dropped, *see* Army Air Forces and Navy air forces  
 Bong, R., 142, 266  
 Bonham, L. D., 478  
 Boone, P., 476  
 Boston Insulated Wire & Cable Co., 321  
 Botany Worsted Mills, 321  
 Bourne, T. B., 446  
 Bowersock, J. D., 460  
 Boyle, J. K., 458  
 Bradley, O., 38-39  
 Bradley, S. S., 460  
 Brady, G. W., 472  
 Brakes and parts, 522  
 Branch, H., 448  
 Brand, H., Jr., 458  
 Braniff, T. E., 476  
 Braniff Air Lines, 93, 96, 127  
 Brashear, H. R., 458  
 Bray, D. C., 285  
 Breech, E. R., 458  
 Breeze Corporations, 321-323  
 Brewer, Frank G., Award, 203  
 Brewer Trophy, 160  
 Briggs, L. J., 448  
 Brown, S., 278  
 Brukner, C. J., 458, 460  
 Bruno, H. A., 478  
 Buck, R. E., 478  
 Buckendale, L. R., 478  
 Burden, W. A. M., 448, 472  
 Bureau of Aeronautics, U. S. Navy, 156, 160; *see also* Navy air forces  
 Burgess, R. S., 450  
 Burklyn Co., 323  
 Burma campaign, *see* China-Burma-India campaign  
 Burton, A. T., 460  
 Bush, V., 448  
 Bushings, 522-524  
 Butler, W. O., 444
- C
- Cabin hardware and furnishings, 524  
 Cal-Aero Academy, 146  
 Cal-Aero Technical Institute, 146-147  
 California Flyers, Inc., 323  
 Cameras and supplies, 325, 332-333, 524  
 Cams, 542  
 Camshafts, 542  
 Canadian Car & Foundry Co., 241  
 Canadian Pacific Airways, 163  
 Canadian Propellers, 348  
 Cannon, J. K., 28, 44, 271, 444, 445  
 Cannon Electric Development Co., 323-324  
 Carburetors, 317-320, 325, 524  
 Cargo loading equipment, 524  
 Carney, H. C., 324  
 Carney Engineering Co., 324-325  
 Carrier task forces, *see* Navy air forces  
 Carriers, number of, 69  
 Carter, J., 278  
 Case, N. S., 456  
 Casey, V. F., 88  
 Cassady, J. H., 446  
 Castings, 524  
 Central Pacific campaign, 50-52, 69, 80  
 Cessna Aircraft Co., 233  
 Chamberlain, E. H., 448  
 Champion Spark Plug Co., 325  
 Chandler-Evans Corp., 325  
 Chanute, Octave, Award, 201  
 Chargers, battery, 524  
 Chatfield, C. H., 460  
 Chemicals, 528  
 Chennault, C., 58, 63, 64, 65, 444, 445  
 Chiang Kai-shek, 58  
 Chicago Aerial Survey Co., 325  
 Chicago & Southern Air Lines, 96  
 China-Burma-India campaign, 58-66  
 China campaign, *see* China-Burma-India campaign  
 China National Aviation Corp., 115  
 Civil Aeronautics Administration, 96, 134, 169-173, 174-176; *appropri-*

- tions, 412; Civilian Pilot Training, 141-142; roster, 446; training, 141-143, 159, 160, 398; work of, 158-160
- Civil Aeronautics Board, 95, 96, 109, 115, 119, 123, 125, 159, 171, 252; roster, 448
- Civil Air Patrol, 176-177, 181-188; training, 143-146
- Civil Air Patrol League, 188
- Clamps, 528
- Clare, C. P., & Co., 325-326
- Clark, C. H., 88
- Clark, M., 44
- Cleaners and cleaning compounds, 528; buffing, burring and polishing, 528
- Cleary, M. G., 460
- Clements, B., 478
- Cleveland Pneumatic Aerol. 326
- Cleveland Pneumatic Tool Co., 326
- Clifford Manufacturing Co., 326
- Cloths, 544
- Closures, drums, 528
- Clutches, 528
- Coast Guard, 90-92, 163
- Cochran, P. G., 59, 62
- Coffey, H. K., 478
- Cohu, LaM. T., 458, 462
- Coleman, W. M., 87
- Collector rings, 528-530
- Collier Trophy, 201, 203
- Collings, J. A., 125
- Collins, P. F., 476
- Colonial Airlines, 96
- Colonial Radio Corp., 325
- Colvin, C. H., 472
- Colvin, T. E., 458
- Combat record, 12-13, 18; *see also* Army Air Forces and Navy air forces
- Combat sorties, 13; *see also* Army Air Forces and Navy air forces
- Commonwealth Aircraft, Inc., 233, 280
- Communications equipment, 342, 348, 353-354, 380-382
- Communications systems, 530
- Congressional Committees, 452-456
- Coningham, A., 445
- Consolidated Vultee Aircraft Corp., 194, 233-238, 291, 347
- Continental Air Forces, 68
- Continental Air Lines, 96
- Continental Aviation & Engineering Corp., 302
- Continental Motors Corp., 302, 309
- Controls, 338, 367-369, 372, 530-532
- Cooling systems, 532
- Coordinated land, sea and air operations, 18, 38-42, 49-50, 51-52, 70-71
- Cote, A. A., 474
- Couplings, 564
- Covers, 532
- Cowlings, 532
- Cox & Stevens Aircraft Corp., 326
- Cram, L. V., 478
- Cranes, 556
- Crankshafts, 542
- Crawford, J. M., 478
- Crescent Insulated Wire & Cable Co., 326-327
- Crosby, W., 476
- Cross-license agreement, 192-193
- Culbertson, W. D., 109
- Cunningham, W. H., 275
- Curtis, E., 445
- Curtis, F. L., 87
- Curtiss-Wright Corp., 196, 291
- Curtiss-Wright Corp., Airplane Div., 239-246
- Curtiss-Wright Corp., Propeller Div., 197, 327-329
- Curtiss-Wright Technical Institute, 146
- Cylinder deflectors, baffles, brackets, 532

