The AIRCRAFT YEAR BOOK *For 1952*

TERRESA SMITH

The

AIRCRAFT YEAR BOOK

1952

THE
AIRCRAFT YEAR BOOK
1952

Official Publication

of

THE AIRCRAFT INDUSTRIES ASSOCIATION OF AMERICA, INC.

Thirty-fourth Annual Edition

Editors

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The AIRCRAFT YEAR BOOK

TABLE OF CONTENTS

ACKNOWLEDGMENTS

The contents of the 1952 Aircraft Year Book represent the work of some of the best editorial talent in the aviation industry. Only through the generous collaboration of company public relations officials, aviation writers volunteering their services from the sidelines, or aircraft executives for the moment more interested in documenting aviation history than in making it, has this edition been possible. In sum, the 1952 Aircraft Year Book represents the combined editorial talent of the industry, and we are as grateful for their aid and advice as we are lacking in space to list all the names of those who have made the book possible. We should, however, like to take this occasion to express our special gratitude to the patient cooperation and helpful criticism of the Year Book Editorial Board of the Public Relations Advisory Committee of the Aircraft Industries Association, who give much valuable time in suggesting the handling of the material. The Committee included Mr. Paul Fisher, Director of Public Relations, United Aircraft Corp.; Mr. George Hammond, Executive Vice President, Carl Byoir Associates; and Mr. Ed Ryan, Director of Public Relations, North American Aviation. Coordinating the work of the Committee was Mr. Avery M. McBee, Director of Public Relations of the Aircraft Industries Association.

THE EDITORS

Foreword

As this 34th edition of the Aircraft Year Book goes to press, aviation enters its fiftieth year since the Wright Brothers first proved that powered, controlled flight was more than an age-old dream. It is fitting that this edition be dedicated to the Fiftieth Anniversary of Powered Flight, even though its main purpose is to chronicle the achievements and progress of 1952.

The aircraft industry was born in the Wright's little bicycle shop at Dayton, Ohio, even before the first flights at Kitty Hawk. In the years that followed, the industry continued to grow, even in the face of recurrent adversities. The achievements of 1952, herein reported, may be taken as a measure of progress since the first frail plane of half a century ago.

The chief concern of the aircraft industry was centered on the air research rearmament program. It has been the industry's task to supply in increasing volume the equipment with which our armed services are meeting the enemy in Korea and the threat to world peace.

Much progress has been made, even under the restraints imposed by the "limited mobilization" concept. By and large, aircraft production schedules have been met, and there is every prospect that this record will be improved in the coming year. In the thirty months since hostilities began in Korea, more than 15,000 military aircraft have been delivered to our military services and to NATO countries. It is important to note that *approximately 9,000 of these were delivered in 1952* and that the ratio of combat types to trainers and other administrative models was increased.

This is three times the production of 1950. In the latter part of 1952, the industry established a rate of production equivalent to an annual output of 12,000 military aircraft.

At year's end, more than 700,000 were at work in the aircraft industry, making it the second largest industry from an employment standpoint. Counting subcontractors and suppliers, the total is estimated at some 1,000,000 people.

It is significant that, today, the aircraft industry is not producing at its full capacity nor do presently contemplated schedules call for such a production rate. Rather, our goal has been to produce qualitatively superior airplanes to meet the requirements established by the military services, and, at the same time, to expand the aircraft production base for rapid, quantity production should the need arise.

This edition of the Aircraft Year Book reports not only the aircraft industry but on all aspects of aviation achievement. The air activities of the Air Force, the Marine air arm, Naval and Army aviation are recounted. The Year Book reports on the work of other Government departments and agencies. It also reviews the great progress of the commercial airlines, which set new records in the last year, not only in passenger and cargo services but in safety of operation. It deals with utility aircraft and their progress as servants of business, industry and agriculture, and on the development of the helicopter, both in its military role and its bright commercial future.

The Aircraft Industries Association hopes and believes that the 1952 edition of the Aircraft Year Book will contribute, as have the thirty-three which preceded it, to a more complete public understanding and appreciation of the progress and contributions of aircraft, the industry which produces them, and the military and commercial services which use them for the betterment of mankind and the safety of the free world.

DEWITT C. RAMSEY, *President,*
The Aircraft Industries Association of America, Inc.

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The following bibliography was compiled by Arthur G. Renstrom, Ass't. Chief, Aeronautics Division, Library of Congress.

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Why Boeing has undertaken "Project X"

In a restricted area of one of its Seattle plants, the Boeing Airplane Company is building a new prototype airplane which may be identified for the present as "Project X."

It will be a large, new type, jet-powered airplane incorporating many engineering advancements Boeing has developed and proved over the past several years. It will be a demonstrator model, the basic design of which will be adaptable to two production models:

1. A versatile military airplane for aerial refueling of fast jet bombers and fighters, and for cargo and troop transportation fitted to the tempo of jet-age military tactics.

2. A fast, economically operating airline transport for passengers and cargo.

Boeing has undertaken this program because it has long recognized a real need in America for modern, jet-powered equipment in each of these categories. The project has been underway for a substantial period of time. With the prototype Boeing will be able to demonstrate the capabilities of production aircraft in both the military and commercial fields.

The undertaking follows naturally from the company's leadership in the application of jet power to large aircraft. Designing, building and flying the B-47 Stratojet bomber and the new B-52 eight-jet Stratofortress have given Boeing a background of experience unparalleled elsewhere in the world. It has included, for example, 14,500 hours of jet wind tunnel research and more than 5000 hours of test and research flying. The Boeing Company is taking positive steps to apply this wealth of experience to advancement in the field of air transportation.

The prototype airplane – company financed – will be flying in 1954. The project is being carried out with great enthusiasm, bred of highly successful experience with the B-47 and B-52 jet bombers. This will be another great Boeing.

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ROTOR AIRCRAFT

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[1]Note: Also includes 1951 books published too late for inclusion in last year's edition.

Northrop's Prime Equation

Northrop *boundary-layer research scientists,* like the man above, are concerned with complex problems aimed at achieving the maximum efficiency in aerodynamic surfaces at high speed.

Equations are used to solve problems. At Northrop Aircraft, the prime equation combines teams of administrators, outstanding scientists and production specialists with modern industrial and research facilities. The combination efficiently converts imagination and knowledge into actual matériel of advanced design and incalculable value.

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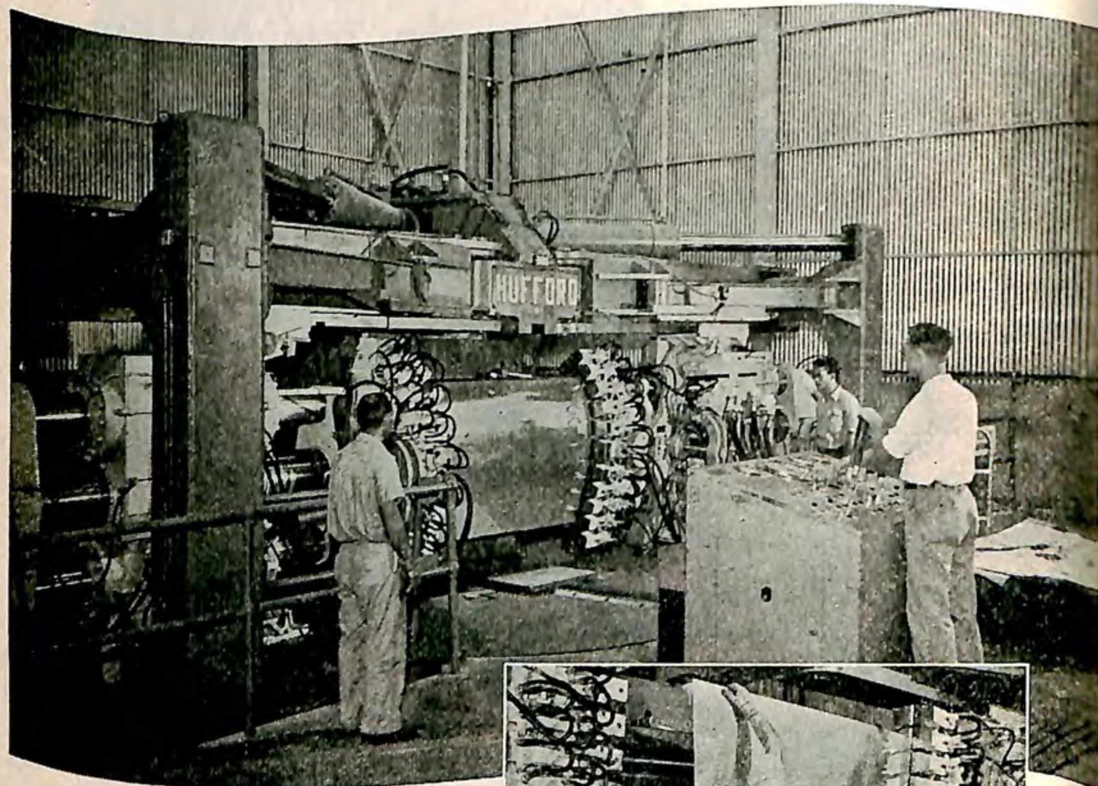
Three new developments for the aircraft industry



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HYDRA-CURVE JAWS

A new development revolutionizing the stretch-wrap forming industry. Replaces straight jaws, pre-curving sheets to cross-sectional curve of die. Saves up to 30% of material, reduces wrinkling and scrap losses, makes possible formation of deep curves—either convex or concave.

HYDRA-CURVE JAWS load with segments vertically aligned, instantly match almost any desired convex or concave die shapes when curving cylinders are energized. Forms half circles, "S" curves, etc. Sizes for all Hufford machines.

SUMMARY STATISTICS

The following statistics are as nearly up-to-date as was practicable at the time the Year Book went to press. Wherever possible, last-minute, 1952 figures were included in the main text of the book, and may be found under appropriate chapter headings.

The Editors

AVERAGE WEEKLY HOURS IN THE AIRCRAFT, ENGINE, PROPELLER, AND PARTS INDUSTRY

(Source: Bureau of Labor Statistics)

Year and Month	Aircraft and Parts	Aircraft	Aircraft Engines and Parts	Aircraft Propellers and Parts	Other Aircraft Parts and Equipment
1949	40.6	40.5	40.7	41.0	40.4
1950	41.6	41.4	42.1	42.4	41.7
1951	43.8	43.3	45.4	46.2	43.7
1952					
January	43.2	42.3	45.9	45.3	44.0
February	43.2	42.7	44.8	44.8	43.2
March	42.9	42.3	44.8	45.2	42.9
April	42.0	41.7	42.7	44.5	42.0
May	42.8	42.5	43.5	45.0	43.1
June	42.7[a]	42.4[a]	43.2[a]	45.5	43.1[a]
July	42.6	42.5	43.1[a]	45.8	42.2
August	42.4	42.4	43.1	45.2	41.7

AVERAGE WEEKLY EARNINGS

Year and Month	Aircraft and Parts	Aircraft	Aircraft Engines and Parts	Aircraft Propellers and Parts	Other Aircraft Parts and Equipment
1949	63.62	62.69	65.24	66.83	65.08
1950	68.39	67.15	71.40	73.90	70.81
1951	78.05	75.82	85.90	89.17	78.53
1952					
January	79.53	76.82	88.50	88.97	80.78
February	80.01	78.40	85.66	87.36	79.75
March	80.57	78.59	87.23	91.21	79.71
April	78.08	76.56	81.98	89.27	78.33
May	80.38	78.58	85.13	92.75	80.98
June	80.36[a]	78.48[a]	85.32[a]	93.59	80.21[a]
July	80.51[a]	79.18[a]	85.21[a]	93.52	78.03[a]
August	80.69	79.84	84.56	93.07	77.23

AVERAGE HOURLY EARNINGS

Year and Month	Aircraft and Parts	Aircraft	Aircraft Engines and Parts	Aircraft Propellers and Parts	Other Aircraft Parts and Equipment
1949	1.567	1.548	1.603	1.630	1.611
1950	1.644	1.622	1.696	1.743	1.698
1951	1.782	1.751	1.892	1.930	1.797
1952					
January	1.841	1.816	1.928	1.964	1.836
February	1.852	1.836	1.912	1.950	1.846
March	1.878	1.858	1.947	2.018	1.858
April	1.859	1.836	1.920	2.006	1.865
May	1.878	1.849	1.957	2.061	1.879
June	1.882[a]	1.851[a]	1.975[a]	2.057	1.861[a]
July	1.890[a]	1.863[a]	1.977[a]	2.042	1.849[a]
August	1.903	1.883	1.962	2.059	1.852

[a] Revised

A DIGEST OF NEW DEVELOPMENTS IN HIGH PERFORMANCE PUMPS

PISTON TYPE FLUID POWER PUMPS

Constant and Variable Delivery Types . . . 0.25 gpm to 10 gpm . . . direct engine driven and motorized units.

Featuring continuous working pressures to 3000 psi and continuous speeds to 3750 rpm, today's STRATOPOWER oil hydraulic Pumps (both constant and variable delivery types), afford special advantages for aircraft and other applications. The dual pressure Pumps incorporate remote oil pilot controlled pressure regulator. An electric modification provides selective pressure control and Pump unloading. These Pumps are self-priming and develop suction line pressures approaching 1" Hg. absolute and will also operate under conditions of high reservoir pressurization.

VANE TYPE FLUID POWER PUMPS

Capacities 3 gpm to 120 gpm. Standard models rated at 1200 rpm . . . specials to 3600 rpm.

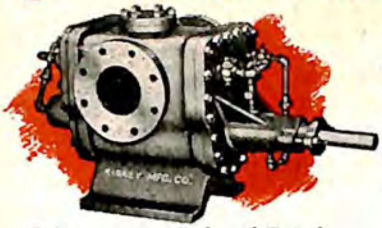
A distinctive Dual Vane construction, which provides increased fluid delivery rates (even with extremely thin fluids), makes DUDCO Hydraulic Pumps and Motors the first single-stage vane type proven for 2000 psi operation. The minimum size and high efficiencies of these Pumps and Motors create new opportunities in the design of hydraulic fluid power systems for all types of industrial equipment as well as countless applications on heavy-duty machinery and ordnance vehicles.

GEAR TYPE FLUID POWER PUMPS

½ gpm to 130 gpm for working pressures to 1500 psi and operating speeds to 2000 rpm.

A unique Four-Bolt design, which locates the assembly bolts within the area of greatest internal pump pressure, indorses HYDRECO Hydraulic Pumps for the heavy-duty required in equipment for the construction and materials handling fields. This Four-Bolt design provides the rigidity and stability that reduces distortion of housing parts and wear plates and insures against uneven wear and loss of overall efficiency in the face of extreme mechanical and hydraulic loads.

LIQUID HANDLING PUMPS



Plain or steam jacketed Rotating Plunger or Heliquad Types 2 gpm to 3360 gpm.

Virtually any material that will flow through a pipe, includin difficult viscous fluid, can be handled with meter-like volumetri accuracy with today's KINNEY Rotary Plunger and Wide Angl Herringbone Gear Pumps. The Rotary Plunger Pump features construction with no valves, blades, pistons or springs. The versa tile line of Herringbone Gear Pumps includes models driven b timing gears with anti-friction bearings located outside the pum chamber. Both types available with or without heating jacket

HIGH VACUUM PUMPS

Single Stage and Compound types, ¼ HP at 2 cu. ft. per min. to 75 HP at 1800 cu. ft. per min.

There is only one principle which has been found suitable fo Vacuum Pumps in all capacity ranges . . . that of the Rotar Plunger employed in KINNEY High Vacuum Pumps. First to us the oil-sealed Rotary Plunger, these Pumps develop absolu pressure readings of 0.1 Micron (0.0001 mm Hg.) or better. Alon or in combination with oil diffusion Pumps, they provide th answer to the most exacting high vacuum applications in th electronic, processing and research fields.

MOTORS, VALVES & CYLINDERS

In addition to the complete range of Pumps described, there ar equally important components . . . Hydraulic Motors, Valves an Cylinders . . . all available from a single source. DUDCO Hydrau lic Motors, employing the remarkably efficient DUAL-VAN principle, with high running torques averaging 90% or more o theoretical at any speed down to nearly stalled and with smoot operation under load. Models rated from 9 to 720 in. lbs./100 ps for 2000 psi operation. HYDRECO Hollow Plunger Valves i single or multiple plunger units for controlling single, doubl acting or telescopic HYDRECO Cylinders as well as other Hy draulic Power Units . . . capacities from ½ gpm to 150 gpm and fo operating pressures to 1500 psi. Relief Valves, Pressure Regula tors, Flow Dividers and other special purpose Valves are avai able for nearly any type of Hydraulic circuit.

The New York Air Brake Company and its affiliates provide a most comprehensive coverage of Pumps and related equipment for the needs of defense and industry. Here, in one organization, is "Know How" teamed with advanced facilities and a tradition of precision and craftsmanship. Here is research and development dedicated to the constant improvement and the ever-broadening service which hydraulic and vacuum equipment can contribute now and in the future.

Catalogs and complete information on the Hydraulic Pumps, Motors and other components herein described are available on request.

THE NEW YORK AIR BRAKE COMPANY

420 LEXINGTON AVE., NEW YORK 17

AFFILIATES: DUDCO DIVISION • • • HYDRECO DIVISION • • • KINNEY MANUFACTURING CO.

QUARTERLY BACKLOG OF ORDERS BY AIRCRAFT, AIRCRAFT ENGINE, AND PROPELLER COM ANIES

1950-1952

(In millions of dollars)

(Source: Bureau of the Census, Series M42D)

Product	June 30, 1950	Dec. 31, 1950	Mar. 31, 1951	Dec. 30, 1951	Mar. 31 1952	June 30, 1952
TOTAL	$2,988	$5,039	$8,068	$12,665	$13,804	$14,507
Complete aircraft and parts	1,908	3,102	5,286	8,126	8,672	9,145
For United States military	1,774	2,759	2,795	7,336	7,803	8,274
Other	134	343	491	790	869	871
Aircraft engines and parts	786	1,470	2,123	3,531	4,080	4,159
For United States military	757	1,399	2,017	3,350	3,887	3,980
Other	29	71	106	181	193	179
Aircraft propellers and parts	100	145	169	241	233	267
For United States military	96	129	150	213	202	235
Other	4	16	19	28	31	32
Other products and services	194	322	490	767	819	936
Complete aircraft and aircraft propeller companies	147	N.A.	N.A.	N.A.	N.A.	N.A.
Aircraft engine companies	47	N.A.	N.A.	N.A.	N.A.	N.A.

—N.A. Not available

COMPLETE AIRCRAFT SHIPMENTS

Airframe Weight[a]

(In thousands of pounds)

	Total	U. S. Military	Civil
1941	....	81,422.0	....
1942	....	275,949.0	....
1943	....	654,657.0	....
1944	....	962,406.0	....
1945	....	540,531.0	....
1946	38,394.4	12,879.0	25,515.4
1947	29,255.4	11,402.0	17,853.4
1948	35,263.5	25,181.0	10,082.5
1949	36,537.3	29,792.9	6,744.4
1950	N.A.	N.A.	5.960.7
1951	N.A.	N.A.	5,111.0
1952 (9 mos.)	N.A.	N.A.	7,074.8

[a]Excludes spares.

N.A.—Not available.

Source: 1941-1945, CAA "U. S. Military Aircraft Acceptances, 1940-1945, Aircraft, Engine and Propeller Production."

1946-1952, Bureau of the Census, Facts for Industry, Series M42A.

U. S. CIVIL AIRCRAFT

By States

(Source: Civil Aeronautics Administration)

State	Number of civil aircraft[1] Jan. 1, 1951	Jan. 1, 1952	State	Number of civil aircraft[1] Jan. 1, 1951	Jan. 1, 1952
TOTAL	92,809	88,545	Montana	1,113	1,111
			Nebraska	1,863	1,790
Alabama	907	787	Nevada	401	390
Arizona	1,156	1,094	New Hampshire	278	235
Arkansas	1,218	1,119	New Jersey	1,772	1,767
California	10,298	9,845	New Mexico	769	708
Colorado	1,363	1,291	New York	4,386	4,308
Connecticut	643	601	North Carolina	1,694	1,627
Delaware	302	283	North Dakota	1,293	1,256
District of Columbia	548	553	Ohio	4,267	4,187
Florida	2,256	2,546	Oklahoma	2,212	1,994
Georgia	1,212	1,159	Oregon	1,803	1,747
Idaho	917	905	Pennsylvania	4,104	4,006
Illinois	4,909	4,779	Rhode Island	211	203
Indiana	2,753	2,675	South Carolina	678	621
Iowa	2,451	2,276	South Dakota	1,034	1,017
Kansas	2,797	2,462	Tennessee	1,024	924
Kentucky	799	678	Texas	6,998	6,404
Louisiana	1,145	1,105	Utah	535	479
Maine	632	583	Vermont	168	153
Maryland	862	859	Virginia	1,363	1,272
Massachusetts	1,412	1,402	Washington	2,224	2,173
Michigan	4,172	3,914	West Virginia	655	615
Minnesota	2,146	2,048	Wisconsin	2,098	2,006
Mississippi	728	762	Wyoming	532	517
Missouri	2,116	1,892	Outside U. S. A.	1,292	1,417

[1]Includes gliders.

CIVIL AIRCRAFT PRODUCTION

Number of Units

(Source: Aircraft Industries Association)

Month	1948	1949	1950	1951	1952
January	462	160	167	255	224
February	461	257	225	239	227
March	578	400	326	272	248
April	766	456	329	247	291
May	812	474	377	248	330
June	959	439	369	216	335
July	920	301	321	207	353
August	700	272	354	171	349
September	590	284	301	184	337
October	502	228	204	124	....
November	317	158	242	162	....
December	235	116	305	152	....
TOTAL	7,302	3,545	3,520	2,477	....

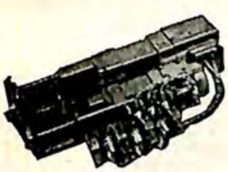
EEMCO technical bulletin

MOTOR ACTUATORS FOR AUTOMATIC FLIGHT

Today's aircraft fly on the edge of human capabilities and endurance. A transition from conventional piloted aircraft to pilotless types is taking place. The development of foolproof power units to actuate controls is a primary factor in the achievement of automatic flight. These units are being designed and produced by EEMCO in close cooperation with the builders of tomorrow's aircraft.

Rotary Actuator for Rugged Duty This Rotary Actuator was designed for trim tab actuation in a long range bomber involving the most rugged duty cycle. It operates almost continuously with the automatic pilot. Required duty cycle is one second full load, one second off and one second full load in opposite direction, continuous. Silicone insulated and high temperature materials used throughout.

Stabilizer Actuator for Large Jet Fighters This unit incorporates two motors of different size, driving into individual gear reductions to operate the screw jack. Small motor of 1/10 h. p. output operates almost continuously with automatic pilot. The large intermittent duty 3.3 h.p. motor provides manual operation of screw jack by pilot for maneuvering



Double Motor Power Unit This unconventional system operates the horizontal stabilizer on a turbo prop aircraft of recent design. A small continuous duty motor of 1/15th h. p operates through a gear reduction in conjunction with automatic pilot. Large intermittent duty 3½ h. p. motor with direct drive of 12,000 rpm is used for manual operation.

Rotary Actuator Package This system provides manual or automatic pilot elevator operation on one of the latest jet fighters. Totally enclosed in box equipped with mounting bracket it incorporates motor, magnetic clutch, radio noise filter and brake. Gear reduction, and auxiliary gear reduction operate adjustable travel limit switches and position indicator. Output rpm at 3 inch – pounds loads, 2500. Weight, complete, 3¼ pounds.

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SPECIAL MOTOR DESIGN

DEVELOPMENT

MANUFACTURING

NUMBER OF ENGINES PRODUCED

1917-1952

	Total	Military	Civil
1917-1919	N.A.	44,453	N.A.
1930	3,766	1,841	1,925
1931	3,776	1,800	1,976
1932	1,896	1,085	813
1933	1,980	860	1,120
1934	2,736	688	2,048
1935	2,965	991	1,974
1936	4,237	1,804	2,433
1937	6,084	1,989	4,095
1938	N.A.	N.A.	N.A.
1939	11,172	N.A.	N.A.
1940[a]	N.A.	22,667	N.A.
1941[a]	N.A.	58.181	N.A.
1942[a]	N.A.	138.089	N.A.
1943[a]	N.A.	227,116	N.A.
1944[a]	N.A.	256,911	N.A.
1945[a]	N.A.	109.650	N.A.
1946	43,407	2,585[b]	40,822
1947	21,178	4,808	16,370
1948	N.A.	N.A.	9,039
1949	N.A.	N.A.	3,982
1950	N.A.	N.A.	4,314
1951	N.A.	N.A.	4,580
1952 (9 mos.)	N.A.	N.A.	4,032

[a]Excludes aircraft engines produced for other than aircraft use.
[b]Excludes experimental engines, engines classified by the armed forces as secret or confidential, engines for non-man-carrying, pilotless aircraft, jet assist mechanisms.
Source: 1917-1947—AIA Aircraft Year Book, 1948. P. xxl.
1948-1952—Bureau of Census Facts for Industry Series M42A.

PRODUCTION OF AIRCRAFT ENGINES

HORSEPOWER (in thousands)

	Total	Military	Civil
1941	N.A.	44.930.0[a]	N.A.
1942	N.A.	147,535.0[a]	N.A.
1943	N.A.	262,282.0[a]	N.A.
1944	N.A.	368,050.0[a, b]	N.A.
1945	N.A.	184,187.0[a, c]	N.A.
1946	N.A.	9,152.5[d]	N.A.
1947	22,217.4	17,069.7[d]	5,147.7
1948	24.832.3	22,033.4[d]	2,798.9
1949	46,743.3	45,511.8[d]	1,231.5
1950	N.A.	N.A.	1,645.4
1951	N.A.	N.A.	2,093.8
1952 (9 mos.)	N.A.	N.A.	2,300.9

[a]Excludes aircraft engines produced for other than aircraft use.
[b]Excludes 238,000 pounds of thrust for jet engines produced.
[c]Excludes 4,151,000 pounds of thrust for jet engines produced.
[d]Includes jet engine pounds of thrust converted to horsepower.
Sources: 1941-48—CAA Statistical Handbook 1949.
1949-52 Bureau of Census Facts for Industry Series M42A.

N.A. Not available.

Bendix Products Division

FIRST IN

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Where Creative Engineering Masters Your Every Problem!

The many contributions to aviation progress, made by the Bendix Products Division of Bendix Aviation Corporation, have resulted from a unique combination of creative engineering and quality production in two highly specialized fields.

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If you have a special problem in the development of new and more efficient carburetion, fuel metering, shock absorbing struts, wheels or brakes, or if your requirements are merely for standardized equipment of this type, you will find Bendix Products the one source best qualified to serve your needs.

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Bendix AVIATION CORPORATION

Export Sales: Bendix International Division, 72 Fifth Ave., New York 11, New York

CIVIL AIRPLANE OUTPUT

By Power and Types

(Source: Aircraft Industries Association)

1936-1951

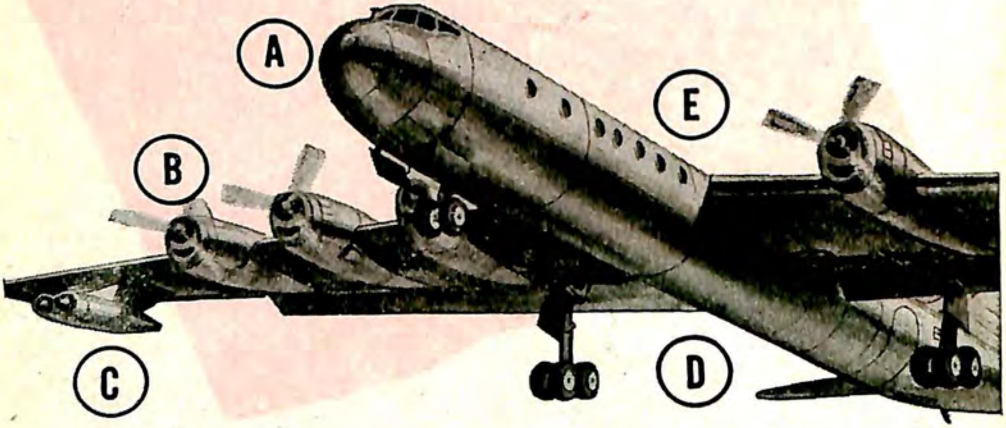
	1936	1937	1938	1939	1940	1941	1945
Total	1,637	2,289	1,823	3,715	6,785	6,844	2,047
				By number of engines			
Single-engine	1,526	2,171	1,770	3,613	6,562	6,629	1,946
Multi-engine	111	118	53	102	167	165	101
Unclassified	0	0	0	0	56	50	0
				By horsepower			
50 hp. and under	772	1,393	1,350	1,686	490	7	0
51-70 hp.	109	44	23	1,349	4,529	4,303	1,828
71-100 hp.	122	183	61	311	935	1,805	105
101-165 hp.	171	193	149	120	211	206	13
166-225 hp.	75	47	16	9	318	309	0
226-300 hp.	214	199	122	86	37	15	0
301-600 hp.	109	142	54	76	72	31	28
601-1,800 hp.	65	88	48	78	137	118	63
	0	0	0	0	0	0	10
Unclassified	....	0	0	0	56	50	0
				By types			
Landplanes:							
1-2-place	....	1,668	1,487	3,118	5,527	6,060	1,929
3-5-place	....	460	258	465	1,031	573	17
6-20-place	....	48	26	21	8	3	63
21-place and over	....	57	17	55	132	112	10
Seaplanes	....	41	26	51	18	16	0
Amphibians	....	15	10	5	3	30	28
Unclassified	0	0	0	0	66	50	0

1946-1949[1]

	1946	1947	1948	1949	1950	1951
Total Civil	35,001	15,617	7,302	3,545	3,520	2,477
Personal	34,568	15,339	7,039	3,379	3,391	2,279
Transport	433	278	263	166	129	198
By Place:						
2-place	30,766	7,273	3,302	996	1,029	2,275 (2-place and 3- to 5-place)
3- to 5-place	3,802	8,066	3,737	2,383	2,362	
Over 5-place	433	278	263	166	129	202
By Horsepower:[2]						
1-74	20,659	2,372	2,990 (1-74 and 75-79)	930	597	2,273 (1-74 to 100-399)
75-79	9,122	4,690				
100-399	4,736	8,246	4,026	2,440	2,789	
400-3,999	345	129	286 (400-3,999 and 4,000 and over)	174	134	204
4,000 and over	139	180				

[1]Exports excluded 1936-1941; no civil production during 1942-44; exports included 1945-50.
[2]Total rated horsepower of all engines.

This is Bendix



The airplane illustrated is a composite since, obviously, no single plane carries all of the Bendix equipment on these pages. However, many Bendix products fly with every U. S. fighting plane and are used extensively on commercial, executive and private planes as well.

(A)

Radio Noise Filters
Switches
Flow Equalizers
Vacuum Operated Instruments
Filters for Aircraft Heaters (Auxiliary, Engine, Cabin)
Pneumatic System Filters
Dynamotors
Blower Motors
Band-Change Motors
Booster Dynamotors
Actuator Motors
Special Inverters
Aircraft Interphone Systems
Radar
Radio Transmitters
Radio Receivers

Radio Communication Systems
Electronic Navigational Equipment
Automatic Radio Compass
VHF Omni-Directional Range Equipment
Automatic Pilot and Flight Path Control Equipment
Autosyn* and Magnesyn* Remote Indicating Systems For
Fuel Flow • Fuel Pressure • Hydraulic Pressure • Liquid Level • Manifold Pressure • Oil Pressure • Position • Temperature • Torque Pressure • Water Pressure
Fuel Flow Totalizing Systems

Manifold Pressure Gauges
Electric Tachometer Systems
Warning Units
Accelerometers
Airspeed Indicators
Attitude Horizon Indicators
Driftmeters
Dual Radio and Magnetic Compass Indicators
Gyro Flux Gate* Compasses
Gyro Horizon Indicators
Magnetic Compasses
Rate of Climb Indicators
Turn and Bank Indicators
ODR Components
Sextants
Control Panels

in Aviation Bendix AVIATION CORPORATION

B

Bendix* Starter Drives
Magnetos
Ignition Harnesses
Booster Coils
Igniter Plugs
Ignition Analyzer
Low and High Tension Ignition Systems for Reciprocating Engines
Radio Shielding Harnesses
Hydraulic—Line Type Filters
Reservoir—Line Type Filters
Vent—Line Type Filters
Fuel System Filters
De-Icing System Filters

Alternators
Fault Protection Systems
Generators
Inverters
Line Relays
Overvoltage Protectors
Reverse Current Cutouts
Voltage Booster Dynamotors
Voltage Regulators
Power Failure Indicators
Engine Starting Equipment, including Booster Coils • Induction Vibrators • Relay Switches • Starters

Automatic Engine Power Controls
Automatic Engine Boost Controls
Propeller Governor Controls
Supercharger Regulator Controls
Injection and float type carburetors
Direct injection fuel systems, including
Distributing Pumps • Regulator Units • Injector Nozzles • Fuel Supply Pumps
Speed-Density Fuel Metering Systems for Jet and Reciprocating Engines
Water Injection Systems

C

Ignition Systems for Jet and Turbine Engines
Igniter Plugs for Jet and Turbine Engines
Jet Engine Starters and Generators
Speed-Density Fuel Metering Systems
Duplex Nozzles
Fuel Metering Systems for Starting Conditions
Fuel Flow Dividers
Fuel Supply Pumps

D

Brake Lining
Hydraulic Actuating Cylinders
Power Brake Valves
Shock Absorbing Struts
Shoe and Segmented Rotor Type Brakes
Wheels
Master Cylinders
Hydraulic Brake Control Valves

E

Electrical Connectors
Small Electric Actuators
4-Way Hydraulic Valves
Hydraulic Accumulators
Hydraulic Hand Pumps

Position Light Flashers
Pressure Control Valves
Electric Timing Devices
Hydraulic Equipment, including Pumps • Valves

Air Pressurization and Ice Elimination Equipment, including
Electronic and Mechanical De-Icer System Timers • Oil Separators • Pumps • Valves • Pressurization and Control Units

ADDITIONAL AVIATION PRODUCTS

Beacons
Telemetering Equipment
Missile Guidance Systems
Micro-Wave Equipment
V. H. F. Ground Direction Finders
G. C. A. Ground Controlled Approach Radar
Long Range Search and Surveillance Radar
G. C. A. Ground Controlled Approach System
Actuators—linear and rotary

Differential Pressure Switches
Oxygen Regulators
Gear Boxes
Flexible Drive Shafts
Special Purpose Electron Tubes, including
Amplifier Tubes • Counter Tubes • Gas Filled Control Tubes • Klystron Tubes • Rectifier Tubes • Spark Caps • Temperature Tubes • Voltage Regulator Tubes

Precision Components for Servo-mechanism and Computing Equipment, including
Autosyn Synchros—(transmitters, receivers, differentials, control transformers and resolvers) • Amplifiers • Low Inertia Motors • Servos • Transformers • Gyros • Rate Generators
For Guided Missiles—Specialized fuel metering and control systems
Aircraft Gun Chargers
Switches • Controls

BENDIX IN THE WEATHER FIELD

In addition to the products listed above, Bendix makes many meteorological instruments which are the source of much of the weather data governing flight schedules for all types of planes.

*REGISTERED TRADEMARK OF THE BENDIX AVIATION CORPORATION

UNITED STATES AIRCRAFT EXPORTS

Number and Value

(Source: Aircraft Industries Association)

Year[1]	Aircraft exported[2] Number	Aircraft exported[2] Value	Value of all aeronautical exports[3]
1913	29	$81,750	$107,552
1914	34	188,924	226,149
1915	152	958,019	1,541,446
1916	269	2,158,395	7,002,005
1917	135	1,001,542	4,135,445
1918	20	206,120	9,084,097
1919	83	777,900	13,166,907
1920	65	598,274	1,152,649
1921	48	314,940	472,548
1922	37	156,630	494,930
1923	48	309,051	433,558
1924	59	412,738	798,273
1925	80	511,282	783,659
1926	50	303,149	1,027,210
1927	63	848,568	1,903,560
1928	162	1,759,653	3,664,723
1929	348	5,484,600	9,125,345
1930	321	4,819,669	8,818,110
1931	140	1,812,809	4,867,687
1932	280	4,358,967	7,946,533
1933	406	5,391,493	9,180,328
1934	490	8,195,484	17,662,938
1935	333	6,598,515	14,290,843
1936	527	11,601,893	23,143,203
1937	628	21,076,170	39,404,469
1938	875	37,977,324	68,227,689
1939	1,220	67,112,736	117,807,212
1940	3,522	196,260,556	311,871,473
1941	6,011	422,763,907	626,929,352
1942	10,448	879,994,628	1,357,345,366
1943	13,865	1,215,848,135	2,142,611,494
1944	16,544	1,589,800,893	2,825,927,362
1945	7,599	663,128,543	1,148,851,587
1946	2,302	65,257,749	115,320,235
1947	3,125	74,476,912	172,189,502
1948	2,259	66,354,000	153,629,000
1949[4]	1,264	37,388,553	128,782,420
1950[5]	759	44,292,222	44,490,900
1951[5]	894	18,606,528	19,115,616

[1] 1913-18, fiscal years; 1919-49, calendar years. Data for the second half of 1918 is included with calendar year 1919.

[2] Exclusive of gliders and barrage balloons.

[3] Total value of aircraft, engines, parts, etc. 1913-21 include values of aircraft and aircraft parts. Prior to 1922, engine values were not reported separately, but were probably included with either "other" internal combustion engines or with "parts" of aircraft. Values for parachutes and their parts have been included only since 1932.

[4] For security reasons the 1949 figures do not include exports after April on military and cargo aircraft and engines of 400 hp and over. Actual total is believed to at least equal 1948 exports.

[5] For security reasons the 1950 figures do not include military, cargo and used transport aircraft, engines of 400 hp and over, propellers, instruments nor any other parts or accessories.

AIRPORTS AND LANDING FIELDS

1926-1951

(Source: Civil Aeronautics Administration)

Calendar Year	Total	Commercial	Municipal	CAA intermediate	All others
1926	[1]	[1]	[1]	92	[1]
1927	1,036	263	240	134	399[2]
1928	1,364	365	368	210	421[2]
1929	1,550	495	453	285	317[2]
1930	1,782	564	550	354	314[2]
1931	2,093	829	780	404	80
1932	2,117	869	777	352	119
1933	2,188	938	827	265	158
1934	2,297	872	980	259	186
1935	2,368	822	1,041	291	214
1936	2,342	774	1,037	296	235
1937	2,299	727	1,053	283	236
1938	2,374	760	1,092	267	255
1939	2,280	801	963	266	250
1940	2,331	860	1,031	289	151
1941	2,484	930	1,086	283	185
1942	2,809	1,069	1,129	273	338
1943	2,769	801	914	240	814
1944	3,427	1,027	1,067	229	1,104
1945	4,026	1,509	1,220	216	1,081
1946	4,490	1,930	1,424	201	935
1947	5,759	2,849	1,818	178	914
1948	6,414	2,989	2,050	161	1,214
1949	6,484	2,585	2,200	139	1,560
1950	6,403	2,329	2,272	76	1,726
1951	6,237	2,042	2,316	57	1,822

[1]Not available.

[2]Include auxiliary marked fields, later classified as to ownership, commercial or municipal.

ALLOCATIONS AND APPROPRIATIONS FOR AERONAUTICS, U. S. ARMY

1899	Langley experiments.	$25,000
1900	Langley experiments.	25,000
1908	Baldwin dirigible, revoked and later applied toward payment for Wright plane.	25,000
1909	Herring & Scott airplanes. Later for Wright plane.	21,000
1910	Wright plane.	9,000
1912	Signal Service of Army.	125,000
1913	Signal Service of Army.	100,000
1914	Signal Service of Army.	125,000
1915	Signal Service of Army.	50,000
		$505,000

AVERAGE SPEED
(Miles Per Hour)

Domestic Scheduled Air Carriers
(Source: CAA Statistical Handbook)

Year	Average speed (miles per hour)
1944	155.6
1945	155.4
1946	160.2
1947	168.2
1948	171.9
1949	179
1950	181.2
1951	184.6

TOTAL EMPLOYMENT IN AIRCRAFT AND PARTS INDUSTRY[1]

(In thousands)

Source: Bureau of Labor Statistics releases as compiled by Aircraft Industries Association

Years and Months	Total	Aircraft	Aircraft Engines & Parts	Aircraft Propellers & Parts	Other Aircraft Parts & Equipment
1950					
January	251.9	166.8	50.1	8.1	26.9
February	251.7	166.2	50.1	8.1	27.3
March	252.4	166.5	50.6	8.0	27.3
April	253.3	167.9	50.7	7.9	26.8
May	253.9	169.0	50.7	7.9	26.3
June	256.4	170.5	52.1	7.8	26.0
July	259.3	172.8	52.8	7.7	26.0
August	272.8	183.7	54.1	7.5	27.5
September	286.0	195.8	52.5	8.2	29.5
October	305.1	205.0	60.1	8.5	31.5
November	323.4	217.5	63.4	8.9	33.6
December	339.1	228.2	66.6	9.1	35.2
1951					
January	354.2	236.7	70.4	9.3	37.8
February	382.7	258.2	74.6	9.4	40.5
March	400.0	271.4	77.2	9.5	41.9
April	415.9	281.7	81.1	10.2	42.9
May	428.5	289.1	84.5	10.5	44.4
June	451.7	304.9	89.6	10.5	46.7
July	471.3	319.7	92.9	10.4	48.3
August	486.3	330.6	95.4	10.5	49.8
September	493.4	330.8	99.8	11.5	51.3
October	496.2	339.8	90.3	11.8	54.3
November	539.0	364.0	106.5	12.1	56.4
December	556.0	373.2	112.6	12.4	57.8
1952					
January	566.4	377.5	116.1	12.7	60.1
February	581.0	386.6	120.4	12.9	61.1
March	586.1	390.2	120.7	13.2	62.0
April	591.9	395.1	120.9	13.4	62.5
May	598.2	399.9	121.6	13.5	63.2
June	611.0	406.1	124.9	13.9	66.1
July	625.0	416.1	127.0	13.8	68.1
August	638.1	425.7	128.4	14.2	69.8
September	620.0	401.3	131.8	14.4	72.5

[1]As of pay period ending nearest the 15th of the month.

U.S. AIRCRAFT PRODUCTION
(units)
1913-1952
(Source: Aircraft Industries Association)

Year	Total	Military Aircraft	Civil Aircraft
1913	43	14	29
1914	49	15	34
1915	178	26	152
1916	411	142	269
1917	2,148	2,013	135
1918	14,020	13,991	29
1919	780	682	98
1920	328	256	72
1921	437	389	48
1922	263	226	37
1923	745	689	56
1924	377	317	60
1925	789	447	342
1926	1,186	532	654
1927	1,995	621	1,374
1928	4,346	1,219	3,127
1929	6,193	677	5,516
1930	3,437	747	2,690
1931	2,800	812	1,988
1932	1,396	593	803
1933	1,324	466	858
1934	1,615	437	1,178
1935	1,710	459	1,251
1936	3,010	1,141	1,869
1937	3,773	949	2,824
1938	3,623	1,800	1,823
1939	5,856	2,195	3,661
1940	12,804	6,019[a]	6,785[b]
1941	26,277[c]	19,433[a]	6,844[b]
1942	47,836[c]	47,836[a]	[d]
1943	85,898[c]	85,898[a]	[d]
1944	96,318[c]	96,318[a]	[d]
1945	49,761[c]	47,714[a]	2,047
1946	36,670	1,669	35,001
1947	17,717	2,100	15,617
1948	9,586[e]	2,284[e]	7,302
1949	6,089[e]	2,544[e]	3,545
1950	6,520[e]	3,000[e]	3,520
1951	7,277[e]	4,800[e]	2,477
1952	12,600[e]	9,000[e]	3,600[e]

[a]Includes military aricraft for Lend-Lease shipments.

[b]Represents domestic civil production only.

[c]Includes United States-financed aircraft manufactured in Canada.

[d]No production except military.

[e]Estimate.

Airline Statistics

AIRLINE REVENUE PASSENGER MILES

U. S. Domestic Air Carriers By Months

(Source: Air Transport Association)

	Millions of Passenger Miles							
Month	1944	1945	1946	1947	1948	1949	1950	1951
January	141,133	200,819	331,714	380,757	401,214	429,935	481,428	742,598
February	124,688	182,869	331.965	372,276	356,859	432,226	479,650	683,196
March	142,258	240,474	406,403	493,864	440,106	533,548	568,162	861,466
April	154,627	246,418	461,703	526,188	483,233	577,852	636,440	860,750
May	180,616	277,213	512,625	563,771	539,431	608,302	684,940	888,380
June	193,322	295,402	562,722	546,685	588,677	676,842	784,870	958,610
July	211,570	320,154	569,875	543,541	561,075	640,718	746,463	949,311
August	227,986	332,014	624,481	611,838	569,583	627,127	775,238	995,394
September	225,476	315,895	611,961	609,756	549,539	634,088	741,777	967,436
October	239,082	339,687	557,223	578,889	534,758	608,837	757,721	952,359
November	217,068	314,704	468,734	435,083	452,441	504,939	639,826	840,837
December	204,792	296,805	507,643	441,231	486,355	478,164	705,953	862,682
Total	2,262,618	3,362,454	5,947,049	6,103,879	5,963,271	6,752,578	8,002,468	10,563,019

AIR CARRIER OPERATING EXPENSES

Domestic

(Source: Air Transport Association)

Year	Aircraft Operating Expenses	% of Total	Ground and Indirect Expenses	% of Total	Total Operating Expense
1941	44,932,205	49.97	44,986,928	50.03	89,919,133
1942	36,392,090	43.14	47,974,400	56.86	84,366,489
1943	34,613,411	36.22	60,949.609	63.78	95,563,020
1944	45,150,125	36.26	79,371,967	63.74	124,522,092
1945	69,222,625	38,32	111,403,704	61.68	180,626,329
1946	129,645,346	40.24	192,573,836	59.76	322,219,182
1947	169,164,673	43.80	217,034,447	56.20	386,199,120
1948	199,990,706	46.33	231,643,571	53.67	431,634,277
1949	223,193,168	48.34	238,539,727	51.66	461,732,895
1950	228,503,346	48.18	245,797,635	51.82	474,300,981
1951	285,176,687	48.45	303,412,880	51.55	588,589,567

BREAKDOWN OF DIRECT AIRCRAFT OPERATING EXPENSES

	Flying Operations	% of Total	Direct Maintenance Flight Equip.	% of Total	Depreciation Flight Equip.	% of Total
1941	27,391,837	30.46	9,789,797	10.89	7,750,571	8.62
1942	21,865,924	25.92	8,664,436	10.27	5,861,730	6.95
1943	20,739,121	21.70	9,132,260	9.56	4,742,030	4.96
1944	28,238,316	22.68	11,892,963	9.55	5,018,846	4.03
1945	43,421,033	24.04	16,392,654	9.07	9,408,938	5.21
1946	70,805,391	21.98	33,272,916	10.33	25,567,039	7.93
1947	88,839,885	23.00	42,902,710	11.11	37,422,078	9.69
1948	109,636,528	25.40	49,034,659	11.36	41,319,519	9.57
1949	127,397,922	27.59	54,028,364	11.70	41,766,882	9.05
1950	131,086,952	27.64	55,768,177	11.76	41,648,217	8.78
1951	173,023,187	29.70				

Includes Trunks, Local Service and Territorial

COMPARATIVE TRANSPORT SAFETY RECORD

Passenger Fatalities per 100,000,000 Passenger Miles

(Source: Air Transport Association)

	1943	1944	1945	1946	1947	1948	1949	1950	1951
Domestic Scheduled Air Lines									
Fatalities	22	48	76	75	199	83	93	96	142
Rate	1.34	2.12	2.23	1.24	3.21	1.30	1.30	1.10	1.30
Buses									
Fatalities	....	....	120	140	1.40	120	120	100	NA
Rate	.22	.22	.17	.19	.21	.18	.20	.17	NA
Intercity Railroads									
Fatalities	262	2.49	142	116	74	52	32	184	121
Rate	.31	.26	.16	.18	.16	.13	.09	.58	.41
Pass. Autos & Taxicabs									
Fatalities	....	....	12,900	15,400	15,300	15,200	15,300	17,600	NA
Rate	2.7	2.9	2.9	2.5	2.3	2.1	2.1	2.2	NA

N. A. Not available.

ASSETS AND LIABILITIES

Domestic Trunk Airlines 1946-1951

(Source: Air Transport Association)

	1946	1947	1948	1949	1950	1951
Current Assets	$152,381,835	$132,484,512	$171,859,726	$175,472,186	$204,018,828	$282,197,000
Flight Equipment—Net	117,884,329	173,886,500	188,351,172	188,619,849	201,630,303	210,773,000
Other Op. Property	30,593,828	52,855,302	59,963,595	61,476,977	58,149,892	61,603,000
Non-Operating Property	2,832,701	2,789,790	5,779,353	2,704,375	1,117,230	663,000
Other Assets	83,407,794	72,561,452	58,286,768	58,668,273	77,624,812	862,000
Total Assets	387,100,487	434,577,556	484,240,614	486,941,660	542,541,065	631,031,000
Current Liabilities	105,659,559	81,829,236	99,836,921	98,428,787	130,111,887	187,684,000
Long Term Debt	89,837,933	154,513,026	167,403,669	148,017,443	135,842,945	143,253,000
Capital Stock	92,896,915	126,621,702	121,312,622	123,710,057	123,467,063	122,561,000
Capital Surplus	46,989,967	41,929,868	53,428,648	56,289,876	57,499,411	68,240,000
Earned Surplus	37,599,404	7,675,418	12,952,554	35,285,887	64,365,672	54,727,000
Operating Reserves	1,139,325	1,591,145	2,387,158	3,635,427	3,970,701	5,569,000
Other Liabilities	12,977,384	20,417,161	26,919,042	21,574,183	27,283,386	48,997,000
Net Worth & Liabilities	$387,100,487	$434,517,556	$484,240,614	$486,941,660	$542,541,065	$631,031,000


SPECIAL DEFENSE ISSUE
FLYING
MARCH 1953 • 50 CENTS
ARMY • NAVY • AIR FORCE • MARINES

PLANES IN USE

Domestic Airlines

(Source: Air Transport Association)

		1942		1943		1944		1945		1946	
Aircraft	No. of Engines	No. Planes	Miles Per Day	No. Planes	Miles Per Day	No. Planes	Miles Per Day	No. Planes	Miles Per Day	No. Planes	Miles Per Day
Beechcraft	2	1.0	325	2.0	437	1.2	323	0.8	66	0.4	502
Boeing											
247-D	2	11.3	521	....	....	....	....	....	....	1.0	607
SA-307B	4	0.8	1230	1.0	248	....	....	3.6	2,094	5.0	1,695
377	4	....	....	....	....	....	....	....	....	....	....
Convair 240	2	....	....	....	....	....	....	....	....	....	....
Douglas											
DC-2	2	5.6	668	....	....	....	....	....	....	....	....
DC-3	2	178.0	1424	161.8	1,671	205.6	1,814	314.3	1,756	426.6	1,638
DST	2	16.5	1584	....	....	....	....	....	....	....	....
DC-4	4	....	....	....	....	....	....	....	....	85.8	1,758
DC-6	4	....	....	....	....	....	....	....	....	....	....
Lockheed											
Electra	2	6.6	559	....	....	....	....	1.3	727	3.0	587
Lodestar	2	10.9	1152	11.5	1,392	14.3	1,719	17.7	1,545	16.7	1,285
Constellation	4	....	....	....	....	....	....	....	....	6.6	1,190
Sikorsky S-38	2	4.0	151	3.0	210	2.8	240	2.0	184	0.1	100
Stinson											
Single Motor	1	9.3	326	9.3	379	10.6	377	10.9	404	11.0	445
Tri-Motor	3	....	....	4.4	151	4.0	148	4.0	61	....	....
Waco	1	0.4	228	0.3	337	....	....	....	....	....	....
Martin 202	2	....	....	....	....	....	....	....	....	....	....
404	2	....	....	....	....	....	....	....	....	....	....
Curtiss C-46	2	....	....	....	....	....	....	....	....	....	....

		1947		1948		1949		1950		1951	
Beechcraft	2	5.3	721	6.4	648	....	....	....	....	....	....
Boeing											
247-D	2	4.0	654	0.6	818	....	....	....	....	....	....
SA-307B	4	5.0	1,344	5.0	1,362	5.0	1,365	5.0	656	....	....
377	4	....	....	....	....	10.0	410	10.0	1,283	16.0	1,630
Convair 240	2	....	....	16.2	899	93.0	853	103.0	940	102.0	1,102
Douglas											
DC-2	2	....	....	....	....	....	....	....	....	....	....
DC-3	2	446.7	1,303	442.4	1,190	398.0	1,077	388.0	972	425.0	1.014
DST	2	....	....	....	....	....	....	....	....	....	....
DC-4	4	149.6	1,546	150.8	1,318	160.0	958	150.0	1,324	137.0	1,614
DC-6	4	21.1	1,462	54.4	1,864	104.0	1,655	111.0	1,751	139.0	2,207
Lockheed											
Electra	2	....	....	3.9	591	....	....	....	....	....	....
Lodestar	2	11.5	1,086	12.0	335	11.0	975	11.0	969	11.0	1,152
Constellation	4	21.3	1,742	32.0	2,067	55.0	1,596	83.0	1,264	101.0	1,976
Sikorsky S-38	2	....	....	....	....	....	....	....	....	....	....
Stinson											
Single Motor	1	7.8	420	7.0	447	....	....	....	....	....	....
Tri-Motor	3	....	....	....	....	....	....	....	....	....	....
Waco	1	....	....	....	....	....	....	....	....	....	....
Martin											
202	2	2.0	782	17.6	859	24.0	1,255	33.0	954	12.0	786
404	2	....	....	....	....	....	....	....	....	18.0	1,089
Curtiss C-46	2	....	....	0.2	802	2.0	224	....	....	....	....

PASSENGER MILES, MAIL, EXPRESS AND FREIGHT TON-MILES

U. S. Domestic and American Flag Carriers

(Source: Air Transport Association)

Year	Total Passenger Miles (000)	Passenger Load Factor	Air Mail Ton Miles	Express Ton Miles	Freight Ton Miles
			DOMESTIC[1]:		
1939	682,904	56.20	8,610,727	2,713,099	....
1940	1,052,156	57.90	10,117,858	3,476.224	....
1941	1,384,733	59.13	13,118,014	15,636,811	....
1942	1,417,526	72.21	21,166,024	5,258,551	....
1943	1,634,135	88.00	36,068,309	11,901,793	....
1944	2,264,495	89.38	51,145,402	17,702,932	....
1945	3,362,456	88.12	65,100,133	22,196,852	1,350,048
1946	5,947,956	78.71	32,962,122	23,788,392	14,822,325
1947	6,103,879	65.12	33,089,696	28,766,659	35,911,554
1948	5,981,003	57.59	37,925,396	30,092,833	71,283,727
1949	6,744,425	57.78	41,418,156	27,773,669	95,057,219
1950	8,002,792	61.25	47,008,947	37,279,035	114,072,045
1951	10,566,139	67.87	63,848,335	41,268,219	102,356,646
			INTERNATIONAL:		
1947	1,810,045	61.90	12,755,998	30,786,465	2,109,948
1948	1,888,947	57.37	17,202,868	41,581,133	4,011,668
1949	2,053,980	56.67	19,365,769	49,443,623	6,714,414
1950	2,206,423	59.66	21,188,090	44,501,521	16,049,809
1951	2,599,915	59.98	21,970,111	44,512,759	68,566,689

[1] Includes Trunks, Local Service and Territorial Carriers.

U. S. AIR CARRIER OPERATING REVENUES

Domestic and International

(Source: Air Transport Association)

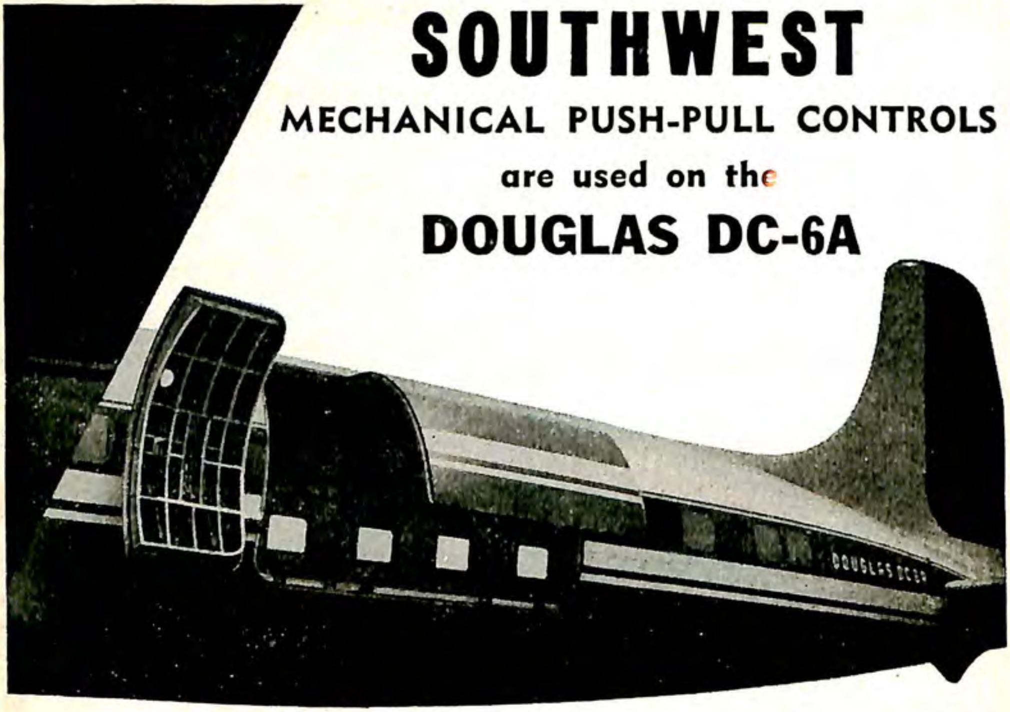
Year	Passenger Revenues	% of Total	Mail Revenues	% of Total	Express & Freight	% of Total	Other Revenues	% of Total	Total Revenues
				DOMESTIC:					
1941	69,791,338	71.72	22,696,351	23.32	2,919,003	3.00	1,904,442	1.96	97,311,134
1942	74,757,776	69.13	23,446,588	21.68	6,968,357	6.44	2,975,188	2.75	108,147,909
1943	87,481,456	71.06	24,212,580	19.67	8,381,539	6.81	3,029,390	2.46	123,104,965
1944	116,440,690	72.36	33,317,399	20.70	8,306,288	5.16	2,863,848	1.78	160,928,225
1945	166,519,923	77.59	33,557,040	15.63	10,835,140	5.05	3,694,562	1.73	214,606,665
1946	275,593,712	86.88	21,953,759	6.92	13,620,295	4.29	6,037,245	1.91	317,205,011
1947	308,575,954	84.58	29,444,746	8.07	19,377,949	5.31	7,440,928	2.04	364,839,577
1948	343,289,730	79.05	59,309,343	13.66	24,372,395	5.61	7,323,916	1.68	434,295,384
1949	385,509,049	78.69	68,569,538	13.99	26,928,631	5.50	8,923,223	1.82	489,930,441
1950	443,852,000	79.66	63,772,233	11.45	35,109,399	6.30	14,428,708	2.59	557,162,340
1951	591,186,365	84.17	57,421,687	8.18	36,914,107	5.26	16,842,347	2.39	702,364,506
	Domestic Lines include Trunks, Territorial and Local Service.								
				INTERNATIONAL:					
1947	140,652,113	67.29	32,299,890	15.45	17,526,276	8.39	18,531,252	8.87	209,009,531
1948	151,337,705	60.72	57,331,556	23.00	20,808,679	8.35	19,756,259	7.93	249,234,199
1949	158,479,705	57.81	75,197,073	27.43	22,126,830	8.07	18,350,930	6.69	274,154,538
1950	156,427,209	58.85	68,348,283	25.71	20,620,858	7.75	20,448,009	7.69	265,844,359
1951	184,691,825	64.14	63,343,846	22.00	25,244,764	8.77	14,655,226	5.09	287,935,661

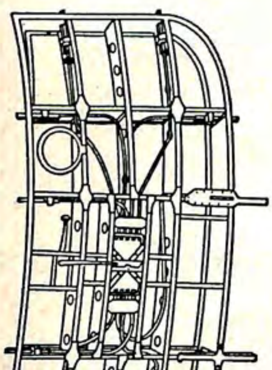
SOUTHWEST

MECHANICAL PUSH-PULL CONTROLS

are used on the

DOUGLAS DC-6A





The main entrance door of the Douglas DC-6A is locked with 8 latches to withstand pressurization, yet it is easily opened by remote Southwest Controls. These modern controls are also used on the DC-6, DC-7, the Convair 240 and 340, Lockheed Constellation 949 and 1049 and other leading aircraft.