## D

- D-day, 37-38
- Dallas, A. W., 476
- Dallas Aviation School, 151
- Daly, J. A., 460
- Damon, R. S., 472
- Davidson, H. C., 58, 60, 63, 444, 445
- De Florez, L., 201, 203, 446
- De France, S. J., 448
- De-icing, 154
- De-icing fluids and equipment, 532-534
- Defense Plant Corp., 302
- Dehydrated packing, 532
- Del Mar, B. E., 458
- Delgado, Isaac, Central Trades School, 148
- Delta Air Lines, 96, 126-127
- Denison Engineering Co., 329
- Designers and industrial engineers, 534
- Devaney, L. G., 474
- Devers, J., 39
- Dexter, R. R., 472
- Dies, patterns, jigs, 534
- Disconnect plugs, 536

Division of International Communica-  
tions, 166  
Dixon, R. E., 446  
Dobson, F., 210  
Dodge Chicago Plant Div., Chrysler  
Corp., 310  
Donaldson, C. B., 446  
Doolittle, J. H., 28, 46, 444, 445  
Dorr, D. H., 478  
Douglas, D. W., 458, 462  
Douglas Aircraft Co., 115, 194, 246,  
254, 291, 294, 301, 347  
Douglass, R. L., Jr., 50, 445  
Douglass, R. W., 444  
Dow Chemical Co., 329-331  
Draper, S. C., 478  
Dudley, A. S., 478  
Dudley, J. R., 446  
Dunn, W. L., 317  
Duramold Div., Fairchild Engine &  
Airplane Corp., 331  
Durand, W. F., 448  
Durham Aircraft Service. Inc., 331  
Durr, C. J., 456  
Dynamotors, 536  
Dzus Fastener Co., 331

## E

Eaker, I. C., 28, 42, 271, 445  
Eagle Parachute Corp., 331-332  
Eastburn, G. B., 478  
Eastern Air Lines, 93, 96, 127  
Eastern Aircraft Div., General Motors  
Corp., 196, 254  
Eastman Kodak Co., 332-333  
Ebel, W. K., 472  
Echols, O. P., 156, 444, 448  
Eclipse Machine Div., Bendix Avia-  
tion Corp., 320  
Eclipse-Pioneer Div., Bendix Aviation  
Corp., 333-338  
Edison, Thomas A., Inc., 338-340  
Edo Aircraft Corp., 340  
Egtvedt, C. L., 458, 462  
Eighth Air Force, 28; bombs dropped,  
18, 392  
Eisemann Corp., 340  
Eisenhower, D. D., 16, 28, 37, 38, 276  
Electrical equipment, 344-346, 357-358,  
534-540; auxiliary motors, 534-536;  
disconnect plugs, 536; dynamotors,  
536; generators, 536; ignition as-  
semblies, radio shielded, 536; mag-  
netos, 366-367, 536; relays, 536-540;

rheostats, 540; switches, 360-361.  
540; terminals, 540  
Ellington, K., 458  
Ellis, W. E., 87  
Emanuel, V., 458, 466  
Embry-Riddle School of Aviation, 148  
Enemy planes destroyed, 12; *see also*  
Combat record  
Engine equipment, 323, 335-336, 540  
Engine mounts, 362, 540-542  
Engine parts, 542-544  
Engineering & Research Corp., 254-  
256  
Engines, manufacturers, 301-310; num-  
ber produced, 207, 400; production,  
302; production by horsepower, 402  
Enyart, W. R., 478  
European theater, 11-18, 28-48  
Evans, R. M., 456  
Exact Weight Scale Co., 340  
Exhaust manifolds, 291, 360, 544

## F

Fabrics, 321, 343, 376-377, 544  
Fairchild, S. M., 472  
Fairchild Aircraft Div., Fairchild En-  
gine & Airplane Corp., 241, 256-  
258  
Fairchild Engine & Airplane Corp.,  
196  
Fairings, 544  
Fairleads, 576  
Farrington, D. W., 460  
Fasteners, 331, 372-373, 544-546  
Federal Communications Commission,  
348; roster, 456; work of, 166  
Federal Products Corp., 340-342  
Federal Telephone & Radio Corp., 342  
Fences, 546  
Fick, H. F., 446  
Filters, 546  
Finishes, 548  
Fire fighting equipment, 548  
Firestone Tire & Rubber Co., 342-343  
First aid equipment, 548  
Fishleigh, W. T., 478  
Fitch, A. W., 446, 448  
Fitch, E. M., 476  
Fittings, 548  
Flares, 548  
Fleetwings Div., Kaiser Cargo, Inc.,  
258  
Fleming, F. N., 460  
Flex-O-Tube Co., 343  
Flightex Fabrics, Inc., 343