Southwest Mechanical Push-Pull Controls remain in selected position and are not materially affected by changes in routing due to structure movement. Used to actuate mechanical, hydraulic or electric devices within .010 of an inch in any selected position. Save on weight, simplicity installations. Eliminate bell cranks, pulleys and dual cables. Three types available, light duty, heavy duty and extra heavy duty. Send for Engineering Manual giving detailed prints, complete specifications. Address Dept. AYB-53.

SOUTHWEST PRODUCTS CO.
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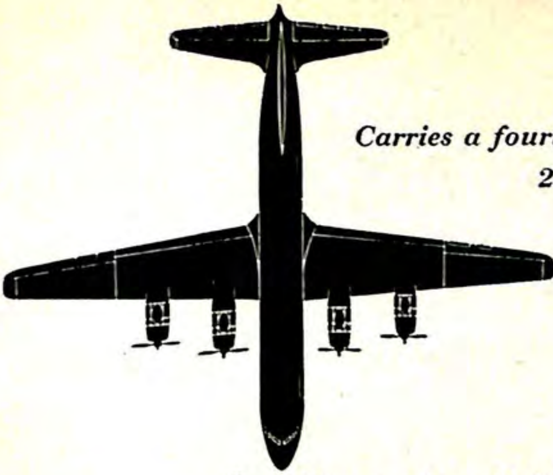
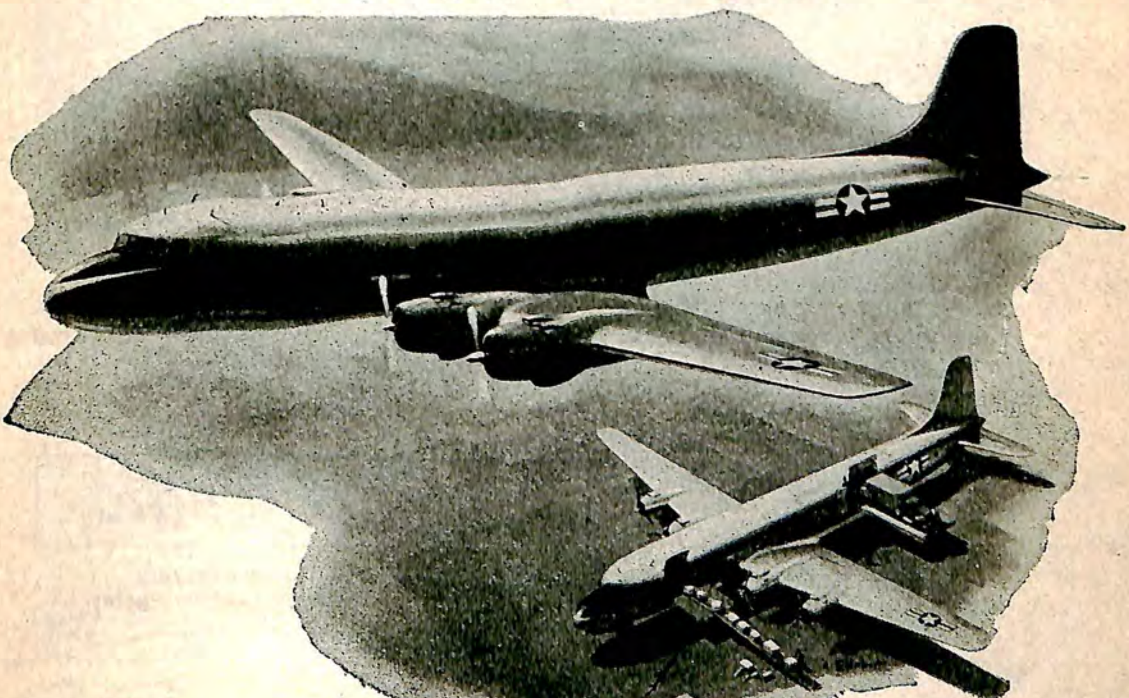




A Preview

NINETEEN HUNDRED AND FIFTY-THREE marks man's fiftieth anniversary of powered, heavier-than-air flight. On December 17, 1903, a 12-horsepower biplane built by Wilbur and Orville Wright was airborne at Kitty Hawk, N. C. Orville was at the controls. He flew for 12 seconds.

That tiny capsule of historic time represents only a moment in contrast to the hours and years and centuries expended—and still being expended—on man's conquest of the air.

The story of how the Wrights realized their dream has been obscured, down the years, in the romance of their achievement, forgetfulness of the conditions under which they worked, and a misunderstanding that marked and sometimes marred their dealings with the public when they were alive.

To recall some details of this story briefly on the golden anniversary of their achievement may add only another footnote to the reams of writing and the hours of oratory that will inevitably mark the event. But it is not without current significance: the same romancing, misunderstandings and difficulties which they faced in creating modern aviation are as green and thriving today as they were in 1903.

Wilbur and Orville Wright are revered in aviation not alone for the first controlled powered flight, but for the day-by-day problems they share with later-day Wrights, who face similar obscure, baffling problems and try to go about the business of solving them.

To understand the Wrights and what they did is to understand United States aviation and its military and peacetime goals on the occasion of its fiftieth anniversary.

Perhaps the greatest paradox connected with the flying machine is that this most dramatic and radical invention was fathered by two most undramatic and conservative men, and their spiritual sons follow their lead to this day. "Our admiration," says Alexander Kartveli, one of America's foremost aeronautical engineers, "has no limit. These two humble men will always be a guiding star to every worker in t e aeronautical field, especially to the coming generations whose great task it is to carry on in this science which every day becomes more and more complex."

These men honor the Wrights, not because they became internationally famous, but because they were colorless and conservative devotees of the slide-rule, and masters at conquering dull technical detail. Instinctively, the brothers were enemies of the banner headline, the wild prophecy, the quick-and-easy result.

They approached everything conservatively. Fred Kelly, their official biographer and author of "Miracle at Kitty Hawk," brings out their rock-ribbed Yankee attitude in all workaday matters. They traveled and piloted their planes in conservative business suits. Every dime they spent on their experiments was budgeted and accounted for. When they made money, they invested a nest egg first, not in aviation, but in real estate. Wealthy, they lived modestly and without ostentation.

Accepting an invitation to a banquet to honor him and Wilbur on the fortieth anniversary of the storied Kitty Hawk flight, Orville firmly refused no less a person than the President of the United States to take part in whooping it up. "I am sorry," he told the Chief Executive firmly, "that inabilities as a speaker compel me to decline any speaking part in the program." When the late General of the Air Forces Henry H. ("Hap") Arnold declined to believe his life-long friend and laughingly led Orville to a battery of microphones, he got a nation-wide rebuff for his efforts. "Thank you, *Captain* Arnold," said Mr. Wright. End of speech.

Some laymen took this for false modesty, if not that the Arnold-Wright friendship had gone on the rocks. But the General and Orville Wright's professional followers knew that he was only being himself, adding another reason for their quiet worship of him. Perhaps it is best summed up by Francis Clauser of the aerodynamics department at Johns Hopkins University.

"Historians," he says, "have had difficulty in finding the proper title for the Wrights. Although they were excellent mechanics, such a designation has two shortcomings. The Wrights strongly objected to it, and it completely fails to convey the magnitude of their contributions to aviation. Sympathetic biographers have attempted to present them as scientists. Their lack of scientific training, their great sense of practicability, and their single-mindedness of purpose all make the term scientist inappropriate.

"I think it has been reserved for M. P. Baker, assistant technical advisor to the Wright estate and a project engineer of the General Motors Corporation, to give them a title which carries with it full power of modern connotation.

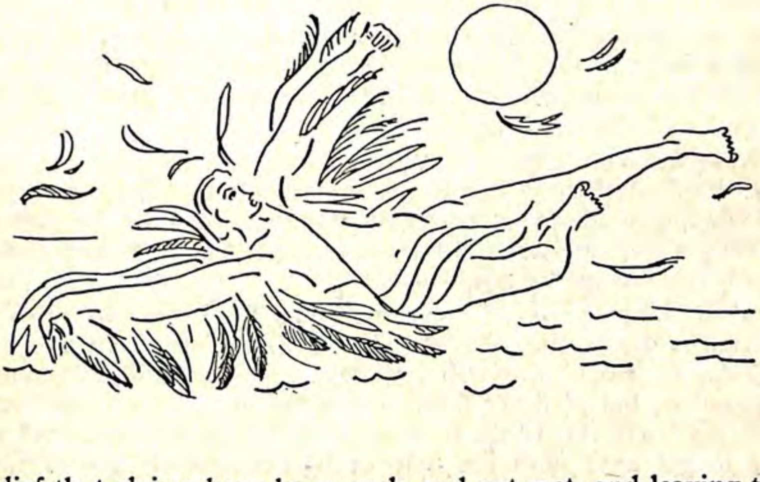
"They were aeronautical engineers.

"This aptly describes their inner desire to create something new, their ability to visualize the assembly of individual parts necessary to accomplish the final goal in a neat fashion. The fact that they were good mechanics simply saved them the tedious job of making drawings."

As such, they devised the odd and retiring rules of etiquette which their engineering descendents observe to this day.

Headlines tell of new victories in the conquest of the air. Limited space and sometimes lack of technical knowledge too often lead to omission of the crux of the story—the new invention, the latest design, while potentially a reality, will take months or years in the building.

This gap between capturing an idea and its practical application is called "lead time." Important though it is to aviation progress, it is often lost in the confusion of the marketplace, leaving the lay public disillusioned



in the belief that claims have been made and not met, and leaving the aviation fraternity sometimes embittered at being misunderstood.

Currently, lead time has been most misunderstood in defense aviation.

Similar difficulties are chronic in transport and lightplane aviation. One day, an aeronautical engineer predicts the coming of jet transports. On another, lightplanes are foreseen that can be used widely by laymen. Laymen promptly clamor impatiently, wanting to know the day of the next week when they can fly in the new equipment.

The lead time on the original powered Wright machine of 1903 was nearly a decade.

In terms of man's history, lead time before the first powered flight was many centuries.

Either way you figure, it was a miracle at Kitty Hawk.

As preacher's sons, born in the late-Victorian era, the Wrights were faced with as varied a collection of alleged facts as can be imagined. Retrospect, fortified by tested scientific data, finds the alleged facts amusing. In the time of the Wrights, these facts were too often treated as Gospel.

Not completely rejected in the '90's were mos of the bird-and-wing folk-tales of history.

One of these was the adventure of Daedalus and Icarus, the Greek father-and-son team, who made wings of feathers and wax and soared like birds until Icarus got too close to the sun. The wax melted, and the man-bird fell to his death in the sea. In 400 B.C., Archytas, a geometrist of Taranto, built a wooden pigeon, but "if it fell," a historian reported, "it could not raise itself up anymore." A number of Romans flew in Nero's time, but all spun in because they were tools of the devil.

Johann Muller, in the fifteenth century, flew an artificial eagle or "iron fly" to greet Emperor Charles V when he returned victorious to Nuremberg—probably the most miraculous event in all aviation history, since Muller died nearly a quarter of a century before it happened.

Proof was lacking on the success of all these feats. The only clearly recorded one failed. The Marquis de Bacqueville, who tried to fly across the Seine in 1742 with flippers attached to his wrists and ankles, crash-landed on a barge, and broke both legs.

The Wrights were free to draw on ample advice from the experts of antiquity. Earliest of these was Roger Bacon, (1214-1294), who suggested an aerial machine made of "a large hollow globe of copper or other available metal, wrought extremely thin, in order to have it as light as possible," and "filled with etherial air or liquid fire."

Closer to things to come were drawings by Leonardo da Vinci, the Italian artist and scientist, who sketched a mechanical bird and suggested what one day developed into the propeller. He even built a miniature helicopter that flew, but couldn't figure out what to use for power in a man-sized one. In 1670, the Jesuit Francesco de Lana drew a model which he proposed to get aloft with the help of lighter-than-air globes filled with emptiness—vacuums. Also helpful—negatively for the most part—were the thoughts of Giovanni Alphonso Borelli, an Italian mathematician, whose conclusions, published posthumously in 1680, were that man had too few muscles and too much weight to fly under his own power. Borelli's observations of birds in flight were keenly accurate. His major conclusion was devastating: he did not believe that anything could be designed "to lift man from the surface of the earth."

Bacon, da Vinci, de Lana, Borelli—no man had answers for the major questions—power and lift.

In the seventeenth century Lord Bishop of Chester, John Wilkins, reported that man could fly in one of four ways—with the help of angels or devils, by using birds (might try South American condors), with home-made wings, or in a chariot.

The Bishop favored the chariot, "so contrived as to carry a man within it" or even "big enough to carry sundry persons together." Skipping over the details, he beamed optimistically toward a time when "it will be as common for a man . . . to call for his wings, when about to make a journey, as it is now to call for his boots and spurs."

The nineteenth century, following the invention of the balloon by the Mongolfier brothers in 1782, was filled with more optimistic—and misleading—data. Benjamin Franklin, Washington and Jefferson all foresaw air transport as a potent factor in war and peace. Franklin launched imaginary attacks against ships of the line and battlements, Washington foresaw that "our friends at Paris, in a little time, will come flying through the air, instead of plowing the ocean." Jefferson envisioned air freight and "the discovery of the pole."

Smaller fry let their imaginations run wild. In the 1820's, one J. Buchanan, a Kentuckian, foresaw Washingtonians dining in Boston and flying back to the District of Columbia the same evening. He had invented an ornithopter to hasten the day, but it refused to soar with his imagination. Rufus Porter, a New York inventor, and, as the founder of *Scientific American,* one of aviation's first journalists, was ahead of his and even present times. In the 1830's, he said that flying machines were going to be the "principal and general instrument of transportation of merchandise, as well as mails and passengers, throughout the world."

Few were the dissenting voices expressing attitudes later patented by the Wrights. John Wise, one of the best of the early aeronauts, was little noticed when, in 1850, he condemned the "tendencies to over-rate the value of the discovery (of the balloon)—and overheated zeal [doing] more harm than good." This, he pointed out, was a permanent handicap. "The infatuation of men carried their minds beyond the legitimate sphere of their operations . . . the earth appeared . . . as the haycock . . . to the lark" and voyages to the moon and neighboring planets were just around the corner. Time and understanding must rein the dreamers, he urged.

In the field of powered, heavier-than-air flight, much had been done, but little accomplished.

The power problem was one of the most frequent—and unsuccessful—points of attack. Among the first suggestions was balloon propellers powered by eighty men, proposed by the Frenchman Jean Baptiste Meusnier in 1783. (Some of Meusnier's ideas, including the need for hangars, were unusually farseeing and prophetic, but hardly helpful to the Wrights.) In 1784, another Frenchman, the gasconading Jean Pierre Francois Blanchard, designed manpowered light-framed oars of silk, and windmill-like props. For both he claimed great successes, otherwise unrecorded.

Steam turned the pioneers away from man-powered devices, but the best engine they could find in the early decades of the nineteenth century weighed some 160 pounds per horsepower.

It took almost a century to work off that poundage.

Sir George Cayley, "father of British aeronautics," may be credited with starting the trend away from human elbow-grease toward mechanical devices. Before the end of his brilliant career, he experimented with steam and reciprocal engines, gas powered. Neither was light enough. He turned to lighter-than-air craft.

Milestones of progress were few and far between. Monck Mason, another Englishman, in 1842 made the first power driven model airship in history, which for years afterwards thrilled spectators with short indoor flights. Its engine was clockworks, powering a heavy prop, but the airship could not be built for a mansized model without piling on too much weight. Less than a decade later, Henri Giffard, a Frenchman who already had steam engine patents, designed one for a balloon that gave one horsepower for every 117 pounds. A three-horsepower drive on a crude prop made Giffard's the first navigable balloon in history. It went an estimated six miles per hour.

In 1848, John Stringfellow, an Englishman, repeatedly flew a model airplane—the first powered heavier-than-air flight in history. But the model had only a ten-foot wingspan, and the problem of increasing the horsepower was, for the time, insurmountable. The best that Stringfellow could do was win a $500 prize in 1868 for a one-horse-power steamer weighing only 16 pounds—one pound heavier than the ultimate Wright 15-pounds-per-horse power, but not big enough to carry a man.

Two electric engines went into airships in the '60's—one developed by the brothers Tissandier (Albert and Gaston), and one by Charles Renard and A. C. Krebs, all Frenchman.

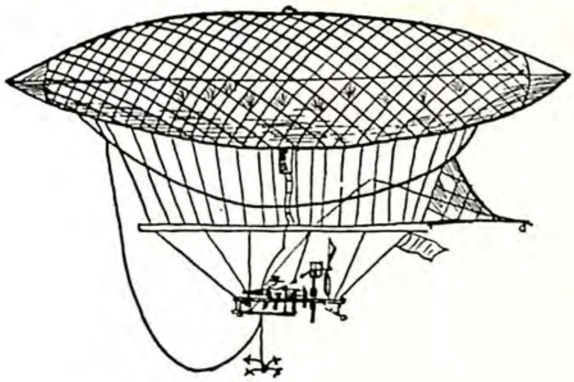
The Tissandier engine was too weak; the Renard-Krebs model, which propelled its ship to a maximum speed of 14½ miles per hour, was prohibitively heavy.

The gasoline engine eliminated all competition. A pioneer in this field was Albert Santos-Dumont, wealthy Brazilian who built a powerplant for his first airship in 1898 that weighed less than twenty pounds per unit, but gave only 3.5 horsepower.

Then Charles M. Manly, a Cornell graduate, built one of the most remarkable gasoline powerplants in all history. It weighed only 2.4 pounds per unit and developed 52.4 horsepower. The ratio is better than in many an aircraft engine to this day, but it was not even on a drawing board when the Wrights went to work, and the engine went to their rival, Samuel Langley, when it was completed in 1903.

In 1897, an old man with a young mind set down ten aviation problems which he considered basic in solving heavier-than-air flight. Item Seven on his list he called "Maintenance of the Equilibrium." This, he indicated, was more important than all the other nine. His phrase is here simplified under the title of "Control."

Control and lift are still the two basic technical problems of aviation. Without lift, a plane will not go up, and without control it will not stay up and may crack up. The old man of 1897, a wealthy Chicagoan turned glider enthusiast named Octave Chanute, had put his finger on one of the two



great pulses of aviation. Control was—and is—the more difficult problem. The supersonic designers, whose planes create strong turbulences when they attempt to go faster than sound, are as baffled as the pioneers and the Wrights, and faced with the same tedious experimenting to attain success.

Control is a triple-headed aerodynamic monster. You don't want your plane to dive into the ground or to climb into a stall. You don't want it to go right when you want to go left—or straight ahead. You don't want the wings to start pinwheeling—wing roll—with you at the center of the pinwheel.

Planes tend to do these things. Turbulent air tends to encourage them.

Jean-Marie Le Bris, a Breton sea captain, is said to have made a great stride toward preventing wing roll by warping the entire wings instead of using ailerons. This was in the 1850's. How he warped his wings is not recorded, nor it is certain that he flew his glider.

Matthew Bolton patented crude ailerons to control wing roll in England in 1868, but did nothing further about it.

One of the more neglected American pioneers, John J. Montgomery, a professor at Santa Clara College in California, used ailerons successfully on gliders. He also deserves a place in history as the first American to make successful glider flights, in 1884, 1885, and 1886. His first ailerons were not adequate. To help them along, he flew in a saddle, and kept control by leaning one way and another. He also used rudders. His best ailerons were, he reported, highly successful. "This machine was in perfect control, whether the wind was regular or gusty."

Also close to the mark was M. A. Goupil, a Frenchman, who designed ailerons but built no plane to prove their worth. His right ideas, like Montgomery's, were ranked with a lot of wrong ones, and there was no telling which was which till years later.

Two Americans may have made powered flights well before the Wrights, but both missed aviation's highest achievement owing to control troubles. One was Gustav Whitehead, who, possibly, flew more than half a mile at Bridgeport, Conn., Aug. 14, 1901. He also may have made a circular flight of seven miles over Long Island Sound on January 14, 1902. That he lived to tell it is one of aviation's minor miracles. So crude were his controls that a single gust of wind would have meant death.

John Hall, near Springfield, Mass., Dec. 6. 1902, probably took a powered ski plane off, but it was so completely lacking in controls that he crashed in an orchard. He was the first to admit that his flight was not comparable to those of the Wrights.

Control was also the prime cause of other pre-Wright powered flight failures. Clement Ader, a Frenchman, made straight flights in a steam-powered plane in the '80's and '90's, most of which ended with conflicting testimony on their success, or crack-ups. Controls were almost entirely lacking. Samuel Pierpont Langley flew a model over the Potomac on Aug. 8, 1903. A man-sized version cracked up only a few days before the Wrights first flew at Kitty Hawk. The Langley plane had neither ailerons nor the equivalent in wing-warping controls.

During the nineteenth century then, not a few problems of powered flight had been vaguely realized, and attacked with spotty success. Someone was needed who could determine which of the problems were basic, and which of the solutions sound.

The experimenter must also have courage, funds, and a rather careless regard for public opinion. "The general public," as Kartveli points out, "discouraged by the failures, considered flight as outside the range of human possibility, in the same category as perpetual motion." "Practically every phase of the problem has been solved," wrote E. W. Roberts in the *New York Times,* on July 31, 1901, "but never combined in one machine. . . . When we find one aeronaut with sufficient means to make a practical series of experiments and who at the same time will subdue self-sufficiency to profit by the experiments of others, it will be but a short time until we have a practical machine."

Two aeronauts, instead of one, turned up. The Wrights otherwise failed to meet specifications. They were not men of means. They subdued their egos long enough to examine the experiments of others—and then threw most of them out.

"We saw that the calculations upon which all flying machines had been based were unreliable, and that all were simply groping in the dark. Having set out with absolute faith in the existing scientific data, we were driven to doubt one thing after another, till finally, after two years of experiment, we cast all aside. . . . Truth and error were everywhere so intimately mixed as to be indistinguishable."

They did not set out to build a contraption in the hope that it would fly. They found out what made flight possible, and built a machine to fulfill those specifications.

Wilbur and Orville Wright not only invented a flying machine—almost as important, they invented a method of work making it possible to build other flying machines, up to and including jets.

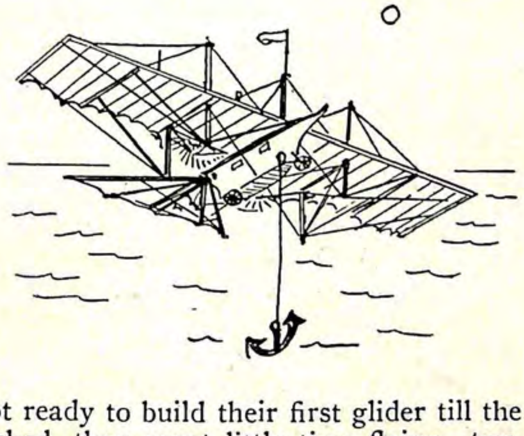
It is one of the ironies of our time that this last achievement is less well-known and honored than the first.

Their active interest in flying was inspired by death. Otto Lilienthal, the German scientist who experimented with gliders, was killed in a flying accident in 1896. Wilbur Wright and his brother had read many of Lilienthal's reports, and now sought more, hoping to carry on where he had left off.

They made no immediate move to build anything but, on the basis of what they read, began to correspond with other investigators, including Chanute.

Most of their conclusions were negative. They rejected the idea of flapping wings, and did not believe that control was practical by the pilot shifting his weight.

Turning to the fixed wing as a possible solution of the control problem, Wilbur finally came up with wing-warping as a possible method of lateral control. This they tested, with moderate success, in a kite. For longitudinal control they accepted the horizontal rudder, but not until they had tested it too.



They were not ready to build their first glider till the summer of 1900. Once it was finished, they spent little time flying—two minutes in some twelve tries. But they were satisfied: they learned that warping and a rudder would work; and they eliminated inaccurate data from Lilienthal on lift and drag.

Another spring, another glider. This was larger and easier to test, Again it belied other data. Accurate data was their most urgent need. They abandoned the air and went to work on ground tests that would nail down facts which they could be sure were accurate.

Their patience was monumental, their tests endless. They groped for what turned out to be a wind tunnel. Their first attempt was a rig on the front of a bicycle, to which they attached wing contours and tried to estimate lift. This was unreliable.

They went indoors and built a frame on which they hung their wing models—a wind tunnel without any sides. They made sides from a large paper box with the ends knocked out. Another try, and the sides were solidly made of wood.

Measuring instruments were developed by he same cut-and-try methods.

By Christmas, they were able to concentrate on the problems they had first brought down from the air. Two months later they came up with data and conclusions that, though unrecognized at the time, made aviation history.

They now knew with accuracy how to shape a wing, how to increase lift on their glider models, the deficiencies of biplane wings and the fact that, at a certain undetermined point, a wing stalled.

"The accuracy of these conclusions," notes M. P. Baker, "is truly amazing when we consider the size of their models and the short time they had to accumulate information. We must not overlook the fact that this was quite contradictory to and beyond the work of all other investigators who were 'better' equipped."

From these make-do gadgets and experiments came a glider built at Kitty Hawk in the late summer of 1902 and perfected after some thousand flights during the fall. A third glider was in the front of their minds when they returned to Dayton.

"The season's work," again to quote M. P. Baker, "gave them utmost confidence in their ability to add an engine and continue their work in powered flight."

Their attack on the power problem was equally careful, detailed and realistic. Each part was built with an eye to lightness, weighed against reliability and power. The result was not as good as Manly's engine, built almost simultaneously, but its liquid-cooled four cylinders turned up 12 horsepower at 1025 revolutions per minute. "Throughout all of their writings," Baker points out, "the Wrights seemed to depreciate the design of their early engines, and yet, as we look over their work now, we see innumerable instances of outstanding ingenuity."

The engine completed, they delayed. It weighed about fifteen pounds per horsepower, as contrasted with Manly's 2.4 pounds. Unsatisfied with data on propellers, mostly from marine sources, they had turned to their own findings, and now they worked up more.

They said afterwards that it was their most difficult problem on the first plane, and, in retrospect, trained observers have confirmed this. It could have meant the difference between success and failure. "In designing the propeller for the first airplane," said Dr. George W. Lewis, "they recognized that the propeller behaved aerodynamically very much in the same manner as the wing, and they advanced the principle that every element of the propeller should be considered as an airfoil.

"Utilizing this fundamental concept, they designed a propeller having an efficiency of 66 percent, an outstanding factor in the success of their first flight, for had the propeller been appreciably less effective, they would have been completely unable to overcome the resistance of the machine and propel it in level flight with a weight of sixty pounds per available horsepower."

When the propellers were completed—they used two on the 1903 model—they were ready for flight.

The rest of the story has been told too often for recounting here. It reached its climax December 17, 1903.

But even on that eventful day the Wrights were unchanged. They made only four flights, each of a few seconds' duration and the longest, by Wilbur, lasting only 59 seconds, in the first powered plane. After that, the brothers packed up and went home.

They didn't consider themselves pilots.

They were aeronautical engineers.

A detailed study of their lead-time work also shows that, despite temporary discouragement, the Wrights, by December, 1903, were absolutely certain to achieve powered flight.

Unlike similar confidence in many of their contemporaries, theirs was not a self-infused illusion of certainty to keep their spirits up; it was the certainty of knowledge, trial-and-error, and Yankee know-how, which, long as it sometimes takes and costly as it has become, makes U. S. aeronautical achievement the best in the world today.

"Stock in Flying Machine," Orville wrote from Kitty Hawk to his sister Katherine, just before the first flight, "sells one day at 175 and the next at about 17."

"Cash on hand \$59," he noted in August, 1907. Then a little more than two years later: "I am sending a draft for \$40,000. If Will is not at home, please place it in different building associations."

Behind these brief fiscal notes lies a running battle with military brass. It began in 1905 with a War Department brush-off letter, stuffy, misunderstanding, and unctuously benighted, and ended with a contract in 1909.

Thus, the lead time on the first United States military plane was six years for all practical purposes. And thus, briefly, did the brothers summarize their financial career in and out of aviation, the while previewing the industry's lean-today-fat-tomorrow, roller-coaster, dog-house-to-wild-blue-yonder history which continues to this day.

"Stock in Flying Machine" was on a day-to-day basis in the early 'teens of this century, dipped to barnstormer levels in the 'twenties, weakened almost to the point of collapse in the depression-ridden 'thirties, and, as far as defense was concerned, hit another low at the end of World War II. "Flying's greatest hazard," the late Richard ("Dick") Depew once summed up, "is the risk of starving to death."

Whether from prescience or pessimism, it is little wonder that the Wrights invested in real estate.

When the industry was not going broke, a frantic public, awakened in crisis to the need of wings, went extravagantly in the same direction to make up for the lean years. For every billion spent on U. S. air defense, a matching billion has been spent in a sometimes futile effort to buy time lost during the years of indifference.

Figures chart the highs and low of the roller-coaster. In 1914, at the beginning of World War I, total plane production in this country was 49; in 1918, the figure had burgeoned to 14,020. In 1939, starting date for World War II, total output was 5,856, of which only 921 were for U. S. military purposes; in 1944, production soared to more than 96,000.

Coupled with lead time needed for modern planes, lack of consistent, high-level production programs has become perhaps the greatest hazard in today's aviation. Lack of a consistent programming is certainly the most expensive item in today's air defense.

But each succeeding low through the decades has been a new high in contrast to the one before it. Steadily, despite ups and downs, U. S. aviation has gone forward. Its social, economic and military progress has consistently made dramatic changes in the history of our times. Similar variations between the peaks and pits have been evident in recent years. Defense efforts today are better planned and production more ample than before World War II.

Today, the nation that fathered the Wrights leads the world in the air. No propaganda is needed to enhance the bare facts. Our latest defense planes, fighters as well as bombers, are superior to any that might oppose them. Our transport systems are the most efficient and far-reaching on earth. Lightplane flying, for business and pleasure, is unequalled. The nation's second biggest hobby is model building. Only in production do we take a second place.

But tomorrow, more than ever before, is the promise that to the brothers' dream-come-true of powered flight will be added their equally cherished hope for sustaining public understanding of aviation and its engineering problems.

CHAPTER ONE

The Industry

WASHINGTON, Dec. 25, 1903 (Special to the New York Times).—The inventors of the airship which is said to have made several successful flights in North Carolina, near Kitty Hawk, are anxious to sell the use of their device to the Government. They claim they have solved the problem of aerial navigation, and have never made a failure of any attempt to fly.

Their machine is an adaptation of the box kite idea, with a propeller working on a perpendicular shaft to raise or lower the craft, and another working on a horizontal shaft to send it forward. The machine, it is said, can be raised or lowered with perfect control, and can carry a strong gasoline engine capable of making a speed of ten miles an hour.

The test made in North Carolina will be fully reported to the Ordnance Board of the War Department, and if the machine commends itself sufficiently, further tests will be made in the vicinity of Washington, and an effort made to arrange the sale of the device to the Government. The use to which the Government would put it would be in scouting and signal work, and possibly in torpedo warfare.

THE BIGGEST PEACE-TIME production year on record, and a year promising even more dramatic progress in 1953, was the historic role of 1952 in U.S. aviation.

Strikes, supply shortages and the maze of technical difficulties arising from jet engines and supersonic speeds combined to make the year also one of the most difficult in airframe history. But handicaps failed to block the industry's goal—expanded peace-time production under the limitations laid down by the Congress and the military.

Outstanding among the year's achievements were introduction of some twenty new military planes, for the most part in the trans- and supersonic areas, widespread development of guided missiles, doubling of our air strength in being, and the climax of a decade of air transport development, signalled by a ten-fold increase in services and paralleled by the best safety record in history.

The tooling-up phase of defense which bega with hostilities in Korea was nearly completed at year's end. Employment in the aircraft industry jumped from an estimated 560,000 to more than 750,000 during the year. Most training programs were nearing completion, although an increase in personnel is foreseen during 1953.

The accelerated production pace was matched by the best sales volume among aircraft companies since World War II. Fifteen top organizations sold an estimated $4.3-billion in airframes, engines, and propellers, approximately 65 percent ahead of the 1951 score.

All this added up at the close of the year to a prediction by Admiral DeWitt C. Ramsey, president of the Aircraft Industries Association, that the industry can anticipate a sales increase of more than $1.2-billion in 1953, with the production peak extending into 1954. Monthly defense plane production rate, he estimates, will stabilize at the present rate of about a thousand units a month.

Detail reports of aviation industrial activities follow. Companies are presented in alphabetical order.

AIRCRAFT MANUFACTURERS

Aero Design and Engineering Co.

The year 1952 saw a new concern, the Aero Design & Engineering Company, take a firm position in the civilian aircraft market with the production and delivery of 32 twin-engine Aero Commanders before November 1, 1952. Production at that time reached two planes a week, indicating a total of 48 planes would be delivered by the end of the year.

Also during the year Aero delivered three Commanders to the U. S. army for evaluation and use tests.

Company officials said that the possibility of military orders would not affect the plans for production of the new high-performance executive plane for the civilian market.

The company also placed a nation-wide distributor sales organization into operation during the year.

The Aero Commander was designed and the prototype constructed by a group of engineers who had a background of long experience. Credit for the original idea goes to T. R. Smith, young aeronautical engineer who devoted six years to seeing his dream airplane come true.

Smith, who for many years was associated with the Douglas Aircraft Company at Santa Monica, California, called a group of engineer associates together in 1944. By the end of 1945 they had arrived at the final configuration and had worked out the engine installation and performance data on the new Aero Commander. Early in 1946 they started tooling for the prototype at Culver City, California. Actual fabrication started in August of that year. The prototype was completed and flown April 28, 1948.

Two men who had long been interested in the development of the Aero Commander organized the company, the Aero Design and Engineering Company, which had placed the plane in production and put it on the market: R. T. Amis, Jr., who is now president of the company, and George T. Pew, who is chairman of the company's board of directors.

The new company acquired its factory site at Tulakes airport, Oklahoma City, in January, 1951. In the late autumn the first completed airplane rolled from the production line.

On January 8, 1951, the plane was turned over to the CAA for flight tests for the approved type certificate, which it received three weeks later. That was January 30, only a few days more than a year from the time the work of tooling up started in the empty hangar.

Now the factory has a total of more than 600 regular employees, and company officials predict the size of the plant will be doubled within the next year.

American Helicopter Co.

The American Helicopter Co.'s XH-26 is a product of armed forces-industry teamwork. Approximately one year and one-half ago, the Army requested the Air Force to initiate the development of a one-man, collapsible helicopter, according to the military requirements established by the Army

The Army specified that the one-man helicopter be collapsible, capable of air drop to infantry units in rough terrain, and that it be capable of quick assembly for observation operations.

The XH-26 program was initiated in June of 1951 after a design competition which was won by AHC. First test flights were made a year from the time the contract was let.

The XH-26 has not yet been officially named, but has been unofficially dubbed the "Jet-Jeep" because its use in the air is quite similar to a jeep on the ground. Also, it can be carried in a jeep trailer, uses jeep fuel and jeep tool kit.

Top speed of the XH-26 is 80 mph. It is the smallest and the lightest helicopter ever procured by the Army. The ship stands six feet high and has a design empty weight of 300 pounds. It carries a load of 600 pounds, meaning that it actually can lift a load equal to twice its own weight.

Engines can be started by pressing a button on the cyclic control stick which injects air and fuel into the engine, during which time a small spark plug ignites the fuel and air. The spark plug then is turned off. Either engine can be started in this way. They require no warm up, and will burn any low grade or high grade petroleum fuel such as gasoline, kerosene, or diesel fuel oil. The ship will fly an hour and one-half without refueling.

Fuel is housed in the lower fuselage structure immediately under the pilot. It is pumped up the side to a shaft, through rotary seals, and out the leading edge of the blade in small tubes to the engine.

The company is developing no ships at present for the commercial market.

All airframe and rotor development work ha been accomplished at the Company's two Manhattan Beach, California, plant facilities, whereas all power plant development is accomplished at the Mesa, Arizona, facility. With the Company's available production facilities, consisting of well over 100,000 square feet, relatively high production rates on the XH-26 can be achieved within a minimum of time.

Anderson, Greenwood and Co.

During the past year, Anderson, Greenwood & Co. expanded its military aircraft work. Engineering contracts continued with Consolidated Vultee Aircraft Corporation allowing Anderson, Greenwood & Co. to assume complete design responsibility for major components of the R3Y turboprop flying boat, including working drawings, structural analysis, weights analysis, etc. Structural test components were fabricated and tested to provide structural data.

Further contracts were signed with Boeing Airplane Company; for the Wichita Division, engineering work on B-47 aircraft; with the Seattle Division, a highly classified research and development project.

During the year the company constructed and occupied a modern 8,000 sq. ft. engineering and administration building in suburban Houston. Shop facilities are under construction, and additional machine tools have been ordered. Facilities are retained at Sam Houston Airport where the company's AG-14 all-metal aircraft were built.

Several advanced research and development projects were also conducted by the company on its own behalf, including small guided missiles, ramjet engines, and various supersonic research projects.

The AG-14 aircraft, developed by the company during the postwar period, is the only landplane pusher aircraft to be type certificated since the war. While seven airplanes were built, production was suspended during the current emergency. One airplane has been placed with the Civil Aeronautics Administration at the Aeronautical Center in Oklahoma City.

Beech Aircraft Corp.

For Beech Aircraft, the fiscal year from October 1, 1951, through September 30, 1952, saw sales nearly tripled.

Sales were more than $90-million for the 1952 fiscal year, as compared to 1951 fiscal year sales of $32.7-million and 1950 fiscal year sales of $16.4-million. Sales of Beechcraft planes to foreign countries totaled an all-time high of $18.3-million during the fiscal year ended September 30, 1951—more than four times the 1951 fiscal year total.

PREVIEW

" 'Listen! The Wind' is about a period in aviation which is now gone, but which was probably more interesting than any the future will bring. As time passes, the perfection of machinery tends to insulate man from contact with the elements in which he lives. The stratosphere planes of the future will cross the ocean without any sense of the water below. Like a train tunneling through a mountain, they will be aloof from both the problems and the beauty of the earth's surface. Only the vibration from the engines will impress the senses of the traveler with his movement through air. Wind and heat and moonlight take-offs will be of no concern to the transatlantic passenger. His only contact with these elements will lie in accounts such as this book contains."

—From Charles A. Lindbergh's Introduction to "Listen! The Wind" by Anne Morrow Lindbergh, 1933.

In dollar volume, Beechcraft made 40.1 percent of all light plane sales to foreign countries, compared to 34.1 percent for the second highest competitor, according to figures compiled by the Aircraft Industries Association. In the Bonanza class, Beechcraft sold 73.8 percent of all airplanes delivered to export markets.

Beech now has more than 12,000 employees in its two main factories in Wichita and in its two major satellite plants at Herington and Liberal, Kansas.

The year saw the beginning of the construction of a new $1.3-million factory and office building on its main field at Wichita, designed to house the production of the new Beechcraft-designed USAF T-36A advanced trainer-transport. Scheduled for completion in the early spring of 1953, the new facility will be located south of the company's main plant and will add 111,000 more square feet to Beechcraft's already expanded facilities, bringing the total floor area owned and leased to more than a million and a half square feet.

Most phases of the manufacture of the USAF T-36A will be moved to the new building when it is completed. At press-time of THE AIRCRAFT YEAR BOOK, no production dates for this newest Beechcraft has been announced. As a transport, the plane is designed for a capacity of 12 passengers and two crew members. Designed by Beechcraft engineers, production of the T-36 was assigned to Beech Aircraft by the USAF in July, 1951, after winning stiff competitive tests.

The company's plans for production of the two-place USAF T-34A basic trainer, the Beechcraft "Mentor," are going ahead with production schedules set up for 1953, but as yet unannounced as to details.

During 1952, contracts and production plans were completed between Beech Aircraft and the United States Army for the manufacture and delivery of a sizable number of the new L-23A, the military transport-trainer version of Beechcraft's new six-place twin-engine Twin-Bonanza.

Much of the company's 1952 production for security reasons continued to remain undisclosed as to rates of production and total production. A sizable number of new Model 18 twin-engine military trainer-transports were delivered to the Royal Canadian Air Force during the year. The rebuilding of military versions of the Model 18 for both the U. S. Navy and the U. S. Air Force also continued during 1952. Throughout the year, Beechcraft built wings for the Lockheed T-33 trainer and wings for the Lockheed F-94C "Starfire" fighter, the newest U. S. jet interceptor, and sub-assemblies for the B-47 "Stratojet" medium bomber. The company also produced undisclosed quantities of droppable wing tanks, napalm bomb tanks, jet engine starting units, and other military items for the military services.

Bell Aircraft Corp.

The program of diversification, which Bell Aircraft Corp. planned and implemented over the preceding several years, became an operating reality in a number of major fields in 1952.

Broadly categorized, these fields would include the design, development and production of guided missiles, rocket motors, helicopters, electronics equipment and the subcontracting of major bomber components.

Products in these categories are being developed and manufactured for all branches of the Armed Forces and a breakdown would list three types of guided missiles, three models of helicopters, a convertiplane, several types of research aircraft, contrasting phases of rocket propulsion, electronics equipment and special airborne devices, missile handling and missile training equipment and jet engine nacelles for the Boeing B-47 and Consolidated B-36 bombers.

Bell's largest facility, the Wheatfield Plant, which is adjacent to the Niagara Falls municipal airport and which houses the company's executive offices, was converted into a guided missile center.

The new $7.5-million helicopter plant near Fort Worth, Texas, was activiated with the transfer of all helicopter operations.

Floor space of all facilities, including company owned, government owned or those under lease, totals 2,431,000 square feet, an increase of .04 percent over 1951 but an increase of 88 percent over 1949.

Employment grew to 13,250, an increase of 15 percent over 1951 and an increase of 165 percent over the 1949 high.

Sales in 1952 were approximately $110-million, an increase of 34 percent over the 1951 figure of $82.3-million. At year's end, the total of unfilled orders reached approximately $485-million. This backlog is within about $15-million of the approximately half-billion dollar peak attained during World War II but approximately 75 percent less floor space is being currently occupied and 76 percent less persons are being employed than in World War II.

Bell's guided missile contracts are in the air-to-ground, air-to-air and ground-to-ground categories with the Air Force, Navy and Army. Exhaustive tests at military centers have been conducted as well as at Bell's two rocket motor test sites, one adjoining the Wheatfield Plant and the other at nearby Modeltown, N. Y.

Work was also continued at an accelerated pace in the field of missile research. Engineering requirements to support the missile and rocket motor programs continued high and more than 3200 persons were employed in the Engineering Department. This number is almost 25 percent of the company's total employment and nearly five times as many engineering personnel as were employed during the peak of World War II.

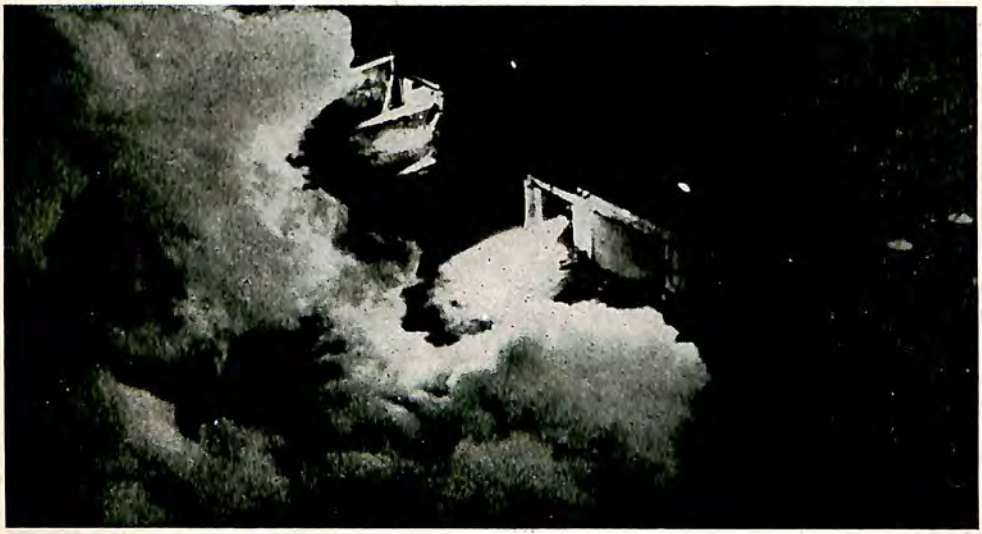
Two new models of Bell's basis Model 47 helicopter were introduced during 1952. One was the Army's H-13E and the other, the Navy's HTL-5, almost identical but incorporating improvements over preceding models.

The H-13 and HTL helicopters continued to perform their roles of mercy in Korea. The evacuations by Army and Marine pilots in these helicopters reached in excess of 10,000, practically two-thirds of all wounded United Nations troops rescued since the outbreak of the conflict in the Far East.

Although the bulk of deliveries from the Fort Worth plant were to the military, a modest number of Model 47D-1 helicopters were delivered to commercial operators and orders were accepted for 1953 commitments, including one for six helicopters for the Norwegian Air Force.

Helicopter Air Service Inc. of Chicago, which operates the country's second helicopter airmail service, passed its third anniversary in August. Its fleet of six Bell Model 47D-1's completed in excess of 96 percent of all

Two Bell rocket motors for guided missiles are fired up at test center



schedules in three years, carried more than 9-million pounds of air mail and cargo and covered close to 1-million air miles without accident.

The New York City police, only municipal agency in the world operating helicopters, increased its 47D-1's to four and expect delivery of two additional ships in 1953. The police records indicate that between 35 and 50 lives have been saved by their rotary wing aircraft in the past three years.

One of the helicopter highlights of the year was credited to a Bell pilot and a Bell helicopter. On Sept. 17, Elton J. Smith set a world's distance helicopter record in a non-stop solo flight of 1217.137 miles from the Bell plant at Fort Worth to the Bell plant at Niagara Falls airport.

The flight was conducted in accordance with regulations of the National Aeronautic Ass'n and was recognized as official by the Federation Aeronautique Internationale. The distance surpassed the previous world's distance flight by 530.4 miles and was 278 miles longer than the longest unofficial flight.

Work on the XHSL-1 tandem helicopter, the first Navy helicopter to be designed specifically for anti-submarine warfare, proceded to testing stage of the first prototypes.

Bell's work on the joint Air Force-Army convertiplane contract also advanced to the successful wind tunnel testing of a scale model. The Bell configuration is of the tilting rotor type, whereby the rotors convert from the helicopter state to the propeller state while the wings assume lift in the high speed airplane condition.

Service testing of the YH-12B helicopter at high altitude was carried on and further experimentation with the XH-15 helicopter was continued. Both are Air Force projects.

Research data in the supersonic, transonic and subsonic areas continued to be fortified with the flight of the Bell X-1 and Bell X-5, two special research aircraft which were in flight research phases of the Air Force and the National Advisory Committee on Aeronautics. More advanced models of the X-1 were brought closer to their flight test debuts and the X-2, a high altitude, high speed craft which makes much use of stainless steel in various outer surface sections awaited only a rocket motor from another contractor to begin powered flights.

The year also saw Bell become an industry source for rocket motor and rocket motor components. The company is one of only seven or eight sources in the country concerned with development and production of liquid rocket motors on a prime basis. Its rocket motor engineering section, which employs more than 400 persons and which occupied a special rocket research laboratory, is engaged on a three-shift basis.

Bellanca Aircraft Corp.

Bellanca's latest development for the use of private owners and commercial users is the Bellanca Cruisemaster, powered with the 190 hp Lycoming engine. It possesses high top and cruising speeds and is equipped with all latest equipment of modern air transportation including controllable propeller, hydraulic retractable landing gear, two-way radio with direction finding, and complete instrumentation for navigational use. Interior styling and fittings are in the most modern manner, and nothing is omitted tc insure the comfort and safety of pilot and passengers.

The advent of the Korean incident found Bellanca manufacturing commercial aircraft only. However, a switch to defense production was started immediately, and today 99 percent of Bellanca's production consists of defense items.

Bellanca's experience in building complete aircraft has proved to be valuable in getting many difficult assemblies into production in minimum time, and in meeting tight schedules on important components. Throughout the factory, in sheet metal shops, welding shops, machine shop, plating and finishing shop, heat-treat and assembly, experienced crews took over the manufacture of such diverse assemblies as the Fin and Rudder for the Martin Marlin; Engine Mounts for the Fairchild Packet, the Martin Mariner and the Mars; Radar Antenna components; complete Naval Air Maintenance trainers; a new Oil Plumbing System for the B-29; thousands of detail parts for many other defense projects.

Boeing Airplane Co.

Test flights and production preparation as they concerned the YB-52 Stratofortress, the new eight-jet heavy bomber, comprised both the spectacular and a major share of news at Boeing during 1952.

Also, sleek, six-jet, swept-wing B-47 Stratojets continued rolling out of the Boeing Wichita plant in quantity during the year—better than one per working day—and deliveries to the Air Force were stepped up. Tanker-convertible C-97 Stratofreighters were completed at a faster rate at the company's Renton, Washington, plant and gas turbine and guided missile work continued at a swift pace. But still it was the B-52 that held the spotlight.

The XB-52, first Stratofortress built, began its taxi tests on Boeing Field in February. In March came the YB-52 rollout followed by ground tests. Meanwhile the XB model was returned to the factory for additional equipment installation while the second airplane was prepared for flight.

First flight of the Boeing YB-52 Stratofortress, eight-jet U. S. Air Force heavy bomber, took place on April 15, when the swept-wing plane left Boeing Field on a flight to Larson Air Force Base, Moses Lake, Washington.

As testing continued, tooling and jig building was accelerated to permit quantity production of the radically new bomber which is still covered with a cloak of security. By mid-year the number of man hours needed to complete a Stratojet had been reduced approximately 88 percent below the number required for the first production model completed little more than two years previously. The Wichita Division had at this time also met or exceeded B-47 delivery schedules to the Air Force for six successive months.

Boeing entered into a modification subcontract with Grand Central Aircraft Company, Tucson, Arizona, early in the year to handle installation of latest military equipment in the Stratojets. Supplemental operations also were instituted at Wichita to permit accelerated incorporation of similar items on the production lines. The work was done in subassembly, primary and final assembly areas and on the flight line.

At the same time preparations for production of additional Boeing B-47's were begun by Douglas Aircraft Company at Tulsa, Oklahoma, and by Lockheed Aircraft Corporation at Marietta, Georgia. As a preliminary to its production of the B-47 the Douglas-Tulsa plant participated temporarily in the modification program.

To speed B-47 production, a $10-million expansion program was completed during the year at the Wichita Division. Additional working area apart from the main factory, for assembly, installation and testing of complicated electronic equipment was one of the principal needs. Built to handle this work were a flight hangar big enough to berth twelve B-47's and an electronics building. Other work included construction of 150,000 square feet of additional warehouse space, a 37,400 square foot building for transportation equipment and additional flight ramp power and fire protection facilities.

And while Seattle served as home base for the B-52 program, at nearby Renton the company was turning out C-97's and TB-50 Superfortresses.

Boeing's new KC-97F, which made its debut during the year, became the tenth model in the C-97 Stratofreighter series. Equipped with new, improved Pratt and Whitney Wasp Major engines, these big Boeings are being delivered to Strategic Air Command. The double-deck Stratofreighter, constructed as a multi-purpose cargo and troop transport, can also be used as a forward area supply transport, tanker, and hospital airplane.

The 350-mile-an-hour KC-97F can be converted from its basic freighter configuration to Flying Boom-equipped aerial tanker through use of unique "packaging" of accessory equipment. The Boeing-designed Flying Boom, its controls and operator's station are assembled as a single unit which is attached beneath the Stratofreighter in the space normally occupied by the rear cargo doors.

During the conversion process, cargo doors are removed and auxiliary fuel pumps, lines and tanks are loaded by means of the C-97's self-contained electric power hoist. After installation of the Flying Boom pod itself—again by self-contained hoist—interconnections of fuel and electrical lines are made through permanent fixtures in the basic airplane.

The Flying Boom system utilizes a telescoping metal pipe to transfer fuel from tanker to receiver airplane. Both bombers and fighters now are being refueled operationally by this method.

With tanker equipment removed, the new KC-97F can carry 134 fully-

The new Boeing eight-jet YB-52 shown on test flight

equipped troops, or 79 litter patients together with medical attendants and supplies. As a cargo carrier, the big Boeing can transport payloads of up to 34 tons on normal missions. The entire airplane (both decks) is pressurized in any of its normal configurations. Sea level cabin pressure is maintained up to 15,000 feet airplane altitude. At 25,000 feet, cabin pressure is maintained at 5,500 feet.

Stratofreighters are in world-wide service with the Military Air Transport Service, carrying troops, supplies and hospital patients for all three MATS Divisions. Strategic Air Command C-97's are used for cargo missions in support of SAC bomber and fighter movements, as well as being the new standard aerial tankers of the command. They complement the earlier KB-29P Flying Boom Tankers, which have been in service for almost two years, and KC-97E tanker-transports.

Also produced in the Renton plant on a production line were the "Flying Schoolhouse" versions of the B-50 Superfortress. These airplanes are designated TB-50H's and are in use as navigator-bombardier trainers by the Air Force's Air Training Command.

The year 1952 also found work underway at Seattle to enlarge facilities to a point where they could adequately handle new demands. The Boeing wind tunnel was thoroughly rebuilt at a cost of $1.5-million.

A new jig building containing 50,000 square feet of flooring and a doorway with 41 feet of vertical clearance, was completed.

At year's end, work will be virtually completed at the Seattle plant on a new five -story addition to the engineering building costing nearly $3.25-million.

By autumn, pile drivers had begun punching fir piling into a piece of ground on the edge of Boeing Field where a new $4-million flight test hangar will be erected.

Shortly before the first of the year the company participated with the community in lengthening the Boeing Field (King County Airport) runway to make it adequate for flight testing of B-52 and future jet aircraft.

During 1952, the Boeing lightweight gas turbine engine went into manufacture on a production basis for the U. S. Navy. A new division of the company was set up in Seattle to handle design, production and marketing of the compact 200-pound, 175-horsepower engine. While tests continued on further refinements and many new applications, production gas turbines were delivered for wholly military uses.

Already undergoing tests in a Navy personnel boat, a Kaman helicopter and a Kenworth heavy duty truck, further turbine installations are planned for light aircraft, military vehicles, generators, ground power units for aircraft, and other applications.

Current production engines are being built for the Navy Bureau of Ships and will be used to generate electrical power for mine-sweepers. Boeing production facilities now include machinery for building the entire engine with exception of accessories, standard parts such as bolts and nuts, accessory gear drives and reduction gearing. The project's aluminum foundry serves the entire Boeing-Seattle organization. It is equipped to turn out aluminum castings of aircraft quality with a capacity of one ton per day. Complete machine and sheet-metal shops were also set up for the new turbine facility.

Fourteen large cells are used to test the turbines under a variety of conditions and for a variety of purposes. Certain of the cells are set aside for production and acceptance testing of newly assembled engines. Others are designed for developmental testing of various turbine applications, and still others are used for research. The average cell is ten by twenty feet, with walls of reinforced concrete. By means of gauges, manometer tubes and automatic instruments the entire story of the engine's performance is recorded.

Each completed engine scheduled for delivery to the Navy goes through two acceptance tests—first by itself and later as part of a generator unit. These are preceded by a "green run" test, following which it is torn down and all parts examined.

During 1952, Boeing was awarded an Air Force contract "for an engineering study of the application of nuclear power plants to aircraft," according to the official Defense Department announcement.

A special group of scientists and engineers is engaged in this project. The contract, under which Boeing is working in close cooperation with Pratt and Whitney Aircraft of East Hartford, Conn., was awarded in 1951, but not announced until this year. No additional details were revealed concerning the scope of the program or as to the power plants or airplanes under study.

Important during the year was the extent to which small businesses took part in the B-47 production program. A study showed that nearly three-quarters of the subcontractors and suppliers of parts and materials for the Stratojet program at Boeing's Wichita Division are small business firms. Altogether, 1,412 firms in 28 states participate directly with Boeing as suppliers of materials included in the finished B-47's.

On an over-all basis, an estimated 60 percent of total Air Force procurement funds assigned Boeing for the B-47 program is diverted to suppliers, large and small, who build assemblies to Boeing specifications and to suppliers of finished parts and raw materials.

TWO MEN IN A BOAT

In preparing for his trans-Atlantic venture in the Columbia with backer Levine, Clarence Chamberlin developed a proper respect for the weight factor. For instance, he decided not to include the oars for the rubber life raft. Reason for the press: "Too far to row back."

—Record Flights, Clarence D. Chamberlin, Dorrance & Co., Inc.

Cessna Aircraft Co.

The Cessna Aircraft Company has received in excess of $100-million in military contracts since the outbreak of hostilities in Korea, consisting primarily of component parts on the Boeing B-47 and Lockheed F-94.

A long range Department of Navy research project is now in progress for design studies, experimental construction and flight tests on the Cessna Helicopter.

The Cessna 170B was introduced in January, 1952. Public acceptance of this particular airplane has been partially responsible for Cessna's sales record which has placed them in the number one sales position throughout the world for each month in 1952.

Cessna has continued during the past year as a builder of military planes and has also engaged in subcontract work for bomber and fighter planes.

Cessna is not exclusively a war industry company but is primarily interested in the constant planning and development of the light commercial aircraft and in enlargement of its diversified production program. One of the most recent and definite steps in production and tooling in use at the Cessna Aircraft Company is called Facility Tooling Template.

While the future of Cessna, as with any manufacturing company, is uncertain as to specific details, the company's dedication is to build the best possible private airplane for the public's use and does not deter from Cessna's ability to fulfill its military contracts as needed.

The development of a twin engine Cessna, the long range research program now in operation with the Department of the Navy and constant and individual improvements are as much a part of Cessna's dedication as is its standard commercial production.

At year end, Cessna announced its new model 180. Powerplant is a Continental 470-A, 225 hp, giving a cruising speed of over 150 mph and a maximum speed near 165 mph. The model comes in both conventional and seaplane versions, and will sell for $12,995.00.

Chance Vought Aircraft Division
United Aircraft Corporation

Chance Vought Aircraft Division of United Aircraft Corporation celebrated its 35th anniversary as one of the nation's oldest airframe manufacturers in June, 1952, with a concentrated production program for its twin-jet Navy fighter airplane, the F7U-3 Cutlass.

The Cutlass, a larger, better equipped and harder-hitting version of the original F7U-1, is designed to give the U. S. Fleet a fast shipboard fighter with high altitude performance, greater rate of climb and greater range.

As the division expanded from 9,500 to more than 10,500 employees during 1952, production of the F4U Corsair series was scheduled to come to an end with the F4U-7 delivered to the French Navy under the Mutual Defense Assistance Pact. Earlier, the division completed a Navy contract for the AU-1 Corsair, a modified version of the World War II fighter and fighter-bomber, for use by the U. S. Marine Corps for close air support of ground troops in Korea.

Chance Vought's guided missile program is clothed in a tight security cover. The Navy has permitted the statement, however, that Chance Vought's missiles are flying and that the program is making good progress.

During 1952 the F7U-3 Cutlass completed its first carrier suitability tests aboard the USS Midway. The production airplane used for these tests first was flown July 5 in Dallas, then flown to the Navy Air Test Center at Patuxent River, Maryland, by a Chance Vought test pilot. Pre-carrier tests were completed in five weeks, described as an exceptionally short period for carrier evaluation work.

Although the F7U-3 Cutlass is a larger airplane than its predecessor, the F7U-1, there has been relatively little modification of the configuration. It incorporates larger afterburning engines for added combat power and has a service ceiling of more than 45,000 feet. It is designed for use both as a land-based and carrier -based fighter.