- Floats, 340, 548  
 Flogans, H. A., 478  
 Flying, publication, 480  
 Flying Aces, publication, 480  
 Flying Facts and Figures, 384-440  
 Foote Bros. Gear & Machine Corp.,  
     344  
 Forest Products Laboratory, 160, 161-  
     162  
 Forest Service, 186, 332; roster, 456;  
     training, 162-163; work of, 160-163  
 Forgings, 552  
 Forman, G. R., 472  
 Formica Insulation Co., 344  
 Foss, J., 142  
 Fowler, F. H., 458  
 Fox, H., 476  
 Francis, D., 460  
 Frigidaire Div., General Motors Corp.,  
     348  
 Froelich, M. H., 460  
 Froesch, C., 472  
 Frye, J., 123, 476  
 Fryhoff, E. V., 474  
 Fuel pumps, 552  
 Fuel systems, 552  
 Fuels, 552  
 Fulghum, J. L., 450  
 Fuller, E., 160, 203
- G
- G & A Aircraft, Inc., 343  
 Gardner, G., 444  
 Gardner, L. D., 472  
 Gaskets, 552  
 Gates, B. E., 444  
 Gauges, 350, 552-554  
 Gears, 554  
 General Aircraft Corp., 258  
 General Analine & Film Corp., 325  
 General Controls Co., 115, 344  
 General Electric Co., 286, 302-304,  
     344-346, 370  
 General Instrument Corp., 325  
 General Motors Corp., 205  
 Generators, 536  
 Gentile, D., 278  
 George, H. L., 96, 444  
 Germany, battle of, 14; destruction of  
     war plants, 29-30; *see also* Aerial  
     campaigns  
 Geuting, J. T., Jr., 458  
 Giles, B. M., 444  
 Gillmor, R. E., 458
- Glass, 554  
 Gliders, 233, 258, 286, 287, 290, 300-  
     301  
 Globe Aircraft Corp., 258-259, 347  
 Globe Steel Tubes Co., 346  
 Glues, 554  
 Goad, L. C., 466  
 Gohn, E. P., 478  
 Goland, M., 458  
 Goodrich, B. F., Co., 346-347  
 Goodyear Aircraft Corp., 259-261  
 Gordon, N., 82  
 Gorrell, E. S., 96, 476  
 Goss, B. C., 458  
 Governmental activities, 153-168  
 Graham, J. R., 478  
 Grant, D. N. W., 99, 444  
 Grass seed, 554  
 Graves, J., 476  
 Green, A. W. F., 478  
 Green, H., 278  
 Gregory, F., 293  
 Grimes Manufacturing Co., 347  
 Grommets, 554  
 Gross, R. E., 458, 460, 462  
 Grumman, L. R., 472  
 Grumman Aircraft Corp., 291  
 Grumman Aircraft Engineering Corp.,  
     261-262  
 Guggenheim, Daniel, Medal, 205  
 Guiberson Corp., 347-348  
 Gulf Oil Corp., 348
- H
- Haddaway, G. E., 460  
 Hale, W., 49, 445  
 Hallicrafters, Inc., 348  
 Halsey, W. F., 74, 76  
 Hamilton Standard Propellers Div.,  
     United Aircraft Corp., 348-349  
 Hansell, H. S., Jr., 66  
 Hanson, P. D., 456  
 Hardware, 554  
 Hardy, E. L., 450  
 Harman Training Center, 152  
 Harmon, H. R., 444  
 Harmon, M. F., 49, 50, 445  
 Harrington, R. P., 472  
 Harris, C. E., 87  
 Harris, F., 446  
 Hartson, J. T., 460  
 Harvey-Whipple, Inc., 349-350  
 Hayes Industries, 350  
 Hayes Manufacturing Corp., 350-351  
 Heaters, 554-556

Heath Co., 351  
 Hedrick, L. H., 444  
 Heintzleman, B. F., 456  
 Helicopters, 210-212, 218, 223, 224,  
 262, 268, 293-294  
 Helms, C. H., 448  
 Herreshoff, A. G., 478  
 Higgins Aircraft, Inc., 325  
 Hilliard Corp., 351  
 Hindman, S. E., 89  
 Hintersehr, J. F., 476  
 Hinton, C., 478  
 Hobbah, H. V., 476  
 Hodges, A. C., 450  
 Hodges, C. H., 28  
 Hodges, J. P., 444  
 Hoists, 556  
 Horchler, B. H., 472  
 Horner, W. F., 317  
 Hose, 556  
 Hose clamps, 556,  
 Hose fittings, 556  
 House, E. J., 444  
 Hub Industries, 351  
 Hubbard, C. C., 476  
 Hughes, H., 123  
 Hunsaker, J. C., 448  
 Hunter, C., 476  
 Hunter, F. O'D., 444  
 Hydraulic controls and assemblies, 233,  
 556-560  
 Hydraulic fluids, 560  
 Hyland Machine Co., 351

## I

Ignition assemblies, radio shielded,  
 536  
 India campaign, *see* China-Burma-India  
 campaign  
 Industrial Sound Control, 351  
 Inland Air Lines, 96  
 Inspection equipment, 586-588  
 Institute of the Aeronautical Sciences,  
 155, 198; roster, 472; work of, 200-  
 202  
 Instructors, licensed ground, 428  
 Instruments, 338-339, 340-342, 355-356,  
 371-372, 380, 560-564  
 Insulating materials, 564  
 International Civil Aviation Confer-  
 ence, 159  
 International Technical Committee of  
 Aerial Legal Experts, 167  
 International Telephone & Telegraph  
 Corp., 342

Interstate Aircraft & Engineering  
 Corp., 351-352  
 Invasions, 14-18, 22-23, 31-32, 37-39  
 Ireland, C. L., 474  
 Irwin, R. R., 458  
 Italian campaign, 44

## J

Jack & Heintz, 352  
 Jackson, A., 210  
 Jacobs Aircraft Engine Co., 304-305,  
 351  
 Jacoel Cable Splicing Equipment Co.,  
 352-353  
 Jakle, V. E., 450  
 James, W. S., 478  
 Japan, *see* Aerial campaigns  
 Jefferson, G., 450  
 Jeffries, John, Award, 201  
 Jet propulsion, 153, 207-208, 217, 222,  
 263-264, 302-304, 338, 345, 370, 376  
 Jett, E. K., 456  
 Johnson, D., 53, 444  
 Johnson, E., 476  
 Johnson, J. B., 478  
 Johnson, O. B., 284  
 Johnston, D. C., 474  
 Joint Aircraft Committee, 156  
 Joints, 564  
 Jones, C. S., 472  
 Jones, J. W., 444  
 Jones, Casey, School, 148  
 Jouett, J. H., 478  
 Journal of Air Law, publication, 480  
 Journal of the Aeronautical Sciences,  
 publication, 480  
 Joyce Aviation, Inc., 353