Longitudinal and lateral control is furnished by ailavators, combined ailerons and elevators, eliminating the standard aircraft horizontal tail surface. The airplane also is equipped with hydraulically-operated wing leading edge slats.

Performance, armament and range of the F7U-3 are classified.

Since the outbreak of the Korean War June 25, 1950, Chance Vought's Corsairs have carried a large part of the Navy's air strikes against North Korean targets. In action in the Far East were seven versions of the Corsair—The F4U-4, F4U-4B, F4U-5, F4U-5P, F4U-5N, F4U-5NL and the AU-1.

Performance data and armament are restricted on the F4U-5, the AU-1 and the F4U-7. The AU-1 and F4U-7, however, are little different in outward appearance from the F4U-5. Powerplants have been changed, with the AU-1 using a single stage Pratt & Whitney R-2800-83WA engine and the F4U-7 a Pratt & Whitney R-2800-18W engine. Both airplanes, as well as the F4U-5 series, are equipped with Hamilton Standard propellers.

A facilities expansion program, adding testing and production capacity, was underway at year's end. Other expansion plans were in the exploratory stage.

Chase Aircraft Co.

During the year 1952, Chase was involved primarily in tooling and planning for production of the C-123B aircraft in quantity for the U. S. Air Force.

The Kaiser-Frazer Corporation at Willow Run, Michigan, was engaged by Chase as a subcontractor to do final assembly work on these aircraft.

The first several C-123B's were produced in the Chase West Trenton facility, along with necessary priming parts to assist the Kaiser-Frazer Corporation in carrying out their subcontract with Chase.

By year's end, the first of the C-123B's had been completed by Chase in West Trenton and was undergoing acceptance tests by the U. S. Air Force.

In addition, Chase was heavily engaged in a classified research and development program involving several separate classified projects for the Air Force.

Also during 1952, Chase produced and delivered to the U. S. Air Force a substantial quantity of spare parts for the company's C-122C aircraft, which had previously been produced by Chase and are currently in service for the U. S. Air Force.

In May, 1952, Mr. Clay P. Bedford was elected President of Chase succeeding Edgar F. Kaiser, who remained as a Director. Michael Stroukoff, who founded Chase and is principal owner, remained as Vice President, Chief Engineer.

Consolidated Vultee Aircraft Corp.

Already established in the realm of the commercial transport, the large bomber, the navigator-bombardier trainer, and the flying boat, Consolidated Vultee Aircraft Corporation this past year emerged as a potential prime producer of supersonic, delta-wing interceptor aircraft and provided hints for the future in its revolutionary seaplane and guided missile programs. The public generally was aware of the Convair-Liner commercial transport, the Air Force B-36 bomber and T-29 trainer, and, to a lesser, degree, the shape of things to come in Convair's interceptor, seaplane, and guided missile activities.

Noteworthy among 1952 activities at Convair were: Launching of the world's first delta-wing seaplane, the Navy's jet-powered XF2Y-1 fighter, designed for supersonic speeds; award of an Air Force production contract for the world's first delta-wing, supersonic interceptor, the F-102; mating of the world's first production turboprop seaplane transport, the Navy R3Y-1; first flight of the Air Force eight-jet, sweptwing bomber, the YB-60; announcement of the Convair-Convertible; award of production contract for new Air Force evacuation transport, the C-131; dedication and initial use of new $3,000,000 Engineering Development Center; the nearing completion of Navy facility in which Convair will produce guided missiles; installation of machine tools valued at $7.5 million.

The revolutionary XF2Y-1 delta wing Navy seaplane fighter, designed for speeds faster than sound and launched from San Diego Bay late in the year, was developed from the Skate blended wing-and-hull fighter by the Convair Hydrodynamic Research Laboratory at San Diego. The original Skate, built only in dynamically-similar, small-scale, model form, was intended to operate at transonic speeds. Apart from supersonic performance, a major difference between the XF2Y-1 and the early Skate proposal is the incorporation of the triangle-shaped delta wing to the XF2Y-1 seaplane. Convair designed, built, and flight-proved the world's first delta-wing airplane, the XF-92A research interceptor, and has now extended its "delta" leadership by adapting this shape of the future to water-based aircraft.

In mid-October, it was officially announced that Convair had received an Air Force production order to build—at San Diego—the world's first supersonic, delta-wing interceptor, designated the F-102. The triangle-shaped aircraft is designed for very high speeds in the stratosphere and incorporates significant improvements in electronics and armament. Details of its performance and production rate are classified, but the F-102 was described as one of the most advanced interceptors being produced.

The announcement was the first official disclosure that the F-102 has the delta-wing configuration, since the Air Force earlier had referred to it only as a new high performance interceptor. Convair-San Diego built the world's first delta wing airplane, the XF-92A Air Force research interceptor, which has flown extensively since 1948 at Edwards Air Force Base, in California's Mojave Desert.

Following Convair's successful experience, other leading American aircraft manufacturers, along with several in Great Britain, Sweden, and Soviet Russia, have been working on delta-wing types. "Delta" is from the fourth letter of the old Greek alphabet, an equilateral triangle, and is applied generally to planes of triangular shape. The true delta airplane has no horizontal tail, but is equipped with a vertical fin-rudder. It has "elevons" on the wing trailing edge instead of aileron and elevator controls.

Production of the Navy's first high-performance R3Y-1 turboprop flying boat moved into the final assembly phase at San Diego. Construction of R3Y-1 airframes was expedited through use of unique twin bucks, which permitted simultaneous side-by-side assembly of hull center sections, nose sections, and other major components. The first R3Y-1 will be used for static tests to prove out the ruggedness of construction. The second production seaplane will be the first to fly, with maiden flight scheduled for March, 1953.

The 80-ton R3Y-1's, largest flying boats yet built by Convair, are the first in a series of new-type, water-based aircraft developed by the company for the Navy's Bureau of Aeronautics. They are the cargo-transport version of the experimental Convair XP5Y-1 patrol seaplane—currently undergoing flight tests—which holds the world's air endurance record of 8 hours 6 minutes for turbine-powered aircraft. Four Allison T40 gas turbine engines, developing 5500-horsepower each and driving contra-rotating Aeroproducts propellers, provide the big R3Y-1 with exceptional performance and maneuverability.

Rated the fastest large American seaplane in the 40-year history of water-based aircraft, the pressurized R3Y-1 has design top speed of more than 350 miles per hour, takeoff time of approximately 30 seconds in a calm, and rate of climb exceeding that of many World War II propeller-driven fighters. Another R3Y feature is a long, slender hull with length-to-beam ratio of one to ten, almost double that of stubby conventional flying boats. The new design provides greatly improved performance on the water and in the air, and also absorbs greater structural loads than old-style hulls, according to Convair hydrodynamic engineers.

Early in 1952, Convair-Fort Worth completed the first of two experimental aircraft designated YB-60. The eight-jet, sweptwing bomber, developed from the basic B-36 design, was first flown April 18, 1952. Flight tests are continuing on the airplane, powered by Pratt & Whitney J-57 turbojet engines, most powerful of their type now in use. The second YB-60, which will have full tactical equipment, is in final stages of construction.

Wingspan of the YB-60 is 206 feet; its length, 171 feet; its height, 50 feet. The plane is nine feet longer and three feet three inches higher than the Convair B-36. The B-36 wingspan is 230 feet; the shorter wingspan of the YB-60 is occasioned by the sweep of its wings which reduces the span from tip to tip. The YB-60 was built in record time. A contract for two sweptwing jet bombers was awarded Convair by the Air Force on March 15, 1951. Eight months later, the first of the two airplanes was ready for engines.

Meanwhile, development work continued at Fort Worth on the airframe for the world's first atomic-powered aircraft. General Electric Company holds the contract for developing the nuclear propulsion system.

Emphasizing its popularity as evidenced by a sales record of $100-million for Convair-Liner 340 commercial transports during the 18 months prior to September, 1952, was the announcement of a new version of Model 340, designated the Convertible. The Convertible offers a 27 percent increase in seating capacity—from 44 up to 56 passengers—through provisions for quick rearrangement of the cabin interior. All seats are mounted on tracks which run the length of the cabin, making it possible o adjust seat spacing in one-inch increments.

Except that an additional window has been added on both sides, forward of the propeller plane, the Convertible's design is structurally the same as the basic Model 340. Interior of the Convertible is arranged so that intervals between the rows of seats may be easily changed. Nonstructural bulkheads at the front of the cabin have been made movable so that space now used for luggage and cargo can be converted to passenger seats in a very few minutes.

This expansion-contraction feature—allowing for change of the Model 340's basic-seating arrangement of 44, to 46, 48, 50, 52, 54, or 56, depending upon day-to-day needs of the airline operator—makes it possible to accommodate 56 passengers without resorting to five-abreast seating (three seats on one side of the aisle, two on the other). It is expected that the Convertibles will be used either on standard-fare or low-fare flights, as individual airline requirements dictate.

Production on orders for 175 Convair-Liner 340 transports is steadily increasing at Convair-San Diego. At the end of 1952, at least 22 airlines and private companies had ordered the pressurized 340's, bringing total operators of Convair-Liner 240's and 340's to 35. More than 30 340's were delivered during 1952.

United Air Lines ordered 50, largest number purchased by one airline. Other 340 purchasers include Braniff International Airways, Inc., Chicago & Southern Air Lines, Continental Air Lines, Delta Air Lines, Hawaiian Airlines, National Airlines, Northeast Airlines, Pioneer Air Lines, Aero O/Y (Finland), Aeronaves de Mexico, Avensa (Venezuela), Cia. Mexicana de Aviacion, Garuda Indonesian Airways, KLM Royal Dutch Airlines, Philippine Airlines, Servicos Aereos Cruzeiro Do Sul (Brazil), Jugoslovenski Aerotransport, Arabian-American Oil Company, The Texas Company, and Pratt & Whitney Division of United Aircraft. Delivery of the first Model 340 to United was observed publicly on May 24.

The Model 340 is designed so that turboprop engines can be installed with a minimum of modification and expense as soon as gas turbine engines are available for commercial operation.

Billions of passenger miles logged by airlines on all six continents, an unequaled safety record, and dependable and economic operation have established the Convair-Liner as the world's new standard twin-engine transport. In 1953, more than 300 Model 240's and 340's will be operating throughout the world.

In fact, the first Convair-Liner 240 to log 10,000 hours passed that mark in May, 1952, in the service of Trans-Australia Airlines. TAA, which accepted delivery of its first Model 240 on Dec. 30, 1948, has averaged more than 9,000 hours' operation with its fleet of 240's, highest utilization reported by airlines flying the transport.

Model 240's had compiled a record of 3,650,000,000 passenger miles without a fatality prior to the loss of an American Airlines plane at Elizabeth, N. J., on Jan. 22, 1952. First flight of a Model 240 was made in San

Hydro-ski application is featured on Convair XF2Y-1 jet seaplane

Diego on March 16, 1947. Until the Elizabeth accident, Convair-Liners had logged more than 840,000 hours of fatality-free service, considered by far the best safety record ever established by a single-type aircraft in the history of air transportation.

Vital role played by the T-29 "Flying Classroom" in Air Force plans was emphasized during the year with three announcements concerning the twin-engine airplane.

The first was that the company had delivered its first T-29B, the pressurized version of the T-29A navigator-bombardier trainer and one equipped with new electronic equipment. Pressurization provides the 14 students and instructors with conditions simulating high-altitude military missions. Gross weight of the new model is 43,575 pounds, compared with 40,500 pounds for earlier model T-29's. Major exterior difference is the installation of three astrodomes and one periscopic sextant atop the fuselage instead of four astrodomes on early T-29's.

Production of T-29C's (similar to T-29B's except for a different engine model) is scheduled to begin in 1953.

Then in April the company announced that the Air Force had ordered an undisclosed number of a new pressurized twin-engine air evacuation transport designated C-131 "Flying Samaritan" and based on the T-29B design. The new transport, designed especially for air evacuation operations, will be equipped with 20 rearward-facing seats and 16 litters, with an alternate arrangement for installation of 20 additional seats in place of litters. Provision also will be made for carrying iron lungs and oxygen equipment for all passengers. The first transport is scheduled for delivery in 1953.

In June, it was announced that the Air Force had ordered a fleet of new T-29D bombardier training aircraft from Convair, based on the T-29B design, with plans to carry many of the same instruments the bombardier will find on operational bombers. The latest type "K" bombsight will be installed, in addition to other classified electronic equipment. In lieu of practice bombs, camera bomb-scoring units will tally the trainees hits and misses. Stations for seven students and instructors will be provided.

B-36 production at Fort Worth extended into the "H" model during the year. Major improvement in the "H" over earlier models is a two-station flight engineer's panel. A second flight engineer assists the first flight engineer during takeoffs and landings and periodically during long-range missions. Improved night lighting of all four stations in the flight deck, and improved radar and electronic equipment are other features of the "H" model. Like the B-36F, it is powered by six Pratt & Whitney 3,800-horsepower piston engines and four General Electric J-47 turbojet engines rated at 5,200 pounds thrust. Ford Motor Company's aviation division at Chicago started delivering piston engines to the company during the summer.

Under Secretary of the Air Force Roswell L. Gilpatric disclosed in July that B-36 production would continue until late 1954. He stressed, however, that as B-36 production tapers off, other essential work will be scheduled into the plant, assuring a continuing work load of substantial proportions.

An extensive B-36 modernization program was launched at Fort Worth late in the year. The Air Force awarded the company a $3,000,000 facilities contract for the program, involving paved working areas, modernization stations, and service buildings. This work brings Air Force B-36's now in operational service with the Strategic Air Command up to date with airplanes fresh off the assembly line. They are equipped with the latest design improvements and refinements, among those being the addition of crew-comfort features. This program is a continuation of that which originated at San Diego earlier in the year. By December, 1952, all B-36's scheduled for San Diego modernization were to be back in service with SAC. Also at San Diego, the last operational B-36B modernized by the addition of four turbojet engines was returned to SAC early in the year as the plant swung into the B-36 modernization program completed in December and taken over by Fort Worth.

Fort Worth fell heir to a major repair job after extensive Labor Day storm damage to Air Force B-36's parked at Carswell Air Force Base. The Fort Worth plant immediately set up a "fixit" program and was returning the B-36's to service ahead of the schedule assigned to it. The "fixit" work, however, did not interfere with B-36 production.

Production schedules on B-36's were maintained despite nagging shortages. A commendation for this achievement came from Lt. Gen. E. W. Rawlings, commanding general of the Air Materiel Command, who said, "Your performance in the face of continual troublesome shortages is considered excellent."

Part of the credit for keeping abreast of schedules could be attributed to Convair's broad B-36 subcontracting base, comprising 1,600 subcon-

Test model Convair Skate, proposed transonic Navy fighter

tractors and suppliers in 36 states. At the same time, Convair-San Diego continued building B-36 components for shipment to Fort Worth.

Employment at Fort Worth on Oct. 1, 1952, totaled 25,393, of whom 3,764, or 12½ percent, were women. San Diego Division employment on this date totaled 21,437, of whom 6,601, or nearly 31 percent, were women. At Daingerfield, total employment was 291, of whom 28 were women, while employment at the San Diego and Pomona facilities of the Guided Missile Division was 2,751, of whom 604, or 22 percent, were women.

Convair's Guided Missile Division at Pomona, Calif., is engaged in a comprehensive program of research, development, and production of guided missiles for the Navy Bureau of Ordnance.

The above program includes weapons systems analysis and the preliminary design of new and improved guided missile systems.

Doman Helicopters, Inc.

Doman Helicopters Incorporated revealed in 1952 that it is developing a helicopter which will soon be available for urban transportation of passengers, mail and cargo. In announcing this new twin-engine commercial helicopter, company officials cited the fact that major expansion of inter-airport and airport-to-city transportation by helicopter has awaited an aircraft offering such twin-engine reliability; has awaited an indefatigable helicopter such as this. They stated that offering a twin-engine helicopter of more than one ton useful load capacity will make available the one most essential ingredient for the expansion of commercial helicopter operations.

The twin-engine helicopter is a conversion of the Doman LZ-5 commercial ship which is also being manufactured for the U. S. Government as the YH-31 medical evacuation helicopter. The original LZ-5 which is powered by one Lycoming 400 hp reciprocating engine, is capable of efficiently carrying 2,140 pounds of useful load up to 98 mph, and has a hovering altitude of up to 8,000 feet. Both the YH-31 and LZ-5 feature the Doman four-bladed lifting rotor which is the world's only successful hingeless rotor. This rotor is built without hinges in order to secure long, safe operating life and to eliminate vibration in the fuselage and controls. The rotor mechanisms in the Doman helicopter are housed in a sealed compartment and are lubricated under pressure by oil which is kept at an even flowing temperature under the most severe climatic conditions.

The new twin-engine version will be obtainable either by purchase of a new helicopter in that configuration or by a factory conversion of existing ships of the LZ-5 type by installing dual 200 hp gas turbine engines which power the main rotor through a mixing gear box. These turbines require no cooling system or clutch and are extremely light in weight, therefore greatly reducing the empty weight of the helicopter. They also have a much more variable operating shaft speed than comparable reciprocating engines. These factors give the aircraft a large increase of both useful load and maximum speed in addition to the underlying twin-engine reliability factor.

Delivery of the twin-engine ships will be made following the approval by the Civil Aeronautics Administration of the turbines. At present, the Doman company is encouraging commercial operators to use the single-engine machine and set up service with the idea that such ships may be converted or a mixed fleet may be developed.

Douglas Aircraft Company

Spurred by production contracts for ten different models of commercial and military airplanes, plus two guided missiles, manufacturing activity at Douglas Aircraft company soared during 1952 to its highest level since the peak of World War II.

To meet increased production requirements, employment and plant facilities were expanded in all four of the company's divisions at Santa Monica, Long Beach and El Segundo, California, and Tulsa, Oklahoma.

Successful first flights of two important new aircraft of advanced design also were made late in the year. Of historic interest was the delivery of the 35,000th airplane to be built by the company, a DC-6B commercial transport completed in May, 1952.

This four-engined airliner rolled off final assembly line at Santa Monica, location of the largest of the four Douglas divisions and of the general offices.

Since 1946 the principal production effort at Santa Monica has been directed toward the manufacture of transports of the DC-6 type. During 1952, the plant delivered 58 of the newest configurations, the DC-6A Liftmaster cargo model and the DC-6B luxury passenger airliner, to commercial operators. An undisclosed number of Liftmasters also was delivered to the U. S. Navy and Air Force under the designations of R6D-1 and C-118A, respectively.

A total of 364 commercial airliners of the DC-6 type have been ordered by 11 domestic and 12 foreign airline operators. Douglas also had orders for 58 of its new DC-7 four-engined transports, designed as a successor to the DC-6 series.

Engineering of the DC-7 was completed by the Santa Monica Division during 1952 and, as the year drew toward a close, first steps had been taken toward production of the airplane.

The DC-7 has a top speed in excess of 400 miles per hour and an average cruising speed of 360 miles per hour. Power is provided by four Wright R-3350 turbo-compound engines which develop a total of 13,000 horsepower for take-off. The 3,250 horsepower of each engine represents an increase of approximately 30 percent over the most advanced DC-6B aircraft.

This new airplane is more than eight feet longer than the DC-6 and will seat from 60 to 95 passengers in its various interior arrangements. Span of the DC-7 is 117 feet, six inches, identical to that of the DC-6 series. Length is 108 feet, 11 inches and overall height is 28 feet, seven inches.

There are two basic versions of the DC-7, one with a maximum take-off weight of 116,800 pounds and one weighing 122,200 pounds. In the former, the transport carries 4,512 gallons of fuel. The long-range model carries 5,512 gallons of gasoline and has an absolute range of more than 4,800 miles.

In addition to increased speed, power, size and range, the DC-7 has a number of improvements contributing to safety and passenger comfort.

Wing and tail surfaces are protected by a thermal anti-icing system designed for all-weather, high-speed operation. Douglas engineers also designed a new carburetor airscoop which prevents ice-inducing moisture particles from entering the fuel injection system of the engines.

Delivery of DC-7's is scheduled to begin late in 1953, concurrent with continued production of DC-6B transports.

The Santa Monica Division also continued deliveries of the R4D-8 twin-engine transports to the U. S. Navy. These are reconstructed from existing aircraft of the R4D (DC-3) type to produce a utility transport which has higher speed, greater payload and nearly double the range of the original airplanes.

Development and production of guided missiles, now of sizable proportions, also was centered at the Santa Monica plant. On this security-bound subject the company was permitted only to disclose that it had development contracts, in conjunction with leading electronics research organizations, for every basic type of missile: ground-to-air, ground-to-ground, air-to-air and air-to-ground. In production are a ground-to-air missile developed for Army Ordnance and an air-to-air missile designed for the Navy Bureau of Aeronautics.

Also deeply cloaked in security was the Douglas X-3, advanced high-speed research airplane which made its maiden flight at Edw ds Air Force Base on October 20, 1952. Bill Bridgeman, Douglas test pilot who has flown higher and faster than any other man, was at the controls for the successful test hop.

Undertaken by the Air Research and Development Command with the cooperation of the National Advisory Committee for Aeronautics and the Navy, the X-3 project is directed toward the development of an aircraft design capable of unusually high speeds. More than 60 combinations of power plants and configurations were investigated by Santa Monica Division engineers before selecting the final aircraft design.

Production of C-124 Globemaster heavy duty transports entered its third year at the Long Beach Division. In global service of the Air Force, these aerial behemoths can carry virtually any military vehicle, general cargo, 200 fully-equipped troops, or 125 stretcher patients.

Globemasters were actively used to support operations of the Strategic Air Command by the Troop Carrier Command and the Military Air Transport Service.

As the year drew to a close, the Long Beach plant was shifting to production of an improved model, designated the C-124C. Substantial advancements over the earlier version include the change to Pratt & Whitney Wasp Major R4360-63 engines which provide 3,800 BHP at take-off as compared with 3,500 BHP in the -20W power plants currently in use on the C-124A. The new engines drive Curtiss three-bladed, 17-foot propellers which are reversible.

An important tactical improvement is the new single point fueling system which makes it possible to refuel the airplane to its full 11,000 gallon capacity through a single hose connection at ground level in a matter of minutes. A further change from six to 12 compartmented fuel tanks in the wings reduces vulnerability to shell fire.

Improved control characteristics at the stall also have been obtained by deflecting the inboard wing flaps to an increased angle, thus eliminating the outer wing flaps. The trend toward the use of flush antenna on U.S. A.F. aircraft is also evident on the C-124C.

Major engineering effort at Long Beach was directed toward development of design details for the new Air Force RB-66 reconnaissance bomber. This plant will build the twin-jet, swept-wing airplane for the Tactical Air Command. Based on the A3D, originally designed for the Navy by the El Segundo Division, the RB-66 carries a three-man crew and is rated in the 600-700 mile-per-hour class. The El Segundo plant has produced the piston-powered AD-Skyraider series of attack bombers since 1945.

Newest models of the Skyraider, not yet ready for delivery, permit quick shipboard conversion of the basic airframe into 12 separate specialized versions. This versatility is accomplished through the use of conversion kits supplied with each plane.

In addition to their primary role as bombers capable of strafing, high or low level bombing, the AD-5 and AD-6 versions are swiftly convertible to passenger transports, aerial ambulances, early warning radar planes, anti-submarie hunter-killer teams, or photographic planes.

Twin-jet Skyknights, whose radar equipment permits operations under all weather conditions by day or night, also continued to roll from the El Segundo production lines. Like the ADs, Skyknights were employed against Communist forces in Korea as land-based aircraft.

Three Navy airplanes built by the El Segundo plant were undergoing flight development testing during the final months of 1952. Two of the models already were in early stages of production—the turbo-propeller driven A2D Skyshark and the F4D Skyray. The latter is an extremely high speed jet-powered interceptor of modified delta-wing design.

Third of the new models was the powerful A3D attack bomber which made its successful maiden flight at the Air Force Flight Test Center on October 28th.

The A3D was guided on its maiden flight by veteran Douglas pilot George Jensen. It can be used as a high-altitude, high-speed attack plane, or at low level for mine laying. It can be adapted aboard its carrier for photo reconnaissance. Built to perform in the 600 to 700 mile per hour class, the A3D can fly at altitudes above 40,000 feet.

Internal bomb-bays of the swept-winged twin-jet can carry large type bombs, torpedoes or other munitions the Navy is expected to utilize in striking actions from carriers.

High-wing design of the Douglas-built craft accommodates underwing jet engine pods. Both the wing and the tail fold for compact handling and storage aboard carriers.

A pressurized cabin accommodates a crew of three—pilot, pilot-bombardier and gunner-navigator. A simple slide-type escape chute like that used on the Navy's F3D twin-jet fighter is incorporated into the new sky warrior by Douglas. An upper ditching hatch also is provided.

Speed brakes successfully introduced on the Navy's Korea-famed AD attack-bomber are again utilized on the A3D.

Expansion of facilities continued at the "youngest" Douglas division at Tulsa. One of these was to complete tooling and start production of Boeing-designed B-47 Stratojet bombers for the Air Force. The other project was modification of B-47's built elsewhere. First of many Stratojets under modification at Douglas Tulsa was accepted by the Air Force in August of 1952. The following month the Air Force revealed that production models of Tulsa-built B-47's were scheduled to roll out of final assembly early in 1953.

To accommodate the fast and heavy aircraft, improved 10,000-foot runways and parking ramps were under construction during the year. A new million-dollar electronics laboratory building was completed and occupied during July and August.

New buildings either were erected, leased or purchased by other Douglas divisions to keep pace with the growing production activity. Covered plant area increased during 1952 by 4,828,000 square feet to a total of 11,560,000 square feet.

The company's financial position, at the conclusion of the third quarter on August 31, was strong. Earnings for the first three quarters of 1952, after estimated income taxes, amounted to $6,757,347 or $5.6 per share of capital stock outstanding. This compared with a net of $5,249,513, equivalent to $4.37 per share, at the comparable period of the previous year.

Net sales of $342,722,873 for the nine month period represented an increase of $189,351,059 over the corresponding period of 1951.

Net worth increased during the third quarter from $83,997,050 to $85,499,877, an appreciation from $69.96 per share to $71.21 per share.

Directors declared a quarterly and extra dividend of 75 cents each on October 15, 1952, making total dividends for the year $3.75.

Military contracts accounted for 88 per cent of the company's backlog of $1,950,000,000 on October 1, 1952. This represents some four years of future production.

Employment in the four Douglas divisions rose during the calendar year from 46,000 to more than 60,000.

Fairchild Aircraft Div.
Fairchild Engine and Airplane Corp.

"Business as usual during alterations" was the slogan of the Fairchild Aircraft Division in 1952 as the company continued production of its C-119 Flying Boxcars during a $7-million expansion program at its Hagerstown, Maryland, plants.

Current construction adds 153,000 square feet of production space to the airframe manufacturing facilities, giving it a total of more than 1,000,000 square feet of floor area.

Division employment rose steadily during the year, passing the 9,000 mark in September and topping the Fairchild World War II employee peak.

Fairchild continued its program of technical assistance to the Kaiser-Frazer Corp. which is building C-119's under Air Force contract. Skilled technical personnel were sent to Kaiser-Frazer's Willow Run plant to lend Fairchild production, tooling, and engineering methods to Flying Boxcar production there, and Kaiser-Frazer personnel visited the Hagerstown plants to observe Fairchild manufacturing techniques.

The company's battle-proved C-119 continued to be its major production item, with quantities being delivered to the Air Force and, under designation as the R-4Q, to the Marine Corps. Late in August, the Royal Canadian Air Force accepted the first consignment of Flying Boxcars to be built for a foreign nation. The RCAF planes were assigned to the Canadian Air Transport Command and the Tactical Command.

During the latter part of 1952, minor modifications were made in production versions of the Flying Boxcar to bring it up to the C-119F design. Changes included addition of ventral fins as standard features on Air Force and Marine Corps ships and installation of a crew compartment bail-out chute.

The Fairchild Aircraft Division's radically redesigned prototype, the C-119H, made its initial test flight in May and underwent an exhaustive company and Air Force testing program in succeeding months. Dubbed the "Flying Van," it differs in configuration from the C-119 production model even more than did the C-119 from its predecessor, the C-82.

The C-119H is essentially the C-119 fuselage with a long, narrow wing, longer booms, and enlarged empennage. The 148-foot wing has a constant center-section chord without dihedral. Most obvious change in configuration is the application of external fuel cells, all fuel being carried in two fixed tanks mounted on struts beneath the wings.

This "H" prototype is powered by two Wright R-3350-30W compound engines developing 3,500 horsepower each. Its wing area has been increased approximately 40 percent. A rough-field landing gear makes it capable of operating from advanced bases and unimproved runways and with maximum cargo loads.

Fairchild continued its experiments with the detachable fuselage concept by developing and testing a readily removable airborne cargo pod that can be towed along highways and secondary roads. The pod is equipped with dual truck-type wheels and closely resembles a heavy-duty tractor trailer when its folding doors are locked in ground position. These cargo doors open out in a modified "V" shape fore and aft to streamline the pack for flight. With this new pod, heavy cargo loads may be flown into an airfield and immediately towed away without off-loading onto trucks.

Other adaptations of the pod idea, including a pallet-type cargo pack with removable side panels for quick loading and unloading, also were built at Fairchild during the year. Further experimental activities included design of a "beavertail" door system which may become a standard feature on the C-119. This cargo-door assembly contains integral ramps which may be opened and closed in flight and do not require removal for cargo drops as is now the case with the C-119's conventional clam-shell doors. The bottom section of the "Beavertail" may be retracted into the upper section while in flight to provide a completely unobstructed opening for airdropping heavy equipment, supplies, or paratroops. On the ground, the bottom section forms a ramp to meet virtually any special loading situation.

A rough-field landing gear developed by Fairchild will further increase the utility of its medium transports by permitting them to land on unimproved as well as normal runways. The system features lever-type suspension and extremely long oleo strut travel and is a readily convertible tandem gear, with provisions for installation of extra sets of wheels.

Paving the way toward faster and easier engine servicing, Fairchild this year designed a radical three-piece engine cowl. The two lower sections are hinged down the center, and the top section is hinged to fold back over the nacelle, permitting easy accessibility. Vibration is eliminated because the cowling is not supported by the power plant. The engine and its accessories may be serviced or adjusted with all cowling in place while the engine is operating. All of the cowl sections may be opened independently or together, completely exposing the power plant from propeller to firewall. Since the cowl remains attached to the airplane at all times, possibility of losing or damaging cowl sections is eliminated

Company developments included the signing of an agreement with the Fokker Corporation of the Netherlands under which Fairchild is licensed to build the two-place Fokker S-14 jet trainer. Announcement was made in July of the initial agreement for a period of one year during which Fairchild will obtain necessary clearances and complete negotiations of license agreements. Under the agreement, Fairchild will handle the sales organization of all Fokker planes in the United States and has an option on all manufacturing rights in this country for the Dutch firm's models. Included are the S-11 and S-12 primary trainers, the S-13 crew trainer, the S-14 jet trainer, and the F-27 feeder transport.

Production at Fairchild Engine Division in 1952 was marked by completion of a move into additional manufacturing space at Valley Stream, N. Y., adding over 25 percent more floor area to the main plant at Farmingdale, N. Y.. The additional facilities are being devoted almost entirely to the Division's mass producing major components parts for G.E.'s J-47. During the year the engine division was manufacturing the J-44 turbojet identified as the first true concept of expendable turbojet power plant. Completely Fairchild designed, developed, and manufactured, the J-44 weighs only 300 pounds and delivers a thrust of approximately 1000 pounds. One of the most compact engines in its power class, this product is now being produced exclusively for the Armed Forces.

The division continued in quantity production of an auxiliary powerplant, the V-32 D-2 which is providing electrical power for virtually every large military aircraft. During the year the Division continued to place strong emphasis on the design and development of many unconventional power plants, some of them for unusual applications for all branches of the Armed Forces.

During the year the engine division was awarded an approved quality control rating from the Air Force sharing the distinction with only one other aircraft engine plant in the eastern procurement District.

The Stratos Division of the Fairchild Engine and Airplane Corp., during 1952, put into operation an ultra modern 140,000 square foot plant at Bay Shore, Long Island. With greatly enlarged test and production facilities, the division began production of a number of new products in addition to the cabin superchargers and air cycle refrigeration equipment which it has been supplying for commercial air liners and military aircraft. Among the new products introduced were a series of auxiliary power turbines. Designed for operation by air bled from the compressor of jet engines, they are used for driving such accessories as alternators and generators, hydraulic pumps, fuel pumps, inflight refueling pumps, mechanical actuators, starters and hydraulic pumps. Units ranging in size from 2 hp turbine for operation of a generator to provide emergency electrical power in fighters to equipment developing as much as 100 horsepower were designed.

To eliminate the problem of cockpit fogging which occurs in jet aircraft operating under humid conditions, Stratos developed an air moisture separator.

One model, refined from a basic design evolved by Boeing Aircraft Company, was placed in production. It is used in B-47 type aircraft. In addition, smaller units for fighter and attack aircraft were carried through final development stages and prepared for production.

In the aircraft pressurization and refrigeration equipment field, Stratos continued to expand its line of cabin superchargers for reciprocating engine powered transports and trainers and put into production several new models of its air cycle refrigeration packages. Among the models were equipment for both pressurizing and cooling the new Beech T-36A Trainer Transport, refrigeration units for the F-86F and the French fighter "Mystere."

The Fairchild guided missiles division during 1952 placed in operation this country's first privately owned plant built specifically for missile development and production. The plant, located at Wyandanch, Long Island, N. Y., was completed early in the year. While specific projects cannot be discussed, the division during the year delivered several models of its "Lark" missile to all three branches of the armed services. In addition, progress was made on several other missile programs, all covered by security classification.

Besides its work directly in the missile field, the Fairchild Guided Missiles Division announced orders for an undisclosed number of radar simulators. The simulators are designed for training the radar operators of a Navy night fighter. Simulating the airborne equipments of the night fighter, the equipment is designed to permit the presentation of the many and varied problems the operator might encounter on an actual combat flight mission.

Grumman Aircraft Engineering Corp.

Manufacturing for the Armed Services continued to monopolize production of Grumman Aircraft throughout 1952. The rate of delivery was increased on each of three types of airplanes but the Panther as a production model was phased out during the year and the Cougar was phased in.

The Cougar is a sleek, swept-wing successor to the battle-proved Grumman Panther, first jet used in combat by the U. S. Navy. During the year, this plane moved from production lines into active operation with the fleet. Much faster than the "over 600 mph" Panther, the Cougar has the same low landing and take-off speed. This difficult performance operation is ideal for carrier and front line operations by Navy and Marine Corps pilots.

Although constantly being improved in detail, with occasional major design change, the Grumman Albatross and Guardian continue to round out the "Big Three" production models. The Albatross, a twin-engine utility amphibian, is used by the U. S. Air Force, U. S. Navy and U. S.

Coast Guard. (Most Albatrosses are in operation by the Air-Sea Rescue Service of the U.S.A.F.) The Guardian, single-engine propell plane, is used by the Navy in anti-submarine warfare.

In general, the company's output of all production models remained close to schedule throughout the year—despite acute shortages which caused delays in receipt of motors and equipment.

The company's present facilities are inadequate to meet the production and experimental schedules, as now projected for 1953 and 1954, in that there exists a lack of sufficient final assembly space, and suitable capacity of the flying field. Since no expansion is possible at the organization's present location at Bethpage, construction of its new Peconic River facility at Calverton, Long Island, has recently been started. The completion of this final assembly plant will take a tremendous load off the Bethpage facilities.

Where possible, the severe overloads on the company's plants and facilities have been relieved by sub-contracting. During 1952, approximately 50% of the year's volume of work continued to be obtained from outside sources. Biggest sub-contracting venture of the year was the inauguration of a "cross-country assembly line" with the Chrysler Corporation in Evansville, Indiana. Massive Albatross hull sections are constructed in Evansville and shipped to Grumman for final assembly by specially-built trailers adapted from regulation auto trailers.

Grumman's guided missile project was continued through 1952, and satisfactory progress was made. Details of this project are classified and unavailable for release.

Manufacture of aluminum truck bodies by the company's wholly owned subsidiary, Aerobilt Bodies, Inc., at Athens, New York, continued in 1952 and with restriction due to material shortages, production of the company line of metal boats and canoes was considerably curtailed during the year.

Hiller Helicopters

Hiller Helicopters' was granted a production certificate by the Civil Aeronautics Authority in January, 1952. In June, the CAA appointed two Designated Manufacturing Inspection Representatives, which further extended the privileges granted by this production certificate; and in August, two designated engineering representatives were appointed, one a flight analyist, the other a structural engineer.

The Engineering Division was enlarged and organizationally refined under the direction of Chief Engineer James B. Edwards, who came to Hiller from Douglas in January. Other helicopter leaders were added to rotary wing engineers already with Hiller; and, as Hiller Helicopters continued its advance into the new field of jet power, jet experts also joined Hiller's staff.

Employment was stabilized at approximately 700 persons with completion of the company's first expansion program. From a former building area of 36,000 sq. ft., the firm expanded to approximately 130,000 sq. ft.

In June, the Army, Navy, and Marines ordered a service test quantity of HJ-1 Hiller-Hornets, the company's two-place ram jet helicopter. Deliveries are scheduled for the middle of 1953.

With the first deliveries of HTE-2's for the Navy in April, Naval Reserve Helicopter Squadrons were activated throughout the United States, using these helicopters for training. The H-23B was continued in production for the Army. Both models use a 200-hp engine, and were designed specifically as military aircraft.

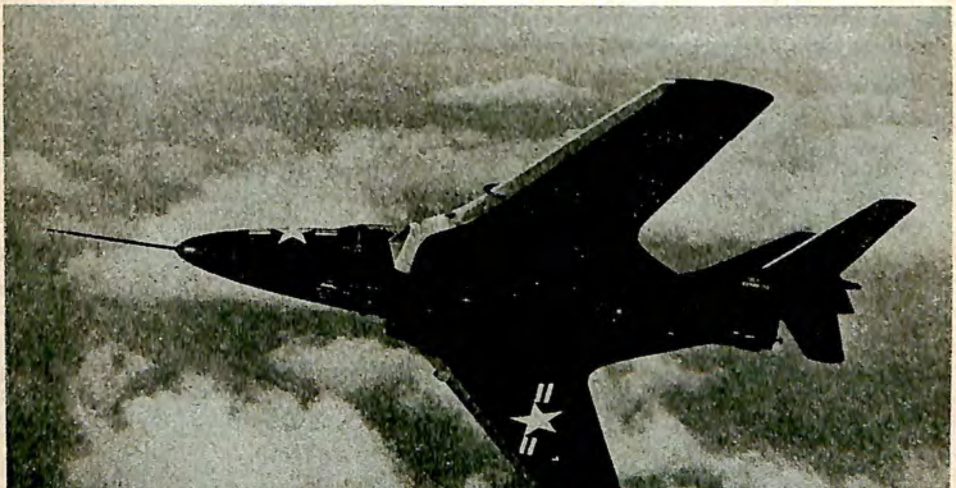
Commercial helicopter deliveries were resumed in May, after eighteen months of exclusively military production. The first UH-12B, commercial version of the H-23B, was also the first commercial helicopter sold in Japan.

Meanwhile, operations of the Hiller 360 continued throughout the world in such varied applications as: inauguration of the first helicopter airmail service in Newfoundland; evacuation work in the Indo-China conflict; geological survey work in Canada; agricultural work in Brazil; and reforestation in the Pacific Northwest.

Kaiser-Frazer Corp.

In December of 1950, K-F was awarded a prime contract by the Air Force to build the Fairchild C-119, and in the same month the auto company signed a technical assistance agreement with the Fairchild Engine and Airplane Corporation. The contracts provided that K-F tool for volume production of the airplanes, with Fairchild supplying engineering, design and technical aid, and all airframe components on the initial two ships and a decellerating ratio of components for a designated number of succeeding units.

Latest Grumman Navy fighter, the F9F-6 Cougar



K-F planners determined a total of 1,834,745 square feet of floor space—direct, indirect and allocated—were required for the C-119 job and the Chase C-123 job, which was to be phased in later.

Although K-F builds more than 60 percent of the C-119 and a slightly larger percentage of the Chase airframe, it purchases more than 11,000 items from suppliers in 35 states.

In addition to its role of prime contractor for production of C-119's, Kaiser-Frazer in 1951 also became a sub-contractor for production of the Chase C-123, designed and developed by the Chase Aircraft Company of West Trenton, N. J. Following a purchase agreement whereby K-F obtained an option to buy 49 percent of Chase, the auto firm was selected to produce the 123's in volume at Willow Run.

The Chase plane has approximately the same wing span and cargo cubic capacity of the Fairchild. Termed an "assault-transport," it has demonstrated unusual ability to land and take off under the most unfavorable conditions. It gets its name from its ability to provide close front-line support of men and materiel without resorting to costly and hazardous drops.

For its defense program, K-F created a wholly-owned subsidiary corporation—Kaiser Manufacturing Corp. KMC is prime contractor for production of the C-119 airframes at Willow Run; subcontractor under Chase for production of C-123's; subcontractor to Lockheed for production of fuselage components of P2V Navy planes at the K-F Oakland plant; subcontractor to Boeing for machined parts for B-52 bombers at the K-F Richmond, Cal., plant; licensee under Wright Aeronautical Corp., for manufacture of R-1300 series of aircraft engines at the Detroit and Dowagiac plants. In addition, it holds a contract for production of classified ordnance equipment at its Shadyside, Ohio, press plant, and a contract for production of electronics equipment at a plant in Nashua, N. H., acquired from the Sanders Electronics Company.

Kaman Aircraft Corp.

During 1952 the Kaman HTK-1 (company designated K-240) was certificated by the CAA. The company has no immediate plans for commercial production however.

HOK-1 helicopters are in the pre-production stage.

The company now occupies 134,000 square feet in 18 buildings on Bradley Field including a new Air National Guard hangar of 60,000 square feet.

A $2-million plant is being built in Bloomfield, Connecticut. This facility, which will be ready for occupancy about April 1953, consists of 104,000 square feet. It is located on an 85 acre tract of land. Employment as of October 1951 will be approximately 850 persons.

Kaman has contracts to develop a number of new products, which, although related to the helicopter field, are not in themselves helicopters. All information is classified at the present time for security reasons.

Kaman's present backlog is in excess of $25,000,000. Sales for first 6 months of 1952 were 145% of sales for like period in 1951.

During 1952 Kaman conducted tests under Navy contract on the world's first turbo-rotor helicopter; a K-225 powered by a Boeing gas-turbine.

The HTK-1 helicopters currently being produced are the only intermeshing and fully aerodynamic-servo-controlled aircraft in the military service today.

The turbo-rotor helicopter tests indicate that gas-turbines as helicopter power plants are the answer to many helicopter problems, and that gas-turbines may eventually replace piston engines entirely as helicopter power plants. Lighter weight, mechanical simplification, ease of maintenance, and operating characteristics that are ideally suited to helicopter operations make the gas turbine outstanding for use in helicopters.

Lockheed Aircraft Corp.

Two anniversaries were observed by the Lockheed Aircraft Corporation in 1952, the 40th year since the first Lockheed plane flew and the 20th year of the company's operation under its present management team.

In 1952, Lockheed rapidly approached the peak production goals required to meet continually rising military and commercial orders. After months of buildup, preparing materials and machines and manpower for the big job ahead, Lockheed swung into high gear around mid-year on all major models.

Orders for Super Constellation transports, both for military and civilian use, were larger than ever before. The first Super Constellations, 18.4-foot-longer versions of the famous Constellation in use since 1942, went into

Lockheed Super Constellations line up for finishing touches

full-scale service during 1952 on Eastern Air Lines and Trans World Airlines. The Super Constellation is designed to fly with piston engines—it is the first to use the 3250-hp compound engine—and be converted later to turboprops for speeds in excess of 400 mph. Orders from 13 airlines for more than 90 planes were backlogged into mid-1954.

Another new Lockheed airplane introduced in 1952 was the F-94C Starfire, designed to fly almost entirely automatically. This two-place interceptor, armed with 24 rockets in its nose in place of machine guns, carries more than 1200 pounds of electronics. Its electronic brains enable the Starfire to spot its target, lock on, approach, close, aim and fire automatically, while the radar operator and pilot act principally as monitors. The F-94C is another development in a long line of jet warplanes originated with the F-80 Shooting Star, one of the world's first mass-produced jets, one of the first jets to see combat, and one of the most valuable weapons in Korea.

Production of P2V Neptunes, manufactured without interruption since 1945, reached new high levels in 1952. Both the P2V-5 and -6 were in production at year-end. The -5 is described as an anti-submarine plane, heavily equipped with radar; the -6 can serve both in ASW operations and as a mine-layer.

Another derivative of the F-80 in the Lockheed family is the T-33, first developed in 1947 as the first two-place jet, used for training. It is used by nine foreign countries, partners in the Mutual Defense Assistance Pact, and is in production also in Canada under license to Canadair, Ltd.

A new Lockheed production still in the prototype-building stage is the C-130A. This four-engine medium transport, embodying a low-slung design with huge rear cargo doors and integral loading ramp to a floor only 45 inches off the ground, will be manufactured at Lockheed's Marietta, Ga., plant. Prototype work is under way at Burbank. Specifications and first flight schedules have not been released.

Early in 1952, Lockheed opened the doors of a $3,160,000 Engineering Building, which in addition to providing expanded quarters for more than half of the company's 3500 engineering personnel, contains a large array of electronic brain machines. The four-story structure has been described as the most complete engineering edifice of its kind.

Plant expansion during 1952 also included completion of a four-story addition to research laboratories, at a cost of about a half-million dollars, including machinery and equipment.

A foretaste of the future was contained in disclosure that the flight test and delivery station established by Lockheed at Palmdale, Calif., will be developed by the Air Force into one of the world's largest jet flying centers. The Air Force designated Lockheed to coordinate planning of the jet base, eventually to be used by three or four companies. It will remove much of the Southern California aircraft industry's ground and air jet testing from the dense metropolitan region to the sparsely populated desert area.

Lockheed's new Georgia Division, building B-47 jet bombers in the second largest aircraft factory under one roof, at Marietta, achieved significant progress during the year. First activated with an assignment to modify and de-mothball B-29's, the Marietta plant swung into production on jets and built up to a work force approximating 12,000 at the end of 1952. A significant industry development was the decision to utilize the Marietta plant for C-130A production, taking advantage of available manpower and engineering talent in the Southwest and decentralizing military plane manufacturing.

For the whole corporation, including Georgia and subsidiaries, employment increased in 1952 from about 39,500 to 49,000.

Lockheed's backlog, including firm and in-negotiation contracts, was reported in the neighborhood of $1,800,000,000 shortly after mid-year. Sales in the first six months showed a 92-percent increase over the same 1951 period, up from $98,053,883 to $188,629,000. Earnings after provision for taxes amounted to $2,610,000, equivalent to $1.15 per share, as compared to $1.66 on $3,763,000 in the first half of 1951. President Robert E. Gross said at midyear that a marked improvement in earnings was expected by the year-end if current schedules and operations were not interrupted. The company paid three dividents of 30 cents per share each through September.

Lockheed's 1952 activities were by no means wholly confined to the piston and jet aircraft fields. Numerous special projects in various aeronautical and scientific avenues were kept tightly under wraps for security purposes.

Marquardt Aircraft Co.

The Marquardt Engineering Department consists of more than 400 engineers and technical personnel—highly trained specialists in the fields of aerodynamics, thermodynamics, hydraulics, metallurgy, mechanical design, stress and weight, servo mechanisms, etc. The organization is qualified to perform both analytical and design services in such lines as burner development, combustion engineering, diffuser design, fuel and power controls, turbine-driven fuel pumps and auxiliary power units, pulse jet engines, aerodynamic research and design, product testing and evaluation and afterburner development.

Engineering services also include the Marquardt Jet Laboratory. These testing facilities are designed for flexibility in operation and application and are particularly suited to the evaluation and production testing of full-scale components requiring large mass flows of air over widely varying ranges of temperature, density and Mach number. High inlet stagnation temperatures for subsonic Mach numbers can be provided. Instrumentation is adequate for recording both static and dynamic test data. The company also has facilities for the full-scale testing of fuel pumping and metering devices, pre-flight checkout of completed engines, components, etc.

The company's manufacturing department is organized for the handling of complete prime and subcontract programs relating to machined, sheet metal and other products throughout tl entire manufacturing sequence.

Among Marquardt's subcontracting activities was the production of ailerons for the Douglas Aircraft Company. The company also engineered and produced subsonic ramjet engine for the Martin Plover. This was the first time a ramjet engine had been produced on a production line basis.

Glenn L. Martin Co.

During 1952, the Glenn L. Martin Co. settled into a steady, two-shift production pattern on two airplanes, and began production on two others.

In the face of deliveries of both commercial and military aircraft against existing contracts, the Company's backlog had risen appreciably by September 15, 1952.

The fourth production contract for P5M-1 Marlin anti-submarine warfare flying boats was announced in July and the existence of a second order for substantial numbers of Martin B-57A night intruder bombers from the U. S. Air Force was divulged during October 1952.

Revelation was also made in July of a previously received initial order for an air-sea rescue version of the P5M-1 for the U. S. Coast Guard.

A statement issued on October 6, 1952 by the U. S. Navy aroused more than usual industry interest. It said, "As a result of a design competition, The Glenn L. Martin Company has been awarded a contract to build a high-speed, multi-jet, engine-powered seaplane. Designated by Martin as the Model 275 SeaMaster, the proposed seaplane will be radically different in its concept and design."

Disclosed in 1951, for the first time, was the existence and first flight of the Martin M-270—an experimental Navy flying boat featuring a new version of the P5M-1 hull with 15 to 1 length to beam ratio.

In the special weapons field, orders were received for guided missiles, rockets, turrets and electronics work. Details on all these are classified.

The company's employment level was relatively stable throughout the year with total personnel numbering slightly over 20,000.

During the year the maximum floor space expected to be made available by the Signal Corps at Plant 2 was turned over to the Martin Company, and a 500,000 square foot warehouse was finished and put to much needed use.

A U. S. Air Force night-intruder Canberra twin-jet bomber is being built by Martin under the designation B-57A. Power will be furnished by Wright J-65 Sapphire engines. The aircraft has a rather conventional configuration, possessing excellent maneuverability and high speed. Production of the B-57A was well under way by the end of the year, though it had been anticipated that there would be problems arising out of American construction of a British-design airplane. In the adaptation, three targets were set for Martin engineers: (1) to make the B-57A an effective weapon in its night intruder role; (2) to preserve the particular characteristics which make it so efficient in this category; and (3) to make it as inexpensively as possible compatible with its mission. Deliveries are expected to begin during the spring of 1953.

On January 15, 1952, both Eastern Air Lines and Trans World Airlines began integrating Martin 4-0-4 commercial transports into their regularly scheduled flights.

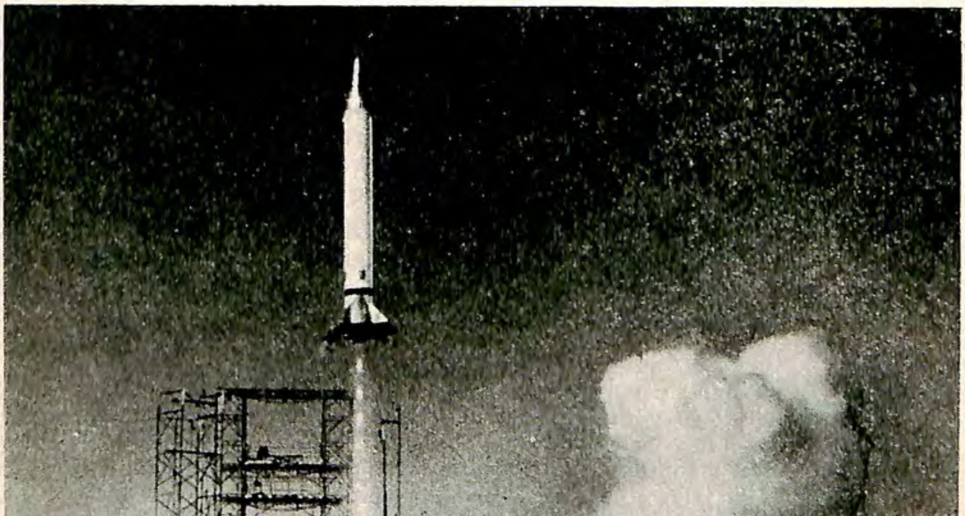
The last of 41 TWA 4-0-4's was delivered in September 1952 and all of EAL's 60 were expected to be in customer hands by the year's end.

Deliveries were made also of two three-jet high speed XB-51 bombers to the USAF.

The first Martin P5M-1 Marlin flying boat joined the fleet in April 1952. Successor to the Martin PBM Mariner of World War II fame, the P5M-1 Marlin is featured by a long afterbody, or hull extension, the keel being under water from just behind the nose to the sternport. Gull wings are complemented by a high, single vertical tail. Engines are twin 3,350 Wrights. Accommodating a crew of seven, the Marlin was designed primarily as a long range sub-hunter and destroyer. It is adaptable, however, for use as a cargo carrier, air-sea rescue or general utility plane. The P5M-1 is equipped with the latest electronic detection devices.

The overall Martin guided missile program picked up speed with the B-61 Matador pilotless bombers being flown regularly at the USAF Missile Test Center, Cocoa, Fla. The B-61 is fired from a zero length launcher,

Martin-built Viking rocket is launched on 135.6 mile flight



by rocket propulsion. Once under way, the rocket drops off and a turbojet takes over.

Production continued through the year on the Viking high altitude research rockets at a pace to match Naval Research Laboratory requirements. So far as is known, the Viking continues to hold the altitude record for single stage rockets of 135.6 miles established on August 7, 1951.

A number of successful launchings and flights were made with the KDM-1 Plover gunnery target drones and exhaustive testing continued. Powered by a Marquardt ramjet engine, the Plover is radio-controlled.

Other items in production at the Martin plant included aircraft gun turrets, besides subcontracted components for Grumman Navy fighters and radar trailers for the Western Electric Company.

In the fall, the Martin Company made delivery of a T-13 flexible gunnery trainer to the USAF. The finished product was the result of nearly two years of research, development and building on the part of Martin electro-mechanical engineers. The new trainer cross-checks the abilities of different gunners—as well as of the same gunner at different times. It quickly eliminates marginal students, while enabling the better marksmen to progress with a minimum of costly in-flight training. The T-13 affords an inexpensive alternative to formal practice in aerial gunnery.

Sales by The Glenn L. Martin Company for the nine months ending Sept. 30, 1952 were $101,.680,468, resulting in a net income of $2,756,764 (no provision required for income taxes), equal to $1.48 per share on the 1,861,432 shares outstanding.

McDonnell Aircraft Corp.

Increasingly rapid expansion of McDonnell Aircraft Corporation's integrated production and development facilities at Lambert Municipal Airport, St. Louis, continued throughout calendar 1952, to keep pace with a similarly rapid growth of production and development work in the fields of jet airplanes, helicopters and guided missiles.

At the end of McDonnell Aircraft's fiscal year 1952, on June 30th, the annual audit showed a backlog of $315,818,517 and employment of 11,258. To further increase the production backlog, an Air Force order was received in September for production quantities of the McDonnell F-101 Voodoo, a twin-jet long-range, high altitude fighter that is designed to escort bombers and attack distant targets.

To accommodate the increasing volume of business, McDonnell Aircraft progressed rapidly with a $17,839,919 facilities program which was begun during 1951. Almost completed at year's end was a $3.6-million flight test hangar. Another $1 million is being expended on a low-speed wind tunnel, and a new propulsion lab is being completed for another estimated $1 million. This laboratory will be completely equipped for testing jet power plants under simulated flight conditions.

Already completed is a new microwave laboratory in which electronic tests are being conducted.

A total of $9,873,093 of the remaining $11,199,919 is being used for the purchase of the main portion of the company's plant from the City of St. Louis.

A sum of $1.1-million was also allocated to cover the extent of McDonnell Aircraft's one-sixth interest in a $6,600,000 improvement program that will increase the range of the Southern California Cooperative Wind Tunnel to include transonic and supersonic speeds.

McDonnell F2H-2 Banshee production deliveries, which began in November 1949, were completed on schedule in April 1952. These twin-jet fighters, which first saw combat action during the winter of 1951-52 while flying from the USS Essex in Korean waters, continued to log more combat hours.

Deliveries of the F2H-2P photographic models, which began in February, 1951, were concluded on schedule on September 30, 1952. These airplanes operated extensively in both the Korean and Mediterranean areas during the year.

Containing six interchangeable aerial cameras, the F2H-2P has completed missions ranging in altitude from 50 feet to ten miles. Its performance is similar to the F2H-2 Banshee.

Production deliveries began during 1952 on a third Banshee model, the more powerful F2H-3, which is an all-weather fighter with greatly improved radar, more armament, greater fuel supply, and other major improvements. Further performance details remain classified.

Work continued successfully during the year on the flight testing and experimental development of the XF3H-1 Demon which made its initial flight on August 7, 1951. This is a single-engine, carrier-based jet fighter with sweptback wings and tail, which is being developed by McDonnell for the U. S. Navy. It is powered with a Westinghouse J-40 engine.

Intensive efforts continued under a contract for the F3H-1, which is the production version of the Demon. In line with the U. S. Government's policy to expand the production base for certain airplanes, TEMCO Aircraft Corporation of Dallas, Texas, became the second source of supply for the F3H-1 Demon under a royalty-free license agreement granted by McDonnell.

Experimental work continued during the year on the XF-88A Voodoo, Air Force high-speed fighter which had made its initial flight on October 29, 1948. The fighter weighs over 20,000 pounds and is powered by twin Westinghouse J-34 turbo-jets. These engines, with afterburners, develop approximately 4,000 pounds of thrust each.

The company's helicopter activity was up sharply during the year with new orders requiring an increase in the personnel complement of the helicopter engineering division by more than one-third.

Work continued on the experimental development of a convertiplane for the U. S. Air Force. This craft has a small lifting rotor, with pressure jets for vertical flight and a reciprocating engine driving a four-bladed propeller for high forward speed. The converti ıne is of the "unloaded rotor" variety.

Engineering development also continued on an assault transport helicopter for the U. S. Navy. This helicopter is designed to meet Marine Corps requirements for operation from all types of Naval vessels. It will carry a crew and passengers as well as litters of cargo.

The McDonnell asault transport design was one of the two accepted from a field of 23 entrants and will feature a single, three-bladed jet-propelled main rotor, which is foldable for ease of stowage.

In April 1952, the company received an experimental contract from the Navy for a cargo unloader helicopter which uses the same type rotor as the assault transport helicopter. This is a ship-based helicopter capable of transferring heavy equipment to other ships or to combat units ashore under all weather conditions.

The cargo-unloader design features a single, three-bladed rotor driven by small jet engines mounted on the blade tips. The craft is designed for short-range, high pay-load operations. It will be equipped with powerful winch equipment and a retractable cargo sling, so designed as to be capable of airlifting cargo pods.

Activity in McDonnell's third engineering division—Missiles Engineering—expanded to the extent that the personnel more than doubled in number. Security prevents any discussion of activity in this division.

Sales for fiscal 1952 were $81,743,306. On these sales, earnings after taxes were $3,064,243. The ratio of earnings after taxes to sales was 3.75% as compared to 4.35% for the 13 years since the beginning of the company.

The company's earnings after taxes were $902,262 for the three months ended September 30, 1952, being the first quarter of the company's fiscal year 1953. Earnings per share in the first quarter of fiscal 1953 were $1.33 on 682,120 shares outstanding compared with $1.21 per share on 681,520 shares for the first quarter of fiscal 1952.

For the first time in its 13 years of growth the firm's weekly payroll exceeded the $1 million mark in mid-1952. A total of $1,002,599 was paid to the 11,431 workers in August, and this mark was repeatedly exceeded as the payroll swelled to list nearly 13,000.

North American Aviation, Inc.

North American Aviation, Inc., this year turned out a new model F-86 Sabre jet for Korea, qualified a jet fighter for Navy carrier duty and demonstrated California's first atomic energy reactor. North American also pushed research deeper in the new fields of aerophysics, cybernetics and automatic flight as well as atomic energy. Air Force F-86 Sabre jets boomed their kill ratio to 10 to one over Communist MiG's in Korea. In one month alone Sabre pilots blasted 61 MiG's out of the sky to run their total kills over the 400 mark.

A new model Sabre, the F-86F, began rolling off production lines at Los Angeles and Columbus plants. Major change in the new fighter is installation of a General Electric J-47-GE-27 engine which has ten percent more thrust than engines used in the F-86E. Increased power boosts the thrust rating to 5800 pounds compared to the 5200 pounds of earlier models.

A bigger and faster Sabre, the F-86H, also went into production at the Columbus plant, although two prototypes will be built in Los Angeles. Fifth in the series of Sabre models, the F-86H will be larger than its predecessors and powered by a more powerful General Electric engine. In addition to its mission as a day superiority fighter it is expected to play an important role as a ground support airplane.

Qualifying as a carrier fighter for the Navy, the XFJ-2 Fury completed rigid tests on the USS Midway in August. Production lines at Columbus already were moving and the sweptwing jet is expected soon to be in service with Navy or Marine units.

Aerodynamically similar to the F-86, the Navy's Fury has been modified for the rugged life of a carrier fighter and incorporates many improvements. Its predecessor, the FJ-1 Fury, was the first U. S. operational jet fighter to qualify on a carrier.

A new instrument designed by North American helped greatly in the XFJ-2 test program. It is called "Trodi," for Touchdown Rate of Descent Indicator. A combination of electronics and optics, the instrument tells

Navy's latest carrier-based fighter, North American's sweptwing FJ-2, flies formation with its predecessor, the FJ-1

immediately how fast an airplane drops while coming in for a carrier landing. Before "Trodi" this information was obtained by cameras and usually required days to get back to the pilot.

The instrument sends out two beams of light, very thin in the vertical dimension and very wide in the horizontal plane. These flat pancakes of light broaden out and, as the airplane descends, a special optical mirror on the descending airplane's main landing gear strut cuts the two beams of light. When it cuts the first one, the reflected light starts a photo cell to charging in the instrument. When it cuts the second one, the charging of the cell stops. The voltage can be read off the Trodi dial as a rate of descent in feet per second.

The Navy's first turbo-prop carrier based attack airplane, the XA2J-1 Savage made its maiden hop from the Los Angeles International Airport early in the year. Powered by two Allison T-40 turbo-prop engines the new Savage has a top speed in excess of 400 miles an hour despite its gross takeoff weight of more than 26 tons. Capable of lugging 10,000 pounds of bombs it has a 70 foot wing spread. The plane carries a crew of three in a pressurized cockpit.

Refueling of Navy planes in flight is now possible with a new tanker version of the AJ-1 Savage, already in service with Navy task forces. Designed as a high speed attack plane, the AJ is powered by both piston and jet engines. A standard Savage can be modified into a tanker in a few hours by installing a kit built by North American.

Another version of the Savage, an AJ-2P photo reconnaissance plane, was successfully test flown at Columbus, Ohio. Giving carrier forces a long look in any direction, the photo ship packs 18 cameras which can snoop over enemy territory day or night at almost any altitude.

The Navy, following an Armed Forces standardization policy, ordered production of a modified T-28 trainer to be known as the T-28B. The new Navy trainer will be powered by a 1425 horsepower Wright R-1820 engine in place of the 800 horsepower Wright R-1300 used by existing T-28's. Installation of the new engine will increase trainer's speed from 283 to a top of 343 miles an hour and increase its service ceiling from 24,000 to 35,500 feet. The Navy trainer like the T-28, will be manufactured at the company's Downey, California plant. Export of the T-28 to friendly foreign nations was approved by the U. S. Government.

Two Air Force T-28's set records in aircraft maximum effort at Wright-Patterson Air Force Base by flying 23 hours and 48 minutes during a 24 hour period. Time for ground stops which included refueling, ranged from one minute and 30 seconds to two minutes and four seconds.

A realistic step toward eventual automatic flight was taken this year with the delivery to the Air Force of the first production model of an F-86D Sabre interceptor. The nation's first one-man interceptor, the F-86D is packed with "little black boxes" that enable it to take off, seek out an enemy airplane, destroy it and return to base in any kind of weather.

Bolstering the Italian Air Force, first shipment of the sweptwing Sabres arrived at Brindisi, Italy. It also was announced that F-86's would be built for North Atlantic Treaty Defense Forces under a three-way arrangement among Canada, United States and Great Britain. Under a licensing agreement with North American Aviation, airframes will be built at the Canadair plant in Montreal. Engines and other equipment will be supplied by the United States and the jets will be flown by British pilots.

The sturdy T-6 "Texan" trainers served during the year as spotter aircraft to mark enemy ground targets in Korea. Unarmed and unescorted, the T-6's fly over the front, establishing contact with ground observers. When a ground commander requests aerial support the T-6's dive in to mark the target with smoke rockets for the speedier jets.

Marking the first operation of U. S. Air Force four-engine jets on the European continent, North American B-45's of the 47th Light Bombardment Wing made a mass flight from Langley AFB, Va. to Sculthorpe, England. One of the Air Force's first tactical jet bombers, the B-45 Tornados also are seeing action in the Korean war as high altitude reconnaissance planes.

Total employment at all North American facilities was expected to reach 46,825 by the end of the year. The California total, which exceeds the World War II high of 25,612 is 30,500 with 16,325 employed at the Columbus plant.

To match the employment expansion, total floor area increased to 7,889,-558 square feet for all plants. This compares to a 1951 total footage of 7,596,883.

North American reported a net income of $7.8-million after taxes, for the twelve months period ended Sept. 30, 1952. This compares to $6.4-million for the same period in the preceding year.

Northrop Aircraft, Inc.

A swing into full-scale production of a new, all-rocket armed version of the USAF Northrop Scorpion F-89, increased activity in the guided missile field, plus steady growth and expansion of manufacturing facilities were major 1952 accomplishments at Northrop Aircraft, Inc.

Northrop's principal task was production of Scorpion F-89's. Additional large orders for the company's newest product, the F-89D, increased Northrop's backlog of defense orders on July 31, 1952, to a new, all-time high of $389-million not including an additional estimated $40-million in contracts being negotiated.

Shortly after mid-year the company began production of Scorpion F-89D all-weather interceptors, latest model in the F-89 series. These twin-jet, two-place planes are capable of operating at speeds in the 600-mile-per-hour class and at altitudes above 40,000 feet. Built to the proved design of Northrop's earlier Scorpion models and equipped with large quantities of high-explosive, air-to-air rockets, the "D" is one of America's most heavily armed fighter-interceptors.

The F-89D has been nicknamed the "grand slam" Scorpion because of the destructive force of the 2.75 folding fin aircraft rockets carried in unique wing tip launching pods. Designed to locate, intercept and destroy enemy aircraft in adverse weather or at night, the F-89D combines tremendous firepower with a high-powered electronic radar unit and an accurate fire control system for high combat effectiveness. A crew of two—pilot and radar observer—mans this newest aerial destroyer. The Scorpion is powered by twin Allison J35 turbojet engines and utilizes Northrop-developed speed brakes for slow-downs or fast landings from a high altitude.

Like previous Scorpion models, the "D" is equipped with automatic electronic equipment which enables it to "lock on" a possible enemy, track him down automatically and loose its rocket barrage at a computed time, filling the air with a deadly pattern and blanketing the area where the radar has located the enemy. The rockets carry high-explosive warheads and a single hit is sufficient to down the largest bomber.

Earlier F-89 models, armed with six 20-mm cannon, are manning defense posts for all three sections of the Air Defense Command spanning the nation. F-89D's will soon be joining this force to further bolster the country's air defense.

Considerable progress was made by Northrop's Special Weapons Division in guided missile research and development. Now in it seventh year, the program has several thousand persons working on the project. In 1952 Northrop began operations at the U. S. Air Force's Long Range Proving Ground (LRPG) at Cocoa, Florida, where missiles are fired over the Atlantic Ocean. At Hawthorne, Northrop established one of the first guided missile training programs on the West Coast.

Northrop's Anaheim Division has entered into mass assembly of precision optical range finders for the U. S. Army Ordnance Corps at a 250,000-square foot plant in Anaheim, Calif. Its sighting and aiming devices are used on the Army's new M-47 medium tanks.

In July, 1952, Northrop purchased the Radioplane Company of Van Nuys, Calif., principal supplier of radio-controlled target planes used for gunnery practice by the military services. Radioplane has a high productive ability, a progressive research and development program and a defense order backlog of $18-million, all of which contribute to Northrop's diversification program and its continued financial stability. Employing over 650 persons, Radioplane has produced more than 30,000 target planes since its founding in 1940 and its operation is expected to augment Northrop's guided missile program. A research and development program at the new subsidiary resulted in production of several prototype jet-propelled target aircraft in 1952. Radioplane produces all of the target aircraft for the U. S. Army, Air Force and National Guard and half of the Navy's target planes.

Another division of Northrop Aircraft, Inc., the Northrop Aeronautical

Institute with an enrollment of about 1,000 students, is now in its tenth year. The school offers courses in aeronautical engineering and aircraft and engine mechanics. In 1952 the Northrop Institute participated in establishing the first guided missile training school for the U. S. Army Ordnance Corps at Redstone Arsenal in Huntsville, Alabama.

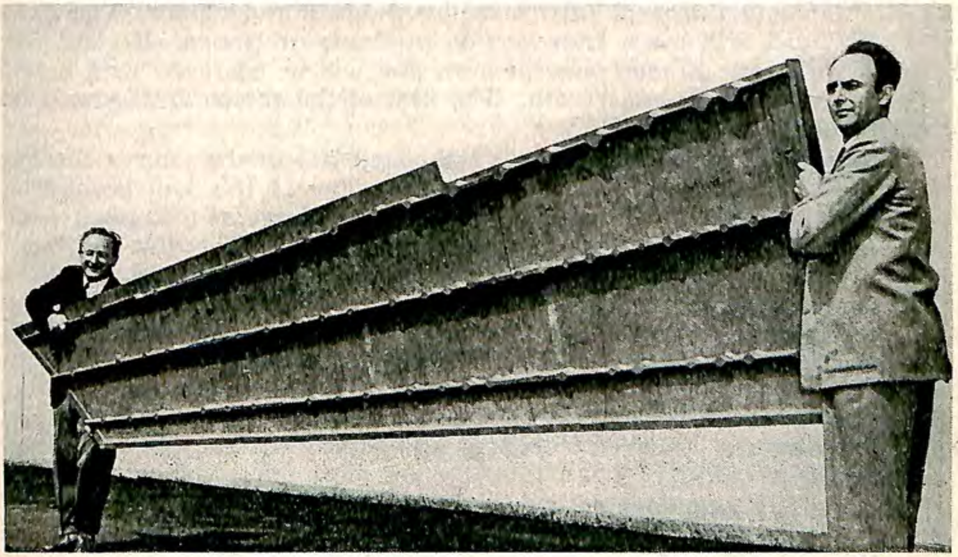
Progress in Northrop's aircraft research and development program during 1952 included production of a revolutionary cast magnesium wing, study of uses for glass fiber plastics in advanced aircraft designs, construction of extensive F-89 flight simulation equipment and further boundary layer control investigations.

New production facilities were completed under a 30 percent production area expansion program at Hawthorne sponsored jointly by Northrop and the U. S. Air Force. The new construction, which includes a tooling building, a final assembly structure, radar hangar and other buildings, has increased Northrop's total covered area to approximately 2,500,000 square feet.

Plans are now underway for construction of additional Northrop facilities, consisting of a large hangar and auxiliary buildings at Palmdale, Calif., airport.

Personnel-wise Northrop increased its payroll by almost 4,000 persons during the year. Growth of the Special Weapons and Anaheim Divisions plus the addition of Radioplane and increased activity at Northrop's Hawthorne plant raised the company's personnel totals from 16,000 in January, 1952, to nearly 20,000 later in the year.

Wing section cast in a single piece of lightweight magnesium



Regular 25 cent dividends were paid each quarter during the 1951-52 fiscal year. In addition, Northrop issued a special 10 percent stock dividend in September, 1952.

For the fiscal year ended July 31, 1952, sales and other income exceeded the volume reported for any previous year in the company's history. They totalled $187,456,926 as compared with $89,947,629 for the preceding year. Consolidated net profit after federal income and excess profits taxes was $2,420,605, which is the equivalent of $4.22 per share on the 574,039 shares of common stock outstanding at the close of the fiscal year.

Piasecki Helicopter Corp.

Early in 1952 Piasecki delivered the first of a production contract of HUP-2's to the Navy. These are similar to the HUP-1, but contain an automatic pilot and a 25 horsepower increase on the Continental 975 engine. The automatic pilot was developed by the Navy and Sperry engineers along with Piasecki technicians.

Flown through a small formation stick midway between the pilot and co-pilot, this autopilot allows effortless flight.

The Navy activated several anti-submarine warfare squadrons on both coasts. Using HUP-2's these groups started training exercises and continued development of tactics for submarine detection.

In September, the Army received their version of the HUP. Designated H-25, the helicopter was named "Army Mule." The Army plans to use this helicopter for rescue, evacuation and light transport work.

On April 11th, the H-21 Work Horse helicopter flew for the first time. Used by the Air Force for rescue operations, it can carry 14 seated troops or 12 litters and a medical attendant, plus the pilot and copilot. The Army and Air Force will use a later version to transport troops. Higher powered, it will carry 20 men plus the crew and will be equipped with a sling to carry heavy loads underneath. The first of the rescue craft was delivered in October.

The first XH-16 helicopter was completed late in the year at the Piasecki plant. Built under Air Force contract, the H-16's will be used by the Army, too. This twin engine helicopter is as large as a Convair Liner and can carry 40 passengers plus the four-man crew. The first ship has a short landing gear. Later a tall landing gear will be fitted and the much-discussed detachable pack will be built for attachment beneath the helicopter. This pack is planned to be interchangeable on other aircraft and transportation vehicles. Fully loaded, it will be placed on the desired spot for use as a ready-equipped field kitchen, hospital or communications hut. By fitting out these packs as working huts or loading them with supplies, considerable time can be saved in setting up operations. They can be moved again, just as quickly.

During 1952, employment rose to more than 4,500.

Completion of a new addition at the Morton, Pa., plant brought the total plant area to over 600,000 square feet. A five-story building in Chester was acquired for warehouse and engineering space.

Piper Aircraft Corp.

The Piper Aircraft Model PA-23, a four-place low-wing model equipped with 150 hp opposed engines and full feathering propellers, has been under development since early 1951 and is expected to be in production in 1953. It will cruise at over 150 mph at sea level, has a single engine altitude of over 5,000 feet at a gross load of 3,200 lbs., and be priced, completely equipped, at less than $25,000. This model represents the Piper Aircraft Corporation's first entrance into the small executive transport field.

The second market trend toward which Piper Aircraft Corporation developments have been pointed is the greatly increased use of utility types for the application of agricultural chemicals. The Piper Aircraft Corporation, in looking toward this market as a future large-scale source of sales, in the past year established itself as the only aircraft manufacturer devoting development and production effort to a model intended exclusively for agricultural use. In order to get started in this field, the corporation modified the model PA-18 Super Cub, which was ideally suited for agricultural work because of high weight-carrying capabilities, low landing and take-off speeds, minimum maintenance, and other characteristics desired in an agricultural plane. The model PA-18A was designed to permit easy installation of a 110 gallon or 18 cu. ft. tank in the rear seat area, which could be used for dispersal of either spray or dust and converted from one type of applicator to the other in less than 2 man hours. Up to 900 pounds of spray or dust, plus pilot and fuel, for a total of 1,300 lbs. can be carried in a light PA-18A, weighing less than 1,000 lbs. empty.

The year-to-year development of improved versions of the fast selling Pacer and Tri-Pacer models has provided the Piper Aircraft Corporation with entrants in the four-place personal plane and small single-engine business plane markets at the lowest available prices. Cruising at 120 to 130 mph, well soundproofed and comfortable, these models are priced at $5,000 to $7,000.

Republic Aviation Corp.

Republic Aviation Corporation in 1952 set new output records and at the same time began production of two new types, continued building up employment and facilities, and saw one of its military models have a revolutionary effect upon aerial warfare tactics.

During the year the 3,000th Republic Thunderjet rolled off the Farmingdale, Long Island, assembly lines as the company not only maintained its record of producing more warplanes than any other company, but drew away to an overwhelming lead.

Even, however, as Republic mushroomed its deliveries to the United

States Air Force and America's European allies in the North Atlantic Treaty Organization (NATO), the company received new orders which brought its backlog to nearly $1-billion—almost double the unfilled-order figure of year-end 1951.

Thunderjets were flying under nine flags in 13 nations as 1952 drew to a close, with total F-84 hours over 700,000 in September, with 1,000,000 estimated by the end of the year.

This flight-time record included approximately 135,000 hours in the Korean War, and 165,000 by USAF in Europe and the NATO air forces.

Probably of greatest significance was a "new" kind of Thunderjet flying which set the military affairs experts to revising long-held concepts of air strategy. These were the flights made possible by development and successful application of an in-flight refueling system in the F-84G Thunderjet.

During 1952, the 'G'—only production fighter-bomber equipped for mid-air refueling—conclusively proved that its range is limited only by endurance of the pilot and availability of tanker aircraft at necessary intervals to refuel the fighter-bombers.

The new, radically-different, swept-wing F-84F—and its twin, the RF-84F high-speed photo-reconnaissance plane—went into production toward the end of 1952. The 'F', which with its 7,200-lb. thrust Wright Sapphire engine boasts far more power than the 'G', and which also carries greater armament loads than its predecessor, was described by the Air Force as the answer to the crack Russian MiG. The 'F' is capable of much greater speed than the 600 mph-class F-84G.

The 'F', which will also incorporate the refueling system, will go to the NATO nations as well as the U. S. Air Force.

Further to perfect the NATO Thunderjet set-up, a program was started during 1952 under which Finmeccanica, an Italian company, will manufacture hundreds of different spare parts for the F-84's in Europe. Republic was the first U. S. airframe manufacturer to enter into such an arrangement, as part of the "Offshore Spares" activity formulated by the Air Force and the Mutual Security Agency to facilitate maintenance of American-built aircraft in NATO nations.

Republic also established its own European Division, with headquarters in London, and sent scores of technical representatives abroad to work with the various air forces in assuring top performance by the Thunderjets. Further cementing the new relationship between the United States and Europe were many visits to the Republic plant by heads of NATO air forces and groups of eminent European journalists, visits which were reciprocated by Republic officials in the NATO homelands.

Back of all these accomplishments by the Republic Thunderjet was a force of more than 22,000 people—the employees of Republic. In addition, numberless additional thousands from hundreds of other companies supported the effort in building components for the aircraft. By year-end more than 50 percent of the F-84G was being built by subcontractors for final

Type KD2R-3 target drone

assembly at Farmingdale, compared with 33 percent a year ago, with plans laid to subcontract up to more than 55 percent of the F-84F. Republic's success in reassembling its World War II subcontracting team, and adding new members to it, was attested by the jump from $95-million to more than $200-million in payments to subcontractors in, respectively, 1951 and 1952.

Employment during the year rose from 18,500 to 22,500. Training courses of diversified nature were established, or continued. More than 3,000 riveters, assemblers and bench mechanics were efficiently trained in the out-of-plant program established a year earlier.

Republic, which had added 440,000 square feet in 1951 to its earlier 1,650,000 square feet, added another 150,000 square feet in 1952, for a grand total of 2¼ million square feet. At the same time, it brought into actual operation 260,000 of the 440,000 square feet it had added the year before. This, with the footage added in '52, was the equivalent of nine football fields.

To insure ample capital for its all-out effort for the Air Force, the company arranged a $10-million line of credit with the Chase National Bank. Net income for the first half of the year was $2,626,225, after provision for taxes. This was equivalent to $2.61 a share on the 1,005,406 shares of common stock outstanding. Sales for the period were $134,526,855, compared with $52,281,021 in the same period of 1951.

Ryan Aeronautical Co.

The year 1952 was a double milestone for Ryan Aeronautical Company. Exactly 30 years ago T. Claude Ryan went into the aviation business in San Diego, with a piano crate for a workshop. And this was the 25th anniversary of the construction in San Diego of one of the most famous of Ryan products, Lindbergh's "Spirit of St. Louis."

It was not, however, a year for looking backward to past accomplishments. The company's backlog of orders for a wide variety of airframe components, exhaust manifold systems, jet engine parts, target planes and other items soared to $70-million; its payroll climbed to near the 4,000 mark; expansion of facilities and equipment continued at a rapid rate, and the production volume mounted to its highest level in seven years.

Almost completely equipped by year's end for high quantity output of parts for jet engines was a new 75,000-square foot building, erected in 1951 at a cost of $300,000. More than $2-million worth of the most modern machine tools poured into this structure during 1952 as production for critically needed jet engines, principally the General Electric J-47, was accelerated.

Other equipment, including the largest presses and horizontal lathes ever in use at Ryan, began arriving to accommodate the demands of a stepped-up production schedule on huge components for the Boeing C-97, including fuselage assemblies, refueling pods, cargo doors, floor beams, etc.

It was a year of vastly improved financial condition. Net profit for the first nine months of the fiscal year was $609,669, or $1.55 per net outstanding share, compared with $402,604, equal to $1.02 per share, for the entire 12 months of the 1951 fiscal year.

The working capital position also showed a marked improvement, increasing $712,515, up to $4,037,123 from the figure of $3,324,608 on Oct. 31, 1951, end of the 1951 fiscal year.

For the first time, the Air Force permitted public disclosure that the giant external wing fuel tanks Ryan had been building for some time were for the Boeing B-47 Stratojet, world's fastest bomber. Photographs were released showing how the Stratojet carries two tanks, one suspended under each wing. Capacity of the tanks remained secret, but they hold so much fuel that the B-47B, which has been closed as a medium bomber, now is able to complete long-range missions carrying more than 20,000 pounds of bombs.

Besides the Ryan-built tanks, another Stratojet feature extending its flight range is the mid-air refueling system, in which Ryan continued dur-1952 to play a vital role. This feature is the refueling pod for the Boeing C-97 Stratotanker, in which is stationed the operator controlling the steel "flying boom" through which fuel flows in mid-air from the Stratotanker to the Stratojet.

The external wing fuel tanks were adapted during 1952 to a revolutionary new development on the new, enlarged long-range Fairchild C-119H, latest of the series of "flying boxcars." On these planes, they would be used for the entire fuel supply, instead of the supplemental supply as in the B-47B. Several advantages were cited for such external suspension of fuel tanks. The internal wing is cleared of numerous fuel cells, thus reducing complexity of construction. A 600-pound weight saving is accomplished by eliminating or cutting down fittings, connections, access doors, etc. Maintenance is simplified because of easy accessibility to the external tanks.

And fire hazard is cut down, as is vulnerability to gunfire by reducing the "inflammable" area, which is virtually the entire wing in an internal fuel system.

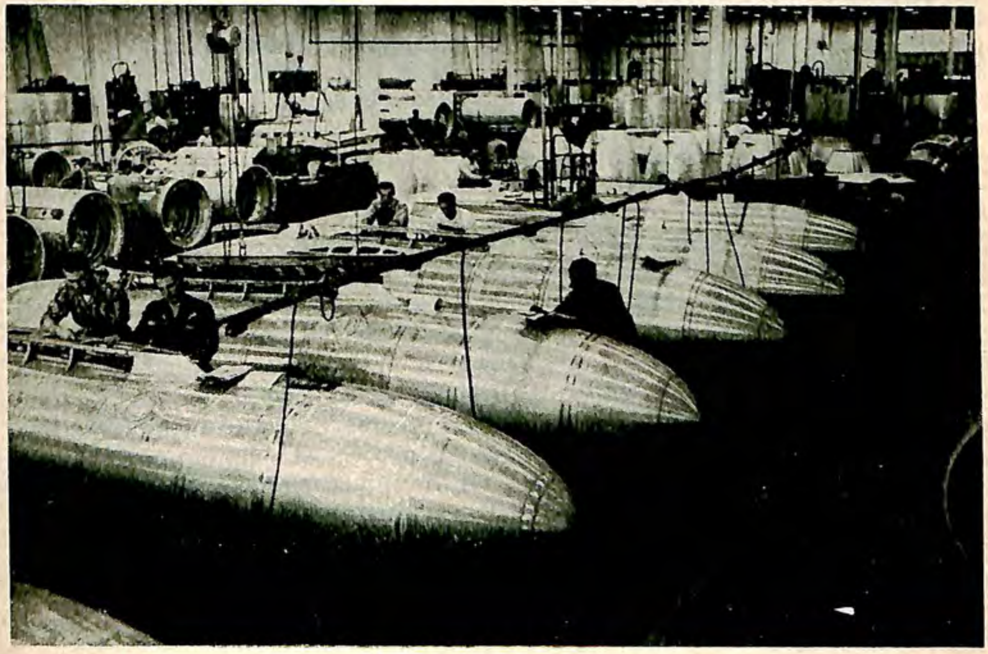
Aircraft and airframe components have shared top billing with exhaust systems, jet engine and rocket parts, and other aircraft components which have made Ryan one of the leading users of stainless steel in the nation.

In the electronics field, Ryan is noted for producing one of the country's first air-to-air guided missiles, the "Firebird," as well as the Q-2 pilotless jet plane.

In the metal products division, Ryan for years has been a pioneer in the development of high temperature metallurgy. Its heat- and corrosion-resistant components are supplied to virtually every major airframe manufacturer. In the piston engine field, Ryan exhaust systems are installed on such commercial transports as the Douglas DC-6, Convair 240 and 340, and Boeing Stratocruiser; on such military aircraft as the Douglas C-124, Boeing C-97, Fairchild C-119, and Piasecki helicopters. Continental engines used in Army tanks are equipped with Ryan exhausts.

In the jet engine field, exhaust cones, tailpipes, combustion chambers, aft frames, afterburners, case assemblies, exhaust nozzles and other components are being produced for General Electric, Pratt & Whitney and

Wing tip tank production at Ryan Aeronautical Co.



Westinghouse. In addition, tailpipes for the Boeing B-47 and Convair B-36 bombers are in production.

And in the increasingly important rocket engine field, Ryan is producing motors capable of generating tremendous bursts of power for Firestone guided missiles. Major components also are being turned out for Aerojet, makers of the Aerobee high-altitude sounding rocket.

Advances were made during 1952 in two phases of production in which Ryan has done noteworthy pioneering. These are the use of ceramic coatings to prolong the life of high-temperature exhaust components, and the extensive employment of electric resistance welding for both aluminum and stainless steel, requiring one of the most elaborate batteries of welding machines in any single factory.

Sikorsky Aircraft Div. United Aircraft Corp.

First helicopters in history to make the North Atlantic passage on their own wings, two Sikorsky H-19's touched down at Prestwick, Scotland airdrome on July 31, 1952. Enroute they had stopped at Labrador, Greenland, and Iceland. The project designated "Operation Hop-A-Long" by its Air Force pilots was activated by the Air Rescue Service, Military Air Transport Service, with Air Force Headquarters' approval. Information on range extension and related problems was accumulated as a result of the operation. The aircraft were standard production units from Sikorsky's Bridgeport, Connecticut, production line modified at Westover (Massachusetts) Air Force Base by the installation of extra fuel tanks and the removal of gear unnecessary for the test.

Certification of the S-55 for commercial scheduled passenger operation was granted by the Civil Aeronautics Authority on March 25th making the S-55 the first transport type helicopter to be so licensed. With the S-51 and S-52 previously CAA ticketed, three Sikorsky types were made available for the commercial market.

Los Angeles Airways began its sixth year of helimail service in California on October 1 by adding a number of S-55 helicopters to its fleet of S-51's. New York Airways, also using S-55's, inaugurated local helimail service in its area on October 15th, and started service as far as Bridgeport in December.

In British Columbia, Okanagan Air Services used its S-55's to haul personnel and material for the construction of a power transmission line across sawtooth mountains for the Kitimat project of Aluminum Company of Canada. And closer at home Rockwell Manufacturing Company obtained an S-55 for executive travel among its various manufacturing plants.

In February, Sikorsky announced its second licensee for manufacture of the S-55 in Europe, Societe Nationale De Constructions Aeronautiques Du Sud-Est. Westland Aircraft, Limited, Yeovil, Somerset, England, was licensed a year earlier.

During the year Sikorsky production processes expanded into the enlarged area provided by the 1951 construction program. New special-purpose machinery including an 80-ton Hufford stretch-wrap forming machine was installed. Total area of the main Sikorsky plant now is more than 600,000 square feet. Several branch installations in downtown Bridgeport are used for pattern-making, sub-assembly work and storage.

In summary, Sikorsky in 1952 supplied helicopters to all branches of the United States military establishment and in smaller quantities to other governments. In Korea the S-51, S-52 and S-55 types were all giving continued service. The North Atlantic was conquered in July by two Air Rescue H-19's. S-55's went into helimail service on both the East and West Coasts.

At the year-end, plans were under way for a further step-up in schedules and the fabrication of at least two models which were classified at press time.

Taylorcraft, Inc.

The Sportsman, powered by an 85 hp Continental engine with starter, generator and 12-volt system, continued to head the list of Taylorcraft's variations of three basic models. Skylights give the pilot visibility comparable to that of low wing planes. The new Sportsman was ATC'd on June 30, 1951, as model 19, and has a gross load of 1,500 pounds. It lists at $3,895 at Conway.

The Tourist is a four-place airplane designed for comfort, eye appeal and easy flying for non-professional, Sunday pilots. It was ATC'd on April 3, 1951.

The tandem agricultural plane for spraying, dusting, seeding, fertilizing, defoliating; for banner towing, for flight training, has flown with outstanding performance. It will be ATC'd when conditions warrant.

Temco Aircraft Corp.

The year 1952 was highlighted for TEMCO Aircraft Corporation, Dallas, Texas, by the receipt in August of a prime letter contract from the United States Navy for the manufacture under a license agreement with McDonnell Aircraft Corp. of a substantial quantity of McDonnell F3H Demon carrier based jet fighters. This was followed in October by a second letter contract calling for additional quantities of the same aircraft.

While quantities, production schedules and dollar value could not be released for security reasons, Robert McCulloch, TEMCO president, said that TEMCO expected employment in its Dallas plant to rise from 5,000 in August 1952 to 10,400 by the last quarter of 1954.

Two other events of particular significance took place during the year. In April, TEMCO stockholders voted to change the corporate name officially from Texas Engineering and Manufacturing Company, Inc., to

TEMCO Aircraft Corporation; and in August, TEMCO ' ıdustrial Engineering announced that the equipping of the TEMCO plant with the most modern types of aircraft production equipment was over 90 percent complete.

On the production side, TEMCO continued to supply increasing quantities of B-47 rear fuselage sections, P2V outer wings, A2D wings, center sections, surfaces and doors, and P5M flaps and bomb-bay doors to Boeing, Lockheed, Douglas and Martin respectively. In addition large quantities of F-47's were rehabilitated for the Air Force at the Dallas plant.

At TEMCO's Greenville overhaul division, production activities included the reconditioning of C-54's for the Air Force and C-47's for the Coast Guard, and overhaul and modification of a fleet of Martin 202's for Pioneer Airlines, and modification and overhaul of twin engine aircraft for foreign and executive aircraft owners. Late in October the Greenville Division announced the inauguration of a complete overhaul and rehabilitation service for multi-engine executive aircraft.

On the design side, TEMCO continued to improve the T-35 Buckaroo military trainer as a result of service experience during evaluation tests which were still in progress at Goodfellow A.F.B. The company began work on a new classified aircraft of its own design which has been submitted to the Air Force in competition with designs from other manufacturers.

TEMCO's subsidiary, Luscombe Airplane Corporation, also made great strides during 1952, the most important being a building program which nearly doubled the amount of available floor space, and added a large high-bay area.

Luscombe activities included production of rudders, elevators and a variety of door assemblies for the Convair B-36, cabin seats for the Beech T-36A, lead edges for the Lockheed T-33 (under sub-contract from Beech) and rehabilitation of F-47 wings, landing gear and surfaces under sub-contract from TEMCO. Employment was close to 1,000 at year end.

United Aircraft Corp.

Because United Aircraft Corporation's four divisions operate autonomously, discussion of the company's 1952 activities are found under the names of the divisions—Pratt & Whitney Aircraft (engines), Hamilton Standard (propellers and aircraft equipment), Chance Vought Aircraft (airframes and guided missiles), and Sikorsky Aircraft (helicopters).

In 1952, United Aircraft completed the major components of the largest privately financed building program in its history. Production has begun at two new Connecticut plants; one major addition to existing facilities has been completed, and another addition is in the final phase of construction.

Hamilton Standard's new plant of more than 800,000 square feet has been occupied by that division. The move from East Hartford to Windsor Locks, Connecticut, was accomplished in three months with a minimum loss of production time. Pratt & Whitney Aircraft has started production of aircraft engines at its new branch plant at North Haven, Connecticut, where more than 500,000 square feet of manufacturing area are available. With the Hamilton Standard transfer to its new home, Pratt & Whitney Aircraft has taken over the vacated propeller plant in East Hartford. An addition has been built to this plant which will add 180,000 square feet of production and office space to the Pratt & Whitney facilities. The engine division is also engaged in enlarging the Andrew Willgoos Turbine Laboratory, its jet-engine development center, in East Hartford.

Sikorsky Aircraft completed an addition to its plant facilities at Bridgeport, Connecticut. The additional 150,000 square feet of production and shipping space make this the largest single facility devoted solely to the production of helicopters.

United Aircraft suffered the loss of Raycroft Walsh, vice-chairman, who died on August 17 after a brief illness. Three United Aircraft executives were advanced during the year. William P. Gwinn, general manager of Pratt & Whitney Aircraft and United Aircraft vice-president, was named to the corporation's operating and policy committee. William R. Robbins, controller of United Aircraft, and Erle Martin, general manager of the Hamilton Standard division, were elected vice-presidents.

In 1951, the last complete year for which figures are available, United Aircraft reported a net income of $14,266,867, or 3.4 per cent, on sales totaling $417,211,980. Total current assets at December 31, 1951, amounted to $175,637,095, compared to total current liabilities of $95,188,980 at that date. Unfilled orders amounted to approximately $1.3-billion at the beginning of 1952.

ENGINE MANUFACTURERS

Aircooled Motors, Inc.

Aircooled Motors, Inc., manufacturer of Franklin air-cooled engines, continued its leading role in 1952 as the producer of engines specifically designed to power helicopters.

Both Bell Aircraft Corporation and Hiller Helicopters greatly increased their production of helicopters. Both airframe manufacturers use Franklin 200 hp helicopter engines for both military and civilian aircraft. During the year, a Bell H-13 Helicopter powered by the Franklin 200 hp engine established a new record for non-stop distance flight of 1,217 miles.

Sikorsky Aircraft Division, United Aircraft Corporation, increased production of its Model H05S Helicopter for the Armed Forces using the Franklin 245 hp helicopter engine. A Franklin powered Sikorsky helicopter holds world's records for helicopter speed and altitude—129.6 miles per hour, 29,200 feet.

Development work continued during the year on the Franklin 200 hp helicopter engine for the McCulloch MC4 and on the 165 hp horizontal engine for Seibel Helicopters being developed by the Helicopter Division of Cessna Aircraft.

The 165 hp Franklin model continued to find application in fixed-wing aircraft, notably the Temco T-35 Trainer and the Continental, Inc. Airphibian roadable airplane which are expected to be in quantity production during the coming year.

Considerable sub-contract work has been done for other Government prime contractors such as General Electric and Link Aviation, Inc.

Engineering activities included further development of the basic 335 cu. in. and the 425 cu. in. engines; also concentrated design and development work on supercharged versions of the 425 cu. in. engine. Other engineering work was conducted on aircraft engines and components under Government contracts, but cannot be detailed owing to security.

Aerojet Engineering Corp.

The celebration of Aerojet's tenth anniversary was highlighted this year by an expansion of its plant facilities and personnel. In addition to expanding the facilities on the 150-acre site in Azusa, Aerojet has recently completed the construction of a new $8-million factory for production of its solid propellant rocket motors on an 8,300-acre location outside of Sacramento, California. Availability of this new production facility, which incorporates four complete production lines, has helped to make 1952 the largest year, in terms of both production and development output, in the history of the company.

The main plant facility at Azusa presently employs 2,300, while the Sacramento production plant payroll totals 500.

Production of the company's 14AS-1000 (14-second-duration, 1000-pounds-thrust) JATO, the only solid propellant rocket in commercial use today, which was designed and developed during World War II as an assist take-off device for use on all types of military aircraft, continued at a very high level. The 14AS-1000 JATO motor is in active use in the current operations in Korea. This rocket motor lends itself to application on virtually any aircraft. One of its most spectacular uses is on the Boeing B-47 long-range Stratojet Bomber, which uses 18 JATOs to provide additional take-off thrust. A new JATO, incorporating a smokeless propellant substantially superior to that now in use, is currently being readied for production.

Of growing importance in the company's activity during the past year has been the manufacture and loading of forward-firing ordnance rockets and large-scale fabrication of metal components for ordnance rockets. The 2.75" AEROMITE, forward-firing aircraft rocket, utilizing a new propellant developed by Aerojet and incorporating the destructive power of a 75 mm cannon projectile, has gone into limited production pending the conclusion of tests on various fighter aircraft. The AEROMITE has been designed as an alternate rocket for use on such aircraft as the F-84, F-86, F-89, and the F-94C "Starfire" Interceptor. In the last application, a total of 24 AEROMITE rockets, which have folding fins, are housed in firing tubes located in a ring in the nose of the plane.

The company has been one of the chief suppliers of rocket boosters and sustaining motors for most of the guided missiles developed over the past several years. The Aerobee, which is not a guided missile but an unguided upper- atmosphere sounding rocket, was designed and manufactured by Aerojet for the Navy Bureau of Ordnance. The Aerobee has reached altitudes of approximately 78 miles and speeds of about 4000 ft/sec. This rocket carries in its nose 150 lbs. of camera equipment and instrumentation for obtaining data on upper atmosphere conditions, such as the prevalence and intensity of cosmic rays. The Aerobee is a two-stage rocket, launched in the first stage with a solid propellant booster, and utilizing a liquid propellant sustainer for the second stage of flight.

The company's activity in the field of liquid assisted take-off rockets increased in proportion to the growth of its other rocket activities. Development of liquid ATO motors for strategic bomber and fighter application progressed significantly, and as a result of successful field tests, large-scale production of liquid ATO motors is anticpated during the months ahead. Further progress was encountered in the development of rockets for underwater application, in which field the company has been, for the past several years, the most active nongovernmental factor.

During the past year, Aerojet has developed and manufactured a number of gas turbine auxiliary power units utilizing either solid or liquid propellant gas generators in a horsepower range from 5 hp to 310 hp for both airborne and underwater missiles.

The company's activities in the chemical field continued to broaden, and a number of new propellant formulations of unusual promise have been evolved. In the field of electronics, the availability of new, ultra-modern laboratory facilities furthered Aerojet's progress in the development of infra-red homing equipment, tracking devices, and other electronic mechanisms.

Aeroproducts-Allison Div.

General Motors Corp.

With so many engines in active service, hours in the air on Allison jets climbed rapidly and near the end of the year a total of 2,000,000 hours in the air was established by all Allison jet engines.

Volume production was continued on both types of turbojets—the J33 centrifugal and J35 axial flow. Toward the latter part of the year Allison began preparation for production of a third turbojet, the new J71 Super-Jet. This is one of the first engines in the new higher power jet field to be run and approach pre-production with a single compressor.

A fourth production project was initiated when Allison became one of the first manufacturers to set up complete facilities for production of turbo-prop engines. Orders were received for T40 turbo-props for the Convair R3Y and the Douglas A2D. A third aircraft powered by Allison

T40's also reached flight status after its initial flight in January. This is the North American XA2J Savage. All three aircraft are Navy-sponsored as is the entire Allison turbo-prop development program.

One of the highlights of the year was delivery to Indianapolis of the Allison Turbo-Liner after completing an historic flight from Edwards Air Force Base, Muroc, California, July 2, 1952. Preliminary flight testing had been going on at Muroc since installation of turbo-prop engines and purchase of this plane from Consolidated Vultee late in 1950. The Turbo-Liner is being used by Allison to proof test turbo-prop engines for military and commercial transport use. The flight to Indianapolis was the longest ever attempted by a turbine transport plane.

Another new high for Allison J33 jet engines came in August, 1952, when two T-33 jet trainers at Wichita Air Force Base broke a world's record for maximum utilization. One of the aircraft established two world's records by flying 400 hours in a 31-day period. Toward the end of the same program, this plane flew 23 hours and 23 minutes in a 24-hour period.

Another significant first was added to the Allison achievement record in July, 1952, when the first mass flight of jet fighters to cross the Pacific was completed with the aid of air-to-air refueling. Flying F-84 "Thunderjets," this flight was made by the 31st Fighter Escort Wing of the Strategic Air Command, led by Col. David Schilling. They started from Turner Air Force Base, Georgia and flew the 11,000 miles to Tokyo, with stops enroute and air-to-air refueling.

This exploit was duplicated a few months later when, in October, the 27th Fighter Escort Wing completed another trans-Pacific flight with the aid of air-to-air refueling. This mass flight started from Bergstrom Air Force Base in Austin, Texas, and after a stop at Travis Air Force Base, flew on to Japan with a total of three stops from Texas to Japan.

In the latter part of February, 1952, another F-84 "Thunderjet" powered by an Allison J35 jet engine broke the world's record for sustained flight of fighter type aircraft by completing an in-flight refueling mission of more than 12 hours. The flight took place at Edwards Air Force Base, Muroc, California.

The expansion program at Allison continued in high gear. In the early spring of 1952, the move was made into a new 10,000 sq. ft. Administration Building, which released 70,000 sq. ft. formerly occupied by offices for production. Total area at Allison in seven plants now stands at approximately four and one-half million sq. ft. with the grounds being broken on an eighth plant which will be a new and additional test facility.

Another move forward was made in September, 1952, when the Aeroproducts Division of General Motors was consolidated with Allison. The Allison Division assumes full responsibility for the management of Aeroproducts.

In the field of engineering and test accomplishments, Allison has announced the completion of special hoist equipment and modification of the

North American B-45 flying test bed for the Allison J71 Super-Jet engine. This "Flying Laboratory" has been modified by the Allison installation engineering department to incorporate the gear and the J71 engine in the bomb bay. When the engine is extended, it reaches well below the wheel line, therefore, special 50-ton hoists were designed and built to make ground testing possible. When not in use the J71 engine is retracted and is extended under the fuselage from the bomb bay when in running position.

First United States' facilities for the production of the turbo-prop engines have been completed and production is now under way on the Allison T40 turbo-prop engine. An area of more than 250,000 sq. ft. at Allison Plant #5 has been tooled up with over 1100 machining tools.

Continental Aviation & Engineering Corp.

A new version of the Continental R975 radial aircraft engine, designed expressly for the sustained high speed and high power output requirements imposed by latest helicopter applications, is now in production at Continental Aviation & Engineering Corp., Detroit, for quantity use in the Piasecki HUP-2.

The new Model R975-42 develops 550 bph as compared with 525 bhp for the earlier R975-34. Dry weight, exclusive of mounts but including carburetor, air deflectors, and ignition and priming systems, is 732 pounds.

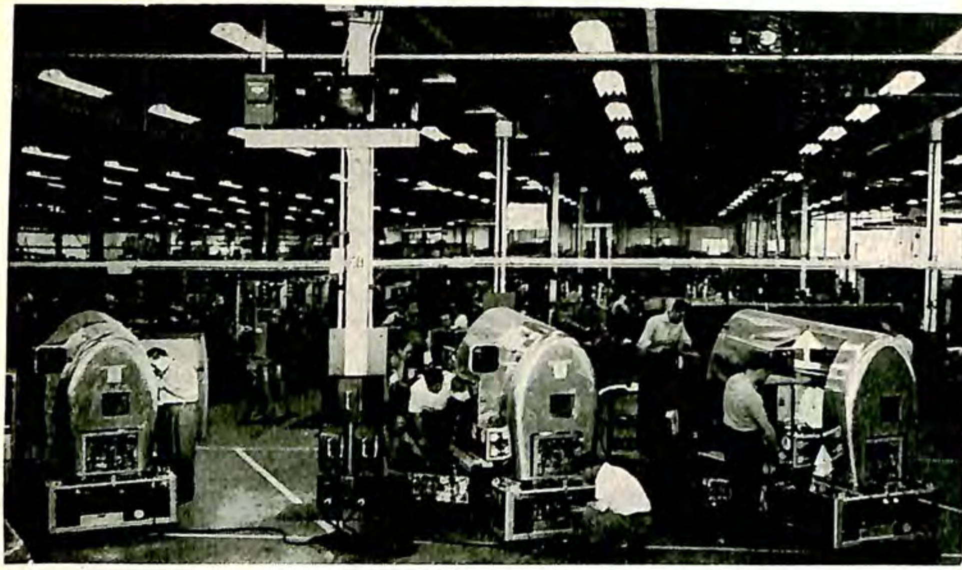
In developing this newest version of the R975, Continental engineers started with the recognition that while helicopters are essentially constant-speed machines, for a given condition, the conditions under which they must be used will vary quite widely, making performance and flexibility essential. The basic R975's were designed for cooling either as fixed-wing power plants, or by fan. The new -42 version has been internally re-designed to permit use of a very small amount of flywheel when fan cooling is used. It is adapted to installation in various types of helicopters, because by the addition of a small amount of external equipment, it will run in any attitude from horizontal to full nose-up vertical.

Continental has been active in helicopter power plant development ever since the start of the Navy's search for a suitable engine at the 500-hp level, for medium-sized helicopters with 5-to-6 passenger capacity. The R975-34 was developed in response to that need, and was used by Piasecki in the HUP-1. As the trend toward higher power continued, the company has been keeping pace, the R975-42 being one of the results of that program.

Curtiss-Wright Corp.

Advancements in the several fields of its program of development and manufacturing—engines, propellers, electronic products and components, and metal products—marked 1952 as the biggest postwar year for the Curtiss-Wright Corporation.

In 1952 Curtiss-Wright also continued its active program for enlisting



Curtiss-Wright electronic trainer production line

the aid of both large and small subcontractors to share the more than $1 billion backlog of the company. By the middle of the year, Curtiss-Wright had more than 4,000 subcontractors and suppliers in 35 states, ranging from small shops with a dozen or so employees upward to such industrial giants as Allis Chalmers and Hudson Motor Car Company.

Licensing also helped Curtiss-Wright spread the heavy load of production without the too-sudden expansion of home facilities that burdened many companies during World War II. During the year four big licensees of the Wright Aeronautical Division were well on their way to full production of various Wright engines. Buick will produce the J-65 (Sapphire) turbojet, Chevrolet the Cyclone 18 and Turbo Compound, Bridgeport-Lycoming the Cyclone 9, and Kaiser-Frazer the Cyclone 7.

Wright Aeronautical, largest division of Curtiss-Wright Corporation, reached employment of more than 20,000 during 1952 and underwent a physical expansion with the acquisition of a new plant in nearby Hackensack to which all cylinder production was transferred.

In September the company announced that it had in an advanced stage of development turboprop engines which, in combination with Curtiss-Wright Turbolectric propellers, would pave the way for speeds up to 1,000 miles per hour for propeller-driven aircraft.

Ram jet development continued during the year at a high pace. Heavy equipment to supplement and enlarge the company's already extensive Ram

Jet Development Laboratory began arriving at the plant early in the summer.

The J-65 (Sapphire) turbojet engine, the first of which had been delivered during the previous year, continued to be delivered in increasing numbers. The program to increase its performance continued on a high-priority schedule in the Engineering Department. The J-65 is currently scheduled for the Republic F-84F fighter, the Martin B-57A Canberra twin-jet bomber, and an undisclosed Navy fighter.

The Turbo Compound engine, in quantity production for the Air Force, Navy and domestic and foreign air lines, took a sizable jump in power during the year.

Airliners powered by the Turbo Compound have been ordered by a total of 15 foreign and domestic carriers. The Turbo Compound engine is also installed in the Martin P5M flying boat, the Lockheed P2V patrol bomber, and the Fairchild C-119H cargo and troop carrier.

The Cyclone 7 and Cyclone 9 engines made test flights during the year in the Sikorsky H-19 and the Piasecki H-21 respectively. Both engines had been extensively redesigned to fit them to these helicopter installations.

The Propeller Division, Curtiss-Wright Corporation announced in 1952 that Curtiss-Wright Turbolectric propellers had been selected for use with each of the high-powered turboprop engines scheduled for production for the U. S. Air Force. Among the engines scheduled to use the new type propellers are the new Wright turboprops, the Allison T-38 and T-40 models, and the T-34.

Some models of the Turbolectrics range up to nearly 20 feet in diameter. They are of the three and four-bladed single rotation and the six and eight-bladed dual rotation types. Blades are of the hollow steel type produced by a new extrusion process perfected by Curtiss-Wright in cooperation with the Air Force. Some of the Turbolectrics are capable of harnessing as much as 20,000 horsepower.

The turboprop engines and propellers are the result of several years' close design collaboration between the Propeller Division and the Curtiss-Wright engine division, Wright Aeronautical.

During the year, extruded propeller blades for the Lockheed Super Constellation were in production at the Caldwell, N. J., plant in addition to a wide variety of welded, hollow-steel blades for military and commercial aircraft.

Rocket development continued as an active item on the engineering schedule of the Propeller Division during the year.

Deliveries of electronic trainers and simulators for aircraft ranging from single-place jet fighters to multi-engine intercontinental bombers were announced in 1952 by the Electronics Division, Curtiss-Wright Corporation.

The jet fighter is the Navy's McDonnell Banshee, for which Curtiss-Wright built a simulator that reproduces all normal or abnormal flight conditions—exactly as they would occur in the plane itself.

The Banshee announcement was followed by delivery of the first of 11 C-97A simulators for the Air Force. One of the largest ever built, this machine reproduces flights of the giant four-engine MATS transport and has accommodations for pilot, co-pilot, and flight engineers plus all the controls and instruments for each.

Later in the year, United Air Lines ordered two DC-6B and two Convair 340 simulators for crew training, thus becoming the second United States air line to use Curtiss-Wright training equipment. Pan American World Airways crews have totalled more than 20,000 hours on a Curtiss-Wright simulator for the Boeing Stratocruiser.

Air Force orders were announced for the C-124A and the C-119C transport aircraft and during the year construction of the B-36F simulator was begun. The Model 501, a trainer for twin-engine aircraft, was also in volume production during the year.

In addition to aircraft simulators and trainers, Curtiss-Wright designed and delivered special electronic simulation and test equipment.

During 1952 the Electronics Division was host at a unique airline clinic at which domestic and foreign carriers' representatives met at the plant to view simulator production and discuss simulator and trainer use in crew familiarization programs.

Increased manufacturing activity led to completion of an addition to the division's recently-acquired plant at Carlstadt, N. J.

Redifon Ltd. of London, England, a licensee of Curtiss-Wright, delivered an electronic simulator for the Comet jet airliner in September, 1952. Redifon had previously delivered a Stratocruiser simulator to BOAC.

Frederic Flader, Inc.

Complete engineering, production, and testing services continued to be offered by Flader during the year in the field of axial flow compressors, turbo jet engines, and gas turbines either for military or industrial uses. These services were available for the development and production of components of such machines or for complete projects of this nature.

The Corporation also has an instrument department which turns out production lots of precision pressure gages of the strain gage type, which measure pressures up to 6,000 pounds per square inch.

One unclassified project was in progress during the year: a portable and air transportable gas turbine to furnish compressed air for the purpose of making oxygen. This gas turbine is being developed under an Air Force Subcontract with the Arthur D. Little Corporation of Cambridge, Mass.

Total business for the company during 1952 was about $2-million.

The New York plant of Flader was recently enlarged by the addition of a new manufacturing building with 8,400 square feet of productive area. The total production area now in operation is 26,000 sq. ft. Other shops include sheet metal, welding, heat treating facilities and tool making shops. Magnaflux and Zyglo equipment is installed for inspection purposes.

General Electric Co.

"The Fastest Ten Years in History" was the dominant theme for the General Electric Company's manifold aviation activities during 1952, for during this year the Company's Aircraft Gas Turbine Division commemorated two events which marked its entrance into the aircraft jet engine manufacturing field. It was ten years ago in March, 1942, that America's first jet engine was tested successfully at a G-E plant in Lynn, Mass. It was ten years ago in October, 1942, that the Bell Airacomet powered by G.E.'s I-A jet engine made the first jet flight in this country.

During 1952 the J-47 was heavily engaged, powering North American's F-86 Sabrejets with which the Air Force racked up a 15-to-1 kill ratio over Russian-built MIGs.

At year's end, other fighters and bombers powered by the J-47 engine include Boeing's B-47 Stratojet, North American's B-45 Tornado, Convair's B-36 (6 piston engines, 4 jets), Martin's experimental XB-51, Republic's XF-91, North American's F-86D interceptor and Navy FJ-2 Fury. And to supply engines for these military planes, the company operated two manufacturing plants and a vast subcontracting network; collaborated with other J-47 manufacturers such as Studebaker and Packard Motor Car firms; operated two Flight Test Centers; and maintained a world-wide service engineering organization.

Service engineers check J-47 jet engine in B-36

During 1952, two engines of the famed J-47 series were announced as the first all-weather axial-flow turbojets. They are now in full production for the Boeing B-47 six-jet bomber. Another all-weather engine of the series is being delivered for use in the Navy's North American FJ-2 Fury fighter, which completed its suitability tests Sept. 18th aboard the USS *Midway* off the Atlantic coast. And yet another will be used in the F-86E, North American's advanced version of the Sabrejet.

The J-47-17, first jet engine with an electronically-controlled afterburner, accumulated extensive time in flight operations, and was well-established in production. This engine powers the North American F-86D interceptor. The J-47 is to be followed by the new J-73 series, on which development was completed in 1952. With considerably more thrust than the J-47 and lowered fuel consumption, it is the most powerful G-E jet engine ordered by the Air Force on a production basis. The J-73's first application will be to power North American's new fighter-bomber, the F-86H.

Though it has the same frame size as the J-47, it has enough extra thrust and a lower rate of fuel consumption per pound of thrust—that G-E engineers stated it was not even in the J-47's class. Improved performance was achieved by means of a higher flow of air per unit frontal area, a higher cycle pressure ratio, and excellent turbine efficiency.

Another production advance was the development of fabricated stator blades for the turbojet compressor. This technique not only speeded up production, but made a substantial cost reduction in blade manufacturing and released an appreciable amount of critical forging capacity to make other parts.

Vertical assembly of jet engines was introduced in 1952 as a common practice in G.E.'s plants at Lynn, Mass., and Evendale, Ohio. Standing the engines on end—rather than assembling them in a horizontal position—eliminated any possibility of sag.

Fortress-like test cells were constructed to meet higher sound levels and more intense turbo-jet exhausts in engine testing. Sound levels were reduced 50 percent. Engineers, seeking materials which could withstand higher temperatures, developed a special cement which also was found to have sound-absorbing qualities. An experimental test cell was tested at the Lynn plant and served as the model for the 33 test stands built at Evendale to meet increased Air Force engine production requirements.

An instrument-laden control room, which literally floats on a cushion of rubber and is surrounded completely by a blanket of air, was put into operation at the Evendale testing area. The "floating" control room records every phase of a turbojet engine's performance, and serves adjacent super-cells where new engines under development are put through their paces. Suspension of the room on rubber and cushioning it by air from the cells reduces sound and minimizes the possibility of instrumentation errors through vibration.

Though production, engineering and executive headquarters for Aircraft Gas Turbine Division were officially centralized at Evendale, Ohio, in March ceremonies, the Company continued its production of aircraft turbojet engines, turbosuperchargers and other accessory turbine products at Lynn, and Everett, Mass.

At Lynn, the Accessory Turbine section was established in July to handle the development, manufacture and sale of aircraft accessory equipment such as gas turbine starters, reheat fuel pumps, turbosuperchargers, impellers and air turbine drives. One of the section's newest products is a small airborne gas turbine, which could start a jet engine without the aid of ground power units.

The principal advance during 1952 in aircraft electrical systems was in the application of a-c power to a number of new aircraft by the Company's Aviation Division engineers. Integrated control panels were developed to provide exciter ceiling, overvoltage, differential, and underfrequency protection for a new line of three-phase a-c generators and static (magnetic amplifier) voltage regulators. Increased demands for a-c power resulted in the successful development of necessary components to provide coordinated and reliable systems. Further developments, such as selective overvoltage protection for parallel systems, are in process.

Also, G.E.'s Aviation Division revealed that development work is being done on electrical power systems for jet transports. This work is being done in cooperation with several airlines and aircraft companies.

Aeronautic & Ordnance Systems division began delivery Sept. 1st of armament systems for B-47 Stratojets.

The G-3 automatic pilot was also developed by Aeronautic & Ordnance Systems engineers. The device was described as a major step toward complete push-button control of high-speed jet interceptor planes, since it controls the plane with accuracy and stability at near-sonic speeds, and can be used in such maneuvers as gunnery runs on enemy aircraft. It was developed by G-E engineers with the cooperation of the Navy's Bureau of Aeronautics. It is designed for use in such Navy jet fighters as the Douglas F3D-2 Skyknight, the Grumman F9F-5P Panther, and the Douglas A2D attack plane.

An intensive standardization program, coupled with engineering improvements in certain G-E aircraft instruments was initiated. Typical of this standardization drive is the aircraft tachometer generator, with the number of models reduced from 102 to 2, without impairing product quality. Aircraft speed indicators and position indicating systems also were standardized.

A new general-purpose hermetically-sealed relay for use in aircraft, shipboard and portable land-based electrical systems and electronic equipment was announced by the G-E Control Department. The relay, conforming to Air Force-Navy Aeronautical Standard AN-3304, resists all harmful atmospheric conditions, including widely varying air pressures.

Several far-reaching steps were taken by the Lamp Division to break production bottlenecks, standardize military items, and effect considerable savings to the taxpayer. The division announced that two years of research had produced a method for automatically manufacturing a tiny lamp bulb, designated No. 327, required in the millions by America's expanding air forces. Hitherto painstakingly constructed by hand under ten-power magnifying glasses, the lamp is used to illuminate the hundreds of instruments and controls in the modern military plane. The average fighter plane employs 150 to 350 of the bulbs. As a result of this changeover from manual to automatic production, G.E. has been able to save the Government from $10 to $25 per plane for one set of these tiny bulbs.

Electronics Division came forth with several contributions to the aviation industry. The first was a small automatic radar, which helped give U. S. jets a shooting edge in Korea. Use of the radar in Korea represents the first combat application of precision radar to direct the firing of weapons from jet fighter planes.

Electronics engineers developed an electronic "finger," which could detect dangerous atomic radiation in planes flying over A-Bomb blast sites. Technically known as the ion chamber, the device was incorporated into two different detection systems built by G.E. at its Electronics Park plant in Syracuse, N. Y. One unit measures radiation intensity on the ground at atomic blast sites. The second unit is used as a protective device in research planes flying over the blast area.

General Electric now operates two Flight Test Centers for research and development of aircraft equipment. The Company added a flight test operation at Edwards Air Force base in California to its existing flight test facilities. Additional engineering personnel (including a pilot) were added to measure the performance of a North American F-86D, under Air Force bailment agreement. In Schenectady, at the company's Flight Test Laboratory, testing operations make use of flying test beds such as the Boeing B-29, and a North American B-45, to test production and development engines. Also, during the year a B-25 was put into operation as a flying laboratory for autopilot developments.

G.E. continued its top-secret development of an atom-powered engine, designed for the airframe now in development at Consolidated Vultee.

Two modified G-E turbojets power the world's largest helicopter, the XH-17, built by Howard Hughes Aircraft Company for the Air Force. The XH-17 is a cargo carrier, for which G.E.'s General Engineering Laboratory at Schenectady performed early power plant development work. Aimed at short-range moving of heavy military equipment such as tanks and trucks, the carrier underwent extensive ground testing. Its blade tips (housing jet burners) were designed and built by the Laboratory's Thermal Power System division. Engine tests were made at Schenectady Flight Test Center.

M. W. Kellogg Co.

Major emphasis was placed, during 1952, on improving the safety and reliability of a liquid propellant aircraft rocket engine being developed for the Air Force by the M. W. Kellogg Co. The non-spontaneous combination of nitric acid jet engine fuel, used in this engine, has been found to require high speed precision flow controls.

Further technical advances were made in the field of high-powered midget-sized turbo-pump assemblies for supplying propellant to the rocket thrust chambers. Improved impellers, seals, bearings and speed controls were developed. Experimental models of gas generators, utilizing normal rocket propellants, to supply the turbine drive were operated satisfactorily.