## K

K.L.M. airline, 116-117  
 Kahn, R. W., 478  
 Keeney Manufacturing Co., 353  
 Keirn, D. J., 202  
 Keller, W. E., 478  
 Kellett Aircraft Corp., 262  
 Kellogg Switchboard & Supply Co.,  
 353-354  
 Kelly, E. F., 474  
 Kelsey, B. S., 201  
 Kemper, C., 448  
 Kennametal Inc., 354  
 Kennard, R. A., 88  
 Kenney, G. C., 53, 445  
 Kidde, Walter, & Co., 354

Kilgen Aircraft Div., Kilgen Organ  
Co., 354-355  
Kindelberger, J. H., 458, 460, 462  
King, E. J., 71, 446  
Kingsley, C., 460  
Kinkaid, T. C., 77  
Kinner Motors, 305  
Kircher, J. C., 456  
Kitrell, S. P., 474  
Knapp, E. F., 476  
Knerr, H. J., 445  
Knudsen, W. S., 156, 444  
Koch, A. S., 446  
Koehler Aircraft Products Co., 355  
Kollman Instrument Div., Square D  
Co., 355-356  
Krembs & Co., 356  
Kropp Forge Aviation Div., Kropp  
Forge Co., 356-357  
Krug, J. A., 156  
Kuter, L. S., 444

## L

Laddon, I. M., 472  
Laird, C., 474  
Landing gear, 320, 326, 564-566  
Langley Memorial Laboratory, 201  
Lankford, J. W., 448  
Lanter, F., 446  
Larson, W. T., 444  
Lawrance Aeronautical Corp., 357  
Le May, C., 50, 445  
Leach Relay Co., 357  
Leasure, C. E., 448  
Ledo Road, 58-59  
Lee, J., 448  
Lee, J. C., 194  
Leece-Neville Co., 357  
Leland Electric Co., 357-358  
Leslie, J. C., 472  
Lewis, G. W., 448  
Leyte Gulf, battle of, 22, 71, 72-73, 78,  
80  
Leyte, invasion of, 22  
Liberty Aircraft Products Corp., 358  
Life saving equipment, 566  
Lifts, 556  
Lighter-than-air, 259-260  
Lighting equipment, 566  
Lights, Inc., 358  
Lincoln Aeronautical Institute, 152  
Link Aviation Devices, 358-359  
Linnel, F. J., 445  
Liquidometer Corp., 359  
Little, D. M., 450

Littlewood, W., 448, 478  
Lockheed Air Terminal, Inc., 268  
Lockheed Aircraft Corp., 194, 262-268,  
291, 347  
Lockheed Overseas Corp., 268  
Lodwick School of Aeronautics, 148-  
149  
Logan, G. B., 478  
Lonnquest, T. C., 446  
Lord Manufacturing Co., 359  
Losey, Robert M., Award, 201  
Lubricants, 566  
Ludington, C. T., 476  
Luscombe Airplane Corp., 359  
Luzon, invasion of, 22-23, 78  
Lycoming Div., The Aviation Corp.,  
196-197, 305, 351

## M

McCain, J. S., 74  
McCampbell, D., 89  
McCann, G., 476  
McClelland, H. H., 444  
McCormick, J. H., 444  
McDonald, W. F., 450  
McDonald, W. P., 478  
McDonnell Aircraft Corp., 268  
McKay, J. G., 148  
MacArthur, D., 19, 21, 22, 23, 53, 54,  
55, 56, 58, 75, 77, 78, 120, 357  
MacCracken, W. P., Jr., 478  
Machine parts, 570-572  
Machine tools, 254-255, 313, 326, 340,  
349, 362, 566-570  
Machinery, 570-572  
Macklin, F., 476  
Macwhyte Co., 359-360  
Magnetos, 536  
Mahoney, E. J., 450  
Maitan, J. J., 472  
Manifolds, 572  
Manly Memorial Award, 205  
Manufacturers Aircraft Association,  
roster, 460; work of, 192-194  
Marchev, A., 458, 466, 472  
Marine Corps, 83-84, 240, 297, 298  
Markham, D. W., 476  
Marshall, G. C., 66  
Martin, D. C., 474  
Martin, E., 478  
Martin, G. L., 458, 466  
Martin, R. M., 450  
Martin, The Glenn L., Co., 196, 291,  
268-274, 383  
Material Distributors, Inc., 217

Meadow, H. L., 446  
 Meixell, H., 476  
 Menasco Manufacturing Co., 194  
 Mercury Aircraft, Inc., 360  
 Merrill, F., 59, 63  
 Merz Engineering Co., 360  
 Meteorology, 163-164, 176  
 Meyers Aircraft Co., 274  
 Micro Switch Div., First Industrial Corp., 360-361  
 Mid-Continent Airlines, 96, 128  
 Miller, J. W., 476  
 Miller, L. W., 444  
 Mines, C. E., 478  
 Mira Loma Flight Academy, 146  
 Mitchell, R. D., 53, 445  
 Mitscher, M. A., 70, 74, 290  
 Model Airplane News, publication, 480  
 Modley, R., 458  
 Monro, C. B., 476  
 Montgomery, B., 28  
 Moody, J., 474  
 Moore-Eastwood & Co., 361  
 Morgan, J. E. P., 458  
 Moseley, C. C., 146-147  
 Mosier, O. M., 476  
 Moss, W. W., 112  
 Motors, auxiliary, *see* Auxiliary motors  
 Mountbatten, L., 61  
 Moxom, W. J., 450  
 Mueller, R. C., 478  
 Murray, G. D., 446  
 Murray, J. P., 460

## N

Nash-Kelvinator Corp., 348  
 Nashville Div., Consolidated Vultee Aircraft Corp., 236-237  
 National Advisory Committee for Aeronautics, 190, 201; roster, 448; work of, 153-155  
 National Aeronautic Association, 180; roster, 478; work of, 202-203  
 National Aeronautics, publication, 480  
 National Aircraft War Production Council, 198  
 National Airlines, 95  
 National Airport Plan, 159, 169-173; cost of, 170, 172  
 National Association of State Aviation Officials, roster, 474-476  
 National Commission of the Permanent American Aeronautical Commission, 167

Navy air forces, 20-21, 24, 69-92, 235, 240, 246, 286, 307, 328, 331-332, 357, 360, 369; bombs dropped, 69, 390; carrier task forces, 19-22, 74-77, 80; combat record, 69, 70, 73, 80, 390; combat sorties, 69, 390; equipment, 392; growth of, 86; Naval Air Transport Service, 93, 100-107, 109-110, 118, 252, 254, 394; personnel, 86, 398; roster, 446; strength of, 69; Technical Training Command, 110, 136-137; training, 134-141, 398  
 Neal, G. A., 448  
 Nelson, H. P., 158  
 New England Aircraft School, 152  
 Newcomb, R., 460  
 Nichols, W. H., 450  
 Nimitz, C. W., 19, 23, 49, 50, 56, 71  
 Noorduyin Aircraft Co., 280  
 Norma-Hoffmann Bearings Corp., 361  
 Normandy, invasion of, 15-18, 31-32, 37-39, 84  
 Norris, E. W., 458  
 Norstad, L. R., 50, 66-67, 444  
 North American Aviation, Inc., 194, 267, 274-283  
 North France campaign, 38-42; *see also* Normandy, invasion of  
 North Pacific campaign, 53, 82  
 Northeast Airlines, 94, 96  
 Northern Aircraft Products Div., The Aviation Corp., 197, 361  
 Northrop Aircraft, Inc., 194, 283-286, 291  
 Northwest Air Service, Inc., 361-362  
 Northwest Airlines, 94, 124  
 Northwestern Aeronautical Corp., 286  
 Nugent, R. E., 28, 445  
 Numberall Stamp & Tool Co., 362  
 Nuts, 544-546  
 Nutt, A., 478

## O

Oexle, C. W., 446  
 Official Aviation Guide, publication, 480  
 Oil seals, 572  
 Old, W. D., 62, 444  
 O'Leary, W., 476  
 Oldfield, H. R., 444  
 O'Neil, J. F., 474  
 Onsrud Machine Works, 362  
 Osborn, E. D., 472  
 Owens, R. L., 444  
 Owens-Corning Corp., 367

Oxygen equipment, flight, 572

P

Pace, E. M., 156  
 Pacific campaign, 50  
 Pacific Div., Bendix Aviation Corp., 317  
 Pacific Engineering Corp., 362  
 Pacific Finance Corp. of California, 268  
 Paints, 548  
 Palmer, R. C., 478  
 Pan American Airways, 94, 103, 109-116, 345  
 Panels, 572  
 Pappas, C. E., 205  
 Parachutes, 331-332, 375-376, 572; hardware, 572; parts, 572  
 Parker, J. E., 444  
 Parker Appliance Co., 362  
 Parks, O. L., 149, 180  
 Parks Air College, 149-150, 180  
 Parrish, W. A., 478  
 Parrish, W. W., 460, 478  
 Parts, aircraft, 502-514; aluminum, 502-508; cork, 508; felt, 508; fibre, 508; leather, 508; magnesium, 508-510; plastic, 331, 510; plywood, 354-355, 378, 510; rubber, 510-512; steel, 512-514; synthetic, 514; wood, 354-355, 514  
 Patch, A. M., 42  
 Patents, 192-194  
 Patton, F. C., 478  
 Patton, G. S., Jr., 18, 28, 39, 40, 42  
 Pennsylvania-Central Airlines, 96, 125-126  
 Perkinson, A., 476  
 Peters, W. F., 194, 462  
 Peterson, Arthur D., Co., 363  
 Peterson, C., 278  
 Philippines, battle of, 21, 71-73; campaign, 53-54, 69, 71-73, 78, 80; invasion of, 22-23, 56-58  
 Philippines Sea, battle of, 76  
 Phillips, W. H., 201  
 Pigott, R. J. S., 478  
 Pilots, number licensed, 426  
 Pioneer Instrument section, Eclipse-Pioneer Div., 338  
 Pioneer Parachute Co., 363-364  
 Piper, W. T., 180  
 Piper Aircraft Corp., 180, 286-288  
 Pistons, 542  
 Pitcairn Autogiro Co., 343

Plastics, 331, 574  
 Pogue, L. W., 448  
 Pokryshkin, A., 219  
 Polaris Flight Academy, 146  
 Pollard, R. E., 450  
 Pooler, F. C. W., 456  
 Porter, P. A., 456  
 Post Office Department Air Mail Service, roster, 450  
 Pratt & Whitney Aircraft Div., United Aircraft Corp., 305-307, 351  
 Preddy, G., 278  
 Price, G. C., 444  
 Price, J. H., 456  
 Primers, engine, 574  
 Production pools, 267, 269  
 Progress of Civil Aeronautics, 432-436  
 Propellers, 214-215, 312, 316, 327-329, 348-349, 383, 574; number produced, 406; parts, 382-383, 574  
 Pruitt, R. S., 460  
 Public Health Service, work of, 165-166  
 Pulleys, 576  
 Pumps, 576  
 Purdum, S. W., 450

Q

Quackenbush, R. S., Jr., 446  
 Quarantine, aircraft, 165-166  
 Quesada, E. R., 28, 276, 445