Successful firing demonstrations were made on short-duration, liquid-propellent missile boosters with thrust output considerably greater than that of the German V-2.

For the development of cheap, mass-producible rocket thrust chambers, research effort has been concentrated on erosion-resistant, high-temperature, refractory liners and nozzles.

During the past year, the M. W. Kellogg Company assumed a major role in the design and production of solid propellant rocket propulsion units for guided missiles. A number of these rocket powerplants are now being successfully flown in development and service tests at remote proving grounds of the Armed Services. Powerful booster rockets, used to accelerate missiles from standstill to supersonic speeds in a few seconds time, were produced in service quantities in the Jersey City shops. Rockets of lower thrust used as prime powerplants for smaller missiles, or to sustain the velocity of certain missiles after the boost period, were also produced. Propellant development, loading and static firing tests have been conducted by other coordinating agencies; the Allegany Ballistics Laboratory of Hercules Powder Company; Picatinny Arsenal, Thiokol Corporation, etc.

Design studies were continued on advanced rocket units for tactical application. New fabrication techniques, heat treatment and final sizing methods for the metal cases, nozzles and end closures were developed. Investigation was pursued on high strength non-metallic materials and methods of employing these in rocket case fabrication.

A re-engineering and expansion of fabrication facilities, plus the addition of higher capacity machine tools, automatic welding equipment and specialized heat treating rigs has resulted in a considerable increase in the rocket production capabilities of the Jersey City plant during 1952.

Pratt & Whitney Aircraft Div.
United Aircraft Corporation

During 1952 Pratt & Whitney Aircraft embarked on a program to develop and build ramjet engines to power several types of Navy guided missiles. This new project, added to the work on a nuclear-powered aircraft engine for the Air Force, enlarged Pratt & Whitney Aircraft's activities to embrace all four of the basic types of air-burning aircraft powerplants.

The J-57 axial-flow jet engine, whose thrust rating is still officially restricted, but which is described as one of the most powerful jet engines now flying in this country, moved from the experimental flight-test stage into the powering of all-jet aircraft which had been designed specifically around it. Within three days of each other, in April, both the Boeing prototype B-52 and the Convair B-60 made their successful maiden flights, each of them powered by eight J-57s.

By the end of the year, Pratt & Whitney Aircraft was well along towards quantity production of the J-57 for deliveries scheduled commencing in the spring of 1953. Substantial quantities of prototype engines have already been delivered.

The 5,700 hp T-34 axial-flow turboprop engine, a powerful single-unit engine, also progressed through further development and improvement during the year and preparation for production of this engine in limited quantities was also in process. Both the Air Force and Navy have selected the T-34 to power prototype turboprop-equipped transports, which are expected to make their appearance in 1953. These are the Douglas C-124B, with four T-34s replacing the four Wasp Majors, and the Lockheed R7V-2, with four T-34s replacing the Wright R-3350 compound engines.

Work on extending the capabilities of the J-48 centrifugal-flow jet engine also continued during the year. In April the company announced that an improved version of this engine, with a great deal more thrust than the basic 6,250-lb. dry rating, had been tested and production deliveries were started in September. Production of J-48s rose steadily in volume during the year, with three versions of the engine being delivered. One version went to Grumman to power the Navy's F9F-5 Panther and a swept-wing development of this design, the F9F-6 Cougar. Later in the year the Cougar passed its carrier-qualification tests and was described by the Navy as being in the "over 650 mph class." Another version of the J-48, with an afterburner of Pratt & Whitney Aircraft's design, powers the Lockheed F94-C Starfire, the Air Force's newest all-weather interceptor.

Construction of three additional high-altitude engine test cells at the company's Andrew Willgoos Turbine Laboratory was begun during the year, as well as a large addition to the hangar facilities at Rentschler Airport to provide more adequate shelter for servicing and modification of the large aircraft now involved in the company's experimental flight test program.

At the East Hartford main plant, assembly of J-48 Turbo-Wasps, R-4360 Wasp Majors and R-2800 Double Wasps flowed at a steadily accelerating pace to meet the stepped-up schedules of this country's rearmament program. Two significant production milestones were reached during the year: in February, total engine horsepower delivered by the company since its founding reached 200 million, exclusive of spares and not counting World War II production by P&WA licensees or the Pratt & Whitney Aircraft Corporation of Missouri; and in July the 10,000th Wasp Major was completed.

An important contribution to this expansion of production was made by P&WA's network of over 5,200 subcontractors and suppliers. Of every dollar paid for Pratt & Whitney Aircraft engines, 50 cents went to the company's subcontractors and suppliers.

Employment rose to nearly 30,000 by the end of the year as three-shift production on a lengthened work-week schedule continued through almost all of the year.

The expansion of potential productive capacity for Pratt & Whitney Aircraft engines neared completion at the end of the year. The company completed a construction program begun in the spring of 1951 that added more than 1,000,000 sq. ft. of production area to its previous 2,500,000 sq. ft.

Meanwhile, during these branching-out operations, a widespread rearrangement and extensive retooling of the main East Hartford plant was being carried out and by the end of the year the main plant was in the main converted for jet production.

A further move to increase the company's engine-making capacity was the completion of eight new 20-ft. square test cells designed to handle the largest jet and turboprop engines which are currently in prospect.

OF THINGS TO COME

Clarence Chamberlin in 1928 had this to say about Germany's potential as a military air power: "Certain it is that a great industry in commercial aeronautics with its trained men, its specialized factories and its perfectly equipped airdromes, could very quickly be turned to production of war types if the nation's life were at stake. And there is nothing in the Versaille Treaty to bar Germany from having airplanes as she chooses. A reasonable guess would be that these not only exist but are kept up to date if not even a few laps in advance of other European powers."

—Record Flights, Clarence D. Chamberlin, Dorrance & Co., Inc.

Reaction Motors, Inc.

Reaction Motors, Inc., the oldest American designer, developer, and producer of liquid propellant rocket engines and allied equipment, was eleven years old this December. In the short time since its incorporation RMI has grown from four to approximately 650 employees.

Since its founding RMI has achieved many of the significant rocket-powered speed and altitude records. In October, 1947, the RMI rocket-powered Bell (Air Force) X-1 airplane first propelled man faster than the speed of sound. The same series of RMI 6,000 pound thrust rocket engines which powered the X-1 has since powered the Douglas (Navy) D-558-2 to a world speed and altitude record for piloted aircraft of 1,238 miles per hour and 79,494 feet. Engines in this same series power the Bell (Air Force) X1-A and the Republic (Air Force) XF-91 interceptor type airplane.

Last year the RMI rocket-powered Martin (Navy) Viking high altitude rocket sounding missile climbed to an altitude of 136 miles and reached a maximum speed of 4,100 miles per hour—both world's records for single stage missiles. RMI rocket engines also power the Consolidated Vultee (Air Force) MX774 high altitude rocket sounding missile and the Fairchild (Navy) Lark subsonic missile.

Westinghouse Electric Corp.

Expansion of plant facilities and an accelerated program for development and production of equipment for aircraft and airborne operations highlighted the 36th year of Westinghouse activity in the aviation industry. It is significant that aviation business now represents the largest single industry activity of the company.

Westinghouse recently announced that an air-arm division had been set up to consolidate the airborne armament activities of the company. The division is headquartered at Friendship International Airport, Baltimore, Md., in a new 425,000 sq. ft. building, housing offices and an engineering laboratory in addition to the manufacturing plant. The new division is devoted to the development and production of electronic and airborne equipment, including Navy and Air Force computers to direct gun and rocket fire, radar and autopilots for fighter planes and guided missiles, and complete airborne armament systems.

Construction is now underway on a $20-million plant in Columbus, Ohio, that will produce assemblies for jet engines. The new building, having 1,900,000 square feet, is the largest single plant yet built by Westinghouse. The Columbus plant will serve as a feeder plant to the existing 86-acre final assembly plant for Westinghouse jet engines located at Kansas City, Mo.

In September, 1952, the Navy and Westinghouse announced that Westinghouse had developed and placed in production one of the world's most powerful qualified turbojet aircraft engines, the J-40 with afterburner. Although its rating was not revealed, it develops thrust equivalent to approximately 25,000 horsepower at today's flight speeds. The engine is of the axial-flow type, a Westinghouse design feature since the company pioneered jet engine development in this country more than ten years ago.

Several new Navy fighter planes are expected to be powered by the new engine, including the McDonnell F3H Demon and the Douglas F4D Skyray.

Retooling necessary to produce the J40 at Kansas City is nearly complete and production will be underway before the end of 1952. When J40 production starts, it is expected that 5,000 new employees will be hired to supplement the present force of about 2,600. An additional million square feet of floor space will be utilized, bringing the plant space at Kansas City to about 2,650,000 square feet.

Production of the Westinghouse J34 continues at the Kansas City plant. Significant of the durability characteristics of the J34, was the performance of J34-powered Banshees in Korea during 1952. The Banshee has been used extensively by the Navy in Korea and there are several cases on record of Banshee engines being shot up or contaminated by foreign material going in the inlet, without preventing the plane from returning to its carrier.

The Westinghouse flight testing program got under full sway during

1952. There are two F3D-2 Skyknights being flown by Westinghouse flight test personnel at the base at New Castle County Airport in New Castle, Delaware. A North American Tornado B45 bomber is being specially fitted as a flight test-bed and will be in use at the test base in the near future. The F3D Skyknights will be used to flight test the Westinghouse J34 and J46 engines and the B45 will fly with the larger J40 engines. The base is completely equipped with aircraft, personnel, maintenance equipment and hangar space to carry on a fully coordinated flight test program.

The first automatic pilot with unlimited maneuverability has been installed in the F-94C Starfire jet warplane recently announced by Lockheed. It was developed by the Westinghouse air-arm division in cooperation with the Air Materiel Command's Armament Laboratory. The automatic pilot utilizes three "non-tumbling" gyroscopes that are locked to the plane.

These gyroscopes, each spinning at 12,000 rpm, follow the plane's movements during all maneuvers without any possibility of tumbling. They differ from the ordinary "position" gyro that is not locked to the plane and hence resists any effort to change its direction of motion. Whereas former gyros were sensitive only to changes in angle of the plane, the new autopilot equipped with "rate" gyros responds to the rate at which changes take place.

The autopilot is suitable not only for military aircraft, but also for large and small commercial planes. Radio-controlled, it can also serve to direct the flight of guided missiles and pilotless aircraft.

The aircraft department of the small motor division, headquartered at Lima, Ohio, recently announced the development of a new magnetic amplifier voltage regulator suitable for use with aircraft narrow-speed-range a-c generators. The unit, identified as the Westinghouse Type AVR-22 MAGAMP Regulator, is completely static, contains no electron tubes, hot-wire tubes, or cold-cathode gaseous tubes of any type, and can be used as a direct replacement for carbon pile regulators now in service with conventional 400-cycle a-c generators.

With no changes in internal wiring, the regulator is equally applicable to either a 208-volt wye-connected system or a 120-volt delta-connected system. Although requiring no shock mounts or vibration isolators, operation is not impaired by shock up to 30 g's or vibrations causing accelerations up to 10 g's.

The MAGAMP regulator was developed to meet military specifications for aircraft a-c generator-regulator systems.

Early in the year, the ordnance department of the transformer division, Sharon, Pa., announced completion of U. S. Air Force acceptance tests on a new radio control for an airborne lifeboat that can be dropped by parachute from an airplane and unerringly guided to survivors in the water. The electrical control system used the radio signal from the air to control the engine and equipment for driving and steering the boat.

After the 30-foot-long craft is dropped by parachute into the sea from the rescue airplane, radio signals at five different frequencies take over complete control in individual stages.

The electronics division announced last year the development of the Rho-Theta Transponder to improve airfield traffic control. The Transponder not only permits an air-traffic officer in an airport tower to positively identify each plane he sees on his radar screen but the planes show up at greater range and at lower altitudes. The Transponder is mounted in the plane.

When the plane antenna receives a radar pulse from the tower the energy received is automatically amplified, its frequency changed, and a generated pulse sent back in the direction of the received radar signal. This signal is much stronger than a reflected signal. When the pilot of a certain plane is asked to identify himself, he presses a button, which causes the Tranponder to send out a double set of pulses so that his "dot" becomes two closely spaced dots on the radar screen.

The aircraft department of the small motor division has developed a new temperature control unit to regulate the application of power for de-icing airplane windows. The sensitive electronic controls are hermetically sealed in inert gas. The entire unit is supported on shock-absorbing mounts and functions normally throughout a temperature range from —65 degrees C to +71 degrees C, and does not change calibration when subjected to humidity or actual condensation of moisture.

The motor and control division at Buffalo, New York, continued the development and manufacture of selenium rectifier units for converting a-c power to d-c in aircraft. These units, despite their light weight, have a continuous output of 200 amperes at 28 volts. Each unit, weighing only 72 pounds, contains a three-phase transformer, and a saturable-core reactor and carbon-pile regulator to maintain voltage constant. At normal input voltage the output voltage is constant to 200 percent load. The unit uses high-voltage (33-volt) selenium cells and is fan-cooled.

PROPELLER MANUFACTURERS

Hamilton Standard Division
United Aircraft Corporation

During 1952, Hamilton Standard completed one of the largest moving operations in industrial history, and by the year's end had settled down to full-scale manufacturing operations in a new, larger plant at Windsor Locks, Conn. Its old quarters at East Hartford fourteen miles away were turned over to Pratt & Whitney Aircraft division for the latter's expansion program.

Of major importance to the division during the year was its continued heavy commercial backlog for propellers. Approximately 30 airlines throughout the world purchasing new airplanes during 1952 specified the division's 43E60 reversing Hydromatics for all their Douglas DC-6A's and DC-6B's, Martin 404's, Convair 340's, and Breguet 763's; the 22D30 Hydromatic for Beech D-18's, and the 34D51 reversing Hydromatic for SAAB Scandias.

In addition, almost all Lockheed 1049 Constellations and Super Constellations ordered by the airlines during the year will be equipped with the 43E60 reversing Hydromatic.

The commercial backlog received an additional boost with selection of the division's 34E60 reversing Hydromatic for the 58 Douglas DC-7's ordered by American, United, National and Delta Air Lines.

In the military field, propellers were in production for the Chase C-123, Beech T-36A; Lockheed R7V-1, C-121C and other versions of the Constellation; the R6D and C-118 versions of the Douglas DC-6; the Boeing KC-97F, the Fairchild C-119C, C-119F and R4Q-2 versions of the Packet; the North American AJ-2; Lockheed P2V-5; Chance Vought F4U-7 and AU-1 Corsair, Grumman AF-2W, AF-2S, S2F-1, UF-1 and SA-16A; Consolidated Vultee C-131A, and T-29B, C and D.

The division's Turbo-Hydromatic line of propellers was selected for one of the military transports for which turboprop installations were scheduled —Navy's Lockheed R7V version of the Constellation. A three-bladed Turbo-Hydromatic for the Lockheed airplane was scheduled to start down the division's production line early in 1953.

Hamilton Standard's growing line of accessory equipment found increasing acceptance during the year. The division announced the start of production on a new type of aircraft hydraulic pump whose first installation would be the Chance Vought F7U Cutlass.

Starters for some of the nation's largest and most powerful turbojet engines also joined the production lines as the Air Force selected the Hamilton Standard products for the Boeing B-52 and Consolidated Vultee B-60 heavy bombers, and Consolidated Vultee F-102 fighter.

Installations of various versions of the division's air conditioning and air cycle refrigeration unit rose to eight and included the North American F-86D, F-86H and FJ-2 Sabrejets, Lockheed F-94C, Chance Vought F7U, Douglas F4D, McDonnell F3H fighters, and the Consolidated Vultee R3Y.

Fuel controls were specified for the Pratt and Whitney J-57, which powers the Boeing B-52 and Consolidated Vultee B-60 bombers.

In addition, the division completed arrangements with the Plessey Corporation, Ltd., of England, to manufacture the latter's liquid monopropellant starter under license in this country. The licensing arrangement was expected to round out Hamilton Standard's coverage of the jet engine starter field.

Note: Also see Curtiss-Wright Propeller Div., page 133.

ACCESSORY MANUFACTURERS

Advance Electric and Relay Co., at 2345 Naomi St., Burbank, Calif., progressed steadily during 1952 in the field of hermetically-sealed relays for use in aircraft, radar, radio, and other type of electronic equipment. Established in 1915, the company's primary target has always been to create and produce outstanding relays of every type for every application, to assure efficient relay performance, reliability, ruggedness and economy.

Aircraft Radio Corp. in Boonton, N. J., continued developing navigational receiving equipment during the year. The company developed the Type 15D for static-free communication and navigation facilities. Light and small, it can be used for flying any desired track on the new VHF "omni" ranges, for obtaining a precise "fix" on two or more omni stations, for making a runway localizer approach, for flying the fixed track on the VHF visual-aural system, for reception of weather and other voice signals on the same frequency that localizer or range signals are being received, for receiving VHF signals from the ground during a GCA operation, or for receiving VHF signals from airway stations or control towers. The Receiver is a *tunable* unit which covers the entire band allocated to these services.

A VHF Transmitter is not part of Type 15D, but provision has been made for powering one or more A.R.C. T-11 or T-13 VHF Transmitters from an outlet on the front of the Receiver. Each added Transmitter weighs 3.4 pounds complete with crystals and shock-mounting, and provides 5 crystal-controlled frequencies within a 2 mc spread. Thus it is possible to obtain say 15 channels in three Transmitters at a cost in weight of 10.2 pounds.

AiResearch Manufacturing Company, a division of The Garrett Corporation, 9851 Sepulveda Blvd., Los Angeles, has continued in research, development and manufacture, in the fields of pressurization and air conditioning, aircraft auxiliary power and specialized aircraft accessories. AiResearch designs and manufactures equipment in the following specific categories: cabin superchargers, air turbine refrigeration, electric actuators, cabin pressure controls, electronic controls, temperature controls, heat transfer equipment, gas turbines and pneumatic power units.

Most of the equipment used by high speed, high altitude military and commercial aircraft in those lines is supplied by AiResearch in Los Angeles and the newest division of The Garrett Corporation, AiResearch Manufacturing Company of Arizona, in Phoenix. One or more of the 750 items which AiResearch developed and manufactured are now used on 150 models of aircraft, jets and missiles now in production.

AiResearch keeps ahead in the development, research and manufacture required from the constant new extremes in altitude, speed, temperature and pressures being met by aircraft today and can supply integrated systems in the fields of cabin pressurization and pneumatic power. AiResearch products are supplied individually or grouped together into entire systems.

AiResearch Cabin Superchargers are the heart of the pressurization systems. They scoop up thin air at high altitudes, compress it into breathable densities and discharge it into cabins and cockpits so that occupants may enjoy low level comfort.

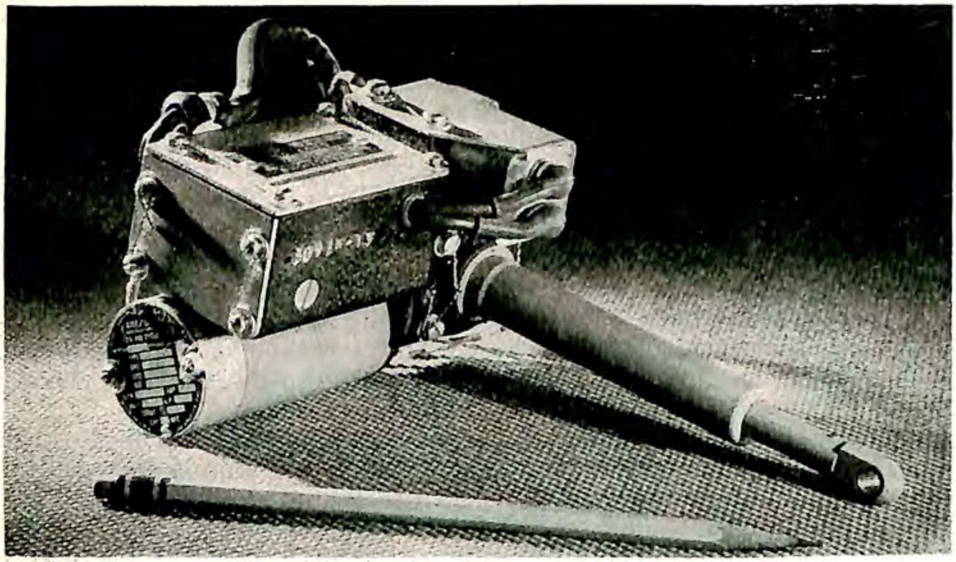
AiResearch Turbine Refrigeration Units cool the hot air from superchargers—dropping the temperature as much as 600° F, with 2/10ths of a second so that comfortable and livable temperatures can be maintained in the cabin and cockpit. These tiny units utilize the air expansion cooling principle and perform the same chore as the total cooling capacity of 40 home refrigerators. AiResearch water seperators take moisture out of the air that is destined for the cabin, so that humidity is assured.

AirResearch Air Valves control air flow in the aircraft ducting so that proper pressures are maintained to all operating power units. They control the mixing of hot and cold air to obtain the desired temperatures. They give the pilot manual-shutoff-control so he can override his system whenever it is required. AiResearch valves and controls perform every air control function that is required in all turbine propelled aircraft.

AiResearch Air Valves control air flow in the aircraft ducting so that of pressurized air from cabins and cockpits and, thus, maintain preselected pressures at all times. Ambient (or outside) pressures may vary tremendously within a very few seconds during a high speed climb or dive and the regulator must maintain the proper balance between the interior and outside air to prevent stressing of the aircraft structure, and to keep the safety and comfort of the passengers and crew secure. AiResearch cabin safety valves monitor the cabin and cockpit pressures as a safety device and prevent excessive buildups of pressure. These are either automatic or manually operated as either dump or safety valves.

AiResearch Electrical Power Systems control many vital coordinated movement functions for the modern aircraft. They operate and control such functions as the setting of the landing flaps (air brakes), cowl flaps (engine cooling), and jet inlet air screen systems (which prevent foreign matter from entering the intake duct). AiResearch floating control thermostats control the oil temperatures in the engines of a high percentage of all U. S. aircraft. This thermostat maintains the oil temperature at operating efficiencies and prevents overheating. Aircraft engines cannot operate when oil temperatures exceed design limits.

AiResearch electric actuators are the muscles of the airplane and of all the auxiliary equipment on the airplane. Torque actuators supply "twist-turn" power movement and linear actuators transmit "push-pull" power movement. These units position valves, control surfaces, and every movable control function of the airplane and require only that the pilot push a button or flip a switch, or they operate completely automatically to maintain preset or preselected conditions. To power these units, the company manufactures its own fractional HP electric motors.



AiResearch motor driven linear actuator

AiResearch non-jamming actuators employ special torque bars that absorb the jam shock at the end of the actuator stroke and store up energy like a spring for the return stroke. The effect is to eliminate an internal jam and initiate positive action in the opposite direction. It is critical to high speed aircraft, where a momentary jam would throw the airplane completely out of control.

AiResearch Electronic Controls measure temperature faster than a man's brain can recognize the pain of his finger seared on a hot stove. This was developed to control the extreme temperature variations encountered in today's high speed, high altitude aircraft. In an airplane climbing from sea level to 40,000 feet, or diving at supersonic speeds, ambient temperature variations of approximately 166° F, may be encountered in a few seconds. The electronic regulator maintains temperature within the airplane preselected by the pilot. This same control is utilized in many other places where extremely sensitive temperature control is desired, such as in oil, fuel, and engine temperature control regulation. The company also manufactures electronic computers, positioners and syncronizers.

Air to air, air to fuel, oil to air, and oil to fuel heat exchangers transfer heat and cold from one element to another in a multitude of applications, all critical to the operation of the aircraft. These units use ambient air to cool extremely hot air in the airplane refrigeration system; they use fuel to cool hot oil; they transfer heat and cold through thin walled tubes with extreme efficiency wherever it is required in the airplane.

AiResearch gas turbine compressors were the first of this type unit to be developed and accepted by the government. This new concept and entirely new field of auxiliary power for aircraft has been pioneered by AiResearch and the company has cooperated closely with the government in design, development and manufacture of this equipment which is extremely vital to the mobility, flexibility and range of the modern Air Force.

These auxiliary power units, about the size of a standard suitcase, consume the same fuel as a jet engine and supply quantities of compressed air that are utilized to heat the airplane while on the ground, cool it, start the engines, and supply all other auxiliary power requirements of the airplane, even though the main engines are in-operative. This small unit replaces heavy and cumbersome ground equipment and allows the aircraft to carry its own ground service to remote bases where standard power equipment is unavailable.

Other pneumatic units in a complete system, such as gas turbine shaft power units, combination compressor and shaft power units, air turbine starters for cranking jet engines, and air turbine motors and gas turbine motors (used for converting power to required mediums) have also been pioneered by AiResearch.

New laboratory facilities were completed at the Phoenix manufacturing division during the year. These are being primarily used for the production of gas turbine and pneumatic equipment and will relieve the load on the Los Angeles facilities, giving more time for creative work.

The AiResearch high altitude laboratory is one of the most completely equipped laboratories of its kind for testing high altitude flight conditions on the ground. Here actual flight conditions—both inside and outside an airplane—can be simulated for the testing of AiResearch equipment. It can simulate altitudes as high as an airplane can fly and go down as low as 1500 feet below sea level. Lab facilities encompass over 100,000 sq. ft. include 29 turbine test cells, scores of other research installations and can produce conditions in excess of all present requirements as well as those projected into the future for several years to come.

All incoming materials are subjected to the most rigid series of tests developed in order to determine that they will heat-treat properly, will mill properly, will cast properly, and will withstand increasing requirements for temperatures as high as 1750° F, down to below 100° F. Unusual testing apparatus, such as the nicro-hardness tester, tests the hardness of metals—often no thicker than one thouandth (.001) of an inch—ranging from soft plastics to super hard diamonds. Supercharger impellers and turbine rotors are whirled in concrete pits as fast as 160,000 rpm. Actuators and motors receive 17 environmental tests in order to determine dependability and ruggedness. There are breakdown tests and other severe ordeals that machinery must pass in order to determine the change in structure of metals.

Aluminum Company of America, Alcoa Bldg., Pittsburgh, Pa., continued in the spirit of research and development in 1952 by announcing over half a dozen new aluminum products, processes and new equipment installations significant to aircraft manufacturers.

Almost all of the developments were characterized by emphasis upon three things: lighter and larger one-piece airplane sections, faster production, close tolerances resulting in less expensive and time-consuming machining operations.

One product is wide, ribbed extrusions. Alcoa gains extra width by extruding aluminum billet into a V-shape and then flattening to guaranteed tolerances. Maximum width at the present time for Alcoa's ribbed extrusions is 27 inches, but when a giant new extrusion press installation is completed in 1953 the maximum width will increase to 34 inches. (Ninety feet is the standard maximum length for all heat-treated extrusions).

The giant new 13,200-ton extrusion press which has been leased to Alcoa by the U. S. Air Force will be capable of extending present extrusion limits not only in wide, ribbed extrusions but also in the more conventional type extrusions used for airframe construction.

With the new press, and new 3-million pound stretcher which is also being installed, the maximum length for heat treated and stretched extrusions will remain at 90 feet, but present limits will be considerably extended in other respects.

Another technological advance, Alcoa's development of *tapered sheet and plate,* resulted in 1952 in plans for a new $4.5-million rolling mill capable of producing extra wide tapered sheet and plate at the company's Davenport (Ia.) Works. Alcoa already has produced relatively large quantities of tapered sheet and plate in widths up to 67 inches and lengths up to and even slightly more than 300 inches, and on the new 144-inch, 4-high, hot and cold reversing mill the company will roll tapered sheets 10 feet wide and in lengths exceeding 400 inches. Supplementary facilities to the rolling mill include an intermediate leveller and pre-heat and aging ovens.

The F-89 and B-47 are outstanding examples of production military aircraft using rolled tapered sheet. The Convair 340 was the first commercial transport to utilize it.

A new aluminum aircraft alloy was also developed by Alcoa and made available for sheet, plate and extruded shapes. Late in 1952 Boeing advised the company that it had completed its tests on high-strength XA78S aluminum alloy and was approving the new alloy for sheet and extrusions in new airframe designs.

XA78S resulted from a modification of the same alloy constituents that were so successfully combined to produce aluminum alloy 75S, the alloy designed expressly to meet the needs of the aircraft industry back in 1944. Both 75S and XA78S are of the aluminum-zinc-copper-magnesium family of alloys, but XA78S is approximately 10 percent higher in tensile and yield strengths with about the same elongation and fatigue properties.

A 15,000-ton forging press has been added at the Cleveland Works. Among the significant advantages which this press will offer to designers are possibilities for the production of large forgings with thin webs and flanges, small draft angles and fillet radii. Such precision forging can eliminate, in many instances, the necessity of complex and expensive machine operations which have been required heretofore on large forgings simply for the purpose of removing unnecessary metal to reduce weight.

Alcoa has installed more than a million dollars' worth of new die sinking equipment, including a huge double-headed die sinking machine capable of cutting steel die blocks up to 40 feet in length and 7 feet in width.

American Airmotive Corp., Miami International Airport, Miami Springs, Fla. is currently working on C-46 Secondary Firewall experiments. The company continued sales and services during the year for aircraft, engines, propellers, instruments, accessories, radio and components, aircraft parts and hardware.

The B. G. Corporation at 136 W. 52nd St., New York, continued manufacturing spark plugs, models RB23R and RB27R for extensive use on engines requiring long reach shielded plugs. These platinum electrode models are designed to furnish good nose scavenging to minimize the tendency toward lead fouling. The platinum electrode spark plugs assure improved lean mixture operation and more satisfactory cold weather starts. The model RB23R features a ¾-20 top to accommodate an altitude seal.

In the piston engine field, B. G. also manufactures long reach and short reach shielded and short reach unshielded spark plugs, as well as spark plug elbows, ceramic terminal sleeves, gap setting tools, spark plug test sets and ignition harness test sets.

In the gas turbine engine field, the corporation is concentrating heavily on developing igniters, thermocouples and thermocouple harnesses for all of the major gas turbine engine manufacturers. The latest development in igniters is in the field of semi-conductors for use in conjunction with low tension capacitance discharge ignition systems. To date, several successful models have been produced and are on test. This development also holds future promise for application in the piston engine spark plug.

In the field of gas turbine thermocouples and thermocouple harnesses, the B. G. Corporation has developed these items using a material which is especially resistant to failures due to excessive heat and vibration normally encountered in tailpipe areas. Through development over a period of the last two years, it has been possible to increase the life of the tailpipe thermocouples fifteen to twenty times. Development in this field as well as in the field of igniters, is continuing at a rapid pace.

For **Bendix Aviation Corp.,** 1952 was a year of greatly increased production. In addition to supplying the Armed Services, the Corporation's civilian customers continued to call on Bendix as their regular source of supply for a long list of products in the transportation and communications fields.

As a result, new Divisions, in new plants purchased by the Corporation, reached full production. The more important of these included: the Hamilton Division, of 175,000 square feet, purchased to expand the manufacture of fuel injection pumps and associated fuel control equipment for ai raft; the Utica Division, of 220,000 square feet at Utica, New York, purchased to expand output of aircraft starters, generators, electrical apparatus and gyros; the Montrose Division, occupying 100,000 square feet at South Montrose, Pa., purchased to expand output of aircraft and ordnance ignition equipment; construction of 120,000 square foot plant for the Red Bank Division at Eatontown, New York, to permit doubled capacity for the manufacture of small rotating electrical products such as motors, inverters, dynamotors. In addition, special purpose electronic tubes for aircraft and communications will be built in this plant.

Other construction involved a 70,000 square foot addition to the Bendix Products Division at South Bend, Indiana, for further expansion of production and research for jet engine fuel systems; an Engineering Building of 50,000 square feet to handle increased engineering loads at the Eclipse-Pioneer Division at Teterboro, New Jersey; a 100,000 square foot plant purchased at Mishawaka, Indiana, for the acceleration of activities on guided missiles; operations also began in a 60,000 square foot addition to the Pacific Division in North Hollywood, California, to increase production on electronic and sonar equipment.

During the past year the Bendix Products Division developed an entirely new brake lining material, a cerematellic structure, to meet the problems imposed by higher landing speeds; the greater gross weights of airplanes; and to give operating life five to seven times greater than resin base linings.

Bendix Cerametallic lining is a high temperature, resistant friction material. It contains no resin or organic ingredient—instead, the base is ceramic and is entirely stable at temperatures far above those encountered in the hardest usage. Mixed with powdered metals the material is compressed into shallow metal retaining cup and is then fired at high temperature.

The result is a brake lining made up of separate discs of friction material which fit into the brake stator with enough discs provided to supply the required area of lining. Discs may be replaced quickly when worn down.

Cerametallic lining is not affected by high temperatures which render inoperative resin base materials. It has been successfully tested at temperatures up to 2000° F.; conventional materials begin to break down at sustained temperatures above 700° F. The brakes do not "fade out" or lose friction even during long and hard applications; do not glaze with use and retain their friction effectiveness down to the last usable thickness of the material.

Bendix Products Division engineering, following its long policy of making ultimate engine performance its goal rather than simply development of accessories, has developed a modification of their electronic control, commonly called the "Knob Box," which made it possible to determine, and even draw out on charts during engine operation, the compressor stall characteristics as modified by fuel feed rate, engine speed, temperature and other determining characteristics. This converted what had been previously a baffling mystery into a clear-cut mechanical problem, and has greatly accelerated the development of new jet engines in America. This Bendix equipment was first applied in the Bendix Laboratories, then made portable in trucks and taken to the laboratories of nearly all the American engine companies. It is also being adapted for use in actual flight test with telemetering to the ground, following guided missile practice.

At the Bendix Eclipse-Pioneer Division delicate synchro type units—literally the heart of thousands of remote indicating and control systems in modern aircraft—were being produced at the rate of one every 20 seconds. In a single month alone, complete product shipments included, among others, more than 1600 electric gyro units, over 5000 carbon pile voltage regulators, nearly 10,000 remote reading pressure indicators; life sustaining oxygen regulators were produced in quantities exceeded only by the record months of World War II all-out production effort; the Division's 6000th military electronic automatic pilot was delivered, and delivery of the first mass-produced fuel-air combustion starter was made on November 1 for use with the Buick-built Sapphire engine.

All in all, production was expanded to a point where output of the Division's products rose to a record 514 percent of its June 1950, or pre-Korea level.

Culminating two years of development, an airspeed and mach number computer and indicator for use up to 150,000 feet pressure altitude was delivered to the Air Force by the Division's engineering forces.

Also, two new altimeters were designed to measure altitudes ranging from 25 to 95 miles into the upper atmosphere. One type was designed for operation between 150,000 and 300,000 feet; the other between 300,000 and 500,000 feet.

Great strides were made in the continuing attempts to reduce size and weight of aircraft equipment, and at the same time increase efficiency. For example, a new amplifier was developed for use with a single engine fuel flow totalizing instrumentation system. This amplifier was about ¼ the size and ½ the weight of previous models but had increased power output to overcome friction encountered in the indicator at very low operating temperatures.

A small motor generator, contained in a single small case was also developed. Weighing less than 3 ozs., it used a 2 phase, 400 cycle motor; generator output was proportional to motor speed. Pygmy Autosyn synchros made possible the design of a miniature combined indicator and amplifier for use in remote indicating systems for fuel flow, manifold pressure and torque pressure functions.

An hermetically sealed Magnesyn compass indicator was also designed and developed during the year. The sealing problem was complicated by the need for a manually operated course setter as part of the instrument. To maintain the seal and still allow knob motion on the outside of the case, a device which incorporated a wobble plate and an eccentric shaft was used.

A group of high-torque, spring-restrained motors was developed or use as valve actuators in guided missiles. The motors were designed to position the pilot valve in high performance, hydraulic servo systems. Motor characteristics included high natural frequency, linear displacement with respect to differential current, and low weight and volume. Several types ranging from 0.005 inch stroke and 2 pound-inches torque output to 0.032 inch stroke and 8 pound-inches torque output, were produced.

A new low drift hermetically sealed directional gyro indicator, capable of operation throughout an entire loop, was being produced for the Air Force.

An experimental model of a three-gyro platform to give space references relative to three axes was developed for the Air Force. This can be used as an attitude and directional reference in guided missiles and fighter aircraft, or as a complete sensing device for automatic pilots or remote indicators. Occupying one cubic foot of space and weighing 50 pounds, it is completely self-contained and can be hermetically sealed.

In the field of auto pilot engineering, an amplifier used for beam guidance was miniaturized and made more accurate, and a new automatic flight monitor and complete automatic flight system, the PB-10A, were under development.

The PB-10A automatic flight system, designed as successor to the PB-10 system, included many new features. The new amplifier and signal generator featured plug-in assemblies; the throttle servo was redesigned to enable one motor, removable without disturbing rigging, to drive all the throttles. A new controller greatly simplified the manual operations necessary to control the auto pilot. The system was designed to follow radio ranges and ILS systems.

Liquid oxygen converters, designed and developed at the Eclipse-Pioneer Division, were put into production at the Pioneer-Central Division. These converters which ranged in capacity from 5 to 25 litres, reduced the weight and space needed for oxygen equipment in aircraft to a fraction of former requirements.

New A-C generators, combination starter-generators, power supplies and controls, and a 3-power output inverter were also developed during the year. Additional electric power requirements brought on by the use of more radar and electronic devices in aircraft led to the development of a 15 kva A-C generator using the same 6½-inch diameter frame as the earlier 8 kva model. A compounding unit, wtih no rotating parts, and suitable for mounting at any convenient place in the airplane, was designed and built to replace the engine driven D-C generator formerly used for excitation. The 15 kva system weighed only 10 pounds more than the 8 kva generator.

A starter-generator was designed and built to yield high horsepower-to-weight ratios. By allowing the voltage to rise above normal starting values, 95 horsepower was made available for starting. Generator output was 30 volts and 500 amperes. An engine driven generator was also developed to provide a source of ground power for the starter-generator.

For use in aircraft electrical systems incorporating large generators and starter-generators, a shuntless current and voltage regulator circuit was designed and built. The new system required 15 watts for operation as against 750 watts for an external shunt. Considerable savings were also effected in unit weight and cost.

An inverter with 3-power outputs was built during the year for missile applications. Input voltage to the D-C shunt motor which operated at 20,000 rpm was 27 to 29 volts. Outputs were: 200 volts, 4,000 cycles, single phase at 1.25 amperes; 200 volts, 4,000 cycles, single phase at 2.25 amperes; and 115 volts, 666 cycles, two phase at 0.326 amperes.

The Bendix Radio Division of Bendix Aviation Corporation continued producing a record volume of aviation communication equipment as well as military and commercial versions of radar.

Pioneer Airlines equipped their new fleet of Martin 202's with the Bendix TA-18 VHF Transmitter, the MN-85 Navigation Receiver, the MI-36 Public Address System Amplifier, as well as compass receivers. Braniff Airlines have been taking delivery on their new Convair 340's which will each be equipped with Bendix MN-85 Navigation receiver, TA-18 VHF Transmitters, MI-32 Multichannel Audio Amplifier, Public Address System Amplifiers, and MN-61 Marker Receivers. Braniff is installing throughout their entire fleet complete NA-3A Visual Omni-Range Navigation Systems.

The recently certificated helicopter service, New York Airways, has installed Bendix TA-18 VHF Transmitters and MN-85 Receivers for communications on its Sikorsky S-55 helicopters.

Bendix Radio has also been active in the executive aircraft field and has equipped several large fleets as well as many individually owned aircraft with TA-18 communication transmitters and NA-3A navigation equipment.

During the past year, Bendix Radio commenced delivery on the Ground Controlled Approach Radar which is currently under production for the Civil Aeronautics Administration. These units are of the latest type fixed GCA.

IRON MIKES

Clarence D. Chamberlin made the following observation about the automatic steering equipment he saw in operation aboard the Leviathan while returning from his New York City to Germany flight in 1927: "Some time when trans-Atlantic has become a commonplace thing, this (automatic steering device) will be worked out satisfactorily and airplanes will have their own iron mikes the same as vessels which ply the surface of the sea."

—Record Flights, Clarence D. Chamberlin, Dorrance & Co., Inc.

Bendix Radio recently developed a new "TVOR" Receiver which will be in production early in 1953. This unit, known as the MN-85DB, is specifically designed for reception of low power omni-range stations currently being installed at airports to provide low cost "terminal area avigation" and to supplement present Instrument Landing System facilities. The even 100 kilocycle channels between 108.0 and 111.9 megacycles formerly used for localizer channels are now used for this low power service.

At the request of the Consolidated Vultee Aircraft Corporation, Bendix developed a coupling unit which will permit multiple ADF receivers to be operated from a single sense antenna. This unit, known as the MR-91, has a small, one tube amplifier with a self-contained power supply and will be located where the antenna lead-in feeds through the skin of the ship.

Currently in the design stage is a new accessory unit for use with the MN-85 VOR Receiver. This unit will have two servo amplifiers, two power supplies, and two omni-converter indicators all mounted in a single ½ ATR housing. Although primarily for dual installations, the convenience of single packaged units may be utilized in single VOR Receiver installations.

Since Bendix began production of MN-61 Marker Receivers in 1945, 2000 of these units have been installed in aircraft.

In the field of guided missiles, the Bendix Pacific Division has developed and placed in quantity production the world's highest response electro-hydraulic servo valve. This device is used in several production missile types for activating control surfaces and other control applications. It develops over three horsepower output for an overall weight of some 2½ pounds. This valve is unique in that the bernoulli forces on the control pistons are compensated and permit a response of over 180 cycles a second. The design of the value is such that it is insensitive to high accelerations and thus provides a stable controlling device under the extreme operating conditions that are encountered in the flight testing of guided missiles.

A subminiature potentiometer has been developed at Pacific Division that is smaller than a man's thumbnail. This unit was developed to measure aileron deflection in extremely small scale flying models, in order to make practical the free flight testing of these models to obtain aerodynamic data that cannot be obtained in a conventional wind tunnel. Work along these lines has also led Pacific Division to develop a miniature vibration pick-up using barium titanate crystal clusters. The object of this device is to obtain acceleration and vibration data from missiles or small scale models of full size aircraft.

The Pacific Division has at the request of the Armed Services made a series of design changes in the APS-42 radar to increase its reliability, simplify maintenance and improve the performance.

The Pacific Division also developed a small motor-driven hydraulic pump and actuator assembly to be used in applying hydraulic pressure to a brake to lock gas turbine rotors in flight and prevent them from windmilling.

One of the outstanding achievements at the Bendix Scintilla Division last year was the release of a dual circuit jet ignition system operating on 14 to 30 volts, 6 amps. (at 30 volts), weighing only 7 pounds. This is in contrast with the first system which required 15 amps at 30 volts and weighed 37 pounds.

The jet ignition systems are all of the condenser discharge type. The high tension units employ two specific types of electrical characteristic for each spark. A high voltage, high frequency, low energy spark forms an ionized bridge across the igniter gap over which a lower voltage high energy spark passes.

The first system, firing two igniter plugs, is called TEN-1 and has four separate units. The 24 volt current enters the system through a solenoid switch and flows through the suppression filter consisting of a choke coil and several condensers. The end use of this current is to power a dynamotor which in turn generates the 600 volt, d-c supply on which the system operates.

The first step in simplification of the circuit and thereby decreasing size and weight of the unit resulted in the TCN-3 design. This system has four high frequency circuits to supply two igniter plugs in the main burner and two in the afterburner. A solenoid switch makes it possible to route the discharge from the main condensers to either burner. The entire system, except the small final transformers, is contained in a single housing. The filter and relay circuits remain the same as TEN-1. The dynamotor is replaced with a vibrator and two transformers, one for charging the main storage condensers and the other for the high frequency circuit condensers. These raise the voltage to about the same value as was the dynamotor output, i. e., 600 volts for the large condensers and approximately 5000 volts for the smaller condensers.

The TCN-5 system represents the next step in this development. This unit is designed to fire two plugs and all circuits including final stage transformers are assembled in a single unit. Here the solenoid switch is rendered unnecessary by the lower current requirement. The same filter as well as the vibrator and two transformers are retained. The regulating resistor with its solenoid switch has been eliminated. Better insulating materials coupled with more compact design and packaging have reduced the weight to 10 pounds. The current demand has been reduced to 16 amps at 30 volts while the energy level at the plug has been maintained at .3 joules per spark.

The latest version of a condenser discharge type is the TLN-10, also supplying the spark for two igniter plugs. Development of an entirely new plug makes it possible to maintain a slightly higher energy value, approximately .4 joules per spark, at 1000 volts. The new plug design also obsoletes the necessity of a high frequency leader spark.

Shortly after being placed on the market by the Bendix Eclipse Machine Division, the Bendix Electric Fuel Pump, which was designed primarily for automotive use, attracted the attention of an engineering official of one of America's leading airlines. This official became intensely interested in this small, light, compact unit and arranged a test installation. Results proved most satisfactory. In addition to affording more efficient and trouble-free performance the current draw required was only ½ amp at 24 volts, as against a draw of 2½ amps required by the equipment previously used. Pumps were coupled in tandem and automatically cycled at a rate directly proportional to the heater demand and with one pump idle the other was capable of providing up to approximately 75 percent of the maximum output required. These advantages were crowned by a tremendous saving in cost—1/5 less than the cost of the equipment originally used.

Several other airlines have since adopted the Bendix Pump for the same job, on various types of ships, including many DC 3's.

The Boston Insulated Wire & Cable Company of Boston, Massachusetts during 1952 continued to manufacture and develop new electric cable for the aircraft industry.

BIW has made a determined effort to provide the numerous types required. The company designs cables for new applications requiring unusual characteristics and has facilities for manufacturing sample quantities for experimental use and evaluation.

With the advent of the jet engine and high speed aircraft has come the necessity of electric wires and cables of all types to withstand high temperatures. Heat from the engine and the tail pipe is supplemented by heat from skin friction at high speeds to such an extent that ambient temperatures from 200°F to 600°F have to be encountered in various parts of the plane.

BIW during 1952 was in continued production on a wide variety of wires and cables to meet these conditions.

BIW issued in its 1952 catalogue a description of these wires and cables to prove its readiness to design, test and manufacture these essential parts to the nerve system of aircraft.

The Cleveland Pneumatic Tool Company, at E. 77th St., in Cleveland, continued to design and manufacture Aerol landing gear struts for both commercial and military aircraft of all sizes and types from small helicopters and fighter gears to those required for the largest bombers and transports. Increased production of ball-bearing screw actuators and various automotive products raised considerably the company's defense output.

A new building adjacent to the main plant, adding some 100,000 square feet, was completed and occupied in October 1951. The company also increased its floor space in the main plant by 20,000 square feet.

In common with many other aircraft component manufacturers, the delivery of new machine tools and related equipment did not keep pace with the production requirements of the military services. The company met its scheduled deliveries by resorting to an expanded subcontracting structure.

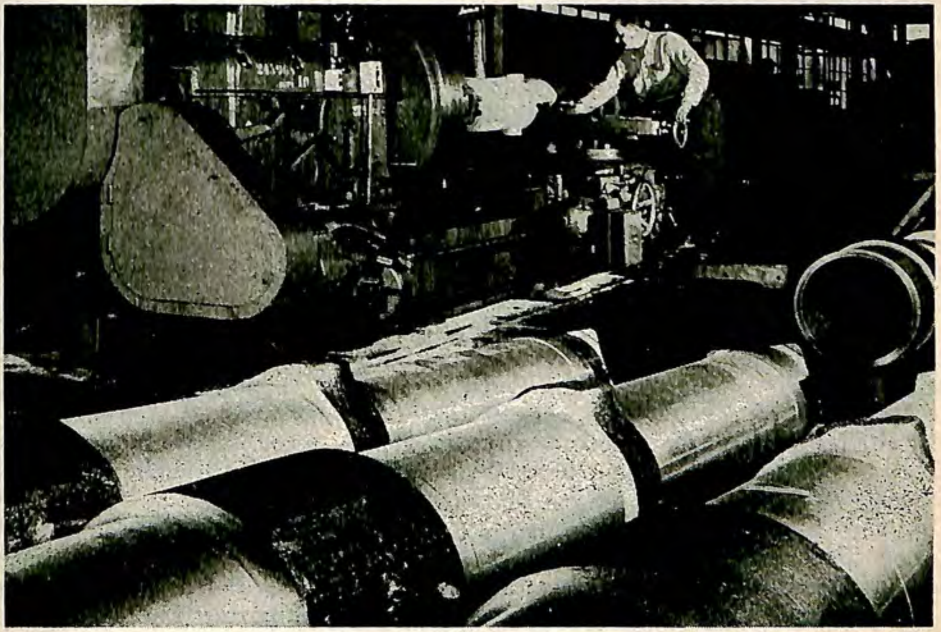
In addition, the company at the request of the United States Air Force licensed Delco Products Division, General Motors Corporation, Dayton, Ohio, to manufacture Cleveland Pneumatic Tool Company gears for Republic F-84F and North American F-86F aircraft, and Willys-Overland Motors, Inc., Toledo, Ohio, gears for Fairchild C-119C and Chase C-123B aircraft. These companies were provided technical assistance in the form of tool drawings, changes, processing, quality control procedures, etc., permitting second strut sources for the increased aircraft program.

In engineering research, Cleveland Pneumatic made two important contributions during the year. Design principles and manufacturing technique for using steel alloys at strength levels up to 280,000 pounds per square inch were developed. A landing gear for service use and based on these principles is now in production in the plant. A number of designs were developed for specific application of liquid spring shock absorbers. Operating at internal pressures up to 50,000 pounds per square inch, liquid springs can crowd high capacity into relatively small space.

The drop test equipment at Cleveland Pneumatic has been completely modernized. The equipment has been strengthened to take the landing loads for even the very large aircraft.

During the past year the Company assigned 16,000 sq. ft. of floor space in the main plant to the production of ball-bearing screws and actuators. Production started in early 1952 with 28 machine tools in operation. During the same period this Division initiated several new designs of actuators,

Main leg columns for B-36 in Cleveland Pneumatic Tool Co.



covering such units as a rudder trim actuator for a jet fighter; horizontal stabilizer actuator for a shipboard jet; actuator for retracting main and nose gear on a Navy blimp; design of a complete flap system for a new personnel plane and future transport. During the year a new devel pment contract was initiated with the U. S. Air Force relating to the design and building of a ball worm drive of high-load capacity.

Cleveland Pneumatic's Automotive Division increased its production of positioning equipment—engine stands and dollies, hydraulic unit lifts and lift kits—to meet the requirements of both aircraft and automotive engine manufacturers.

Large-quantity purchasers, some requiring modifications or unusual mounting features for their work, included Wright Aeronautical Division of Curtiss-Wright Corporation, Continental Motors, the Aircraft Divisions of Ford and Chevrolet, Capital Airlines, Trans World Airlines, and others.

The Connecticut Hard Rubber Co., 407 East St., New Haven, Conn., saw a year of expanded production in 1952 particularly in the field of silicone rubber parts for the military aircraft industry. The increases in production were sufficiently large to call for the complete utilization of a second plant opened in 1951.

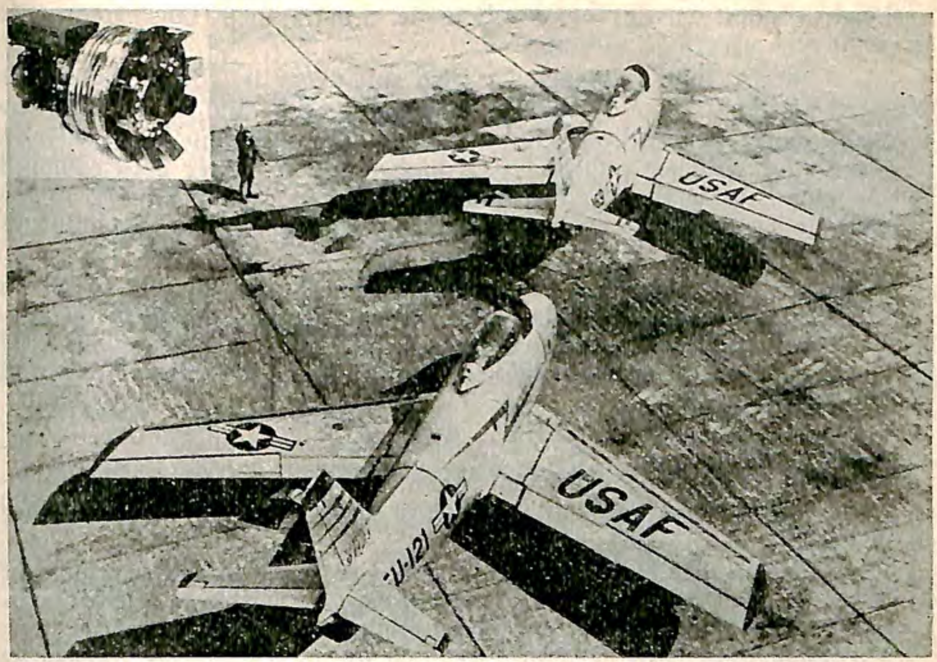
The aircraft engine builders called for largely increased quantities of parts for both reciprocating and jet engines. Improved silicone rubber compounds developed by the company have widened the applications of this material in the engine field.

In the airframe field, a number of new uses for Cohrlastic heating elements were developed. This heating element, which consists of nichrome ribbon embedded in silicone rubber glass fabric blanket was originally designed for the B-36 jet nacelle shut-off doors. Its lightness, flexibility and ability to de-ice under difficult conditions has led it to be called for by a number of the newer fighters.

Fletcher Aviation Corp., of Pasadena, Calif., continued producing external tanks during the year. The patented expandable Fletcher tip tank is now standard equipment on the F-84 and F-94.

Today production at Fletcher continues on the aerodynamically clean 230 gallon tip tank that actually improves both the low speed and top speed characteristics of the planes on which it is used. At low speeds the end-plate effect of the center-line mounting produces quicker take-offs and slower landing speeds. On some aircraft, the top speed is actually increased with these chord-line tanks. The 40-gallon drop tanks on Fletcher's FD-25 are a small-sized sample of the production tank.

Also in production in kit form is the "jet cooling" kit for Navion Aircraft This unit has been recently licensed by the CAA. This augmenter cooling system was originally incorporated on the FD-25, the first modern airplane specifically designed for close-in ground support.



Eclipse-Pioneer push-button combustion starter (see insert) outdates former starting methods for jet engines

The increasing importance of in-flight refueling in military operations and the growing possibility of its use in future commercial service, resulted in a marked increase of activity on the part of **Flight Refueling Inc.** of Danbury, Conn., designers and manufacturers of the probe and drogue system of flight refueling.

The efficiency of this system was highlighted by the announcement by the United States Air Force that a Lockheed F-80 Shooting Star had completed the longest sustained jet flight yet announced—a 14-hr., 15-min. combat mission over Korea.

The FR probe and drogue system was developed under Air Force contract several years ago and represents a high degree of simplification over previously devised refueling systems. It consists of a compact reel unit in the tanker which lets out approximatetly 90 feet of hose at the end of which is an automatic quick-connect coupling with a funnel-shaped unit around it. This is known as the drogue. The receiver is equipped with a protruding probe which can be fully retractable. To take on fuel the pilot merely flies the probe into the drogue—a process termed simpler than a landing—and a fuel-tight connection is automatically made. Fuel is then transferred under pressure at a very high rate of flow.

Adoption of flight refueling was also announced by the United States Navy as an important method of extending the range and duration of carrier-based aircraft. At the Detroit Air Show, the Navy unveiled its North American AJ-1 tanker refueling a Grumman F-9-F fighter both equipped with the FR probe and drogue system. The demonstration made at low altitude under turbulent conditions pointed up the extreme flexibility of the new system.

Since then the Navy has revealed that a substantial number of AJ-1's are to be constructed as tankers. Interest has also been shown in the possibility of using large flying boats, such as the P5Y as a far-ranging aerial tanker equipped with wing-tip refueling units for simultaneous refueling of several fighters.

General Alloys Co. of Boston, Mass., continued during 1952 producing heat and corrosion resistant castings of all types in sizes of one ounce to two tons.

The company has been engaged in extensive research and development activities for the advancement of casting process applicable to aircraft components, engine and airframe and also missiles.

Processes have been developed suitable for high speed production of jet turbine blades with closer tolerances, higher and more uniform physical properties and higher rates of production than is possible by the dental casting processes commonly employed.

Engineering effort in progress includes redesign of a variety of aircraft components from forgings or fabrications for casting in thin sections in high strength alloy steels and non-ferrous alloys. Processes projected can not properly be identified by the name, "castings" as they fall midway between castings and forgings in structure and physical properties in non-ferrous alloys and, in many respects, equal or excell steel forgings.

Perhaps the greatest obstacle limiting the use of castings in aircraft is a lack of uniformity and predictable physical properties. Advanced casting processes are now subject to greatly advanced and closely applied controls. These, coupled with statistical control and inspection at source, are considered to hold great promise in broadly revising the concept of casting potentials in aircraft production.

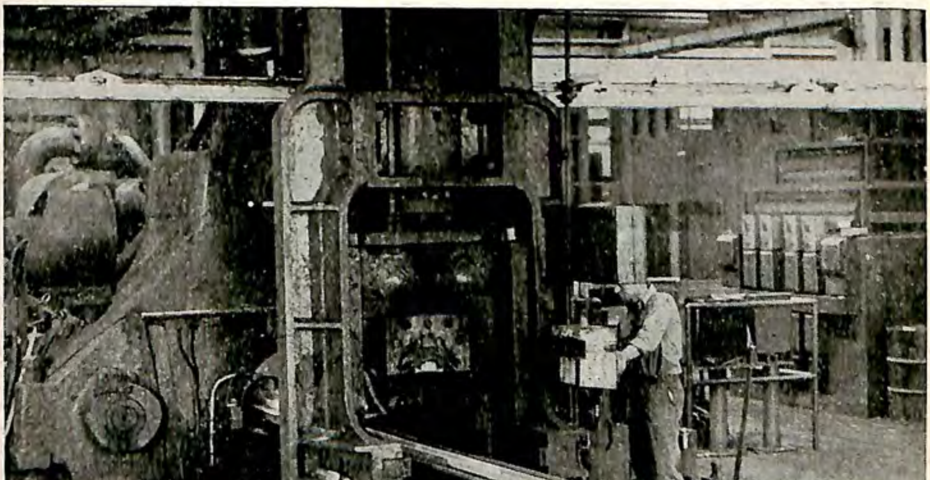
Gerity-Magnesium Corporation's new foundry at Adrian, Michigan, was completed early in 1952. With 20,400 square feet of floor space, the foundry has capacity to produce approximately 150,000 pounds of magnesium sand castings per month. Complete facilities, modern equipment and skilled personnel enable the foundry to turn out castings ranging in weight from a fraction of a pound up to 500 pounds. The Corporation is currently producing magnesium sand castings for manufacturers of civilian products . . . as well as for makers of jet and reciprocating aircraft engines and parts for defense needs.

Harvey Aluminum, a division of the Harvey Machine Co., Inc., at 19200 S. Western Ave., Torrance, Calif., during the past year supplied the aircraft industry with a large percentage of their aluminum extrusion requirements. Harvey attributes its rapid development to four basic factors: engineering knowledge, special service, close personal contact with customers and a flexible operation that can be bent to meet practically any need.

Expansion at Harvey is on an ascending curve. A battery of extrusion presses is added to constantly in order to maintain a plant capable of supplying any of the nation's largest aluminum extrusion requirements. Engineers and technicians are laying plans for new buildings and equipment to represent Harvey's participation in the Air Force "Heavy Press" program. Consisting of extrusion presses as large as 20,000 ton and forging presses of 35,000 ton capacities, this new facility will be erected at Harvey's present location.

Working closely with aircraft engineers on their own design boards, Harvey has perfected many techniques which have contributed to the advancement of the aircraft industry. Special "fine grain" aluminum extrusions that permit a minimum of warpage after machining was first introduced by Harvey. The first fabricator to supply wide profile integrally stiffened extruded aluminum skin in a flattened condition was another of Harvey's achievements.

Harvey 3,850 ton extrusion press



Hufford Machine Works, 1700 E. Grand St., El Segundo, Calif., introduced in 1952 a new and revolutionary stretch-wrap forming, Hufford Hydra-Curve Jaws. These grip the straight sided sheets, then curve them to the approximate cross sectional contour of the die preceding the actual stretch-wrap forming operation. This curving effects as high a a 33% material savings on some jobs, since a large transitional area between die ends and jaws is no longer necessary to equalize stresses and prevent tearing of the sheet.