R

R.C.A., 286  
 Radiators, 576  
 Radios, 578; accessories and equipment, 317, 576; compasses, 576-578  
 RAF, 14, 18, 37-38, 62  
 Railway Express Agency, 107-108  
 Ramey, R., 58  
 Ramsey, D. C., 86, 101, 134, 446  
 Ranger Aircraft Engines Div., Fairchild Engine & Airplane Corp., 197, 307-308, 351  
 Rankin, J. G., 151  
 Rankin Aeronautical Academy, 151  
 Raymond, W. T., 476  
 Reber, W. McK., Jr., 474  
 Reconstruction Finance Corp., 198  
 Redding, J. D., 478  
 Redding, W. P., 478  
 Redfern, M. F., 474, 476  
 Reed, T. R., 450



- Reed, Sylvanus Albert, Award, 201  
 Reeves, J. W., 446  
 Reichelderfer, F. W., 448, 450  
 Reid, H. J. E., 448  
 Relays, 536-540  
 Remington-Rand, Inc., 348  
 Republic Aircraft Products Div., The  
   Aviation Corp., 197, 364  
 Republic Aviation Corp., 196, 205, 288-  
   290  
 Rescues, 76, 84-85, 187-188, 272  
 Research, 153-155, 317, 333-334  
 Resistoflex Corp., 364  
 Reynolds Metals Co., Aircraft Parts  
   Div., 364-365  
 Rheostats, 540  
 Rice, A. H., 460  
 Rice, W. B., 456  
 Richard, F. C., 110  
 Richardson, L. B., 156, 446, 448  
 Rickenbacker, E. V., 474  
 Riley, J. A., 450  
 Ringrose, K. H., 474  
 Rings, 542  
 Rivets, 578  
 Roberts, G. C., 474  
 Robertson Aircraft Corp., 152, 290  
 Robinson, R. G., 448  
 Rocket-propulsion, 207-208  
 Roddy, M., 460  
 Roebing's, John A., Sons Co., Air-  
   craft Div., 365  
 Rogers, J. M., 460  
 Rogers, L. W., 219  
 Rohr Aircraft Corp., 365-366  
 Roosevelt Aviation School, 151  
 Rose, D., 460  
 Roseman Tractor Mower Co., 366  
 Rossman, P. F., 478  
 Royal Dutch Airlines, *see* K.L.M.  
 Royal Engineering Co., 366  
 Russell, F. H., 460  
 Ryan, D. J., 474  
 Ryan, O., 448  
 Ryan, T. C., 458, 462  
 Ryan Aeronautical Co., 194, 290
- S
- SKF Industries, 366  
 Safety belts, 578  
 Sanborn, J. A., 460  
 Sarle, C. F., 450  
 Scales, 340, 578  
 Schader, F. K., 109
- Schroeder, L. L., 474  
 Schupp, R. E., 474  
 Scintilla Magneto Div., Bendix Avia-  
   tion Corp., 366-367  
 Scott, Henry L., Co., 367  
 Scott, O. M., & Sons Co., 367  
 Scott Aviation Corp., 367  
 Screws, 544-546  
 Seaman Paper Co., 367  
 Seats, 578  
 Seebees, U. S. Navy, 173  
 Shanley, F. R., 458  
 Sharp, E. R., 448  
 Sharples, L. P., 476  
 Sharples, P. T., 476  
 Shell Oil Co., Inc., 367  
 Sheridan, M. C., 474  
 Shielding, radio and ignition, 323, 578  
 Shims, 542  
 Shloss, L. W., 460  
 Shock absorbers, 578-582  
 Shop equipment, 582  
 Short, M., 478  
 Show, S. B., 456  
 Sibley, R. B., 460  
 Signals, 548  
 Simmonds Aerocessories, 367-369  
 Simpson, W. H., 28  
 Sikorsky Aircraft Div., United Air-  
   craft Corp., 293-294  
 Sinclair Refining Co., 369  
 Skiis, 361, 548  
 Skydyne, Inc., 369  
 Skyways, publication, 480  
 Slessor, J. C., 445  
 Smith, C. C., 286  
 Smith, F. H., Jr., 444  
 Smith, G. S., 446  
 Smith, J. C., 450  
 Society of Automotive Engineers, 203-  
   205; roster, 478  
 Socony-Vacuum Oil Co., 369  
 Solar Aircraft Co., 369-370  
 Sommers, J. E., 446  
 Sorrell, L. C., 476  
 South France campaign, 42-44; in-  
   vasion of, 18, 42-45  
 Southern Aircraft Corp., 370  
 Southern Flight, publication, 480  
 Southwest Pacific campaign, 54-56,  
   74-76  
 Spaatz, C. A., 28, 445  
 Spark plugs, 316, 325, 582  
 Spartan School of Aeronautics, 150-  
   151, 160