Hydra-curving also eliminates many of the wrinkles introduced in the material when parts having pronounced convexity or concavity are formed with straight jaws. Elimination of high localized stresses has reduced sheet tearing and resulting scrap. Parts previously very difficult or impossible to form by the stretch-wrap process using straight jaws are now made with comparative ease. Skin fits on these parts are excellent. Die costs too, have been cut.

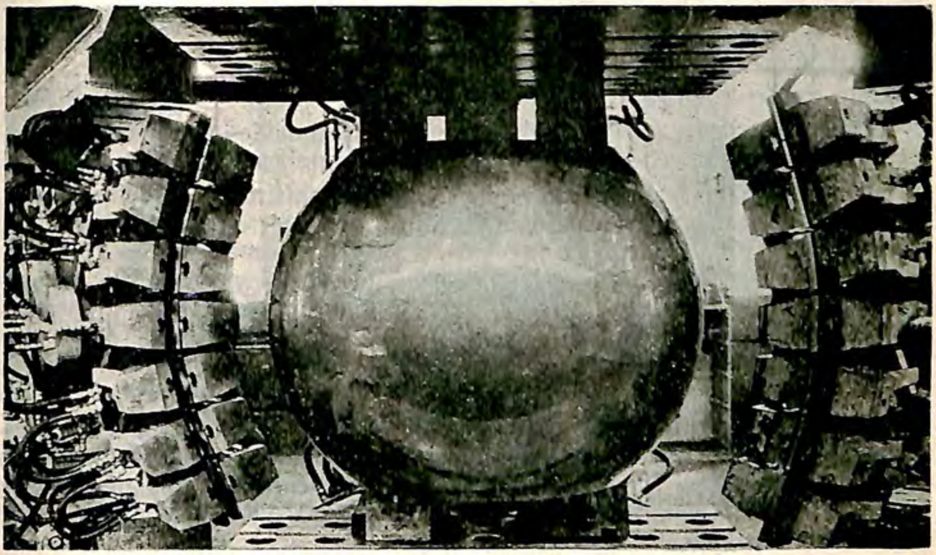
It has been found, using the Hydra-curve jaws, that some parts can now be formed from material in the ST condition, which saves considerable furnace hours.

Each jaw segment is individually hinged to its adjoining segment and is equipped with hydraulic cylinders by which almost any desired curvature can be affected. Curving of either jaw is totally independent of the other—that is, one jaw can be convex while the other is concave.

Sheets do not have to be pre-formed to jaw curvature to load—the jaw assumes a straight line position and grippers firmly seize the sheet. The curve is then applied from the console control before wrapping—or can also be applied while the wrapping motion is being performed, which is frequently of value when forming certain shapes. Calibrated adjustable stops limit the curvature in either direction and insure exact duplication of the curve each time the curving cylinders are energized.

Another feature of the Hydra-Curve Jaws is the degree of curvature possible and the wide variety of die shapes the jaws can duplicate. These range from complete convex or concave semi-circles having a minimum radius of 17", to right or left compound "S" curves and almost any intermediate shape between these extremes.

To centralize the load to the tension cylinders, thus equalizing this load over the complete end surfaces of the sheeet, each jaw is equipped with a centroid shifter. This consists of a special yoke fitted to the jaw body and a hydraulic cylinder coupled between the yoke and the jaw assembly. The complete jaw assembly is slidable, allowing a lateral adjustment up to 8". By deliberately shifting the centroid adjustment off-center, tension can actually be varied between front and rear portions of the workpiece . . . especially advantageous when forming extreme curvatures as an aid in eliminating wrinkling, such as on spherical parts, deep convexities, concavities, etc. In actual practice, while sheet tension is maintained the centroid is shifted and its effect on the sheet watched. At some point the sheet usually tightens up evenly over the complete die surface.



Hydra-Curve jaws for all Hufford sheet forming machines

Hydra-Curve Jaws are designed for all Hufford sheet forming machines and cover sheet widths up to 74". Their use in no way impairs application of the machine to stretch-wrap forming extrusions since extrusion jaws may still be adapted over the Hydra-curve jaw housings.

At **Hydro-Aire, Inc.,** Burbank, Calif., the accent in 1952 was on research and development, with particular emphasis on the company's new anti-skid braking system, Hytrol.

Hytrol operates as an auxiliary to the regular braking assembly. Basic unit of the system is a skid detector mounted in each wheel. This detector is an inertia flywheel driven through a slip clutch by the airplane wheel. It provides two sensing elements. One detects the rate of change of speed; the other detects rotational speed. From these sensing-elements, signals are transmitted to a control box and then to a solenoid three-way valve installed in the brake pressure line. The signals from the skid detector relieve and reapply metered brake pressure. Continued excessive metered brake pressure is prevented by modulation which automatically reduces pressure until the skid control cycling stops. By the use of the change of speed sensing unit, the skid is detected at the beginning and prevented from progressing. By the use of rotational speed sensing element in the detector, locked wheels are eliminated, not only in the normal process of braking a plane but under any and all conditions that could be encountered.

The pilot may land with his brakes fully applied, and keep full pedal force. The Hytrol System automatically detects incipient skidding and reactively releases brake pressure. This on-off braking action can take place as often as three times per second. The sensitivity of the skid detector is the maximum that can be utilized.

Other projects in the works at Hydro-Aire:

Crane Co. purchased the rights to a new inflammable gas sensing device. Hydro-Aire will develop and market aircraft applications of this device.

Hydro-Aire has been licensed by Hughes Aircraft to develop and manufacture transistors and transistor applications for electronic aircraft control systems.

During 1952 Hydro-Aire introduced a new motor operated gate valve, using no rubber or synthetic rubber parts. This valve is lighter and more compact than any previously marketed.

Irving Air Chute Co., 1315 Versailles Road, Lexington, Ky., continued during 1952 producing parachutes for human use, seat, back, quick connector and troop type parachute equipment, cargo chutes of various sizes and loads, parachutes for target aircraft and missile recovery and safety belts of various types.

The aim at **Jack & Heintz,** 17600 Broadway, Cleveland, Ohio, in 1952 was the reduction of complexity in aircraft and associated equipment. A definite stride along this road toward simplification was the newest Jack & Heintz version of the "standard" integrated panelized electrical control system. Built to AMC Exhibit MCREXE 22-89B and designated by the company as Model GC34-2, all of its circuits and components are in accordance with the USAF specification on the standard type B-3 control panel.

Incorporated on the GC34-2 are several new maintenance-time saving features: test jacks for quickly checking the operation of protection circuits; simplified panel servicing by coding of each wire and by inclusion of a coded wiring diagram; new mounting rack with an inject-eject mechanism for fast, positive and easy connecting and disconnecting ground fault detection with either a shunt or a new J&H current transformer.

The GC34-2 offers protection against: selective overvoltage, feeder ground fault, generator ground fault, reverse polarity, reverse current and pull-down voltage.

Jack & Heintz also developed three additional methods of accomplishing heat rejection from electrical generating equipment. One method uses evaporants circulated through the Model G75 Alternator machine.

The second includes a closed recirculating system which circulates a liquid coolant through the machine and rejects heat into a heat exchanger. The latter can be either air-cooled or aircraft fuel-cooled. It is used on the Model G-37 generator.

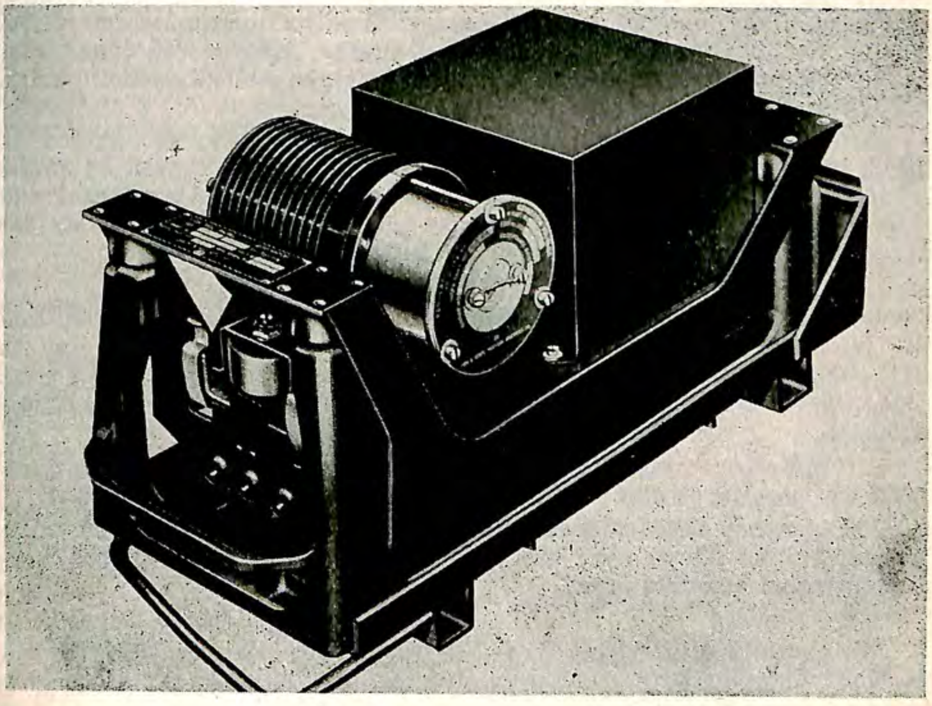
The third method of cooling—the utilization of bleed air from the pressurized cabin—is used on the Model G38 Generator. This is basically an air-blast cooled unit but it offers a lower over-all penalty on the airplane than the present blast cooling systems.

During 1952 **Kollsman Instrument Corp.** of Elmhurst, N. Y., started quantity production of the first of a series of electromechanical flight data computers to supply multiple electrical outputs of flight data such as mach number, true air speed, or altitude for use in gun fire control, bombing, aerial photography and navigation, as well as visual remote indication for the flight personnel.

Also put in production during the year were improved pressure controls for use with airplane and guided missile autopilots. Known as Kollsman Pressure Monitors, these instruments combine diaphragm techniques, used in airspeed indicators, altimeters and other pressure units, with a simple and rugged electrical pickoff and are five to ten times more sensitive than any previously available instruments.

Kollsman's extensive line of standard instruments are being constantly revised, refined and redesigned to meet the exacting demands of modern-day flight. Many instruments previously manufactured in limited number for flight test purposes only, are now produced in large quantities. Exam-

Jack & Heintz standard electrical control system



ples are an ultra-high range altimeter, and a machmeter now standard equipment in combat aircraft.

During 1952, **Lear, Incorporated,** of Grand Rapids, Mich entered the airline and aircargo fields with the introduction of the Lear L-5 Autopilot, a counterpart of the F-5 Autopilot previously produced for USAF jet fighter aircraft. A number of installations of the L-5 Autopilot resulted from an intense program of demonstrating the autopilot and its accessory equipment, the Lear Approach Coupler and the Lear Altitude Control to airline and aircargo operators.

The Lear F-5 Autopilot continued in a high rate of production at the company's Grand Rapids plant for the USAF. In the history-making cross-Pacific flight of the F84G fighters in mass formation during 1952, the lead planes were equipped with the Lear F-5 Autopilot, permitting more concentration on navigation and other flight duties for the lead pilots.

The Lear VGI (Vertical Gyro Indicator) systems were shipped in quantities from the same plant, and are being used on F86D, F89D and the B-47. The Lear VGI, because of its remote-reading feature, was also selected by the Army for use on the Sikorsky H-19 helicopter, and was designated for installation on the Piasecki H-21.

Increased production of Electro-mechanical products of Lear, Inc., was also evidenced during 1952. The Romec Division of Lear, Incorporated, at Elyria, Ohio, reported a record year of shipments of engine driven fuel pumps, vacuum instrument and de-icer pumps, oil-free air compressor pumps and pressurizing equipment, fully submerged water-injection pumps, and other aircraft pumps and kits.

Activity at the LearCal Division in Los Angeles was highlighted, in 1952, by the introduction of the new Lear "Executive" ADF-14 Radio Compass, which featured a ferro-dynamic loop mounted in a moisture and dust resistant housing. The ADF-14 is the commercial version of a similar automatic direction finder supplied to the Army.

During 1952, at **Macwhyte Company,** Kenosha, Wis., the production of "Hi-Fatigue" cable assemblies and "Safe-Lock" terminals, as well as "Hi-Fatigue" aircraft control cable, was continued. Cable assemblies were made from "Hi-Fatigue" aircraft cable and "Safe-Lock swaged cable terminals.

Aircraft wire rope slings were manufactured for use with the airplane itself and for use in the production, handling and shipping of aircraft.

The company also manufactured tie rods for internal and external bracing of aircraft. These were produced from cadmium plated carbon steel and corrosion resisting steel.

Minneapolis-Honeywell, 2600 Ridgway Road, Minneapolis, expanded in 1952 by moving its Aero Division into two new buildings providing over

320,000 square feet. The buildings and their equipment were especially designed for the research, engineering, and production of automatic controls for aircraft and include the latest in research and design tools coupled with extensive test facilities.

Significant developments during the year included the release to production of the E-12 helicopter autopilot which had been ordered for installation on the Piasecki H-21 helicopter. Continuing in the autopilot field in 1952, the company developed the E-11 autopilot for use in jet fighters and light bombers. This autopilot has recently been ordered for installation on the Douglas RB-66 twin jet bomber. It is an advanced autopilot providing not only relief from pilot fatigue but when tied in with radar fire control will guide the plane accurately to the target. With a compass coupler and instrument landing tie-in it will make all weather flying feasible for jet fighters.

Further development in the electronic fuel gage conducted during the year produced a new method of characterizing the tank unit sensing elements so that no matter what the shape of the fuel cell the fuel gage indicator will give linear readings resulting from the characterized tank unit. Considerable weight reductions and improvements were made also in developing a new fuel gage power unit designated the EG5A by Honeywell.

Several new individual components were developed during the year: a hydraulic servo weighing but 2 pounds yet able to deliver 2½ horsepower; and an altitude controller was developed as an accessory to the autopilot line. This controller, designed to hold an aircraft to a constant altitude, is sensitive to a two foot change in altitude throughout the operating range of sea level to 60,000 feet.

Further developments were made in Minneapolis-Honeywell's gyro line. Considerable work was also done in the field of jet engine controls which resulted in the building of a new jet engine control laboratory where jet engine controls are tested without the engine being present. Large quantities of fuel are pumped through the various controls while an analog computer simulates the response and action of the jet engine under test.

The New York Air Brake Co., 420 Lexington Ave., New York, continued improvement of its line of hydraulic pumps. All pumps in the series use rotating cams to actuate pistons in stationary cylinder blocks. Discharge valving utilizes flat checks at the cylinder bore ends.

Altitudes and speeds achieved by some existing and many projected aircraft and missile types extend the temperature range through which pumps must operate in conjunction with control surface, dive brake and other circuits which are active in flight. Pump construction must be compatible with new hydraulic fluids of highly desirable characteristics but presenting new problems in pump design.

The company during the year, marketed a complete line of constant and variable delivery hydraulic pumps in capacities range of ¼ to 10 gpm at specification speed of 1500 rpm. Rated operating speed is 3750 rpm in all models with 7500 rpm permissible in smaller sizes. Integral maximum pressure control in variable delivery pumps is available for all pressures to 3000 psi.

Alternate integral control has been developed for all models to provide remote actuation of control features by hydraulic, pneumatic or electrical signal. An important variation in the conventional variable delivery pumps provides an automatic function, hydraulically controlled through circuit operating valve interlock, whereby the pump assumes zero flow condition, zero pressure, while there is no system demand for fluid flow but instantly reacts to system demand at rated pressure upon actuation of any connected operating valve. The retained pressure during the zero flow cycle may be adjusted to any desired intermediate pressure for application to a two pressure circuit.

Expansion of the Manufacturing Division of **Pacific Airmotive Corporation,** Burbank, California, continued in 1952 in an effort to meet the heightened demands for heating, ventilating, and pressurizing equipment for jet propelled aircraft and guided missiles. Operating as a separate organization, the Manufacturing Division has specialized in the manufacture of test equipment and special tools, in addition to pioneering in the aircraft pressurization field.

During the past year high temperature, high pressure and high flow air test equipment has been added to the company's production and research facilities. A new altitude chamber has multi-compartment selection, enabling PAC engineers to simulate conditions in actual aircraft cabins and pressurized compartments at altitudes above 60,000 feet.

A new and efficient method of compartment pressure control for guided missiles has been developed by the engineers of PAC's Manufacturing Division. In the past, pressure has been controlled as it leaves the pressurized compartment. In this new missile system, pressure is controlled as it enters the compartment, with two alternate sources of air pressure.

Manufacture of test stands for testing jet engines, jet accessories and pressurization equipment continues to be an important part of the Manufacturing Division's activities. Test stand manufacture was one of the most important operations in PAC's Manufacturing Division during World War II. In 1952, PAC's design engineers have developed portable test equipment which meets the needs of today's jet propelled aircraft and guided missiles.

Sales volume of **The Parker Appliance Company,** Cleveland, O., reached $21.8-million for the fiscal year ending June 30, 1952, as compared with $12.2-million for the previous year.

Aircraft products being made by Parker include AN flare and MS flareless tube fittings, tube fabricating tools, synthetic rubber O-ring seals, hydraulic and fuel check valves, fuel selector and shutoff valves, fuel level control valves, fast-fueling nozzle and fuel receiving adapters, and various jet engine parts.

With important new additions to the Parker engineering staff, progress is being made in fuel system components and other specialized parts to meet the ever more critical requirements of modern aircraft. In this connection, an elaborate test facility has been installed at Parker's Los Angeles plant. This is a high flow fuel network, with a 6000 gallon underground reservoir, with intricate controls and instrumentation for testing of various fuel system units.

Note: See end of chapter for Pioneer Parachute Co.

Randolph Products Co., of Carlstadt, N. J., continued serving the industry during the year with a wide range of finishing products, including fabric lacquers, stiffening lacquers, water-proofing compositions, pencil finishes, paper finishes, pearl lacquers, Metallic S-G, and others.

Randolph has a modern laboratory equipped with spray units, semi-plant coating machines for dip and spreading methods of application. For the bake type finishes controlled temperature ovens are provided to meet all the requirements of the industry for short period high bake to longer period baking at lower temperatures. The modern lab must provide itself with panels of various woods, plastics, metals and composition materials used by manufacturers. In this way it is possible to determine by accelerated testing, finishing materials best suited for the particular problem at hand as well as the most practicable and economic method of finishing.

Rohr Aircraft Corp., of Chula Vista, Calif., during 1952 continued building power packages for the aircraft industry. The package consists of the bare engine, which Rohr receives from the engine makers, or from the government, and around which they build and assemble the motor mount, sheet metal cowling, panels, diaphragms, supporting structures, air ducts, fuel and oil lines, electrical harness and other items necessary for the engine's operation. When completed, the "package" is then sent to the airplane manufacturer, complete and ready to install on the wing of the plane. This "package" can be installed within an hour.

For the B-24 power package Rohr made more than 1300 parts, while for the modern multi-engine plane of today, each package contains more than 3400 Rohr-made parts.

With the Korean outbreak Rohr began filling military orders. By November of 1950 orders had reached $41-million. A year later they were $100-million, and today they stand in excess of $156-million, despite sales of more than $41-million for the last year.

The company recently expanded its manufacturing facilities and began construction of a new plant at Riverside, Calif, as well as a 45,000 square foot addition at Chula Vista.

The corporation now employs more than 6000 persons, occupies 715,000 square feet and has 245,000 square feet under construction.

Scott Aviation Corporation, 207 Erie St., Lancaster, N. Y., has continued to progress in the development and manufacture of aircraft accessories of various types, including tail wheels, control wheels, hydraulic brake equipment and oxygen breathing equipment for civilian and military aviation.

The Scott Aviox placed on the market in 1952, was a complete portable oxygen system in a leather carrying case, simulating standard luggage. It was designed primarily for private executive or commercial type planes, not equipped with fixed oxygen systems, to supply supplementary oxygen for one to four persons at altitudes up to 30,000 ft.

The Scott 8600 Econo-Mask, is a partial rebreather type mask for supplementary oxygen in commercial and personal planes. It consists of a pliofilm bag attached to a porous filter paper face piece, with a gum rubber tubing, terminating in a coupling to fit cabin oxygen outlets.

Also placed on the market was a Flow Indicator, a simple, inexpensive unit inserted in the supply tube of a supplementary oxygen mask to show oxygen flow.

The 8500 Fixed Oxygen System, now appearing in general use, was designed primarily for private or commercial aircraft. It incorporates a manually adjustable pressure reducing regulator, which can be set to deliver at any altitude the required mask flow of oxygen. This flow can be either that stipulated by the CAA, or a mass flow three times greater for therapeutic relief of passengers with respiratory or circulatory conditions.

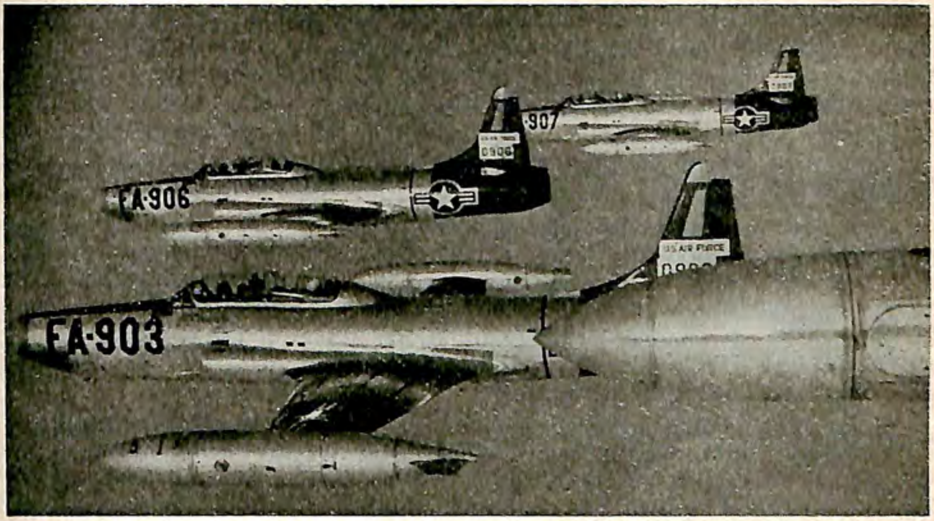
Another new item is a Portable Self-Contained Compressed Air Breathing Apparatus for the protection of crash, fire fighting and rescue crews, and for the protection of Rocket Charging Crews.

Also Scott is again in heavy production of the A-15 "Oxygen Walk-Around" to meet the urgent requirements of the USAF.

Soon in production will be another Portable Demand-Positive-Pressure Oxygen Regulator Assembly for military use. It will provide oxygen on demand up to 30,000 ft. and positive pressure at altitudes from 30,000 to 47,000 ft.

Simmonds Aerocessories, Inc., Tarrytown, New York, during 1952, continued development of a principle originally demonstrated by the Royal Aircraft Establishment in England in the field of explosion suppression. During the past year, Simmonds has been working with several of the largest U. S. aircraft manufacturers on this project on further refinements in this field.

The basic principle of explosion suppression is to stop the process before destructive pressures are created. Oscillograph studies show that pressure rise at the inception of the explosion is relatively mild up to approximately one-fifth of the total time span required to reach maximum explosive force. Thereafter, the pressure increases rapidly. The explosion suppression system scatters an extinguishant during the initial pressure rise period by a simple harmless counter-explosion.



Lockheed F-94's equipped with Fletcher tip tanks

In the Simmonds explosion suppression development, the components are simple, light weight, use no highly strategic materials, and are readily standardized. Components are self-contained, require the simplest sort of attention, and do not rely on a constant supply of materials which require replenishment. The system provides protection at all times, even for parked aircraft and at the inception of flight. It is not necessary to anticipate attack to prepare the system for operation since it is entirely automatic. Extinguishant is at the immediate site of the explosion and is not dependent upon ducting or other means for conveying it to the explosion locality. Equipment is designed for installation within the fuel tanks so that additional space, always at a premium, is unnecessary. Should one tank of an interconnected series be sufficiently ruptured to permit vapors and gases to escape rapidly, protection is still afforded to the other tanks of the interconnected series. The Simmonds system is independent of tank system design and can be tailored to any known configuration.

During the past year, Simmonds continued development work on its capacitance (Pacitron) fuel gage systems introducing a new lightweight amplifier with an overall weight of about 1½ lbs., making this the lightest unit of its kind now available to the aircraft industry. Simmonds gages are now used on more than 40 types of military and commercial aircraft. The company continued to supply mechanical latches, push-pull controls, and hydraulic fuses. It also continued development work on temperature limiters and controls for turbine engines.

Solar Aircraft Co., of San Diego, Calif., continued producing aircraft engine components during the year. Hot parts for piston, turboprop and turbojet engines continue to be principal items of manufacture. but the company entered the airframe field and further promoted the de lopment of its small gas turbines and ceramic coatings. Its plant in San Diego was enlarged and passed all-time employment and production records, while the two plants in Des Moines also surpassed previous levels.

Production continued at record levels in the exhaust manifold section with various components being manufactured for the latest model B-36, the C-54, DC-4 and T-28. Similar products such as turbo hoods for the Super Constellation and turbosupercharger nozzel boxes for the B-29 were manufactured in the San Diego plant. Solar flame dampers found use on the Grumman F7F while ducting systems were supplied for the Lockheed P2V and the Boeing B-47 Stratojet.

Solar shipped large quantities of combustion chambers, transition liners, aft frames, bellows, exhaust cones and afterburners to General Electric for the J47, to Packard for the J47, and to Allison for the J33 and J35. Several large orders totaling over $13-million for high temperature components for the J40, manufactured by Lincoln Mercury, and the T34, manufactured by Alis Chalmers, were received and will be fabricated in the new Wakonda Works in Des Moines.

In entering the airframe field Solar became the first manufacturer to go into the production of engine nacelles fabricated entitrely from stainless steel. These nacelles, used on the Lockheed P2V, weigh only 242 pounds and support an engine weighing 3500 pounds.

Solaramics, Solar's line of high temperature ceramic coatings, were used to coat nozzleboxes, combustion chambers, turbo hoods and other aircraft components in large quantities. A large order was also received for Solaramic coated inner liners for the J47 jet engine, and over 4000 of these units were shipped during the year.

An adaptation of Solar's Mars gas turbine engine has been built into a prototype model under contract with the Air Force, which is sponsoring the development of an airborne auxiliary generator set. A substantial production order for a similar assembly has been received and will be used in the Douglas C-124 Globemaster to supply auxiliary power. The complete turbine driven generator set weighs only 230 pounds and is slightly under two feet on a side. Work was continued on a tooling contract for Solar's portable gas turbine driven fire pump. The small Mars engine which develops 45 horsepower, yet weighs only 60 pounds and may be started by hand, will be utilized for quantity production of this portable fire equipment.

Announcement was made during the year that Solar had delivered the first gas turbine driven generator set ever installed on board an American navy ship. This announcement referred to the Jupiter engine, which is considerably larger than the Mars engine. Developed under Navy contract, the Jupiter engine powers a 250 kw generator. The engine, controls, and reduction gear box weigh 561 pounds and fit within an area five feet long and less than three feet high and wide. The assembly was designed to replace a diesel driven generator set which was over ten times its size and weight.

South Gate Aluminum and Magnesium Co., located at 5331 Tweedy Blvd., South Gate, Calif., continued during the year manufacturing precision aluminum and magnesium sand castings and precision machined parts, cast and machined to specifications of the aircraft, guided missile and civilian industries.

A new addition of 40,000 square feet of production space recently brought plant facilities up to 68,000 square feet.

Sperry Gyroscope Company, Great Neck L. I., N. Y., continued to expand during 1952. Employment increased approximately 3,000 bringing the year-end total to about 18,000.

Although Army ordnance contracts—particularly anti-aircraft systems—continue to top the list of activities, new aeronautical instruments and control system developments pressed close for first place. Within security limits, outstanding aeronautical activities can be summarized as a new automatic pilot for high-speed aircraft, an automatic "cutoff" device, an improved flight director, all-weather research, several airborne navigation systems, and air ordnance including a strategic bombing-navigation system.

Details on extensive missile system work at Sperry remains classified.

The latest in automatic pilots is a new aircraft stabilization and control system which surpasses the performance of the standard USAF Type E-4 (Sperry A-12) automatic pilot. Unlike the E-4 which is applied to every kind of aircraft from blimp and helicopter to jet bomber and fighter, the new "automatic flight system" is designed specifically as part of the latest heavy jet bomber. It follows selection of the A-12D in the Boeing B-47 Stratojet bomber.

In civilian aviation a new device called "automatic cutoff" was developed. It makes an automatic pilot or other control devices "fail safe." If a malfunction occurs suddenly in the automatic pilot, the automatic cutoff device will turn off the automatic pilot before any perceptable or discomforting motion of the aircraft occurs.

The Sperry automatic cutoff reacts only to malfunctions or failures in the automatic pilot and airplane control system or if the device itself fails. It will not cut off merely because of rough air or because a "normal" command signal is applied by the human pilot or radio beam coupler.

The new device may be applicable to higher-speed military aircraft as a "g" limiter to protect the airframe from dangerous stresses which may occur at very high speeds. First use of automatic cutoff is scheduled for the new Douglas DC-7 transports being built for American Airlines.

New in the flight instrument field is an improved Zero Reader flight director for the Air Force. The Type A-2 flight director combii s, in a single panel instrument, heading indication and selection with the cross-bar director indication. The new all-weather flight instrument shows the jet fighter pilot how to apply control stick movements in order to attain and hold a desired heading, attitude, and altitude. It is being installed in all USAF all-weather interceptors—Lockheed F-94C Starfires, Northrop F-89 Scorpions, and North American F-86D Sabres. Over 1500 of the various types have been produced for commercial and military aircraft.

Leading flight instrument production at Sperry is the Gyrosyn® gyromagnetic compass, a directional gyro indicator which is synchronized with the horizontal direction of the earth's magnetic field. This small electronic instrument serves as the pilot's standard steering reference in all types of aircraft, particularly on long hops such as the history-making flight by a Scandinavian Airlines' DC-6B from Los Angeles to Copenhagen via the north magnetic pole and Thule, Greenland, in November 1952.

The Sperry "Type K" bombing-navigation system was revealed early in the year. Under Air Police guard and with informative dials and data plates masked from view, about 25 components of the Sperry "Type K" system were unveiled by Secretary of the Air Force Thomas K. Finletter before reporters at a Senate Appropriations Committee hearing in Washington, D. C.

The senators were told that the new electronic system, combined with radar units and a periscope, will navigate high-speed bombers to any desired seen or unseen target and will place bombs accurately from extremely high altitudes. Mr. Finletter added that it makes its own electric calculations, and, by radar, is able to operate through overcast, at night, or in bad weather. No visual sighting of the target is necessary. It operates automatically, even to the releasing of bombs, and it can be serviced by average-skill Air Force ordnance personnel by replacing "plug-in" units.

Although the bombing navigation system was conceived and first produced at Sperry, additional production is now being carried out by three other prime contractors—all aided by a number of package subcontractors. Production by prime contractors was initiated by means of an "assistance agreement" involving Sperry and AC Spark Plug Division.

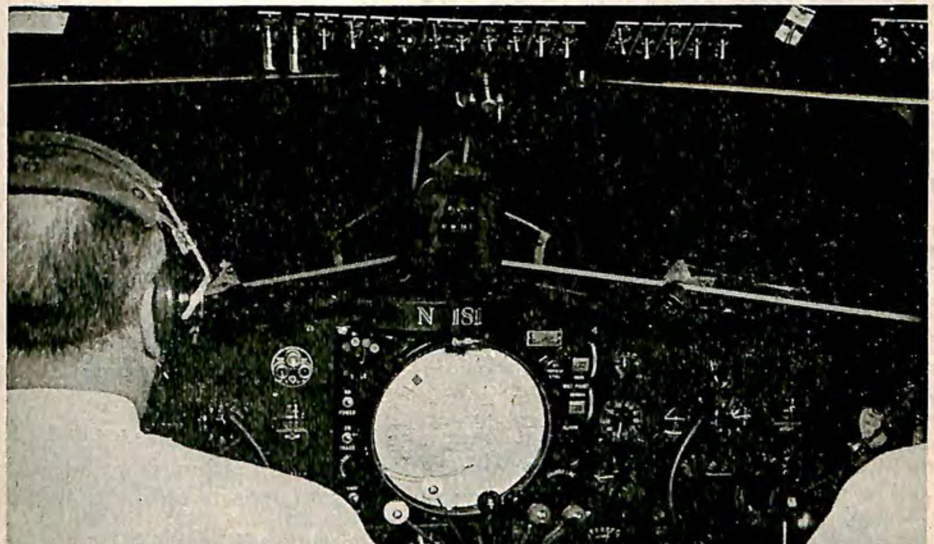
All-weather flight research was highlighted by release of the first statistical analysis of "instrument approach success" and receipt of a joint ANDB and U. S. Weather Bureau contract to find out how to measure weather along airport approach paths in order to aid bad weather landings.

The report on approaches, result of a three-year study, compared actual airline instrument approach performance under different weather conditions of reported ceilings less than 800 feet and for several types of aircraft. Twenty-eight thousand manual ILS approaches were recorded and analyzed. Data showed that approach success for a DC-3 was "significantly better" than that for four-engined aircraft such as the DC-4, DC-6 and Constellation. Approach success for all aircraft deteriorated as reported ceiling and visibility decreased. For example, DC-4's missed approximately one out of ten approaches for a 500-foot ceiling and one-mile visibility. But the DC-4 missed almost 45% of the time when ceilings dropped to 200 feet and visibility decreased to ½ mile.

The airline approach study covered only manual approaches on the CAA Instrument Landing System (ILS). Another part of the report compared the results of three types of ILS coupling—manual, Zero Reader flight director, and Gyropilot automatic approach control—under actual weather conditions generally below airline minimums. Analysis showed that fewer unsuccessful approaches occurred when semi-automatic or automatic coupling means were substituted for manual flight coupling. In fact, out of 99 non-manual approaches only nine go-arounds occurred. Only six of these 99 flights were made under ceilings higher than 300 feet. Only four out of 23 flights under zero ceiling conditions resulted in unsuccessful approaches.

A study of the reported weather observations indicated that the reported

Sperry Pictoral Computer undergoes flight test



ceiling was not a good index of vertical contact height for pilots making instrument approaches. Often weather conditions reported at the airport tower differed from conditions which existed at the runway threshold. Weather conditions over an airport area are not uniform particula y during low ceilings. The conditions are often localized over a small area and may change considerably from minute to minute. Satisfactory means for measuring these conditions so they can be described accurately and meaningfully to the pilot of an incoming airplane do not yet exist.

Later in the year the Air Navigation Development Board let a contract to Sperry to study improved means of approach weather reporting. The two-year flight research program is aimed at improving flight safety during instrument weather approaches to the nation's air terminals. The weather measuring techniques and their relation to flight operation under actual low visibility conditions will be studied at MacArthur Airport, Long Island, with the aid of new engineering and technical instrumentation provided by the U. S. Weather Bureau.

During 1952, **Sundstrand Aircraft Hydraulic Division** of Sundstrand Machine Tool Co., Rockford, Ill., has continued to manufacture and develop Constant Speed Hydraulic Transmissions and several types of hydraulic pumps for the aircraft industry.

One Sundstrand product is a mechanical-hydraulic transmission capable of converting variable engine speed to constant output speed for driving a constant frequency AC generator. This drive was first applied to the B-36 and flew with the first aircraft in 1946. On the B-36, four drives are used and when necessary all drives can be operated in parallel. In this application some drives have logged as many as 1000 hours of flight time in actual service. In 1950 this drive was applied to the Martin P5M aircraft. Today some of the units on this aircraft have as many as 500 hours of service life.

To meet the space and weight requirements for turbo prop and turbo jet engines, new types of alternator drives were developed. The past year has seen production started on the new 60KVA cartridge type drive which is designed as an integral part of the jet engine gear box. This drive operates on the oil system of the engine, eliminating the need for a separate oil system. The new 60KVA is now an integral component of the J-40 engine.

A radial type hydraulic transmission, now in the final stages of development, has also been designed with size and weight limitations in mind. It will be mounted in the engine nose cone and will also operate on the engine's oil system.

To meet the increased demand for constant speed alternator drives, Sundstrand's facilities have been expanded. A recent addition to the hydraulic division will provide approximately 87,000 square feet of additional floor space.

Other products, currently in production and development at Sundstrand, are many types of aircraft pumps. In jet engine lubrication and scavenger pumps, Sundstrand has incorporated its patented Rota-Roll design which provides exceptional high altitude performance. The compactness of the Rota-Roll concentric design makes it posible to accommodate a single or multiple pumping unit within extremely limited space.

A high pressure, 3000 psi 6 GPM variable volume, axial piston type pump is now in the final stages of development.

Thompson Products, Inc. of Cleveland, Ohio, manfacturers of precision automotive and aircraft engine parts, and aircraft fuel system components and accessories, continued during the year of 1952, a very active development program toward the improvement, refinement, and design of their products. Typical of the aircraft products being developed to meet higher performance requirements are: fuel booster pumps (both electric motor driven and air turbine driven), primary engine-driven fuel pumps (both gear and piston type), and afterburner pumps. Also, an extensive research and development program on turbo-jet blade and bucket materials was carried on. The materials in the development program include metals, intermetallics and ceramics. In addition to these basic material studies, development work is continuing on coatings, method of attachment, and wheels, as each relates to the material in question.

A highlight of the air-turbine driven afterburner pump development during the year was the release to production of a model incorporating a titanium air turbine wheel. Machining the wheel completely from titanium has been successful.

Material refinements and improved manufacturing techniques enabled Thompson to manufacture approximately the six-millionth powdered metal jet engine compressor stator blade during the year. The production of these powdered metal parts is being greatly expanded.

A new Division, the Electronics Division was established in 1952 to design, develop, manufacture and sell Coaxial Switches and allied electronic equipment.

In Staff Development work is continuing on complete automatic control systems and also on the following components: magnetic amplifiers, transistor ampifiers, and several kinds of servos.

Flight tests of the Thompson Fuel Flow Distributor and Variable Orifice Fuel Nozzles, installed on a J-47-19 engine in a B-45 airplane, were completed in 1952.

During 1952 **Vickers Incorporated**, located at 1400 Oakman Blvd., Detroit, Mich., a Division of the Sperry Corporation, placed in operation a new facility for the fabrication of aircraft accessories. The new uilding at Joplin, Mo. consists of 100,000 square feet. Vickers Administra.ive and Engineering activities will remain at Detroit. The home factory will continue to produce aircraft accessories and very high production aircraft parts and assemblies will be assigned to the factory at Joplin, Mo., for manufacture.

Vickers designs and builds all of the major accessories necessary for the assembly of a complete 3000 psi aircraft hydraulic system. Although these accessories, for the most part, are individually supplied for use by the aircraft manufacturers, Vickers many times will provide a complete hydraulic system. The Vickers electro-hydraulic servo power unit, which provides rapid and accurate control of up to 50 hp by means of a 30 milliamp signal input, is an example. Also in operation on a number of prototype aircraft are constant speed alternator drives, variable speed supercharger drives and direct ratio, remotely located, accessory drives. In these cases, Vickers provides the complete hydraulic system.

The Vickers pump and motor line is built around eight basic rotating group sizes, This permits the fabrication of 32 standard fixed displacement pump sizes and 32 motor sizes. Variable displacement pumps are available in 8 maximum displacement sizes—the smallest having a theoretical delivery in gallons per minute (at 1500 rpm) of .61; the largest pump delivers 23.8 gallons per minute at 1500 rpm. The smallest pump (or motor) can operate intermittently at 9100 rpm.

A recent Vickers development is the light-weight variable displacement pump design. The new PV-3909 model is 32% lighter and 39% smaller in envelope than the present standard design. Other sizes of the new pump design will have comparable improvements in weight and size. The new pump configuration will continue to be available in the various standard designs such as cylinder controlled, pressure compensated (automatic), electrically depressurized, flow reversing and servo controlled.

During 1952, the Vickers two port balanced piston relief valve passed tests indicating that they conform to Military Specification MIL-V-5523. The basic valves can be supplied with four ports or two ports and with three separate types of mounting flanges. They may be provided with an external vent which will allow the valve to be manually unloaded. An external drain detail is available which will make the valve independent of back pressures which may occur in the return line.

Through extensive development activities at the various airlines, Vickers has been able to increase hydraulic accessory reliability to an exceptional level. At TWA, for example, 304,598 variable displacement pump hours were accumulated for a twelve month period and only one malfunction was experienced—this was a simple pintle seal leak. The pump was a 6.17 gallon per minute size of the cross senter design which is designed to deliver oil at 3000 psi in either of two directions while being driven in a single direction of rotation.

Trans Canada Airlines operated the 2.7 GPM fixed displacement pump for 133,440 pump hours during a twelve month period with only one malfunction.

Waltham Screw Co., 71 Rumford Ave., Waltham, Mass., continued during 1952 producing all sizes and types of precision instrument screws for industrial and scientific use, in sizes from #0000-200 pitch up. Long recognized as producers of small parts and close tolerance work, Waltham also has "heavy work" automatic screw machines capable of producing top quality parts up to 1⅝ in. in diameter and 8½ in. long.

Wyman-Gordon Company in 1952 continued to operate for the Air Force a plant incorporating an 18,000 ton forging press at North Grafton, Masachusetts, in addition to its Worcester, Mass. and Harvey, Ill. facilities. The Air Force is expanding this facility with the addition of a 7,000 ton press, a 35,000 ton press, and a 50,000 ton press.

Since World War I, Wyman-Gordon has been one of the largest manufacturers of aircraft forgings in the world. With the outbreak of World War II, the aircraft industry was called upon to expand its output, and Wyman-Gordon similarly increased its output. Production at Worcester was multiplied many times—new facilities were erected at Harvey to supply aircraft forgings of all types to the new producers in that area. After the war, these facilities were converted to automotive crankshaft production while the Worcester Division continued to concentrate on the aircraft field.

Over a period of many years much important research work has been done by the Company on the forging of aluminum and magnesium alloys. With the expansion of its North Grafton, Massachusetts, plant to include a 35,000 ton and 50,000 ton press, production of forged aluminum and magnesium parts many times larger than any heretofore possible will be accomplished. In the field of hammer forgings, Wyman-Gordon also continues at the forefront of forging development. It has been one of the leaders in developing techniques for forging of titanium and projects currently underway will maintain Wyman-Gordon's reputation for advanced development of aircraft as well as other forgings.

A NON-SCHEDULED AIR FORCE

The backbone of this country's air defense will be the private flyer, 60,000 strong. The Aircraft Owners and Pilots Association proposes that a Civil Air Reserve be formed in the U. S. to give some military training to civilian pilots, airplane mechanics, amateur or professonal radio operators, photographers, and those other civilians whose technical training parallels that of Air Corps personnel.

—Aopa Pilot, March, 1941

During the year, **Zenith Plastics Co.**, Gardena, Calif., continued as custom molders of low pressure laminated reinforced plastic articles using fiberglass fabric, fiberglass strands and fiberglass mat as reinforcing materials. The company's material "Zenaloy" provides lightness with strength; is moisture and stain proof and will not corrode.

Zenith manufactures radar housings and wing and fin tips as well as primary structures for all the major airframe manufacturers in the country. The company has highly trained technical personnel and a complete testing apparatus for electrical testing of radomes.

The **Pioneer Parachute Co.,** of Manchester, Connecticut, designs, engineers and manufactures parachutes of various types. These include personnel parachutes, giant cargo parachutes, and ribbon parachutes used as auxiliary controls for jet planes in flight and in landings. The company is closely affiliated with Chesney Brothers, world-famous textile manufacturers, of Manchester.

In 1952, Pioneer-built parachutes continued to serve the armed forces of the United Nations and the United States, in combat, in training, and in test flights. Uses for Pioneer-built giant cargo chutes have developed and increased until these 100-foot chutes are used for delivery of an incredible number of items to spots which are so inaccessible that they could not possibly be reached except by plane and parachute combined. Pioneer's cargo chutes have delivered jeeps and howitzers, mass food supplies and medical supplies, enormous steel girders for bridges, and life boats to fliers adrift at sea.

Through its affiliation with Chesney Brothers, Pioneer Parachute Company has been able to develop remarkable new fabrics for parachute manufacturers, such as Chesney Parachute Nylon, and the Rip-Stop Weave. These fabrics are lighter, thinner, more compact, and at the same time much stronger and safer than any fabrics previously known for parachute use.

CHAPTER TWO

Department of Defense

MILITARY AVIATION in the U.S. during 1952 was fighting a war in Korea, strengthening its forces in Europe, expanding its size and strength at home and making elaborate preparations for the future. It was the busiest year since the end of World War II.

The hectic years of explosive expansion and myriad technical problems of 1950 and 1951 following the outbreak of hostilities in Korea bore fruit in 1952 as planes, men and materiel flowed into the armed forces in ever-increasing quantities. It was a year of reaping the first harvests of the post-Korean seedlings.

U.S. Air Power continued to be broadly based on the productive power of its aircraft manufacturing industry and at the close of the year Admiral Dewitt C. Ramsey was able to announce that the industry had attained an output rate of 1000-1100 airplanes per month. Deliveries of military airplanes set new post-war records yet the services and the industry were still able to maintain an ever-increasing combat quality of these aircraft through continuing introduction of new models.

With this mounting tide of production deliveries, the services were able to move forward rapidly with their scheduled build-ups. The Air Force, although building toward a target 143-wing strength, attained a force of almost 100 wings by the end of the year. This expansion was double-barreled insofar as it included not only the outfitting of additional new wings but continued the re-equipment of existing wings with modern aircraft. Naval aviation received back into service a number of carriers that had been undergoing modernization for the jet age and new carrier air groups were formed. Marine Aviation formed its third air wing and Army aviation increased its complement of fixed and rotary-wing aviation units by one-third.

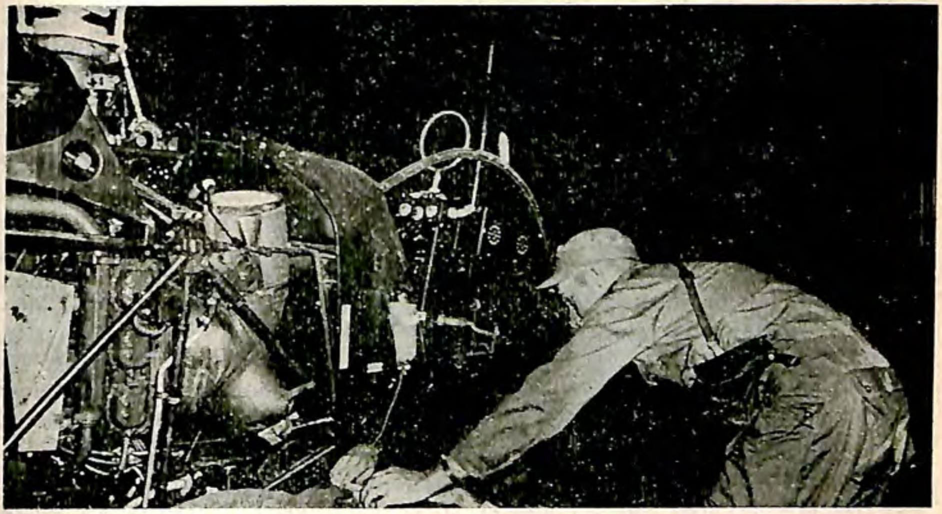
Meanwhile, more modern aircraft were being supplied to United Nations units in Korea. Most significant new addition was the North American F-86E model of the famed *Sabre*, which differed from the F-86A model previously in service in two important respects: a new radar computing gunsight and a "flying tail," which substantially increased the maneuverability of the swept-wing fighter. So effective was this new model that the *Sabre's* 9-to-1 ratio of victories over the Communist Mig-15 swept-wing fighter was increasing to an astonishing 15-to-1 ratio as the year ended.

Air Force

The United States Air Force was beset by enormous and complex problems during 1952 ranging in scope from the redesignation of its non-commissioned officers as "airmen" to the discovery that one of its vital airplane models had developed a serious structural deficiency. Early in the year an economy-minded Congress in an election year threatened to slash its budget to an extent seriously imperiling its ability to continue its expansion program. At one point in the complex procedure of budget approval the Air Force request for the 1953 fiscal year had been slashed to a level "imperiling the security of the nation" yet, upon its enactment into law, the Air Force found that it had received $22,318,000,000 for the new fiscal year, only a fraction under its 1952 award.

With more than $11.3-billion for new aircraft procurement, the Air Force set about the business of buying the most effective yet most economical aircraft available in the nation. Its production base had been expanded almost to complete fulfillment of the original post-Korean program, employment stood at more than 600,000 men and women. But all was not smooth. A costly steel strike threatened complete cessation of vital turbojet engine production. Another cutback and then still other came during the year. Strikes lost valuable combat aircraft. At year's end, however, the Air Force had received some 6500 new aircraft for its rapidly-expanding wings and production was at a postwar high.

The Lockheed F-94 program moved ahead rapidly early in the year and all-weather squadrons of the Air Defense Command were converted to the



Plasma for wounded Marine before night evacuation in Korea

new two-man interceptor throughout the nation, in Alaska and in Korea. The new F-94C model was introduced and featured a big Pratt & Whitney J48 engine with afterburner plus 24 2.75-in. rockets in the nose and an additional two dozen in wing nacelles especially designed. Late in the year, however, the Air Force cut back the F-94C program by 35 percent in order to concentrate on more advanced designs.

The other two-man all-weather fighter, the Northrop F-89, ran into the most serious difficulties the USAF has experienced with a new combat design in many years. The heavy extruded fittings attaching the wing to the fuselage began to suffer fatigue failure under the transonic loads of the fast fighter. Five fatal accidents in a space of a few short weeks resulted in grounding of the airplane. After careful analysis it was clear that the manufacturer was blameless, the failures being due to the lack of scientific knowledge on fatigue of structural materials. A $15 million contract was awarded Northrop to permit reworking about 150 F-89C fighters with machined fittings replacing the extruded type and all were due back in service in less than a year.

Most promising new all-weather fighter of the year, however, was the North American F-86D, which is a single-seat design. This amazing new fighter set a blistering pace over the Salton Sea, Calif., late in the year to establish a world's airplane speed record of 699.92 mph carrying full military equipment including retractable rockets. It was in full quantity production at North American's sprawling Los Angeles plant to succeed the two-man designs presently in use.

Contracts for new fighters let during the year included the North

American F-100, a "Super Sabre" incorporating 45 deg. wing sweep and powered by the giant 10,000-pound thrust Pratt & Whitney J57 turbojet engine. Also ordered was the McDonnell F-101 long-range fighter a development of the XF-88 *Demon* of previous years. Convair's extensive experiments with the XF-92A delta-wing design resulted in the award of a contract for the bigger, supersonic XF-102 delta-wing interceptor, which will carry a giant missile as its offensive load.

New models of familiar aircraft continued to appear on the assembly lines. The Republic F-84F swept-wing fighter rolled off the factory line late in the year. Powered by the Wright J65 engine, it promises a 700 mph or better speed for future Korean combat. A companion, the RF-84F, featured the mounting of cameras in the nose and the location of air inlets in the wing leading edge of the fuselage. Northrop introduced the F89D model featuring rockets carried in wingtip pods that house fuel in the after portion.

Most impressive new aircraft of the year was the giant Boeing B-52 eight-jet bomber, which promises new potentialities for strategic planning. The monster bomber has jet fighter speed yet carries an enormous bomb load for thousands of miles. The Convair YB-60 joined it in the eight-jet class, the new model being an adaption of the familiar B-36. The B-36F model was in production at the Fort Worth, Tex., facility of the company, featuring advanced Pratt & Whitney *Wasp Major* engines of 3800 hp, most powerful piston engine in production.

Air Force stole a leaf from the Navy's book and ordered the Lockheed RC-121 fitted as a flying radar station. The big transport with long-range search radar and relaying equipment is able to cruise at high altitude and thus increase the detection range of radar against enemy aircraft, quickly relaying the information to the ground. The new Super Constellation design will use the Wright Turbo Compound engine for its fuel economy to permit the RC-121 to remain on station for as long as 12 hours.

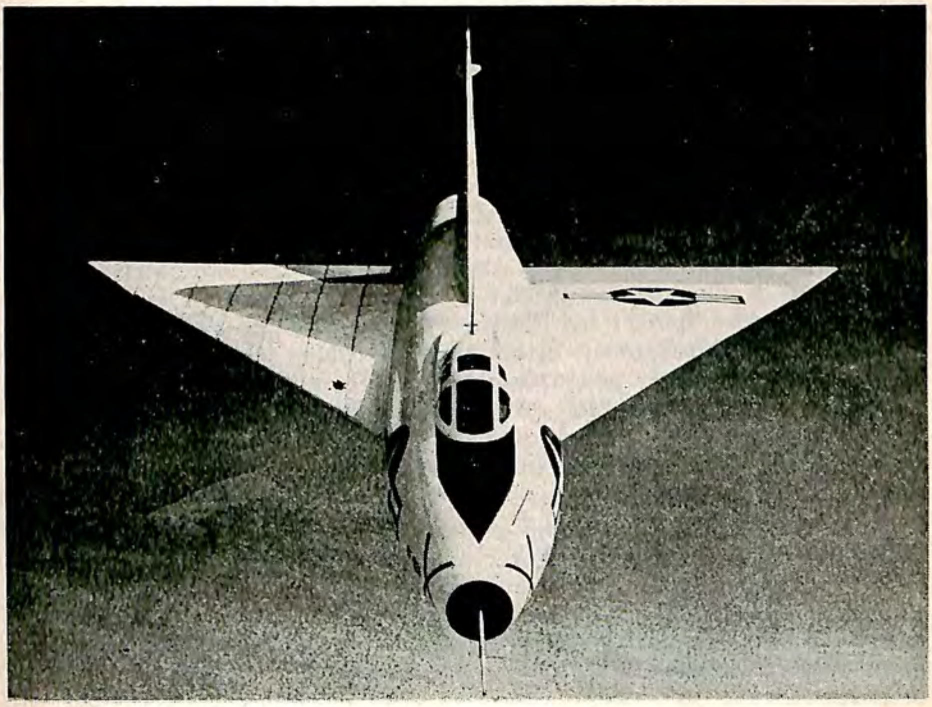
Also ordered was the Convair C-131 military air evacuation version of the popular Convair Liner. In its military passenger version it will feature rearward-facing seats, now standard for both Air Force and Navy passenger transports. It is powered by two Pratt & Whitney R-2800-52W engines.

Two new research airplanes received preliminary tests during the year. The long-awaited Bell X-2 was shipped to Edwards AFB, Calif., where it received a series of mid-air launchings as a glider to check its general stability and control. The big research airplane is of stainless steel construction and features heavily-swept wings and tail. Upon conclusion of the gliding tests it was returned to the Bell plant at Buffalo, N. Y., for installation of its Curtiss-Wright XLR-25-CW-1 of 8000 pound thrust. The first test flight of the sleek Douglas X-3 supersonic research airplane was made successfully in October at Edwards AFB, Calif. It is expected to fly at speeds greater than 2,000 mph and its design was evolved from a study of 60 different configurations. There are few who doubt that man will fly at 2,000 mph during 1953, the Golden Anniversary of the first flight.

The giant Hughes XH-17 made its first test flights successfully. The huge machine features a jet-driven rotor with a diameter of 136 ft. The rotor is driven by compressed air from two General Electric TG-180 turbojet engines. The air is piped to burners in the rotor tips, where it is mixed with fuel and ignited. The big helicopter is designed to straddle tanks, bulldozers or heavy trucks weighing up to 25,000 pounds, hoist them over mountains, rivers or other obstacles and deposit them gently on the other side. Amazingly enough, however, the monster machine will be used to provide data for development of the Hughes XH-28, a still larger flying crane!

For the first time the Air Force took the wraps off some of its top secret missiles, now in the production stage. Both the Hughes XF-98 *Falcon* and the Boeing XF-99 *Bowmark* were announced as pilotless, supersonic interceptor missiles capable of tracking down and destroying an enemy bomber in a matter of seconds after launching. In addition to the Martin B-60 *Matador*, announced last year, the Air Force has revealed the Northrop XB-62 *Snark* and the Bell XB-63 *Rascal* offensive missiles, the former a surface-to-surface design, the latter intended for launching from a heavy bomber against ground targets.

First head-on flight view of Convair's delta wing XF-92A



Despite these brief glimpses of supersonic missiles, the Air Force spent the year working hard on the day-by-day improvement of its conventional weapons. One of these was the Republic F-84G *Thunderjet* especially equipped for in-flight refueling from a Boeing KB-29 tanker plane. The Air Force program for this airplane typifies its thoroughness in planning. Early in February, an F-84G remained aloft over Edwards Air Force Base, Calif., for 12 hr. 5 min. to determine the ability of a pilot to handle his airplane effectively for such periods. Then, in March two standard F-84's equipped with additional belly tanks, covered a distance of 2800 miles in a nonstop flight across seven nations in Europe before returning to their base at Neubiberg, Germany. This determined the ability of pilots to sustain long distances without errors in navigation or equipment control. In April an F-84G covered a distance of 4,000 miles in a flight from Eglin, Fla., to Santa Barbara, Calif., and return, using Boeing KC-97 flying tank cars. A few days later two F-84G's flew from Langley AFB, Va., to Edwards AFB, Calif., dropped practice bombs and returned to Langley, being refueled on the 4,775-mile flight by Boeing KB-29 aerial tanker. Finally in July the purpose of all these test flights was revealed graphically when 59 F-84G fighters of the 31st Fighter-Escort Wing were flown from Turner AFB, Albany, Ga., to Yokota, Japan—a distance of 10,895 miles. The hops across the Pacific required 118 aerial refueling contacts with escorting Boeing KB-29 tankers. This amazing flight was followed in September by 47 more F-84G's, which made the Midway-Japan hop of 2,575 miles over open water using aerial refueling. The final result of this program was the readiness of complete jet fighter wings to be flown to any trouble spot on the globe in a matter of hours, bridging the longest over-water barriers through aerial refueling, one of the great developments of recent years.

The atom received its full share of attention in the Air Forces activities during 1952. Secretary of Air Force Thomas K. Finletter revealed that small atomic bombs suitable for tactical use were now available and stated flatly that "nearly all" USAF combat airplanes were being equipped to carry them. It was revealed that Boeing Airplane Co. had received a contract for the development of nuclear-energy-powered aircraft using a powerplant under development by Pratt & Whitney. This parallels an earlier project for the development of a Convair airplane powered by a General Electric nuclear energy powerplant. Air Force continued its participation in Atomic Energy Commission bomb tests in Nevada and at Eniwetok Atoll and expanded its own development work on the use of atomic bombs in aerial warfare at its New Mexico bases.

Air Force continued its policy of rotating major combat units to duty in Europe and assignment of some of them permanently. As the year ended the USAF has its Third Air Force in England and its Twelfth Air Force at Weisbaden, Germany. Both are tactical air forces, the Third including two fighter-bomber wings of Republic F-84 fighters, one fighter-intercepter wing of North American F-86 swept-wing fighters and one light-bombardment wing of Douglas B-26 twin-engine bombers. The Twelfth Air Force included three fighter-bomber wings of F-84's, one tactical reconnaissance

Air Force loads up Douglas C-124 in Korea

wing of Douglas RB-26 aircraft, one light bombardment wing of Douglas B-26 light bombers and two troop carrier wings using Fairchild C-82 and C-119 flying boxcars. Thus, of its approximate 100 wings in service, the USAF had 11 in Europe and 11 in Korea, or about one-quarter of its strength abroad.

As part of its characteristic planning for any eventuality, the Air Force completed plans during the year for the immediate mobilization of some 400 of the nation's four-engined civil airliners. Unlike the hectic days following Pearl Harbor, the Air Force plans to provide an orderly transfer of fully-equipped military transports into emergency service and is providing funds to the airlines—as well as to manufacturers for transports now under construction—for the modification of their passenger airliners to permit their immediate conversion into cargo and troop-carrying models. Thus, these provisions will be installed in these airliners in peacetime at Air Force expense. Air Force will, of course, automatically lease these transports and their crews from the airlines and will make regular payments for their use. Air Force also completed a plan through which the airlines may obtain badly-needed spare parts for their aircraft from military stores. Many airlines are now operating war surplus and transports now out of production spare parts for which are only available in Air Force depots. Air Force, through the CAA Office of Defense Requirements, made a substantial number of transfers of major aircraft and engine assemblies during the year to hard-pressed airlines.

Another forward-looking program was initiated during the year when the Air Force set out to straighten its records on some 300,000 reserve officers and airmen, most dating back to World War II. Although every attempt has been made to keep such records straight, they hav been kept at widely-scattered commands and kept up to date only as hard-pressed personnel found the time. The Air Force created teams to visit 25 principal cities and make personal interviews with reservists to bring their records up to date and, also, to apprise the reservist of current opportunities.

Important personnel changes occurred during the year. General Hoyt S. Vandenberg, USAF Chief of Staff, became the most important of these early in the year when it was revealed that although his term of office was due to expire April 30, 1952, he would not have completed either 30 years of service or be 62 years of age on that date. This would have required him to accept a subordinate command until completion of 30 years' service June 18, 1953. President Truman appointed General Vandenberg USAF Chief of Staff for an additional 14 months to permit his retirement as Chief of Staff. Vandenberg will be only 54 upon retirement. Vandenberg underwent a serious abdominal operation May 7 and was on leave until August 15 before resuming his duties, which were handled by Vice Chief of Staff Nathan F. Twining. Other important assignments during the year included: Maj. Gen. Patrick W. Timberlake as Commanding General, Air Proving Ground Command; Maj. Gen. Norris B. Harbold as Director of Training; Maj. Gen. Clarence S. Irvine as Deputy for Production, Air Materiel Command; Maj. Gen. Bryant Boatner as Inspector General; Lt. Gen. Howard A. Craig as Commandant, National War College; Maj. Gen. Francis H. Griswold as Commanding General, Third Air Force; Maj. Gen. Frederick H. Dent to Munitions Board; Maj. Gen. Franklin O. Carroll as Chief, Human Resources Research Institute, Air University, and Maj. Gen. Leon W. Johnson as Commanding General, Continental Air Command.

Despite its rapid expansion and the introduction of jet aircraft, the USAF showed a continued reduction in its accident rate. Final statistics showed the rate for 1951 to be 32 major accidents (those in which there are crew injuries or substantial aircraft damage) per 100,000 flying hours, compared to 34 in both 1950 and 1949. For the first six months of 1952 this rate was slashed to only 29 major accidents per 100,000 flying hours. As before, the highest major accident rate was 79 jet fighter accidents per 100,000 flying hours but this figure, too, was reduced from the 101 of the last half of 1951. The low accident rate in transports and trainers served to pull the average down to the figure of 29 per 100,000 flying hours.

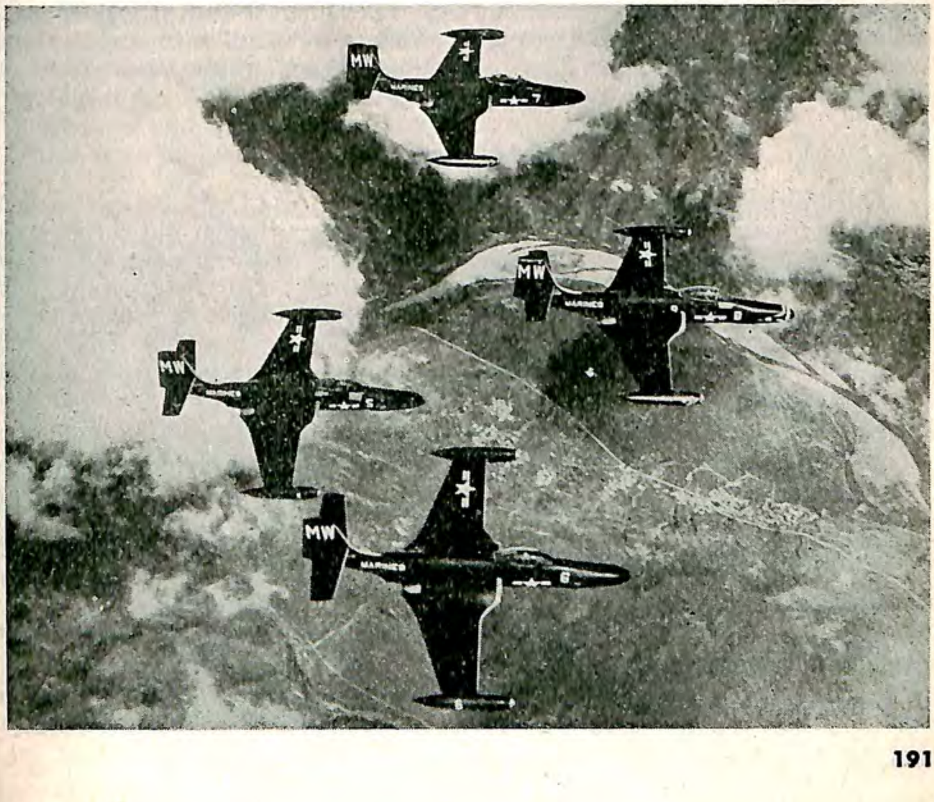
The USAF decided to discontinue its use of civilian schools for other than flying instruction. Previously, USAF students had been enrolled in commercial schools for courses in aircraft and engine mechanics, radar and electronics, automotive mechanics, meteorology and other aviation subjects. After careful and continuing analysis, however, the Air Force decided that it can train its men more economically and more quickly in its own schools.

This decision did not affect the nine commercial flight training schools used by the Air Force for primary training of potential pilots.

The Air Force took yet another step in its growth to independence with the designation of "airman" ratings for enlisted men. Privates became "Airman, 3rd Class," corporals "Airman, 2nd Class" and sergeants "Airman, 1st Class." Other changes in the jet age was the decision to train all three crewmen in the Boeing B-47 for all functions aboard the aircraft with each man aboard able to perform the duties of pilot, bombardier, navigator or radar operator.

Military Air Transport Service, a joint USAF-Navy undertaking, continued to hang up new and astonishingly-high records in its conduct of not only the Pacific Air Lift in support of the Far East Air Forces in support of the Far East Air Forces in Japan and Korea but its many other world-wide routes. During 1951 MATS carried 23,000 tons of cargo and 68,000 passengers across the Pacific and throughout the world it performed 1¼ billion passenger-miles and 302 million ton-miles of service. Its 1952 totals had well exceeded these amazing figures as the

Marine photo squadron flying McDonnell F2H-2P's in Korea



year drew towards its close. An innovation during the year was the attainment of Impact-O-Graph units on typical cargo packages. This tiny unit records the bumps and jostles it receives for a seven-day period. Not only does this provide an important record of the handling the package receives en route but will also indicate long stretches of no bumps, indicating that the package is lying idle somewhere—longer than it should be.

MATS ferrying service was extended to single-seat jet fighters and during March the first jet fighters intended for France, three Republic F-84 *Thunderjets,* were flown across the Atlantic by MATS pilots. MATS also showed the potentiality of delivering helicopters via fixed wing aircraft when a big Douglas C-124 flew two dismantled Sikorsky H-19 helicopters to Korea inside its cavernous interior. But the big H-19's proved later in the year that they didn't need such mothering when two of them flew across the North Atlantic from Westover AFB, Mass. to Wiesbaden, Germany to join a squadron of the Air Resue Service stationed there. In September MATS received the first of its big, fast Douglas C-118A transports, which are capable of doing the job of two Douglas C-54 transports. The new DC-6A's are 40 percent faster and carry 10,000 lb. additional payload over their older sisters. MATS speeded its services to wounded Korean veterans by establishing a high-speed east-west "express service" across the Northern part of the nation. The older route through Texas, Georgia and Maryland often required patients to spend as many as three nights en route. Now, MATS is operating "feeder" routes to these bases so that the big mainline transports will not be delayed.

Naval Aviation

During the first two years of combat in Korea the U. S. Navy dropped a greater tonnage of bombs and fired more rockets than it did throughout the entire Second World War. During 1952 the Navy stepped up its participation with even greater tonnages, most of it delivered by the propeller-driven Vought *Corsair* and the Douglas *Skyraider,* the backbone of the Navy's air war in Korea. Its Grumman F9F *Panther* and McDonnell F2H *Banshee* jet fighters continued to hit ground targets from aboard carriers off the Korean east coast.

Navy revealed in September that it had experimented with pilotless aircraft in Korea by using pilotless Grumann F6F *Hellcat* fighters carrying a 2,000-lb. bomb. The television-guided fighters were launched from carriers at sea and escorted to their targets by Douglas AD *Skyraider* "mother" planes. Television transmitters in the drone *Hellcats* enabled their "pilots" in the *Skyraider* to dive them directly into railroad tunnels and other hard-to-hit targets.

Navy received funds for the construction of not one but two "super" carriers during the year and keels were laid for the *U.S.S. Forrestal*-class 59,900-ton monsters. To equip these giants, the Navy developed prototypes of a variety of promising new carrier aircraft. The big new Douglas

XA3D-1 made its first test flight successful at Edwards AFB, Calif. in October and the Navy's latest crop of jet fighters: the Grumann F9F-6, McDonnell F2H-3, Vought F7U-3 and North American FJ-2 all passed their carrier qualification trials at sea aboard the huge *U.S.S. Midway* early in August.

Navy's aircraft development and procurement program proved unusually fruitful during the year. Early in January the first Vought AU-1, latest and, perhaps, last of the great *Corsairs,* began rolling from the line and were dispatched promptly to Korea. The big, new North American XA2J-1 made its first flight powered by two Allison T40 turboprops. North American also delivered its first North American AJ-2P, a special photographic version of the *Savage* to the Navy to inaugurate Navy airplane deliveries from the new Columbus, Ohio plant. The first North American FJ-2, carrier version of the successful *Sabre,* began delivery to the Navy early in the year. A later version, the FJ-3, was projected using the Wright J65 Sapphire engine.

The first of the big, deadly Martin P5M-1 *Marlin* anti-submarine patrol planes was formally accepted by the Navy at Norfolk Naval Air Station with more on the way as Martin received its fifth production contract for the monster killer. The new Lockheed P2V-5 version of the famed *Neptune* was taken on a 17-day, 15,000-mi. tour of Naval bases to demonstrate its new Wright Turbo Compound engines. Late in the year the P2V-6 model was announced with 12 in. additional length and more powerful armament, radar and equipment aboard. Navy also received the new Lockheed R7R-1 version of the Super Constellation, also featuring the low-fuel-consumption Wright Turbo Compound engines.

Armament and external fuel tanks carried by Republic F-84F

Navy expanded its interest in new aircraft types throughout the year with announcement of new awards. Most unusual is the new Convair F2Y-1 flying boat fighter equipped with hydro-skis, small plar ıg surfaces located under the hull to accelerate takeoff and to permit operation safely in rough water. The big, fast McDonnell F3H *Demon* production order was increased to include its output by Temco Aircraft Corp. in Dallas, Tex. An award was made to Grumman for an XS2F-1 twin-engine anti-submarine plane together with a TF-1 training version. Vought also received an order for its WU-1, a special search design. Navy expanded its interest in the rotorplane field by contracting with McDonnell for an XHCH-1 "flying crane" and by awarding development contracts for an experimental convertiplane design. Navy development work on the high length-beam ratio hull went forward during the year. A Grumman Widgeon was especially modified by Edo Corp. with a hullform having a length-beam ration of 12½-to-1 and research data obtained in an extensive test flight program. This was followed by the Martin adaption of the XP5M-1 patrol plane with a 15-to-1 ratio hull. These long, slim hulls not only provide greatly reduced drag in flight but also offer improved water handling characteristics.

Navy began its own experiments with in-flight refueling and made successful tests with the North American XAJ-1 as the tanker and a Grumman F9F *Panther* receiving the fuel. These tests proved so successful that the Navy is equipping its new F9F and McDonnell F2H jet fighters with refueling equipment. Unlike the Air Force, however, the Navy is using the British-developed "probe and drogue" system in which the tanker trails a flexible hose into which a fixed pipe in the nose of the fighter is injected. Navy carrier aircraft cannot accommodate the long "flying boom" developed by Boeing for the Air Force.

Entirely new performance attainments were revealed during the year when the Navy announced that its Douglas D-558-II *Skyrocket* had smashed all speed and altitude records for piloted aircraft. The flights actually took place last year but were withheld from announcement. The white research airplane reached an altitude of 79,494 ft. on Aug. 7, 1951 and attained a speed of 1238 mph on Aug. 15, 1951 with Douglas test pilot Bill Bridgeman at the controls on both occasions.

Navy revealed the outlines of its guided missile program early in the year. Projects announced include the Douglas Sparrow, an air-to-air missile capable of hitting its target over a distance of 2-4 miles; the Convair Terrier, a surface-to-air interceptor missile now in production at Convair's new Pomona, Calif. missile plant and the Vought Regulus, a surface-to-surface missile of substantial size, speed and range. The Navy also revealed that all of its attack planes and all long-range fighters now being procured are capable of carrying tactical atomic bombs and, in addition, a significant number of its planes delivered in prior years are being modified to permit them to carry small atomic weapons. Moreover, the Navy said flatly that it has definite use for the larger A-bombs and has already on hand carrier planes capable of delivering this full-size bomb.

Navy continued its aggressive development program during the year on carrier aircraft operations. Delivered was a special, fully-enclosed escape capsule developed by Goodyear Aviation Corp. This capsule, mounted as the cockpit in a fighter, is armor plated, pressurized, contains oxygen equipment, a raft and automatic ejection and parachute opening equipment. It was announced that the British-developed steam catapult would be adapted to U. S. carriers and late in the year the "canted" deck was revealed in which a carrier actually has separate runways for takeoffs and landings. Instead of a single longitudinal runway, the new canted deck incorporates two decks set at an angle to the centerline of the ship. This arrangement prevents landing aircraft from crashing the barrier and damaging planes parked forward.

Navy completed arrangements for joint use of the Air Force Missile Test Range and began a test program on high altitude interception problems. Naval aircraft and pilots will perform the problems with Air Force ground equipment and crews recording the results.

Fairchild cargo compartment is at home on the road or in the sky

Another new development was the use of highly-streamlined aircraft bombs pioneered on the Douglas F3D *Skyknight* all-weather carrier fighters. These slim, low-drag bombs, which permit a speed increase of as much as 50 mph on certain aircraft types, are the first major change in bomb shapes in 25 years.

Army Aviation

The U. S. Army continued rapid expansion of its aviation units with deliveries of the de Havilland L-20 and Beech L-23 liaison aircraft. Greatest expansion, however, was in the helicopter field, where the Army Ground Forces are showing extremely forward-looking developments. Army purchased small evaluation quantities of the Doman YH-31, 6-passenger or 4-litter type Hiller Hornet, a ramjet-powered, two-place design, and the American Helicopter XH-26, one-man pulse-jet design weighing only 300 lb. and quickly assembled after truck transportation to operating site.

Also ordered for evaluation was the Aero Commander, light transport, and the Helio Courier, a four-place safety plane capable of landing at less than 35 mph and operating from any cleared strip 300 ft. long.

Army Aviation's steady insistence on its tactical need for aircraft won it a lifting of the USAF-imposed ceiling on the size of aircraft it can purchase directly to an empty weight of 5000 lb. Army also won recognition with full membership on the Air Coordinating Committee, inter-governmental aviation policy group.

CHAPTER THREE

Technical Progress

One of the first and longest-lived aviation accessories is the parachute. The first successful one recorded in history was made by Joseph Montgolfier, co-inventor with his brother of the first balloon. The Montgolfier chute was made about 1779 and was safe enough to drop a sheep. First man to make a chute jump and live was Andre-Jacques Garnerin, at Paris, Oct. 22, 1797. He probably survived because he designed a hole in the top of his device to cut down oscillation. First great American parachutist was Capt. Thomas S. Baldwin, of California. He was a star in the '80's. At least one balloonist discovered parachuting by accident. In 1838, over Easton, Pa., John Wise went so high in his balloon that it exploded. The casing doubled into the netting, and an emergency chute was born. Wise landed hard but staggered to his feet full of happy plans, later carried out, to do the accident again on purpose as a crowd-catcher. Baldwin rediscovered the basic design of the modern parachute through a chance remark. One day his chute oscillated so badly that he was slapped to the ground like a ball at the end of a string. 'Why don't you put a hole in the top?" yelled a boy in the audience. Baldwin did, and the oscillation was eliminated.

Bell Aircraft Corp.

Expansion of scope and diversification of activity have marked the recent history of the Bell Aircraft Corporation. With the presentation of new and unusual problems in research, development and production engineering programs, have come equally unconventional and novel approaches to their solutions. Creative work of a high level has been encouraged in the various research departments.

One of the latest manufacturing processs for the fabrication of tapered metal sheets for aircraft and missile application, the Abrasive Belt Grinding Method was developed. This entirely new method of generating tapered sheets involves the use of a sine bar type reciprocating table inc rporating a vacuum chuck. Th plate or sheet material is placed on the sin bar table and the machine is set for the required taper. The machine is started and the entire width of the sheet is ground on a plane parallel to the abrasive belt on contact roll. This grinding cut gradually runs out, resulting in a perfectly ground tapered skin. Demonstrations substantiate that greater economy and precision, as well as increased production, can be achieved by this process.

Recent developments and improvements in the techniques of the Precision Investment Casting Process have led to its widespread usage in solving many of the problems of producing intricate aircraft and missile components and assemblies. Parts of intricate configuration have been cast successfully; some as large as 16 inches in diameter; some weighing as much as 35 pounds.

Located in strategic points through the Design Engineering Department are production engineers who have intimate knowledge of all manufacturing methods and practices, tooling problems, tolerance limitations and plant facilities. The task of these men is production analysis. They review all designs on the board and suggest possible changes to simplify tooling and production.

As a result of this effort, details and/or assemblies are procurable with a minimum change from the prototype to the production item. This department thus constitutes a direct and important link between production and design engineering in advising the former regarding all advance tool planning.

It is also the function of the analysis group to collaborate with the necessary departments to analyze and review the advance planning of new facilities and the procurement of critical machinery and equipment. The close coordination of effort thus achieved, especially in the matter of solving problems as soon as they arise and well before they become critical, is a direct and highly efficient method of achieving maximum economy.

The fabrication of complex parts of close tolerance, with their related costly machining and tooling and the scarcity of skilled labor have created major problems, which are now being solved through the use of powder metallurgy.

As a means of reducing the tooling cost for these short runs, there have been developed metal-reinforced, compression-formed dies of a thermosetting resin with suitable fillers. Small powdered metal parts such as gears, friction clutch facings, etc., have been successfully fabricated by the use of this tooling.

A similar story is told in the field of rocket research. The year 1952 marked Bell Aircraft's seventh anniversary as a center of rocket research. From the small beginning of one test cell, improvised to accommodate the rocket engine for the X-1 airplane, the organization has grown to include a complete rocket engineering laboratory, housing over 400 experienced personnel. Numerous test facilities are also in operation. During these years, a number of power plant development programs were successfully completed, providing experience on most liquid propellants and on all types of feed systems.

Highlighting the work in 1952, was the design of a new type of thrust chamber incorporating simplified manufacturing techniques, thus eliminating the need for strategic metals. This development presents not only a decrease in weight and cost, but also a significant increase in unit life.

Boeing Airplane Co.

While a new eight-jet airplane took the headlines during 1952 at Boeing, the men who work in laboratories and on test projects earned the plaudits of their fellow men for endlessly prying into and coming up with answers to problems confronting the industry.

Studies were being conducted to compare high strength welds made by new electrodes with those made by present electrodes. Welds made with the new electrodes are heat-treatable and can develop joint strengths equivalent to base metal properties when heat-treated to 180,000 psi.

Newer synthetic fabric laminates are now employed as edge attachment materials for transparent plastic enclosures which reduce the problems encountered due to differential expansion characteristics. Additional applications are being investigated on sandwich construction as used in secondary structural applications.

Boeing's mechanical equipment group found plenty of problems to cope with, also. With the incorporation of greater quantities of electronic equipment in modern aircraft, the problem of equipment cooling has increased. A detailed study was made to estimate cooling requirements for electrical equipment and for aircraft cabins. Various cooling methods were studied from the standpoint of weight, space required, cost, performance and reliability. Growth factors were included in the study to plot future requirements.

A permanent magnet velocity pickup has been developed with a self-contained integrating circuit to give amplitude measurements accurate within 2 percent from .0005 to .25 in. at frequencies from 1 to 2000 cps.

Since jet engines and sonic speeds produce a spectrum of vibration frequencies from a fraction of a cycle up into the kilocycle range and at intensities up to tens of "G's," equipment has been built and is being developed to produce and measure these vibrations both in the laboratory and in the field. Existing equipment provides 300 pounds of force to 2500 cps, and a ten-kilowatt power unit is being constructed to provide driving force for several 3000 lb. electromagnetic vibrators. Pre-amplifiers and integrating amplifiers have been developed for use with the Barium Titanate type of pickup and successfully have been used for laboratory measurements up to several kilocycles.

Two electronically-controlled devices, one using eccentric weights, and the other an airfoil, have been developed for aircraft installation to produce fuselage or wing bending modes in flight as an aid to flutter studies.

In the industrial controls group an extensive study was direc d toward the development of a high speed three dimensional duplicating mill. During the course of this study, engineering contact was made with the major machine tool manufacturers in the United States and the Air Materiel Command. Results of the studies were presented to these companies and it is believed the program will accelerate application of up-to-date control techniques to the design of machine tools.

A laboratory flight simulator was developed to permit study of automatic pilot problems in the lab. As a result, a device was developed to remove unwanted modulations and variations and to clarify the a-c power supplied to the automatic pilot signal system. Termed an A. C. Modulation Suppressor, its purpose was to reduce automatic pilot "jitter" which can be caused by modulation and variation of the supply voltage.

During the year Boeing made considerable progress in the field of plastic tooling. For instance, a "wiper block," a fibreglass-and-resin tool, is used to form complex curves and joggles. It does this job simply by "wiping" the vertical portion of a metal part, under pressure, against the fact of a die in a big press. In addition plastic has been used to make the metal-bonding jigs formerly machined from aluminum. Boeing has been able to use plastic to make drill cages, trim templates and mandrels.

A major company development was Boeing's creation of helical carbide cutters. Carbide cutters of standardized shapes and sizes had been on the market for some time, but inserts to fit helical tool bodies were not available. Boeing succeeded in successfully twisting and bending a standard carbide insert so it would fit a helical tool body. After successfully doing this complicated operation by hand, Boeing carbine-development men next designed a mechanical bender-twister, to work inside the turns of an electronic induction-heater coil. This device, as soon as it was put into production, contributed greatly to the speedy finishing of urgently-needed cutters for maching wing spars, body stiffeners and other portions of bombers.

Cessna Aircraft Co.

Unique in the tooling programs at Cessna is a tooling template which is called a Facility Tooling Template, or in shop vernacular, an FTT. The FTT is an exact reproduction of a developed blank part made of mild steel 1/16" thick, to which much reference data has been added. Once the FTT is complete and has been accepted by inspection it is the final word in acceptability of tooling. This template is not used as a production checking device but as an instrument to make and check tooling. Since tool holes are placed at tooling convenience and acceptable to engineering the FTT is then the record and the device by which the holes are placed on tooling.

Holes up to 1" diameter are usually full size on the FTT while larger holes such as lightening holes are piloted with #30 holes. These pilot holes are stamped with full size callout and the full size hole is scribed on the template and outlined by a dotted yellow line, the face of the template being black. Station and water lines are indicated by scribe lines which have #30 holes at each end for use as a transfer punch. These lines are labeled with the pertinent locating dimensions. Since the tooling holes at the end of these lines are not used on the parts, they are circled with a solid red line to prevent their incorporation in tooling and blanking dies.

This type of template allows tooling to progress on several mating parts with matching holes at the same time. For example—the FTT for bulkhead "A" has rivets holes locations for pulley brackets "B" and "C," the FTT on the bulkhead "A" will be referenced as the measuring media for locating the rivet holes in brackets "B" and "C." This assures positive mating of prepierced holes in actual assembly.

Consolidated Vultee Aircraft Corp.

The achievement of a high-performance, delta-wing, jet seaplane in itself has been of far-reaching significance. Utilizing another Convair development—the radio-controlled, dynamically-similar model, with blended wing-and-hull design—the efficient delta-wing configuration incorporates a unique hydrodynamic system that frees the land-based airplane from the requirement for elaborately-prepared and expensive concrete airstrips, with no sacrifice in aerodynamic performance. The ability to base such aircraft at forward combat areas, with little or no advance preparation, promises important consequences in the concept and execution of a fluid, fast-moving environment.

Simultaneously with its airframe progress, San Diego's specialized laboratories were fulfilling many components and systems research contracts for the armed services. Included were intricate guidance and tracking systems for missiles, new jet and rocket power plant investigations, weapons systems analysis, structural and materials research, and advanced aerodynamic and hydrodynamic research. Investigations are also being conducted in the use of titanium, porous sheet, 75SW aluminum, plastics, extruded sheet and other advanced construction materials and methods.

With respect to manufacturing operations and tooling, Convair-San Diego in 1952 was faced with initial production of the Navy's 80-ton R3Y seaplane transport, for which was designed and erected what is believed to be the largest fixture ever employed in the aircraft industry. The R3Y is the largest seaplane ever built by Convair, and, from the outset, its production program presented several unique problems. Part of them stemmed from the size and shape of the airframe, part from the extremely rugged construction requirements. Nearly 65,000 tools peculiar to this one project were required, in addition to thousands of so-called standard tools. Six subcontractors, with their multitude of Convair-specified tools, are likewise concerned with R3Y manufacture.

For sheer size and weight, the hull major assembly tooling job was the most difficult encountered. One tool, earlier referred to, alone weighed approximately 1,000,000 pounds and stands four stories high. It is the twin-hull assembly buck 150 feet long and 65 feet wide which utilizes an erector-set type of construction and required nearly two miles of pipe. Three main work levels were provided, with a fourth at the tail section.

In the wing assembly department, Convair was faced with assembling in a single structure an R3Y wing center section weighing more than 13,000 pounds. This fixture was fabricated from 22-inch diameter pipe as a base structure. The vertical buck is 12 feet wide, 17 feet high, and nearly 100 feet long.

Convair-Fort Worth acquired a Reeves Analog Computer (REAC) initially for conducting dynamic response and autopilot studies on B-36 aircraft. Actual aircraft flight characteristics could then be simulated electronically and accurate results obtained without costly flight testing. Actual flight testing, to some degree, verified the theoretical results. The electronic approach provided data which were more accurate than was hitherto possible, thus increasing specifically knowledge in the field of stability and control.

The application of punched-card mechanical computing systems also made possible the theoretical investigation of many thousands of airplane parameters, resulting from combinations of specific advanced aircraft characteristics with various types of power plants and power-plant combinations. Thus an encyclopedia compilation of data was developed from which the Air Force could generate type specifications for specific bombardment aircraft for particular missions.

Investigations are being conducted in the Convair-developed Metlbond process which will be productive of higher sheer allowables in the future and also expand the application of bonding in aircraft structure. Applications of bonding in areas of higher temperature are under investigation.

Advanced theoretical investigations continue on theoretical analysis of thermodynamic cycles as they apply to aircraft, with applications which have resulted in improved aircraft performance. Equally important are thermodynamic studies relating to the world's first nuclear-powered aircraft, the airframe for which is being developed by the Fort Worth Division.

Doman Helicopters, Inc.

In the past year Doman has pioneered a number of innovations in both design and manufacturing techniques which are incorporated in the YH-31 model helicopter.

New to the industry is the use of a fluid coupling to initially engage the rotor system to the engine. This clutching-in method incorporates a lock-up feature which engages automatically after the rotor is brought to speed providing a positive drive system between the engine and rotor during all flight conditions.

Another innovation in this new military helicopter is the introduction of compound exhaust ejectors to draw cooling air over the engine cylinders. Using exhaust gas energy in this manner not only eliminates the complication of a cooling fan but greatly improves the fuel economy for cruising flight.

Douglas Aircraft Co.

Douglas Aircraft Company, responsible for the Guerin process of rubber pad hydroforming, introduced a revolutionary new type of hydraulic press during the year. The design was completed, prototype demonstrated and first production models delivered during the second half of 1952.

Only one-tenth the size of conventional presses, the new production machine is capable of exerting up to three types the pressures previously available for shallow forming of metal aircraft parts. Higher pressures make it possible to form the heavier gage metals currently employed in modern, high-speed aircraft. Another advantage offered by the press is that it reduces handforming by some 50 percent.

Developed under the direction of O. A. Wheelon, production design engineer of the Santa Monica Division, the press bears his name as well as that of the manufacturer. One future application of the Verson-Wheelon direct acting hydraulic press will be the hot forming of titanium and magnesium.

Douglas engineers reading data telemetered from test airplane

Simplicity of the hydraulic, mechanical and structural elements of the Wheelon press makes possible a functional design which results in low initial manufacturing cost and easy operation. Working pressures range up to 10,000 pounds psi on some models.

Pressure is applied through a bag or fluid cell mounted in the roof of the press. Inflating the bag with hydraulic fluid displaces the working pad down over the part to be formed. Normally, the pressure is raised to 5000 pounds psi, although lower pressures may be used. Because the working pad is softer and has considerably more elongation than those employed in conventional rubber pad presses, pressure on the sides are as high as those on the face of the block.

First production models of the Verson-Wheelon press exert 2500 tons pressure at 5000 psi on a platen measuring 20 by 50 inches.

The science of flight testing was advanced in 1952 by the Douglas High Speed Recorder, developed by the testing division. The recorder permits engineers to monitor and direct high speed aircraft tests from the ground through telemetry. Douglas engineers modified telemetering techniques used for more than five years in the company's missile development program to devise the more complex system for piloted aircraft.

The airborne portion of the equipment occupies less than two cubic feet of space and weighs less than 110 pounds. The complete system is comprised of two separate 88 channel FM radio transmission links. It is capable of sending information from 176 separate measuring devices at the rate of 16 samples per second for each, making a total of some 3000 items of intelligence per second.

Another interesting contribution of the Douglas Santa Monica Division is the development of the Douglas Scoring Camera System. Its function is to photographically record and thus provide the means of reconstructing the relative approach histories of high-speed objects arriving in a somewhat random fashion about an aerial target.

The scoring camera system is fundamentally based on the use of at least two widely separated "conjugate" high-speed, wide-angle scoring cameras, provided with a common time base, whose separation, calibration, and orientation are accurately known. Assessment of film records from such cameras by triangulation computations will yield successive time-space positions of an object traveling within the photographic field of view and range. The camera sampling rates are from 200 to 500 pictures per second, with exposure times of one millisecond or less, and a field of view of 142 degrees full cone angle.

Motion picture color film is loaded into scoring camers located in precisely positioned camera stations aboard the aerial target. The number of cameras involved and the type depends on the target and its specified mission. In practice, the number of cameras used ranges from two to fourteen, with eight cameras considered optimum for complete binocular coverage.

The processed film records of encounters between the target and attacking objects are analyzed photogrammetrically by either an Overlay Grid Method or with a semi-automatic Iconolog-IBM Method. In either case, the analysis yields data in the form of plots of the time-space positions of the object as it intercepts the aerial taget. From these data, such information as direction, velocity, slant ranges, time, and position of the occurrence of special events may be determined between the objects and the target, in the coordinates of the scoring camera system.

Objects as small as high velocity aircraft rockets can be detected at ranges up to 250 feet when aspect and contrast are favorable. When camera separation is of the order of 50 to 100 feet, range data is accurate to within 3 to 5 percent up to 100 feet of range and to within 10 to 12 percent up to 250 feet of range. Significant object images on the film records can be read to an accuracy of $\pm\frac{1}{4}$ degree within the range of 0 to 40 degrees from the optical axis of the camera, and $\pm\frac{1}{2}$ degree from 40 degrees to the edge of the field, which is about 72 degrees.

After processing the film records, preliminary qualitative data can be obtained in about half an hour, while preliminary quantitative data will take about four hours. Complete analysis and plots of a single object-target encounter requires about 20-30 man hours.

In the field of plastics, Douglas engineers developed a design and perfected a technique for manufacturing thermally anti-iceable radomes. Radomes produced by the new process are now in service on late models of the C-124 Globemaster and on C-118A and R46 Liftmasters. Outstanding advantages of the process include ease of design change, relatively low tooling cost and excellent quality control. For these reasons, the process may be adapted also to fabrication of aircraft components other than radomes, such as antenna housings, air ducts, structures involving undercuts and integrally molded sections.

The fabrication technique is described as the "lost wax" process, which produces a fluted plastic sandwich. The process begins with the extrusion of rectangular strips of wax. After being wrapped with resin-impregnated fiberglas tape, the strips are laminated between face sheets of resin-impregnated fiberglas cloth, cured under heat (below the wax soften point) and between 10 and 15 psi pressure. When the laminated construction has hardened sufficiently, pressure is released and the wax is melted out at a higher temperature. This leaves a plastic sandwich construction of integrally molded columns supporting the face sheets. Hot air forced through the flutes eliminates or inhibits the collection of ice on the exposed skins.

The sandwich has excellent radar transmission characteristics, is structurally sound and allows manufacturing techniques which lend themselves easily to engineering designs required for anti-icing.

Weight of the fluted core is less than honeycomb or foam-filled core of comparable thickness, but at some sacrifice of strength. The "lost wax" process and the complete radome production was developed under the direction of C. R. Lemons, of the Douglas Santa Monica process engineering staff.

Kollsman Instrument Corp.

In the development of its electromechanical flight data computers, which supply multiple electrical outputs of flight data, Kollsman has progressed rapidly and the first of a series of these units has been put into production. Moreover, development of a new line of units, known as Pressure Monitors, was completed. Basically a diaphragm instrument activating an electromechanical "E-Pickoff," a Pressure Monitor provides very precise indication of either altitude, airspeed or pressure within predetermined limits. The design is adaptable to use in the control and preselection of indicated airspeed and pressure altitude of airplanes and missiles, in the control of aircraft, cabin pressure, of pressurized radar enclosure, barographs, manifold and turbine pressure.

In the radio and radar field, research and development has increased rapidly during the year. Kollsman's Radio Communications Engineering Section now occupies 5000 sq. ft. of floor space with laboratories at Elmhurst and Astoria, Long Island, and an antenna test facility on the roof of the Elmhurst plant. The laboratories are complete with precise measurement equipment of the most recent design providing full coverage including microwave (X-band) frequencies. All types of signals from continuous wave to milli-microsecond pulses can be generated, measured and displayed. The antenna test facility is equipped for microwave antenna pattern and gain measurements, and for operational measurements on radio and radar systems.

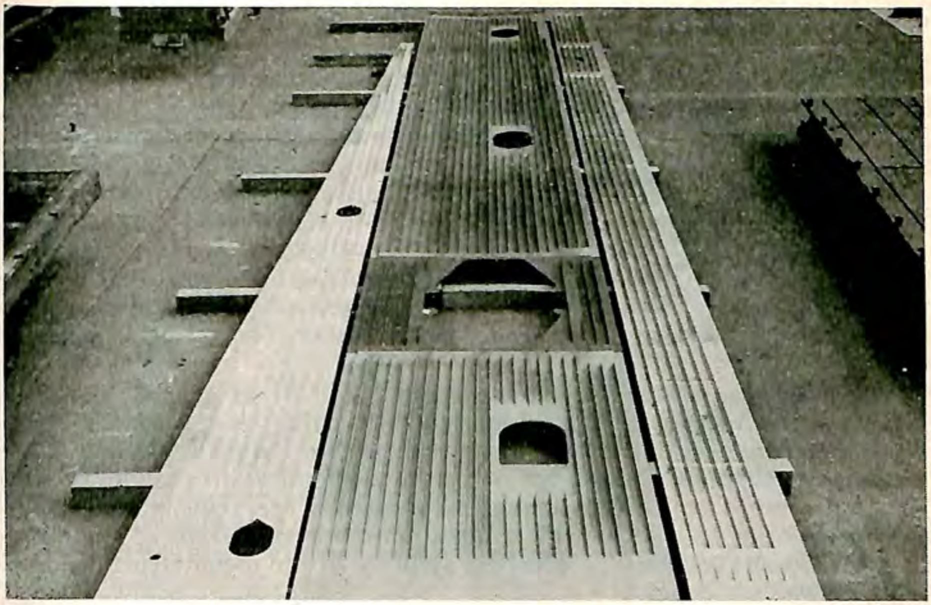
Lockheed Aircraft Corp.

In the structural field at Lockheed, continuing close attention was paid during the year to large integral unit type construction because of the obvious advantages it proffers in structural integrity, assembly, producibility, maintenance and eventual low cost.

The Constellation integrally stiffened inner wing lower skins produced in this fashion became regular production items, and it is of interest to note that the 32-foot long central panel of these skins is, it is believed, the largest integral airframe unit manufactured anywhere up to the present.

Further, to solve a critical design postulate the leading edge structure of the Starfire is also fabricated of integrally stiffened machined panels which are later formed to the abrupt leading edge contour of the fighter wing. Thus, an efficient solution is provided, both production-wise and structurally, to a design problem that did not lend itself readily to convenitonal fabrication methods.

On the new projects there are in prospect wing box beams 48-feet long made up entirely of sculptured 75ST integrally stiffened spars, ribs and skin panels. Present indication is that this type wing will make possible exceptionally tight fuel cells with a consequent reduction in maintenance; and



Integrally stiffened wing surface for Lockheed Constellation

weight savings in the hundreds of pounds with a proportional improvement in performance.

The use of integral structure produced by the extrusion method is also being forwarded. Extruded integrally stiffened skin panels of aluminum alloy are being incorporated in the Constellation outer wings and as reinforced skins for pressurized sump tanks. In addition, extruded integrally stiffened floor panels are being used both on the cargo version of the Constellation and on newer projects with the Constellation floor panels being made from magnesium alloy.

Exploratory work on production method techniques for titanium and its alloys was continued during the year. In spite of serious forming and machining difficulties two jet aft fuselages were completely fabricated from the material on an experimental basis. Also, somewhat limited production uses for commercially pure titanium sheet have been found in several radiation shielding applications which do not call for too severe forming. Plans are now under way for a forged titanium alloy jet engine mount for a number of stretch formed, punch press and hydroformed parts both in the commercially pure and the alloy sheet material.

The adoption by Lockheed of the use of metal coated glass cloth for vertical fin as well as canopy antennas has resulted in the elimination of installation labor and 15% better reception.

The use of glass cloth laminates has been extended to include ducts on the hot side of the cabin heaters where temperature conditions permit. Also planned for use are glass cloth air ducts of very light weight and thin walls, and a glass cloth laminate intake fairing enclosing the entire forward portion of a projected jet pod. This latter item makes possible reduction in tooling cost while providing an improvement in the functional efficiency of the fairing.

Lockheed has extended its use of industrial adhesives to include the metal to metal attachment of a fairing on the F-94 and honeycomb construction to include aluminum floor panels for the Constellation passenger version along with its existing applications on this and other projects. This is not to mention the widespread use at Lockheed of glass cloth laminate honeycomb structure in radomes and protuberances for various electronic devices.

An aileron has been incorporated into the F-94 in which the major portion of the internal structure has been replaced by plastic foam material chemically expanded to internal dimensions within the aileron itself. This type construction affords savings in weight and cost and in addition, provides continuous support to aileron skins which are rendered smoother aerodynamically and 170% stiffer than conventional designs. The foam material has the property of adhering securely to the metal structure with which it comes in contact.

The cargo version of the Constellation features a unique light-weight continuous chain drive cargo loading device which appreciably cuts down time for loading freight and, therefore, will reduce ground time for the airplane.

Also, before long the Constellation will be equipped with 600-gallon wing tip tanks 19-feet long and 42-inches in diameter—the first commercial air transport to be so equipped. These tanks, for which there will be very little aerodynamic penalty, will be removable on the ground and will provide the additional fuel capacity necessary for the turbo-prop version of the airplane.

The Glenn L. Martin Co.

Highlighted among a number of technological advances achieved at the Glenn L. Martin Company during 1952 was the successful proof of theoretical calculations made on a new type of seaplane hull with a 15 to 1 length to beam ratio.

This new hull was built into the research model M-270 and proved highly satisfactory both aerodynamically and hydrodynamically in tests which began in late Spring of 1952. The hull embodied the results of years of towing tank and wind tunnel tests conducted by Martin in cooperation with the U. S. Navy's Bureau of Aeronautics, the National Advisory Committee for Aeronautics and the Stevens Institute of Technology.

The M-270 research program revealed a very important fact: a seaplane hull can be relatively short and broad or long and narrow and still provide the same hydrodynamic efficiency. However, aerodynamic efficiency rises sharply as the length-to-beam ratio increases because as the ratio increases, frontal area decreases and so does hull volume and total skin area.

Studies and towing tank model tests showed that these aerodynamic, hydrodynamic and structural weight factors reach the point of optimum correlation at the length-to-beam ratio of 15-to-one. It was to this ratio that the full size M-270 was built, the highest disclosed for any seaplane, the nearest being 12½-to-1.

During taxi and flight tests conducted in the Chesapeake Bay area near the Martin plant the M-270 was flown in overload condition up to 71,000 pounds and taxiied at nearly twice its normal gross weight.

Notable in another branch of Martin endeavors was development and delivery to the U. S. Air Force of the T-13 flexible gunnery trainer. The trainer uses the same fire-control equipment found in such bombers as the B-36 and B-50, in combination with the necessary measuring and scoring devices. The turret, however, is simulated by electronic means. Tracking, sighting and gun-laying errors are summarized, continuously, throughout the course of the gunnery exercies. As many as a dozen different kinds of error can be measured at the same time. Hence the trainee's mistakes can be discovered and corrected before they become habits.

The Company also was successful in developing for the Ordnance Corps at the Aberdeen Proving Ground, Md., a microwave interferometer. This is an instrument capable of measuring the continous time displacement of a projectile within the barrel of a gun. The microwave interferometer is useful in determining the proper length of a gun barrel for obtaining the maximum muzzle velocity. It also enables the operators to determine the best propellant for gaining a particular muzzle velocity for the minimum pressure within the gun barrel. In addition it helps determine the efficiency of the projectile obturator and finally it reveals the distance by which the shock wave precedes the projectile.

North American Aviation, Inc.

A major change in the method of manufacturing wings for high speed jet fighters highlighted a year of technical progress in many phases of aircraft produtcion at North American Aviation, Inc., during 1952.

For years wings have been built with ribs and spars catacombed between the upper and lower skin. As wings became thinner and at the same time subjected to greater stress loads, new methods of strengthening the wing had to be found. North American design engineers solved the problem by using aluminum grids in the wings. The manufacture of these long waffle like sections of contoured aluminum presented a real problem. Joe Corral, general foreman of the company's Machine Forming Department, suggested a new technique, called "die quenching." Through this method, designers have saved 225 parts in the wing of the new F-86H Sabre jet and a total of 214 parts in the Navy's FJ-2 Fury. In addition, thousands of rivets can be eliminated.

Briefly, "die quenching" involves heating the pre-machined aluminum plates and transferring the grids to a set of Kirksite dies mounted in a hydraulic press. The process of moving the wing grid from the heat treating oven to the big 9 million pound Birsboro press, requires a great amount of agility and teamwork on the part of the press operators. s the oven doors open the operators have thirty seconds to pick up the grid by a special handling device, and place it in the die under the press. As the press moves down on the hot part it is sealed into the die. Water under fire-hose pressure rushes up through the die and around the grid members. After being formed to exact contour, the part is heat "aged," milled and installed in the wing.

Two new presses, one for the Columbus plant and one for Los Angeles, are being purchased by North American for the "die quench" program. The part formed by the "die quench" process is relatively "stress free," which may mean a "gift" of several thousand pounds per square inch to the designer.

The process allows the purchase of less expensive sheet, which has been only partially heat treated, and is not limited to forming heavy grids. Many other smaller parts also are being produced by this process, with a substantial savings in manhours and with more accuracy. "Die quenching" in partially eliminating internal stresses, shows a considerable advantage over drop hammer and power hammer forming.

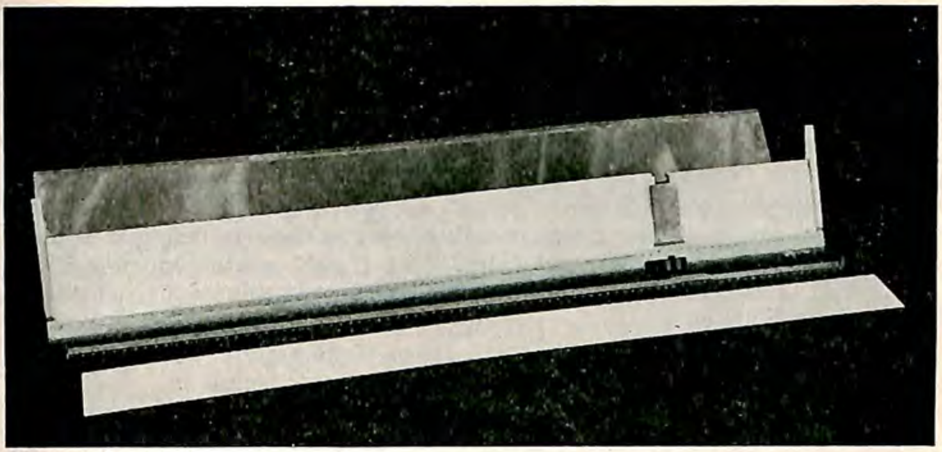
Searching for new uses of materials already common to aircraft building, North American engineers have turned to the use of aluminum honeycomb core for trailing edges of both wing and tail surfaces. During the past year, these parts of metal sandwich construction have received considerable interest at North American. This type of construction offers substantial increases in stiffness-weight ratios and savings in cost and weight over conventional sheet metal designs.

North American's major application of metal sandwich material has been in secondary structures such as floors, walkways and table tops, although some use also has been made for wing and tail trailing edges. It is anticipated that use of these materials will be greatly increased when more complete design and service data becomes available.

During the year the company announced construction of the first atomic energy reactor to be built in California and today is one of the few industrial concerns in the United States ready to go into production of reactors when customers enter the market.

Northrop Aircraft, Inc.

Northrop Aircraft, Inc., made substantial progress in a number of research and development programs during the year. Among the most significant was a closely-guarded research project sponsored by the U. S. Air Force to produce cast magnesium aircraft wings. A section of an airplane wing 16 feet long and adhering to exacting tolerances—believed to be the largest cast aircraft surface ever produced—was cast from magnesium



Light weight Styrofoam is used by Northrop in control surfaces

through the joint efforts of Northrop's engineering and development team and the Aluminum Company of America. Northrop aeronautical and metallurgical engineers pooled their knowledge with that of Alcoa's engineers, metallurgists and skilled foundrymen to produce the wing section from AZ-92 magnesium alloy. Northrop employed Alcoat facilities at the latter's Vernon, California, foundry, under sub-contract for the project.

Process engineers of Northrop have also developed a successful method of using Styrofoam, a hard plastic foam with a density of 1.6 pounds per cubic foot as an inner "filler" for control surfaces. Overall adhesion of this foam material permits elimination of 80 percent of the rivets now used in control surfaces.

Northrop process engineers have developed successfully a metal-plastic adhesive, which is a modification of existing synthetic resins, for bonding Styrofoam to sheet metal. The ahesive, being patented by Northrop, provides an exceptionally high-strength bond. It may be applied to small surfaces by brushing, and is sprayed on larger surfaces. The adhesive is applied to all mating surfaces, and then sealed by pressure contact. Use of Styrofoam as a substitute for ribs makes possible control surfaces as much as 15 percent larger in size, with decreases in weight up to 10 percent or more. Strength is increased as much as 10 percent. Designed for stress loads of 150%, a control surface underwent tests at stress loads exceeding 300%. By use of the patented Northrop adhesive, Styrofoam may successfully be used with either wood, glass laminate, fabric, aluminum or metal, Northrop's process engineers feel.

The company continues its pioneering work in the field of deceleration and velocity track test equipment, and currently is working on several large-scale operations in this field.

Republic Aviation Corp.

Republic's F-84F Thunderstreak fighter-bomber is one of the first high-speed, production fighters to incorporate a large percentage of heavy forging parts in place of bulky, built-up members. Inboard sections of front and rear spars and more than 14 leading edge ribs are among the large number of parts being forged by the 18,000-ton press operated by Wyman-Gordon, North Grafton, Mass.

Republic was also first to design fighters for mid-air refueling, a feature which made long distance over-water mass flights routine during 1952. The F-84F incorporates a mid-air refueling system plus other classified technical developments.

Ryan Aeronautical Co.

During the past year Ryan has moved into first place in the field of High Temperature Ceramic Coatings for Aircraft Applications and together with Cameo (California Metal Enameling Company) is producing approximately 80% of all of the ceramic coated components for the aircraft industry. This production is reaching more than 12,000 components per month.

With the advent of a successful ceramic coating for the stainless steels, now generally used for high temperature applications, Ryan began a series of comprehensive, world-wide service tests to correlate and evaluate these new ceramics for aircraft applications. Three years ago, Ryan, Boeing Airplane Company and Pan American World Airways mutually arranged these flight tests in which Ryan exhaust systems were installed in the engines of Boeing Stratocruiser aircraft in scheduled transpacific flights. These test headers were removed at approximately 800-hour intervals, returned to the Ryan laboratories for scrutiny and then replaced on the aircraft. They are now approaching 3000 hours in actual flight test service.

The results of these tests have definitely validated the ceramic coatings which Ryan is using and the methods of application and fabrication of both the stainless steel structures and the coatings. Consequently, Ryan is now furnishing thousands of these components each month to the aircraft industries.

Ryan has added to its electric welding facilities to the point where there are now approximately 75 welding machines in the Ryan plant, including the nation's largest capacity electric resistance welders. For the Boeing B-47B Stratojet external tank production, Ryan is using huge Federal and Thompson spot welding machines which are the nation's largest. Especially designed for this tank fabrication, these machines can squeeze aluminum sheets together with 11,000 pounds of electrode pressure and fire 120,000 amps through them.

For welding stainless steel jet engine structures such as combustion chambers, aft frames, afterburners and exhaust cones, Ryan has purchased substantial numbers of new Taylor Winfield and Sciaky spot welding machines specifically designed for fast stainless steel work. In this work, Ryan spot welding engineers have stepped up the speeds of these machines from 100 to 200% by ingenious techniques. By improved air intake valves, different mufflers and improved gearing in drive mechanisms, Ryan engineers are able to get as much work from one of these new machines as two machines could formerly produce. It is interesting to note that in this development; Ryan is using these machines with wheel-type electrode as fast roll-spot machines, and getting twice the speed under these conditions as they will produce under normal seam welding conditions.

Since Korea, approximately $2 million worth of new, big machine tools have flowed into Ryan and a goodly percentage of that has arrived during the past year. These big tools emphasize the trend at Ryan toward the design of larger, single-piece structures rather than innumerable bits and pieces. By blanking out large stainless steel sheets into bigger designs, thousands of manhours of assembly, welding, finish and machining can be avoided.

Solar Aircraft Co.

Development work on Solar's several gas turbine engines was greatly facilitated by the construction of a new test building in their San Diego plant. The Mars engine, which was announced last year as the prime mover for a portable fire pump assembly, was adapted for use in an airborne generator set after considerable testing and research. The generator assembly utilized a tiny turbine engine which weighs only 60 pounds but produces over 45 horsepower. Starting is accomplished by pushbutton rather than by hand, which was preferred for the portable fire pump. Total weight of the generator assembly is only 230 pounds and it will fit into an area slightly over two feet on a side. The unit will operate on the same high octane fuel that is used for regular aircraft piston engines, although it may be adapted to diesel oil, natural gas or other fuels.

Following release from navy restriction, design data on the Solar Jupiter was revealed and work on this engine and others of similar type was undertaken during 1952. In its application as the prime mover for a 250 kw emergency generator set for shipboard use, the Jupiter replaced diesel equipment ten times its size. Weight of the engine totals only 561 pounds. The engine will fit within an area five feet long and less than three feet in depth and height. Starting is accomplished by directing compressed air against the turbine blades, this method being chosen because of easy availability of compressed air aboard the ship.

In addition to continued research in methods of application, the Solaramic line of ceramic coatings was further perfected by development work on several special purpose coatings. Successful results were obtained in the development of abrasion resistant coatings for high temperature use on furnace gate wheels. Similarly, coatings for mild steels were under development for a variety of applications ranging from piston engine mufflers to water tanks, with very promising results.

The shell molding process for casting high alloy steels was introduced to the West Coast by the Stainless Alloy Foundry at Solar's San Diego plant. The adaptation of this process to the casting of stainless alloy steels has been successfully accomplished, and it is now used in roduction of numerous parts for aircraft and industrial use. Remarkably smooth finish and close dimensional control are provided by this method, which often completely eliminates the need for machining cuts.

Specially designed equipment for welding ferrous metals has been perfected to weld mild and low alloy steels, dissimilar metals and stainless steel sections as thin as .05 in. at speeds up to ten times those formerly obtained with manual welding. Known as Sigma welding, this equipment utilizes an inert gas shielded arc but with a consumable electrode and is built around two welding heads purchased from Line Air Products Company. A quick change of the electrode plus the addition of flux makes the equipment adaptable for submerged arc welding.

Temco Aircraft Corp.

Probably the most important development in the course of the year's activity at Temco was an installation which permits push-button controlled lateral shifting of contoured skin panels on General Drivmatic Riviters. The new installation saves from four to eight hours each on P2V-5 wing panels which Temco is manufacturing for Lockheed Aircraft Corporation, and is permitting approximately 1,000 more rivets per panel to be pressed with the Drivmatic than was previously possible.

A major improvement of the Temco facilities was the installation of what is believed to be one of the best equipped radiological laboratories in the air-industry. Heart of the installation, which is capable of processing 79,000 square feet of film in an eight hour working day, is a Westinghouse 250,000 volt, full wave rectified, constant potential, industrial x-ray unit with an oil cooled 250 KV, 15MA x-ray tube mounted on a motor operated jib crane. The unit is enclosed in a 22 by 33 foot room lined with 79,000 pounds of sheet lead. Due to its high power factor, the unit is capable of penetrating four inches of steel, three of bronze, fourteen of aluminum and from sixteen to eighteen of magnesium. Objects as large as six by ten feet may be inspected, making it unnecessary to remove structural members from sub-assemblies for inspection.

One of the largest anodizing, alodining and chromodizing installations in the Southwest was also placed in operation at Temco early in 1952. The installation consists of six 5,500-gallon processing tanks, a steam dryer, an overhead bridge crane and a centralized control panel. All tanks are six feet deep with a five and one-half foot solution depth to avoid spillage and internal dimensions are 38 feet in length and three and one-half feet in width.

One of the most unusual features of the Temco set up is the control panel which was designed and fabricated by the Temco Maintenance Department, and provides a single, centralized control for all three processes—anodizing, alodining and chromodizing.

Westinghouse Electric Corp.

During 1952, the aviation gas turbine division announced two major developments in gas turbine engineering. A combustor was designed of telescopic circular sections that allow relatively cool air to pour over the inner surface of the combustor wall. This effectively cools it and eliminates the damaging hot spots encountered in previous designs.

Late in 1952, the aviation gas turbine division announced that the principle of curvic couplings had been applied successfully to the manufacture of jet engine compressor and turbine rotor assemblies.

Use of curvic couplings permits compressor and turbine stages in a jet engine to be replaced independently of one another, thereby eliminating the need to scrap an entire rotor if only one stage should be damaged. Considerable savings in weight can be effected, smaller and more readily available forgings can be used, greater flexibility of design is possible, and engine structure has been mechanically improved.

Instead of manufacturing compressor and turbine rotors as a single complex piece, the rotors are made as a set of interlocking discs, each connected to the other by a curvic coupling. The coupling consists of two toothed connection members, one with concave and the other with convex teeth, which when joined together form a highly-accurate yet simple and firm connection.

The successful machining of titanium posed one of the most difficult problems in the use of titanium in jet engines. Westinghouse was one of the first to apply the CO_2 coolant technique to this problem and it proved to be quite successful. Briefly, CO_2 is used as a coolant by shooting tiny streams of the gas directly at the tool-work interface. The result is much better cooling, giving longer tool life, reduced smearing of the metal, and clean, recoverable chips.

The aircraft department of the small motor division has developed a new motor for driving the hydraulic boost system that operates the control surfaces of a jet bomber. The motor delivers 3½ horsepower from a 30-volt, d-c supply and commutates well at elevations from sea level to 50,000 feet.

Unusual for a motor of this size is the construction of the armature. The commutator is rib-mounted on a splined shaft, providing air passages under the commutator and into a unique winding. Also, a spiral groove is cut into the commutator, providing better cooling of the commutator and brushes through forced-air circulation and preventing the formation of hot spots on the brush face. Because of this groove, the brush spring pressure is decreased by enough to cut the friction (and heat) in half. The incorporation of this groove has permitted the use of high-altitude treated brushes for both altitude and sea level operation.

The aircraft department of the small motor division has put into quantity production a new 6000-rpm, 40-kva alternator having a number of new technical features. The punchings for the eight-pole field are cut from a single sheet. The poles are not separate entities. This gives the salient-pole rotating field greater strength, prevents poles from loosening on the shaft, eliminates any indefinite or changeable airgap where the poles fasten to the shaft, and maintains the gap between the rotor and the stator more constant. The generator has a one-piece shaft, an improved torsional-vibration damper, and an aluminum housing instead of one of magnesium to raise the natural frequency. The machine has been tested on overspeed to 11,000-rpm. With an unbalanced load equal to two thirds of the single-phase load the voltage unbalance is less than four percent.

Adjustable frequency radar sets must have adjustable magnetrons—the precision, multi-cavity generator of microwaves. The electronic tube division has devised a way for shifting the tube frequency electronically instead of mechanically. This is done by passing an electron beam down all the cavities and modulating the beam to achieve the frequency shift. This scheme is used to obtain tuning over a six-mc band for FM-type radar systems.

CHAPTER FOUR

The Government and Aviation

Aviation made its first visit to Congress by balloon on June 14, 1906. The results, if not fruitful, were sensational.

Piloting the airship was Lincoln Beachey, who later added to his fame by barnstorming in planes.

"For the first time in history," reported the Star, "Washington was treated to the sight of an airship in full flight." (Editor's Note: John Wise had made a balloon ascension at Washington some 71 years before, but it had passed practically unnoticed.)

Newspapers all over the country commented on the Beachey stunt, which also included landing at the Washington monument and on the White House lawn, where Mrs. Roosevelt (T. R.) officiated in her husband's absence. "Inauguration parades," commented the Star, *"seldom draw a larger crowd." Beachey "successfully held up government business for practically two hours," said the New York* Herald, *and so great was the subsequent interest of the legislators," reported the New York* Times, *"that men went about with a typewritten slip on their coat lapels, saying 'Yes, I saw it!'"*

"Fewer than twenty-five members remained on the floor (of the House)," said the Star, *"and it is rumored that these gentlemen were hard of hearing and didn't know what was going on." Those who did, predicted the Boston* Transcript, *would do something about it: "Science will profit by today's incident, for Senators and Representatives alike are human."*

Civil Aeronautics Administration

Civil aviation recorded a year of healthy growth during 1952 except in one area, that of personal flying.

In safety, in the increase of dollar volume of business done, in number of persons carried by air and in expansion of air transportation generally, the overall effect was improvement, according to reports of the Civil Aeronautics Administration, based on statistics and upon observations by skilled observers.

As this is written, early in December, the scheduled airlines promise to make an all-time record in safety, with the domestic scheduled carriers turning in a possible .4 passenger fatalities per 100 million passenger miles, and the international rate being 2.9. Domestic carriers have never equalled this record which is based on an estimated total passenger mileage during 1952 of 12,866,000,000, and 46 passenger fatalities which was the figure early in December. The international rate was based on an estimated 1952 passenger mileage of 3,212,000,000, and an accident figure of 94.

Large irregular air carriers had made a good safety record when by the end of the year they had piled up an estimated billion passenger miles with but one fatal accident costing 26 lives for a prospective average of 2.6 passenger fatalities per 100,00,000 passenger miles, as compared to 7.3 for 1951.

Alongside the high tempo of manufacture of military planes, the production of civilian planes was small, but increases over previous years were registered in 1952. In the first nine months of the year, more personal aircraft were produced (2,366) than in the corresponding period of 1951 (1,923). In all of 1951, the number produced was 2,477, and 1952 was certain to beat that record.