Spelis, T. J., 283-284  
 Spencer, J. W., 456  
 Spencer, L. V., 460  
 Spencer, R. E., 450  
 Spencer & Morris, 370-371  
 Sperry, E. A., Jr., 472  
 Sperry Gyroscope Co., 371-372  
 Sperry, Lawrence, Award, 201  
 Sperry Products, Inc., 372  
 Spool Cotton Co., Crown Fastener Div., 372-373  
 Sportsman Pilot, publication, 480  
 Springs, 582  
 Sprouse, V. E., Co., 373  
 Spruance, R. R. A., 74  
 Stack, J., 155, 201  
 Stalin, J., 219  
 Stampings, 582-584  
 Standard Oil Company of California, 373  
 Stands, engine, propeller, servicing, 584  
 Stanford, E. W., 474  
 Stanton, C. I., 159, 446  
 Stark, H. A., 476  
 Starters, 584  
 Statistical tables, 384-440  
 Steeneck, R. F., 478  
 Steers, S. B., 474, 478  
 Stern, B., 446  
 Stewart Technical School, 151-152  
 Stilwell, J. W., 59, 62, 63, 65, 98, 99  
 Stilwell Road, 58-59, 60, 64-65  
 Stinson Div., Consolidated Vultee Aircraft Corp., 234-235, 238-239  
 Stockburger, A. E., 446  
 Strainers, 546  
 Stratemeyer, G. E., 58, 62, 445  
 Stratos Corp., 373  
 Streett, W. St. C., 53, 444, 445  
 Strehlow, W. F., 478  
 Stevenson, A. R., 458  
 Stout, W. B., 478  
 Straight, J. L., 458  
 Studebaker Corp., 309  
 Stumpp & Walter Co., 374  
 Subassemblies, 212, 224, 227, 233, 258, 260-261, 323, 350, 355, 359, 369, 584-586  
 Superchargers, 586  
 Superior Tube Co., 374  
 Surface Combustion, 374-375  
 Swenson, L. H., 478  
 Switches, 540  
 Switlik Parachute Co., 375-376

## T

Tanks, 586  
 Tannehill, I. R., 450  
 Tapes, 544  
 Taylorcraft Aviation Corp., 294-296  
 Teetor, M. O., 478  
 Teichman, F. K., 458  
 Terminals, 540  
 Testing equipment, 586-588  
 Texas Co., 376  
 Thickstun, W. R., 450  
 Thompson, C. C., 478  
 Thompson, E. S., 458  
 Thompson Aircraft & Engineering Co., 325  
 Thompson Aircraft Products Co., 376  
 Thompson Grinder Co., 376  
 Thompson Products, Inc., 376  
 Thurston, W. Harris, Inc., 376-377  
 Timberlake, P. W., 444  
 Timken Roller Bearing Co., 377  
 Tipton, S. G., 476  
 Tires, 588  
 Tomkins-Johnson Co., 377  
 Tools, 377, 383, 588  
 Toombs, F. A., 448  
 Topflight Tool Co., 377  
 Towers, J. H., 49  
 Tractors, 588-590  
 Training, 129-152, 162-163, 358, 398;  
*see also*, Aircraft manufacturing industry, Army Air Forces, Civil Aeronautics Administration, Civil Air Patrol, Forest Service, Navy air forces  
 Training devices, 590  
 Transcontinental & Western Air, 94, 122-125, 349  
 Trippe, J. T., 115  
 Tube bending, 590  
 Tube Turns, Inc., 377-378  
 Tubes, 588  
 Tubing, 590  
 Tully, A. H., Jr., 474  
 Turner, R., 478  
 Turrets and parts, 590  
 Twentieth Air Force, 50, 66-68  
 Twining, N. F., 28, 444, 445

## U

U. S. Air Services, publication, 480  
 Uniforms, 590  
 United Air Lines, 94, 119-122; Training Center, 152  
 United Aircraft Products, Inc., 378

United States Plywood Corp., 378  
 United States Rubber Co., 378-379  
 University of Southern California, 371  
 Uthus, B., 446  
 Utica Drop Forge & Tool Corp., 379

## V

Valentine, R. A., 474  
 Valk, W. E., 460  
 Valves, control, 550-591; engine, 542-544  
 Vandenburg, H. S., 28, 38, 444, 445  
 Varnell, J., 278  
 Varnishes, 548  
 Vaughan, G. W., 458, 466  
 Veneers, 592  
 Ventilating equipment, 592  
 Vest, J. P., 446  
 Vibration dampers, 592  
 Vickers, Inc., 379  
 Victory, J. F., 448  
 Vought, Chance, Aircraft Div., United Aircraft Corp., 196, 296-300  
 Vultee Field Div., Consolidated Vultee Aircraft Corp., 237-238

## W

Waco Aircraft Co., 300-301  
 Wakefield, R. C., 456  
 Waldes Koh-I-Noor, 379  
 Walker, F. C., 450  
 Walker, P. A., 456  
 Wallbank, S. T., 478  
 Walsh, R., 460  
 War, 11-26  
 War Manpower Commission, 157  
 War Production Board, 156-158  
 War Training Service, 159, *see also* Civil Aeronautics Administration  
 Ward, J. C., Jr., 458, 466  
 Warden, O. S., 478  
 Warner, E. P., 448  
 Warner, J. A. C., 478  
 Warner Aircraft Corp., 308  
 Washers, 544-546  
 Waters, V. B., 450  
 Watson, T. A., 458  
 Weather Bureau, 369; roster, 450; work of, 163-164  
 Weatherhead Co., 379-380  
 Webb, L. D., 446  
 Weber, S. M., 450  
 Weems System of Navigation, 380

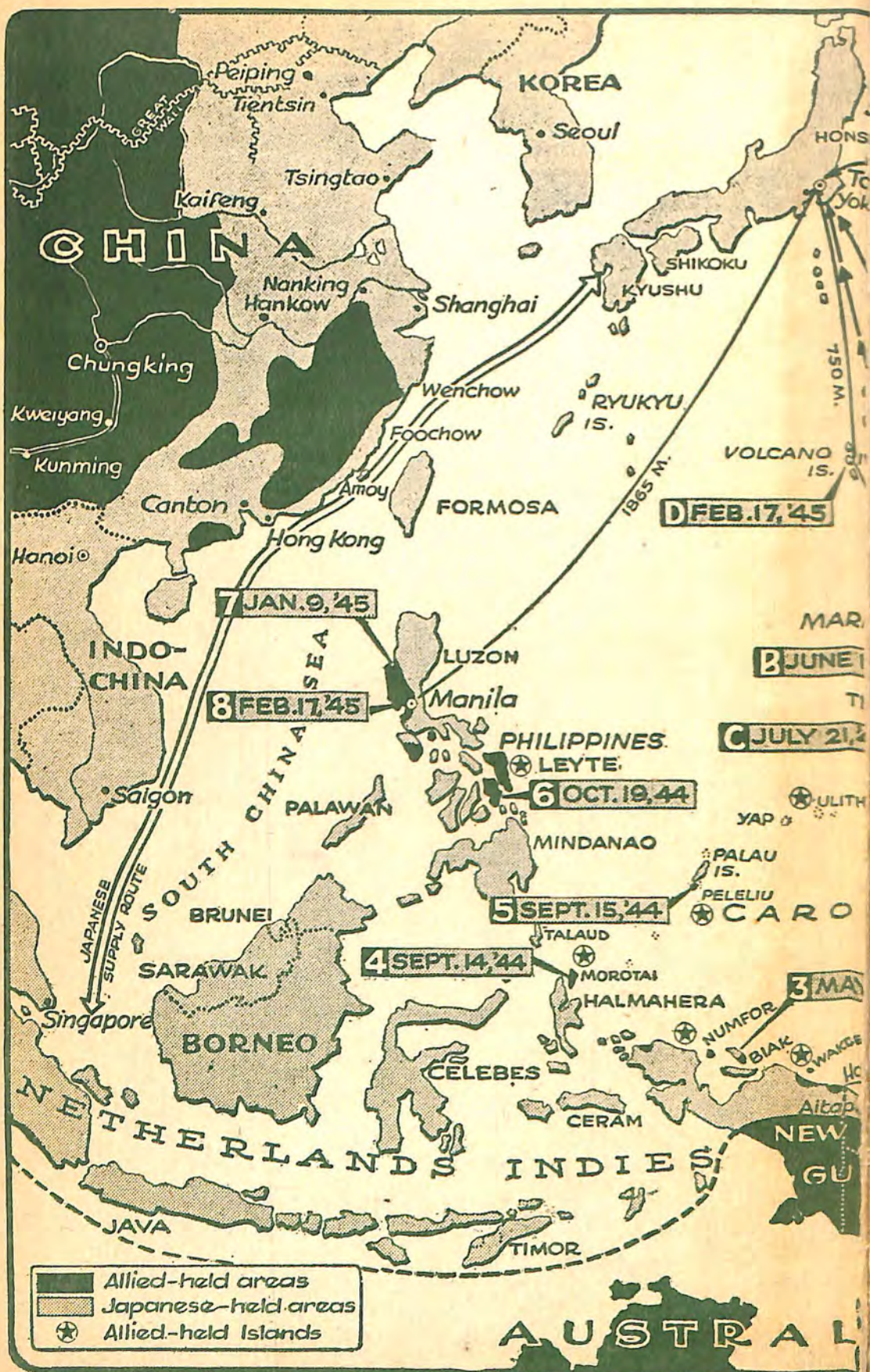
Welding equipment, 592  
 Wellman Bronze and Aluminum Co., 380  
 Welsh, W. W., 444  
 Western Air Lines, 94, 95  
 Western Electric Co., 380-382  
 Western Flying, publication, 480  
 Westinghouse Electric & Manufacturing Co., 382  
 Wetmore, A., 448  
 Weyland, O. P., 28, 40, 445  
 Wheels, 592  
 White, T. D., 53  
 Whitehead, E. C., 53, 444, 445  
 Whitman, R. P., 460  
 Whittingham, H. E., 201  
 Wilcox, J. H., 478  
 Willey, J. E., 474  
 Williams, R. B., 444  
 Willoughby, A. O., 450  
 Wilson, C. E., 156  
 Wilson, D., 444  
 Wilson, E. E., 458  
 Wilson, G. R., 474, 478  
 Windshield wipers, 594  
 Wingate, O., 59  
 Wire and cable, 594  
 Wolf, A. L., 476  
 Woodhead, H., 458, 462  
 Woodmansee, G. D., 446  
 Woods, L. E., 50, 445  
 Worthington Mower Co., 382  
 Wright, O., 448  
 Wright, T. P., 156, 159, 446, 448  
 Wright Aeronautical Corp., 308-310, 351  
 Wright Brothers Lecture, 155, 201  
 Wright Brothers Medal, 205  
 Wyman-Gordon Co., 382  
 Wyman-Gordon Products Corp., 382-383

## Y

York Electric Tool Co., 383  
 Young, F. D., 450  
 Young, R. W., 478  
 Younger, J. E., 458  
 Youngren, H. T., 478  
 Yount, B. K., 444

## Z

Zimmer-Thomson Corp., 383



# ROADS THAT LEAD TO TOKYO

COURTESY *The* NEW YORK TIMES

JAPAN

TOKYO BOMBED -

1

BY PLANES FROM  
TASK FORCES  
OPERATING HERE

BONIN IS.

2

Pacific Ocean

ONE YEAR AGO  
JAPANESE DOMINATION  
EXTENDED TO HERE

MARCUS

WAKE

URACAS

BY B-29S BASED  
ON ISLANDS HERE

POKAAKKU

ENIWETOK

BIKAR

MARSHALL

RONGELAP

WOTJE

UJELANG

KWAJALEIN

FEB. 6, '44

WOLEAI

TRUK

PONAPE

MILI

JALUIT

MICRONESIAN ISLANDS

KUSAIE

EBON

MAKIN

TARAWA GILBERT IS.

44

2 APR. 22, '44

ADMIRALTY IS.

NEW IRELAND

NAURU

OCEAN

Wewak

Rabaul

NEW

BOUGAINVILLE

BRITAIN

SOLOMON IS.

NANUMEA  
ELLICE IS.

Lae

Buna

GUADALCANAL

FUNAFUTI

Moresby

ROSSEL

NEW  
HEBRIDES