Business flying continued its boom. It was estimated on the basis of surveys admittedly not 100% accurate, that some 800 business firms were using more than 1700 multi-motored aircraft for executive transportation. A total of 16,200 planes were in use for business flying by individuals and companies.

Against these encouraging reports, the CAA found that personal flying is in a steady decline. In the first nine months of 1951, beginners had received 35,000 student permits. In the same 1952 period, only 20,000 have been issued. The score was 17,402 private licenses in the 1951 period against 10,217 for 1952.

This challenge to the industry and to the federal agency charged with regulating and promoting civil aviation, was taken up by the CAA, which late in the year, had ready the draft of a nationwide program for consideration by the industry to revive interest in personal flying by means of a collaborative program of "institutional" advertising and promotion. The agency previously had established a 14-point program for its guidance in this field, and hoped for encouragement and financing by the industry of a drive that would do two things: interest more people in the pleasures and adventures of personal flying, and make it financially possible for those people to fly.

The aviation industry continued to assume more responsibility in the certification of its products, especially aircraft accessories. Only three manufacturers had accepted the CAA's urging to certify their complete planes, but virtually all accessories except radio had been blanketed under the CAA's Technical Standard Order system.

Important services were rendered to various sections of the industry when the CAA helped the cause of deferring dusting and spraying pilots from military service because of the essential nature of their occupation. The Office of Aviation Defense Requirements assisted airports to get essential materials to restore their facilities after serious damage by floods, and throughout the year represented civil aviation in the allotment of critical materials.

Two proposals by the CAA during the year for standardization ran into snags, and one was dropped. This was the plan to change over to nautical miles as a unit of measurement, in order to improve safety in airways operations. Opposition by private fliers resulted in abandonment of this plan. The other standardization was the adoption of a new phonetic alphabet for use in communication, and at year's end, discussion on details of this alphabet was still under way.

During the year a significant forward step in the changeover from low to very high frequencies on the airways was taken, when 45,000 miles of airways implemented with omni-directional ranges were added or superimposed on existing airways. This step recognized the status of the changeover to VHF equipment by a great number of active aircraft using the airways. The Office of Airways continued in its establishment of new type airway aids, including radar, improvement of the Instrument Landing System, and a new type radar partaking of television character for "clear and bright" display of signals both day and night.

Safety again monopolized most of the attention of CAA Agents. A top management change took place when a chief for aviation safety was appointed in each of the Regions, concentrating safety work nearer to the grass roots of the industry. Stall-spin accidents continued to decrease under the impact of the CAA's educational program and demonstration in a specially equipped plane. Pilots over the country gathered in nearly 1,000 meetings for panel discussions of accidents which they, themselves, caused. Duster pilots, heeding caution words on the poisons they handle, turned in a good safety record. Aircraft owners responded to an educational campaign by the CAA to emphasize preventive maintenance.

The influence of U. S. civil aviation methods and equipment continued to spread abroad. The CAA's International Region issued its eighth approval for a foreign aircraft repair station. It sent a mission of experts to Turkey as a part of the Mutual Security program. CAA took advance steps to prepare for the day when Japan would be operating airway aids so that the high standards of U. S. airways would be maintained in that part of the world for use by U. S. flag carriers. Reports by a mission which spent two years in Greece revealed that American effort there was of help in the establishment of an excellent airways system.

The International Region also established a hemisphere headquarters for aviation technical assistance in Panama, and staffed it with experts competent to demonstrate U. S. know-how to neighboring nations to the South.

Further easing of the path of the trans-border flier and traveler occurred in 1952 when the airlines and various government agencies began an experiment in "pre-clearance" of U. S. customs at Toronto, saving the time of travelers on Canada-U. S. flights, and in providing for faster, simpler and less expensive clearance procedures for private fliers crossing the Canadian and Mexican borders.

In Air Education, the CAA staged the first of Aviation Leadership Institutes to which some 50 leaders in municipalities over the country came to Washington for indoctrination in aviation matters. The CAA also urged more schools to teach students of the importance and the development of general aviation.

Increasing use of the helicopter in commercial aviation was reflected in the total of nearly 1,000 commercial helicopter pilot certificates. The CAA further simplified the procedures by which pilot certificates are obtained.

To keep pace with the development of the jet-powered transport, the CAA, late in 1952, appointed a team to evaluate jet and turbo-prop aircraft.

The 1953 fiscal year airport program administered by the CAA involved 163 projects and a total of federal expenditure of $9,977,250.

Civil Aeronautics Board

Mergers and increased service to the public remained principal problems for the airline industry during the last year. These, together with other measures for improvement in the economic position of the industry, through modification of route pattern, received major attention of the Board during 1952.

Merger of Braniff Airways and Mid-Continent Airlines was approved. The Board also approved the final step in the merger of Western Air Lines, Inc., and Inland Airlines, Inc., by ordering the dissolution of Inland as a separate operating entity, and its integration with Western in accordance with a plan filed by Western.

Merger of West Coast Airlines and Empire Airlines was approved to improve local service in the northwest region and provide the basis for reduction in operating cost and subsidy payments.

Other proposals for merging various domestic trunkline carriers were pending. Still in procedural stages are proposals to merge the route systems of Delta Air Lines, Inc., and Chicago and Southern Air Lines, Inc., on the one hand, and Eastern Air Lines, Inc., and Colonial Airlines, Inc., on the other.

During no other year of its existence has the Board placed as many air

The first official air meets in the United States were held in 1910 and 1911. The Wright brothers (non-contestants) and the entire Washington diplomatic corps attended. In 1910, the *Globe* offered a prize of $10,000 for a flight around Boston Light and return. An Englishman, Claude Grahame-White, won, and picked up another prize by scoring successful bomb hits on a battleship more than a decade before Billy Mitchell. The ship was a dummy built on the field, the bombs were plaster of Paris. Another first was an airway beacon. This was the second year, when the big *Globe* event was a tri-city race. It had not ended by twilight. Anthony Philpott, who died early in 1952 at ninety, was the *Globe's* aviation editor at the time, and suggested a bonfire. This was done and there followed the first official night landings in America. The field for the meets still figures in aviation history. Among the youngsters at the shows were George C. Kenney, who became commander of the Far Eastern Air Forces, and Edward P. Warner, now head of ICAO. Amelia Earhart learned to fly here, and the field is now a Naval Air Station.

—ARTHUR A. RILEY, Aviation Editor, Boston *Globe*

carriers on final mail rates as during the fiscal year 1952. In the Fall, the Board instituted an investigation into the fare structure of the domestic airlines. If this investigation is processed as expeditiously as planned, its results should be of great significance since C.A.B., in cooperation with the industry, will be provided with the basis for evolving sound principles of fare making which will have far reaching and beneficial effects on the air travellers of this country and the revenues of our airline industry.

The safety factor in airline transportation is, of course, a matter of paramount importance to the Civil Aeronautics Board. Every effort has been made during the past year to promulgate regulations designed to insure a greater degree of safety for the airline passenger, crew and the general public. The Board's activity in Safety Investigation was marked by significant recommendations for additional safety regulations arising from analyses by its own experts and those of other Governmental agencies of accidents and near-accidents.

The report on the administrative separation of subsidy mail payments from total mail payments to international air carriers was issued by the Board in June, 1952. In October, 1952, there was issued the first revision of a similar study concerning domestic air carriers. The Board has now completed its first steps in administrative subsidy separation which will be followed annually by revised separation reports and will be supplemented throughout the year by indications, as final mail rates are established, of the amount of subsidy and service mail pay included in each final mail rate.

Defense supported activities of irregulars were extended by Board order dated August 27, 1952. The special authority which was granted irregulars for defense activities in March, 1951, authorized unrestricted operations pursuant to military contracts and established joint representation at military bases to arrange for flights of uniformed military personnel travelling at their own expense. The benefit of such special authority to the defense effort is evidenced by the fact that during the past three years the irregulars have operated in connection with Pacific and Atlantic airlifts more than 24,000,000 revenue miles in both cargo and passenger service. Through this special exemption procedure the Board has avoided disruption of this vital defense traffic.

The basic organization of the Civil Aeronautics Board consists of the Offices of the Members and eight operating and staff Bureaus and Offices reporting to the Chairman and the Board through the Executive Director: Bureau of Air Operations; Bureau of Safety Regulations; Bureau of Safety Investigation; Bureau of Hearing Examiners; Office of General Counsel; Office of Administration; Office of Enforcement; Office of Public Information.

During the year under review the Board continued its efforts to develop a more efficient and effective organization. Several changes were made. The distribution of activities to organizational components resulted in a reduction in the number of divisions. As a result, additional benefits of specialization by function as well as a simpler organization by structure will be available.

The Board completed its review and revision of the Rules of Practice, and the new rules were made effective April 28, 1952. This revision reflected the combined efforts of the Board's staff, individual carriers, and an Advisory Committee on Practices and Procedures consisting of industry representatives. The revision is designed to expedite formal hearings, insure more uniform application of the rules, and to save time for the Board Members, staff, and parties appearing before the Board, by simplification of procedures.

The procedure providing for pro forma mail rate hearings was eliminated and written statements and informal negotiations are now utilized in lieu of formal hearings in certain commercial rate cases.

The practice was instituted of collecting information concerning aircraft accidents by taking depositions when public hearings were, for various reasons, deemed not to be feasible.

Special studies were initiated of crop-control accidents, involving the development of a new format for the presentation of supplemental analyses, for dissemination to groups active in, or interested in, agricultural uses of aircraft.

National Advisory Committee for Aeronautics

Research at the laboratories and field stations of the National Advisory Committee for Aeronautics during 1952 was projected to study of problems arising at ever higher speeds. This was equally true for the powerplant work at the Lewis Flight Propulsion Laboratory in Cleveland, and the study of aerodynamic and other problems at the Langley Aeronautical Laboratory in Virginia and the Ames Aeronautical Laboratory in California.

Development of the transonic-throat tunnel was reported in the 1951

Aircraft Yearbook; during 1952 this unique research tool was effectively used by the NACA.

In addition to the problems arising from transonic and supersonic flight, old problems found at low speed required attention. For example, landing an airplane remained critical.

Previous research had shown that one cause of loss of lift was due to accumulation of slow-moving boundary-layer air over the upper surface of the wing. In seeking to deal directly with this boundary-layer air, two possibilities have been studied. Either the slow-moving air can be speeded up, or it can be removed, thus bringing the fast-moving air of the free stream to the wing surface.

In the past, the improvement to be gained from application of boundary-layer control for increasing the maximum lift of airplanes at low speed has not been commensurate with the complication involved. For the transonic or supersonic airplane, boundary-layer control appears promising and research effort has been directed toward its application.

Boundary-layer control by means of suction applied to slots or porous areas on the wing and re-energizing the boundary layer by means of air blown through slots over the upper surface are among methods being investigated. The use of boundary-layer control in conjunction with wing flaps or other conventional high-lift devices appears promising for not only increasing the maximum life but also for decreasing the angle of attack at which the airplane lands.

During the year, the Ames Laboratory reported it had studied the swept wings of a North American F-86 which had been reworked to include an experimental installation consisting of porous metal leading edge and flaps. A suction pump system built into the test model sucks off the slow-moving boundary-layer air. The special wing was studied in the 40- by 80-foot full-scale wind tunnel at the Laboratory, and it was announced the special wing and pump system would be installed in an F-86 for further study under actual flight conditions. It was made plain, however, that the setup was not to be considered the prototype for future production aircraft.

The old problems of performance and static stability are also still requiring considerable research effort; however, in general, new solutions now are required. For example, at the higher speeds and higher altitudes attainable, stability and control problems have become greatly aggravated, and satisfactory answers must be found if the supersonic aircraft of tomorrow are to serve as steady gun platforms or as vehicles for precision bombing.

Flutter, which had been effectively restrained if only imperfectly understood in pre-World War II days, has reappeared to challenge the best efforts of both the aerodynamicist and the structures specialist. In attacking the flutter problem today, the characteristics of the airplane structure have to be studied together with the nature of the air loads imposed on it. It is necessary to consider the vibrational characteristics of many different types of wings. The thin wing, which does not remain undistorted in its own plane, introduces a new complication. Once, it was sufficient to consider only the more simple vibrational characteristics. Now, it is being found that unless the flutter analyses take into account as ma· y as possible of the characteristics, the results will be seriously in error.

At the higher altitudes at which airplanes are flying today, the ratio of air density to airplane density becomes so low that different patterns of flutter vibration and altogether different flutter speeds (the lowest speed at which flutter occurs) may occur as the airplane climbs or dives from one altitude to another. Variable structural stiffness, and the distortions resulting from aerodynamic heating, add further to the difficulty of the problem.

In fact, flutter has become so complex that scientists have been frustrated in attempts even to formulate it theoretically, much less suggest theoretical solutions. Meantime, the most effective solutions are resulting from experimentation. Flutter today is, at best, an art, not a science. But unless flutter is to impose limitations upon performance, the research scientist must learn how to rationalize the many asumptions and cut-and-try simplifications, now used in desperation, into reliable, useful theory. When that day comes, and only then, flutter analysis will indeed have become a science.

In October, 1952, a new research airplane was first flown. It is the Douglas X-3, sponsored by the Air Force with Navy support and NACA cooperation. It is a project directed toward the development of an airplane design capable of unusually high speeds and altitude ceilings, and more than 60 combinations of power plants and design shapes were studied before the final design was selected.

William Bridgeman, Douglas test pilot, was at the controls of the X-3 during the first flights. During the year, it was announced that in August, 1951, he had attained speeds and altitudes greater than ever before achieved by man. Flying in a Douglas D-558-II Skyrocket, he reached a speed of 1238 mph, and an altitude of 79,000 feet plus.

The purpose of the high-speed research airplane program, a three-way partnership of the aircraft industry, the military services, and the NACA, is to investigate, in actual flight, problems which are anticipated from theoretical and wind-tunnel studies in the transonic and supersonic speed range. In addition, any unexpected problems which may arise in connection with the operation of very high-speed airplanes are explored. In pursuing this work, speeds and altitudes far beyond the capabilities of current production airplanes have been reached.

The problems investigated to date with seven special airplanes include aerodynamic loads and buffeting, stability and control, the effects of such airplane design variables as sweepback and wing plan form, the effects of aerodynamic heating (see below), and the difficulties of landing airplanes designed to fly at high speeds. Airplanes now on the drafting board will reflect in many ways the new aerodynamic information gained. Another important benefit has been the experience gained by the pilots' participation in this program. Much of the mystery about the "sonic barrier" has been dissipitated, and the training of pilots for tomorrow's high speed airplanes has been put on a rational basis.

As more is learned about aerodynamic conditions exisiting in the transonic range, it is becoming increasingly apparent that actually no "sonic barrier" exists at the speed line of sound. Rather, the aerodynamicist finds a "shoals region" where subsonic and supersonic air flows mingle in a manner which is constantly changing, and is difficult to predict in advance. Enough has been learned already to enable reasonably safe transition of this transonic region by the supersonic aircraft of tomorrow. What remains to be learned is information which will make possible routine operation of aircraft within the transonic speed band.

But if the transonic range is not to be considered a "sonic barrier," there is a growing feeling that, at least for a time, aerodynamic heating may present what is effectively a speed barrier. At high supersonic speeds, the viscous or sticky nature of air produces two effects which become very important: the friction of the air over the surface of the aircraft, usually termed "skin friction"; and the associated rise in temperature of the air called "aerodynamic heating."

In order to study these effects it is necessary to learn more about the thin layer of air, known as the "boundary layer," which is next to the surface of the aircraft. The characteristics of this layer determine the amount of skin friction and the rate at which heat is transferred to the skin of the aircraft.

At speeds of M-3 or more, the drag due to skin friction can be more than one-half the total drag of an aircraft. The temperature rise in the boundary layer at Mach numbers of 3 and 5 are as much as 600°F and 1600°F, respectively. At the lower temperature, aluminum alloys now used in aircraft construction would lose most of their strength; at the higher temperatures, ordinary steels would be greatly weakened. And long before such temperatures were reached, the pilot would be roasted and the complicated electronic equipment carried today would become inoperative.

However, this temperature rise does not affect the aircraft instantly since time is required for the heat to flow from the boundary layer into the surface of the aircraft. The NACA is currently engaged in research to provide experimental information about skin friction heat transfer over a wide range of supersonic speeds, and to investigate the validity of existing theories for calculating these effects. The factors controlling the transition of the flow from the laminar (where friction drag is only about one-sixth as great) to the turbulent type of boundary layer are being studied. Meantime, of course, other measures, including refrigeration and insulation, are being taken to protect the pilot and instrumentation.

Late in 1952, the Navy's Bureau of Aeronautics disclosed successful development of a device which enables an airplane to operate effectively from both land and water. In making the announcement about the "hydro-ski," the Navy noted that it was the NACA which had initiated studies of the hydro-ski principle soon after the end of World War II.

The early NACA investigations consisted of dynamic model tests centered around applying hydro-skis to a high-performance ai-plane. In later work, tests were made in the towing tanks at the Langl-y Aeronautical Laboratory of both single and twin hydro-ski arrangements.

In its announcement, the Navy disclosed that "because of the encouraging results obtained thus far BuAir has undertaken the construction of a high speed airplane embodying many of the favorable features" of the hydro-ski principle. The announcement said further that "it seems safe to look to the future for water takeoff and landing characteristics and simplified methods of beaching and ground handling."

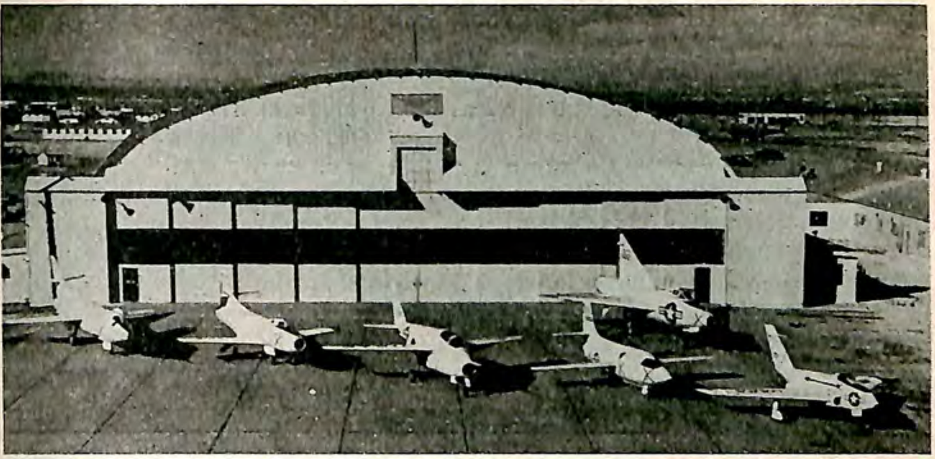
At the year end, announcement was made by the NACA that a five-year program to learn more about fires occurring during airplane crash landings indicated the possibility of realizing significant reductions in the crash-fire hazard.

Research by the NACA included study of the crash-fire problem under full-scale conditions. The tests contained the elements of a very severe fire hazard, but from the standpoints of impact, such crashes were considered to be survivable for a majority of the plane occupants. Special instrumentation was provided to enable gaining a much clearer understanding of the mechanism of a crash fire—why and how a fire starts and spreads. Because the current research was conducted with modern aircraft and more complete instrumentation than previously had been possible, the findings permitted an appreciation of important factors in th problem heretofore not fully recognized.

Once the series of crash tests had enabled rather precise establishment of a "standard" set of ignition sources, as well as a better understanding of how the fires, once started, spread, modifications in the crash procedure were made to discover other ignition sources. For example, the plane was made to ground loop, by knocking off only part of the landing gear. Another modification raised the contact angle, between plane and ground, at point of crash to cause more damage to the belly of the plane during impact. One by one, ignition sources—such as electrical wiring, hot metal surfaces of engine exhausts, etc., were identified and evaluated.

During the summer of 1952 a new research tool was put into use at the NACA's Lewis Flight Propulsion Laboratory. Termed the Propulsion Systems Laboratory to distinguish it from other, smaller engine testing facilities at the Lewis Laboratory, the new equipment marks another milestone in a successful, nine-year effort by American research, first to catch up with the turbojet revolution, and then take the lead. Throughout this period, the NACA has continually increased the capacity of its altitude facilities to enable testing the more powerful engines under development.

Altitude facilities must duplicate in the laboratory the pressures and temperatures encountered at the altitudes and speeds simulated for engines



NACA fleet of Transonic Research Planes

under test. Air pressure drops from 14.7 pounds per squire inch at sea level to 3.5 pounds at 35,000 feet and to 1.7 pounds at 50,000 feet. At 100,000 feet it goes to 0.2 pound. Air temperature drops from the NACA standard of 59.5°F at sea level to —67° at 35,000—100,000 feet. The air entering the engines of an airplane is subjected to a ram effect which causes a rise in both pressure and temperature. This ram effect becomes more pronounced as speed increases. For example, the ram effect experienced by an airplane flying at 35,000 feet at twice the speed of sound would result in a pressure rise from 3.5 to 27 pounds per square inch, and in a temperature rise from —67° to 250°F.

At the Lewis Laboratory there are two kinds of altitude facilities for testing full-scale engines. In one, the Altitude Wind Tunnel, an engine may be mounted in a wing or fuselage section,and the airflow around the outside of the engine studied in addition to the air flow through the engine. The other altitude testing facilities, including the new equipment, are used principally to duplicate internal air flow conditions. Here a ram air supply and a refrigeration system are needed to duplicate the pressure and temperature conditions encountered over the range of flight speeds and altitudes desired. Exhausters subject the gases leaving the engine to a pressure equivalent to the altitude conditions being stimulated, and also provide cooling.

Because the turbo-jet engine is basically an air-heat machine, its production of greater thrust is limited by the amount of air it can handle efficiently. In the few years this type of powerplant has been under development, its air-handling capabilities have increased enormously. The earliest engines handled hardly 25 pounds of air per second; turbojet powerplants now in full production require 100 pounds of air per second or more, and tomorrow's engines will be even more voracious. During this same brief period the production of useful thrust has increased correspondingly from 1500 pounds to more than 6000.

The new research facility has exhauster equipment with a total capacity of 825,000 cubic feet per minute which may be connected with other exhauster equipment at the Laboratory. Such facilities are vital in the investigation of the aircraft engines of today and tomorrow. Without them altitude research would be reduced to a crude cut-and-try projection of information gained either from tests at sea level, or flight test which is becoming less practicable as engine performance potentials exceed the performance capabilities of test-bed airplanes. Used effectively, these laboratory facilities can contribute greatly to the further improvement of the powerplants specified for the faster, higher-flying aircraft of tomorrow.

Weather Bureau

During 1952 the Weather Bureau introduced an intensive in-service training course on pilot briefing for its professional personnel for the purpose of providing an even higher quality of weather briefing service to aviation interests. In addition, it completed its program of consolidation of aviation weather forecast offices with flight advisory weather service (FAWS) centers located at each of the 26 air route traffic control centers. These units furnish aviation weather forecasts for distribution on national teletypewriter weather circuits and provide flight advisory weather service to air route traffic controllers and to pilots in flight through air-ground radio facilities.

The Air Navigation Development Board (ANDB) and the Bureau are continuing an intensive study of weather observational techniques at air terminals to improve the information given to pilots during conditions of low ceiling and visibility.

The Weather Bureau is using a Cessna 190 airplane for in-flight and on-station checking of its aviation weather service.

Department of Agriculture
Forest Service

In 1952, the Forest Service, U. S. Department of Agriculture, owned and operated 17 single-engine, fixed-wing aircraft. In addition, the services of approximately 250 commercially owned and operated aircraft were chartered or contracted for at various times.

The use of fixed-wing aircraft showed an increase of more than 2,000 hours over the preceding year. The Forest Service reduced its use of helicopters, however, to less than half as many hours as in 1951. A scarcity of suitable helicopters and of helicopter pilots qualified for operations in high, rugged mountainous terrain, and a sharp rise in the cost of chartered helicopter service, were factors limiting the use of such service.

In addition to the aircraft use given above, the Forest Service participated in a spruce budworm control project with the Bureau of Entomology and Plant Quarantine and the State of Oregon. In this project, 640,000 acres of forest were sprayed by contractors in 1952. Total use of planes was about 430 hours. This was the fourth year of this cooperative undertaking in the Pacific Northwest by the Federal and state governments and private forest-land owners, in which a total of more than 2,000,000 acres of budworm-infested forest have been successfully treated. In Montana and Northern Idaho, about 23 flight-hours were used in aerial spraying for control of spruce budworm infestations. The Forest Service also conducted insect control spraying operations, with a total of about 80 hours of aircraft use, on national forests in the Southeastern and North Central regions.

Bureau of Entomology and Plant Quarantine

Four planes owned by the Bureau of Entomology and Plant Quarantine treated 580,337 acres of crop and range land with insecticides at an average operating cost of a little over 12½¢ an acre, excluding cost of insecticides and ground support. Two other Bureau planes were used in supervising contract planes, and 8 additional planes were used in experimental work.

An estimated 9 million acres of cotton were treated by airplanes in 1952, for insect control and defoliation, largely on a contract basis.

To control the spruce budworm, over 612,000 acres of Douglas-fir and white fir trees in Northwestern States, and about 200,000 acres of Canadian forests, were sprayed by contract planes from this country. Planes sprayed 1,500 acres of Southern forests to kill pine sawflies, and 8,000 acres of New Mexico forests to control spruce budworm and white fir looper.

Over 823,000 acres in the West were baited, or sprayed with insecticides by Bureau and contract aircraft to control grasshoppers and Mormon crickets.

Over 200,000 acres of gypsy moth-infested area in New England were sprayed with DDT by Federally-owned, State-owned and contract aircraft during the spring of 1952 through cooperative Bureau-State efforts.

Almost 440,000 acres of Oklahoma crops were estimated as air-sprayed by contract planes to control greenbugs in 1952. Large acreages of alfalfa and clover were treated by air to control meadow spittlebug in Ohio and states to the East. Some corn was sprayed for corn borer and Japanese beetle control.

In experimental work, better methods of detecting and appraising forest insect infestations in the East by aerial surveys were developed in Maine in cooperation with that state. A line-strip method was used, and extent of spruce budworm defoliation of balsam fir was recorded on a moving chart. About 0.7 percent of a 10 million-acre area was surveyed in 23.7 hours of actual flying time, at a cost of only 18¢ per 1,000 acres. It was also found that pines infested with white pine weevils could be photographed in stereo color from the air with fair accuracy, especially on plantations where taller stands of pines with dense crowns interfered with observations from the ground.

Tests showed that in aerial spraying of large areas for spruce budworm control, it is feasible to fly at heights of 100 to 250 feet rather than 50 to 150 feet as previously recommended.

An apparatus developed for use on a helicopter to improve spray distribution and deposit of insecticides, uses air from the engine cooling fan and exhaust stacks to help break up spray as it leaves the helicopter. It produces finer atomization of spray at slow speeds than the nozzle-boom type of spraying apparatus usually used on helicopters. In comparative tests the helicopter deposited twice as much insecticide as did the airplane from a given amount of spray. The state of Connecticut cooperated in some of these studies.

A new approach to disinfestation of airplanes is being investigated by using insecticidal vapors. Fibre-glass filters coated with lindane are placed in the air-intake ducts of pressurized plane cabins. Insect-killing vapors given off into the air stream are carried throughout the plane cabin. The extremely low concentration, considered harmless to humans, is not detectable by either crew or passengers.

Department of the Interior

Fish and Wildlife Service

Aircraft are used by the Interior Department's Fish and Wildlife Service for surveying waterfowl, planting waterfowl feed, controlling noxious vegetation, hunting predatory animals, conducting big-game and fur animal censuses, and patrolling in connection with game and fishery law enforcement. During the fiscal year 1952, the Service owned and operated 46 aircraft, of which 29 were based in Alaska and 17 in the United States. Service planes and pilots flew approximately 10,000 hours during the fiscal year. Operations ranged from Banksland in the Arctic to the West Indies in the tropics and included Canada, Mexico and Alaska as well as the United States.

The chief types of aircraft used were the Grumman Goose and Widgeon (amphibians), Piper Supercubs and Pacers, Cessna 170's and Stinson V-77's.

During the fiscal year, 50 qualified agent-pilots and pilot-mechanics held Fish and Wildlife Service letters of flight authority. Periodic flight checks were made to assure proficiency and familiarization with the aircraft.

Great strides have been made since fiscal 1951 in the field of predatory animal control. One plane of Service hunters assigned to stalk predators from the air accounted for 633 coyotes and 9 bobcats in Idaho during fiscal 1952 and set a record of 78 coyotes and 2 bobcats in a single day. Considerable livestock and desirable wildlife, upon which these predators prey, were thus saved from destruction.

Federal Communications Commission

The Aeronautical Radio Services (ARC) division of FCC reported a total of 34,070 authorized aircraft radio stations as of Sept. 1, 1952. Of that number, over 29,000 were private aircraft.

An apparent decrease in the number of stations resulted from the deletion from the files of over nine thousand expired licenses. Actually, more than seven thousand new aircraft licenses were issued during the year.

The Commission has again been active in various inter-Government coordinating and policy groups and international groups, such as the International Civil Aviation Organization, and the International Telecommunications Union (ITU), a group responsible for the allocation of frequencies, which has allocated exclusive frequencies to the aeronautical services, and Radio Technical Communications for Aeronautics (RTCA).

Important on the Commission agenda has been improvement of very high frequency (VHF) utilization, to meet congestion of communication channels caused by the increase in civil aviation.

Aeronautics Division, Library of Congress

The most significant event of the year was the acquisition in March of the personal papers of the late General H. H. ("Hap") Arnold, pioneer flyer and World War II commander of the Army Air Forces. The Arnold papers are an invaluable addition to the Library's collections of aeronautical manuscripts, to which the papers of Wilbur and Orville Wright, Gen. Billy Mitchell, and Gen. Carl Spaatz have also been added in recent years. The papers were presented to the Library of Congress as a gift to the United States by the General's widow, Mrs. Eleanor P. Arnold, of Sonoma, Calif. In making the donation, Mrs. Arnold stated her hope that when these papers of the Nation's only five-star air general eventually become available to research workers they will "constitute a valuable contribution to American history."

Among the more than 15,000 items received are diaries, albums of photographs, scrapbooks of newspaper clippings, manuscripts of speeches, statements, articles, and books, as well as extensive files of correspondence, some of it with such outstanding persons as President Franklin D. Roosevelt, Harry L. Hopkins, Gen. George C. Marshall and other American and Allied leaders. The papers date from 1903 when Arnold entered West Point to his death in January 1950.

For 25 years, access to the papers, which will be known as the H. H. Arnold Collection, may be obtained by scholars and other qualified writers only by permission of Mrs. Arnold or her children.

Other significant acquisitions of the year included the papers of Frank S. Lahm, pioneer American balloonist, an early friend of the Wright brothers, who was responsible for one of the first full published accounts of their achievements, and the papers of Maj. Gen. Hugh J. Knerr (USAF, Retired), brilliant air strategist widely respected for his prominent role in the development of U. S. air power.

Mr. John F. Stearns, Chief, resigned August 31, 1952 and was succeeded on October 1, by Mr. John C. L. Andreassen.

National Air Museum

The National Air Museum was established as a bureau of the Smithsonian Institution on August 12, 1946, by Public Law 722 of the 79th Congress. This law directs (Section 2) that the National Air Museum "shall memorialize the national development of aviation; collect, preserve, and display aeronautical equipment of historical interest and significance; serve as a repository for scientific equipment and data pertaining to the development of aviation; and provide educational material for the historical study of aviation." A Board of five members is appointed to advise the Secretary of the Smithsonian Institution in matters relating to the Air Museum. On August 1, 1947, the National Air Museum received by transfer 3,500 items of aeronautical material which had been acquired and assembled by the Smithsonian Institution over the previous 70 years.

A large portion of the collection is on permanent exhibition in Washington, D. C., in buildings of the Smithsonian Institution. Original aircraft include the Wright Brothers' first aeroplane of 1903 (the "Kitty Hawk"); General Billy Mitchell's "Spad"; such "Famous Firsts" as First to Cross the Continent (Rodgers' "Vin Fiz"—84 days in 1911); First to Cross the Atlantic (the Navy's NC-4—1919); First Non-Stop Transcontinental (the "T-2"—1923); and the First to Fly Around the World (Douglas World Cruiser "Chicago"—1924). Among the representatives of the Golden Age of Aviation are Lindbergh's Ryan "Spirit of St. Louis," Wiley Post's Lockheed "Winnie Mae," Lincoln Ellsworth's Northrop "Polar Star," Eaker and Fairchild's Loening "San Fransisco," and the Curtiss Army Racer in which Jimmy Doolittle won the Schneider Trophy in 1925.

The remainder of the collection is housed in several storage facilities, while plans progress to provide adequate housing for exhibition of the entire collection in a complete museum unit. Stored aircraft include the famous Martin B-26, "Flak Bait"; Boeing B-17, "Swoose"; Boeing B-29, "Enola Gay," the atomic bomb ship; representative examples of World War II enemy aircraft, and some early pioneer types.

Many fine specimens were received during the year. Outstanding among them is the famous Collier Trophy now on exhibit in the National Air Museum. A 1:10 scale model of the Convair XPY-1 came to the Museum upon termination of tests and is now on display in the Aircraft Building. Consolidated Vultee Aircraft Corporation received recognition for developing a progressive method of testing aircraft characteristics through the use of this radio controlled free flight model. The prototype Hoppi-Copter designed in 1945 by Edward Pentecost was received and attracted considerable attention for its design as a one-man helicopter supported by and strapped to the shoulders of the operator. Telemetering and film-recording instruments used in the Bell X-1 on its transonic flights were transferred from the National Advisory Committee for Aeronautics. One of the Pratt and Whitney 4360 engines from the Boeing B-50, "Lucky Lady II,"first nonstop round-the-world flight, came to the Museum where it is displayed with other famous engines in "engine row."

Two excellent collections of enlarged photographs were received, one from Consolidated Vultee Aircraft Corporation and the other from North American Aviation, Inc. Both collections cover aircraft produced by these companies in chronological order from the earliest to the latest types.

Five collections of aviation periodicals published in the United States and England were sorted, integrated, and temporarily bound, thus establishing a ready reference library of an estimated 18,000 issues. The library is by no means complete, and efforts continue toward locating missing issues to complete the volumes.

Search for desirable specimens for the Museum continues, but the assistance of the aviation fraternity is invited in locating evaluating, and procuring aeronautical objects and documents which should be preserved in the national collection.

Post Office Department

The fiscal year ending June 30, 1952, showed a continued increase in the use of the air services. Over 1,324,000,000 pieces of domestic letter mail were transported, an increase of approximately 22.45 percent, while air parcel post increased in about the same ratio with the number of pieces approximately 16,566,000, or 30 percent.

The total weight of air mail and air parcel post was over 77,621,000 pounds, exceeding the previous year by nearly 15,000,000, or approximately 30 per cent.

During the fiscal year 1952, a total of over 14,502,000 pounds of United States mail was transported by air to foreign and overseas destinations. Parcels and other articles accounted for 1,721,510 pounds.

Foreign air parcel post service is now available to 95 countries. Air service for other articles, i.e., prints, samples, newspapers, etc., is now available to 96 countries.

Air Coordinating Committee

The Air Coordinating Committee, established in 1946 by the President to coordinate Federal policy in the field of aviation, is composed of members from the ten Government Departments or Agencies having an important interest in aviation. On November 14, 1952, the President designated Oswald Ryan, Chairman of the Civil Aeronautics Board, as the new Chairman of the Air Coordinating Committee to succeed Donald W. Nyrop. The

Vice Chairman is Thomas W. S. Davis, Assistant Secretary of Commerce. The other members are: J. Paul Barringer, Director, Office of Transport and Communications Policy, Department of State; John S. Grahm, Assistant Secretary of the Treasury; Earl D. Johnson, Under Secretary of the Army; John F. Floberg, Assistant Secretary of the Navy for Air; Edwin V. Huggins, Assistant Secretary of the Air Force; John M. Redding, Assistant Postmaster General; J. Weldon Jones, Economic Advisor, Bureau of the Budget (non-voting); and Col. Alvin B. Barber, Director of Transportation Production Resources Office, National Security Resources Board (non-voting). The Executive Secretary is Charles O. Cary.

At the request of the President, the Committee prepared and submitted recommendations regarding implementation of the recommendations of the President's Airport Commission. Preparations were initiated by the Committee, in response to a letter from the President, to coordinate activities relating to the celebration of the Fiftieth Anniversary of the Wright Brothers' first flight. Further coordination was effected for domestic and foreign civil aviation requirements for new aircraft, maintenance, repair and operating supplies (MRO) for both air carrier and non-air carrier aircraft in accord with established policy of equil priority with the military for production of essential civil carrier aircraft; the submission of recommendations for allocation of control materials to the Defense Production Administration covering complete programs for essential civil aviation requirements; development of policies regarding coordination between the military and civil agencies on airport matters including the planning, construction, modification, maintenance, operation and the use of airports.

Implementation of procedures and an installation coordination program in regard to the U. S. common system of all-weather air navigation and traffic control continued. At the request of the Defense Air Transportation Administration, the Air Coordinating Committee coordinated and implemented the airway task group recommendations of the NSRB Air Transport Mobilization Survey. A U. S. policy and schedule was established for the decommissioning of low and medium frequency system and the commissioning of a national VHF Omni Range System. An air navigational facility plan was developed for the European-Mediterranean area as were coordinated U. S. requirements for long distance navigation aids for the continental United States and its possessions.

CHAPTER FIVE

The Airlines

Felix Nadar, a Frenchman who made the first aerial photographs in 1858, may also be credited with developing the first air transport and airmail. Between September 23, 1870, and Jaunary 28, 1871, during the siege of Paris by the Prussians, he flew 164 persons and 10,000 kilograms of mail from the city by balloon. The first scheduled airline was in the United States. Tony Jannus, piloting a Benoist flying boat between St. Petersburg and Tampa, Florida, started it on January 1, 1914.

TWO ACHIEVEMENTS stand out in the records of the U. S. scheduled airline industry during 1952:

For the 12-month period ended December, 1952, the scheduled domestic carriers had one of the lowest fatality rates in airline history: 0.38 fatalities per 100 million passenger miles flown.

For the first time in their history, the scheduled domestic trunk airlines carried more than two million passengers and flew more than one billion revenue passenger miles in a single month—the month of June. Records to date indicate that this achievement was repeated in July, August and September.

General airline statistics reveal that, with the exception of air express, traffic was up in every service of scheduled domestic traffic, while the international carriers registered gains in all departments.

May 1, 1952, saw the inauguration by the scheduled airlines of trans-Atlantic air coach or tourist travel. The cost of this class of travel is 30% below present first-class fares. The record shows that a 50% increase in trans-Atlantic passenger traffic was made during the first three and one-half months of the new tourist air rates: May 1 - August 15, 1952 registered 73,000 trans-Atlantic passengers as against 50,000 during the same period in 1951. At the present time, U. S. flag international airlines are carrying 35% of all trans-Atlantic passenger traffic.

The scheduled airlines have for some time been providing travel at tourist rates to Bermuda and to most of the countries of Latin America.

Domestic air coach or tourist travel is becoming increasingly a part of the U. S. flying picture. Introduced by the scheduled airlines in 1948, this type of service carried 352,804 passengers close to a quarter of a billion passenger miles in 1949—its first full year of operation. Three and a half years later, during the first six months of 1952, the scheduled domestic airlines flew 1,017,982,000 air coach passenger miles, a gain of more than 70% over the same period in 1951.

In December 1948, domestic scheduled coach service was available to only three of the major cities in the United States. Today, 11 airlines are offering 64 scheduled air coach flights daily to 34 U. S. cities.

There follows a comparative table showing the progress made by the major scheduled air carriers in 1952:

U. S. DOMESTIC TRUNK LINE STATISTICS

	1951	1952 Estimated	Percent Change
Revenue Passenger Miles (000)	10,211,793	11,998,857	+17.50
Revenue Passengers	20,403,387	22,137,675	+ 8.50
Revenue Plane Miles	362,473,887	411,507,862	+13.50
Mail Ton Miles	62,927,454	70,478,748	+12.00
Express Ton Miles	40,265,996	37,366,844	− 7.20
Freight Ton Miles	100,584,179	115,500,000	+14.80
Operating Revenues	$658,520,844	$765,325,000	+16.22
	INTERNATIONAL		
Revenue Passenger Miles (000)	2,596,748	3,046,000	+17.30
Revenue Passengers	2,039,363	2,243,000	+ 9.98
Revenue Plane Miles	97,528,006	103,529,000	+ 6.15
Mail Ton Miles	21,970,111	22,212,000	+ 1.10
Express Ton Miles / Freight Ton Miles	71,195,915	73,519,773	+ 3.26
Operating Revenues	$286,704,441	$315,375,500	+10.00

American Airlines

American Airlines continued setting industry records in passenger traffic during 1952. August topped the heap with 275,685,000 revenue passenger miles, and on August 29, AA became the first airline to fly 10,000,000 revenue passenger miles in one day.

A prime factor in this burgeoning of passenger traffic was American's low fare program which included not only Airtourist fares but also family fares, excursions and "Fiesta" fares to Mexico. The volume of low-fare traffic equalled nearly 23 percent of American's total passenger volume.

Airtourist service proved so successful that in the spring of 1952 American doubled its service and then began laying plans to redouble the service in the spring of 1953.

In January American introduced Holiday on Wings—or HOW. This program substituted travel to far places for refrigerators, electric irons, TV sets or other household appliances as prizes in incentive progams for commercial and industrial firms.

More specialized traffic developed during the Presidential campaign in 1952 when both candidates used aircraft for longhaul hops and for quick, short-spaced "prop-stops." The candidates chartered from American both Convairs and DC-6's, the latter with special equipment such as writing desks, typewriter stands and mimeograph machines installed in place of some of the seats.

Recognizing years ago that early procedures for handling passenger reservations would not be equal to the growth of traffic in the postwar years, American, in 1952, in its huge reservations office at LaGuardia Field put into operation the Magnetronic Reservisor. It is an electronic "brain," the first of its kind in commercial use.

Eight years in development and an outgrowth of an electric reservations machine, the new electronic brain keeps accurate up-to-the-moment information on seats available and reduces to a matter of seconds the time it takes a ticket or reservations agent to make a passenger's reservation.

Also this year the certificated airlines put into effect the so-called "Reconfirmation Rule" to reduce the number of no-shows which had been plaguing the airlines ever since they began to get into high load factors. As a result by October 1, three months later, the new rule had reduced the number of no-shows on American Airlines by 50 percent.

On January 14, 1952, American Airlines with the cooperation of the United States and Canada instituted complete Immigration and Customs pre-clearance for passengers. Under this arrangement passengers leaving Canada for the U. S. by American Airlines clear U. S. Customs before they even board the plane, thus saving ten to twenty minutes in travel time between Toronto and New York, for example.

American Airlines was awarded its second 4-billion mile safety award during the year by the National Safety Foundation for flying 4,675,379,000 passenger miles without a passenger or crew fatality between November 29, 1949, and the end of 1951.

Gains were registered by American in all three categories of cargo, but the biggest gain was in airfreight which jumped 23.3 percent in the first nine months of 1952 over that of the first nine months of 1951. The ton miles totalled 32,993,059 as against 26,748,036 in the first nine months of last year. Mail gained 19.4 percent in the first nine months and express showed a 2.9 percent gain over the nine month period.

During the year American made real strides in improving engine performance. Operating a total of 107,000 engine hours per month, it cut cylinder removals from 313 in January to 68 in August on its 49 DC-6's, from 118 to 36 on its 17 DC-6B's, and from 208 to 55 on its 78 Convairs. Engines feathered in flight on all types of aircraft for all causes dropped from 69 in January to 27 in August and 23 in September.

During 1952 American Airlines had a sizeable fleet expansion program underway. In December of 1951, it placed orders for 36 four-engine aircraft including 8 DC-6B's and 3 DC-6A's (Airfreighters) for delivery early in 1953 and 25 DC-7's for delivery late in 1953 and early in 1954. During 1952 it had in operation 49 DC-6's, 17 DC-6B's, 78 Convair 240's and 13 DC-4 Airfreighters, plus one DC-4 passenger plane for military charter work.

When it takes delivery of the planes on order, American will have a fleet totalling 194 aircraft.

Bonanza Air Lines

For the first nine months of 1952, Bonanza Air Lines carried 28,791 passengers, an increase of over 76% in passenger traffic over the same period in 1951; and reported that it was in better financial shape than ever before. A certain portion of the increase was attributed to the operation of the new Phoenix-Los Angeles segment which started on July 15.

In order to stimulate interest in air travel during the winter months, Bonanza put into effect, as of October 1, special excursion fares between the points of Las Vegas and Reno, representing 40% savings in the cost of a round trip between these cities, as well as between Las Vegas and Minden-Carson City and Reno and Hawthorne.

On April 27, 1952, Bonanza became the first local service line to experiment with a non-stop night coach between the points of Phoenix and Las Vegas at a fare considerably lower than the regular fare. Although the non-stop night coach experiment has had to be dropped from the operating schedule from time to time since its inauguration (because of the gasoline strike and later, because of the start of operations on the new route) it still carried almost 850 passengers in its almost six months of operation.

In 1952 Bonanza carried considerably more cargo that it had previously.

During 1952 Bonanza reconverted its fleet of four DC-3's from 21-seater planes to 28-seaters in order to handle larger traffic loads.

With the inauguration of Bonanza's new route from Phoenix to Los Angeles, with flights terminating in Los Angeles and laying over there overnight, Bonanza has installed its own crew, consisting of three mechanics and an inspector at the Los Angeles International Airport in order that some of the periodic inspections may be made there.

Also, during 1952 Bonanza installed at its main hangar in Las Vegas, its own electrical shop where the testing of electrically operated instruments and the overhaul of electric units can be done at great savings.

Under the heading of "Unusual Cargoes," Bonanza reports for the second year it carried a shipment of ladybugs from Reno to Phoenix to be used for insect control in the Valley of the Sun area. However, this is the first year this cargo was carried without mishap. In 1951 one of the boxes containing the ladybugs broke in transit, inundating the plane, passengers and crew, as well as the Las Vegas Terminal on landing, with over 10,000 of the insects.

On October 4th, the company celebrated its fourth anniversary.

Braniff Airways

Braniff International Airways, during 1952, with its merger with Mid-Continent Air Lines, took its place among the 12 largest airlines in the world and the six largest carriers in the nation.

Braniff, which will celebrate its 25th birthday next year, qualified during 1952 for its 19th annual flight safety record from the National Safety Council. The airline has flown better than 2,000,000,000 (B) passenger miles in perfect safety to passengers and crews.

The merger of Braniff and Mid-Continent, finally approved by the stockholders of both carriers on July 29, 1952, gave Braniff more than 17,800 certificated route miles in the United States and Latin America.

Braniff now serves 64 major cities in the U. S., and eight Latin countries. Following the merger, Braniff Airways had in service 57 multi-engined aircraft. Combined with the Braniff fleet of nine DC-6's, nine DC-4's and 13 DC-3's were Mid-Continent's fleet of five Convair 240's and 21 DC-3's.

The airline ordered 26 Convair 340 airliners, under contracts totaling more than $15,000,000 during 1951. Braniff received two of the 44-passenger, 300-m.p.h., pressurized aircraft during the Fall of 1952. It's third 340 was scheduled for delivery around Nov. 1, four more of the new-model Convairs were scheduled for delivery during December and the remaining 19 units of the carrier's Convair fleet are slated for delivery early in 1953.

During the past five years, Braniff's passenger traffic has shown a steady rise. In 1947, revenue passengers carried totaled 599,815. In 1951, the total was 802,423. Revenue passenger miles flown totaled 199,633,000 in 1947, while the figure was 335,347,000 in 1951.

Total operating revenue, increased from $12,264,198 in 1947 to $25,356,473 in 1951. Air freight and air express increased from 2,844 tons in 1947 to 6,929 tons in 1951.

Net profits in 1947 totaled $37,198, while in 1951 the net profit was $1,337,889.

Braniff has established some outstanding "firsts" in the aviation industry. The airline was the first commercial airline to be certificated for ILS (Instrument Landing System) by the Civil Aeronautics Board. It was the first carrier to have its ILS minimums reduced, first to be certificated for the use of JATO, and first in the history of aviation to introduce reduced rate tourist liner service.

Capital Airlines

Capital's goal of two million passengers for 1952 was certain to be realized for by the end of October, 1952, the airline had already carried approximately 1,700,000 air travelers.

Also, during October a record high in monthly revenues was established when Capital reported a total gross revenue of $4,060,000. It was the first time in Capital's twenty-five year history that monthly revenues had topped the four million dollar mark. Highest revenue day for the company was August 29, the day before the long Labor Day week-end when the airline reported a total revenue of $173,353.

In June Capital Airlines was presented the National Safety Council aviation safety award for its contribution to safe air transportation by flying over one billion passenger miles without a passenger or crew fatality.

In the spring of 1952, Capital Airlines announced that it would reduce its aircoach fares to four cents a mile, or a reduction of approximately 12% in the then existing rate, and James W. Austin, Vice President, Traffic and Sales, stated that Capital will continue to expand its air coach service. He said that Capital flew more coach service in 1952 than in any previous year and that "we will continue to furnish this service to more and more of those cities on our system where the density of traffic will support such a service."

Despite Capital Airlines' contribution of two cargo aircraft to the Korean airlift, the Cargo Department of the airline managed to fly almost the same amount of mail on passenger planes in 1952 as it had in previous years with the aid of cargo planes and at the same time reduce the cost to the Government of handling this mail by approximately 16%. For the first nine months in 1952, Capital flew 1,385,707 ton miles of air mail as compared with 1,385,279 ton miles in the first nine months of 1951. The cost to the Government was reduced by $132,074.

Again because of the contribution of the two air freighters to the Pacific operation it was necessary to fly air express solely in passenger airplanes. Despite this, shipments declined only ⅓ of 1% in the first nine months of 1952 over the first nine months in the previous year. From January to September, 1952, Capital flew 1,732,787 ton miles of air express while in the same period in 1951 the ton mileage flown was 1,739,433. Despite this almost negligible decline the return from air express was up 12.6%.

Air freight also increased in the first nine months of 1952 over 1951. Capital added two more Constellations to its already existing fleet of five Constellations and announced that the airline was purchasing five more of these planes to be delivered in early 1953.

On April 26, 1952, Capital celebrated its twenty-fifth anniversary. The airline now serves 77 cities in the east and south and branches out as far west as Minneapolis-St.Paul, covering 6,000 miles of airlanes.

Capital's "Man of The Year" Award for 1952, given yearly to the person who has made the most outstanding contribution to Capital in the previous year, was awarded in 1951 to Thomas Ned Lee, District Operations Manager, Knoxville, Tenn.

Capital reported its operating income during the first nine months of 1952 at $1,079,497 while the net income (after provision for Federal and state taxes) totalled $916,343. From January to October, 1952, the airline had flown 467,316,043 revenue passenger miles.

Caribbean Atlantic Airlines

Based on figures up to and including September 1952 as compared with figures for the same period in 1951, Caribbean Atlantic reported an approximate increase of 23% in passengers carried, 24% in ton miles of mail and 32% in ton miles of freight with an increase of 10% in flying time. Performance figures were up from 99.26% in '51 to 99.44% in '52.

The airline celebrated its tenth year as a certificated airline on September 22, 1952, and has been awarded the Aviation Safety Award for every year of operation.

Caribbean Atlantic classifies itself as a commuters service since most of its flights are of only approximately thirty minutes duration. In fact, to provide service of this type to cities located in the interior of the Island (Puerto Rico), where only small airports are available, the company is contemplating the purchase of a fleet of helicopters.

Chicago and Southern Air Lines

On April 25, 1952, Chicago & Southern and Delta Air Lines announced a plan to merge the two companies, pending the approval of the Civil Aeronautics Board, the President of the United States and the stockholders of the two companies. If approval is obtained, the combined companies will operate under the name Delta-C&S Air Lines, Inc.

The merger proposal was presented in formal hearings before an examiner of the Civil Aeronautics Board in August, 1952. As the Year Book went to press, the proposed merger had received the CAB examiner's approval, but no final decision was expected until early '53.

The combination of the Delta and C&S systems if approved will form the sixth largest scheduled air carrier in the nation, with 9,508 miles of air

FIRST AIRBORNE AMERICAN

The first American to be airborne was aged thirteen—Edward Warren. He went aloft in a captive balloon built by Peter Carnes near Baltimore. The flight was on June 24, 1784. Either Carnes was afraid to go up, or the balloon wasn't big enough to lift him. Warren was unafraid and his feat was preserved in purple prose the next day by the *Maryland Journal and Baltimore Advertiser*: "He bravely embarked as a Volunteer . . . and behaved with the steady fortitude of an old Voyager. The 'gazing multitude below' wafted him their loud Applause, the Receipt of which, as he was 'soaring aloft,' he politely acknowledged by a significant wave of his Hat."

routes linking 55 cities in the U. S. and the Caribbean. Delta presently serves 33 domestic cities and C&S serves 22 cities domestically with an international service to Cuba, Jamaica and Venezuela.

During the first half of 1952, Chicago & Southern had inc eased operating revenues by 23 percent over the same period in 1951. On August 6, 1952, Chicago & Southern moved into its 17th year of perfect safety.

Although gains were made in all classifications of traffic throughout the C&S system, the most noteworthy progress in 1952 was on its international segments. At the end of June, C&S' passenger load factor of 49.14 percent was an increase of 8.05 percent over the same period in 1951. International airfreight traffic had increased 70 percent during the first six months, compared with that period in 1951.

Chicago & Southern's Aircruise program, providing all-expense aircruises to Cuba, Jamaica and Venezuela, was a contributing factor in the increase in international business. Industrial expansion in Venezuela has created a substantial movement in passengers and goods between the United States, as well as Caribbean points, and Venezuela.

Chicago & Southern charter flights in 1952 included a portion of the trip required to bring Kaiser Aluminum Company officials to New Orleans for the opening of their new plant at Calumet, Louisiana. The most unusual charter flight of the year, and possibly outstanding in C&S' history, was the DC-3 chartered to fly a honeymoon couple from Jackson, Mississippi to New Orleans, Louisiana.

Airport improvement programs initiated by city governments on the route served by C&S provided new or improved facilities for passengers and airlines during the year. New terminal buildings were erected at Shreveport, Louisiana; Evansville, Indiana and Fort Wayne, Indiana. New airport terminals are planned for St. Louis, Missouri; New Orleans, Louisiana; Toledo, Ohio and Indianapolis, Indiana.

C&S has cooperated to the extent of providing better facilities in needed spots, such as a new non-directional air navigational device and fan marker at the Hot Spring (Arkansas) Municipal Airport. The new devices will allow more flights to land at the airport—flights which formerly were forced to cancel scheduled landings due to weather.

During the year Chicago & Southern operated a fleet of six Constellations and twelve DC-3's, with ten Convair-Liner 340's on order. Delivery of the Convair is scheduled to begin in June, 1953.

Continental Air Lines

At Continental Air Lines all categories of traffic during the first nine months of 1952 increased. Passenger revenue amounted to $6,243,710 for 1952, a 41.38 percent increase over the $4,416,262 passengers for 1951. Revenue passenger miles flown in 1952 were 105,161,831, a 32.58 percent increase over the 79,320,229 passenger miles of 1951. Ton miles of mail flown during the past year was 375,281, a 51.22 percent increase over the 248,164 ton miles of mail carried during 1951. Ton miles of express amounted to 144,650, a 26.79 percent increase over the 114,083 ton miles carried during the previous year.

The company attributes these increases to a number of items. First, interchange flights between Continental and American Air Lines on the Houston-West Coast route; and between Continental and Braniff Airways on the Denver-Kansas City-St. Louis. These flights have had a tremendous effect on increasing Continental's traffic both cargo and passenger-wise. No doubt family fares and vacation packages aided substantially in increasing traffic but it is impossible to determine to what extent.

As of the last day of August, 1952, the airline had flown 1,756,337 passengers 642,940,970 passenger miles in its 19th year of unbroken safety.

Continental Air Lines received the first plane of a fleet of 7 Convair-liner 340's on the last day of October, 1952, and has an option to purchase three additional 340's if desired. Two DC-6B aircraft are on order for delivery in May and June 1953. These will be used on the southern interchange route between Houston and the West Coast.

Delta Air Lines

The number of revenue passenger miles flown by Delta Air Lines in March exceeded all previous months in the history of the airline. Revenue passenger miles totalled 42,748,085, an increase of 9 percent over the total of 39,419,393 in March, 1951.

For the sixth straight summer Delta offered all-expense packaged vacations to Miami Beach, Havana, Nassau, and Jamaica. Delta's goal of 5,200 vacations by the season's end, was reached in August.

Delta received two safety awards during the year for flying over a billion passenger miles safely. The awards were from the National Safety Council and from the Marsh McLennan Insurance Company of Chicago.

For the first time in 1952, Delta continued its non-stop DC-6 Chicago-Miami aircoach service during the summer, and it operated with an average of 75-80 percent of its seats occupied.

Late in 1952 Delta expected delivery of its first Convair Liner 340. The airline has ordered ten Convair 340's at a cost of approximately $6,000,000 including spare parts. Also, the company has bought four DC-7's for delivery in 1953. The Convair 340 will be used over the entire Delta system on both short and medium-length hops.

During the year Delta converted the engines on its DC-6's to CB16's and installed paddle blade props. Also water injection was installed to increase the available take-off power for the DC-6. Also, the Visual Omni-Range system was installed on all aircraft.

Delta's youngest passenger—a nine-hour-old baby—flew from New Orleans to Dallas on August 23, 1952. The airline's oldest passenger—106-year-old Confederate General W. J. Bush—flew Delta in June, 1952, en route to a reunion of the Boys in Grey.

During the year Delta raised approximately $2,250,000 through the sale of 100,000 shares of common stock for financing new equipment now on order. Almost simultaneously the company completed negotiations for a $20,000,000 loan commitment from a group of 25 southern banks in 12 states, an arrangement which permits Delta to draw any of the funds during a two-year period for repayment in five years.

Eastern Air Lines

Carrying the company well into its 18th consecutive year of profitable operation, net earnings of Eastern Air Iines, Inc., for the first nine months of 1952 were $1,773,875, or $.74 per share after deduction of normal Federal income taxes.

Though gross revenues of $88,143,000 were 17% over the $75,337,000 earned in the first nine months of 1951, the favorable effect of this increase was offset by increased taxes and higher operating costs across the board, plus the necessary curtailment of operations at Newark Airport and the temporary cut in plane mileage enforced by the petroleum workers' strike earlier in the year.

From January of 1952 through September, Eastern carried 2,874,808 revenue passengers, 8% over the comparable period of 1951. Revenue passenger miles were 1,517,526,162, up 17% and revenue plane miles 51,346,953, up 12%, over 1951.

Reduction of net profits for 1952 also reflected the unusually heavy but non-recurring expenses involved in the integration of 48 new twin-engined Silver Falcons and 14 four-engine Super-Constellations into the Eastern Air Lines Fleet.

October, with 364,615 revenue passengers, was the biggest month in EAL history. On October 24th, 14,469 passengers represented the company's greatest single day's traffic.

Receiving no Government subsidy, Eastern's gross revenue for mail carried in the first eight months of 1952 was $1,800,000 and the total pound miles were 8,161,153,000. The airline carried an average of 58,600 pounds of mail daily. With its air express shipments on the upgrade, Eastern anticipated carrying 25,000,000 pounds for $3,500,000 worth of business in 1952.

Up through November of 1952, Eastern received and integrated into its operations new 40-passenger Silver Falcons and 14 new 88-passenger Super-Constellations through its $110,000,000 fleet expansion program. By the end of the year, delivery of 12 additional Silver Falcons was expected to complete the order of 60 from the Glenn L. Martin Co. Delivery of 16 more Super-Constellations, equipped with compound turbine engines, is scheduled to begin early in 1953.

Both the Silver Falcons and Super-Constellations were designed for "overnight" conversion to jet-type power and provide Eastern with the 60-passenger, four-engined New-Type Constellations. This new equipment has dove-tailed into Eastern's operations, the Silver Falcons over the short-haul inter-city routes and the Super-Constellations on the long-haul "express" flights such as New York-Miami or New York-San Juan, Puerto

SINFUL FLYING

The Wrights, had they wished, could have found ample and ancient moral reasons for abandoning their project. To fly, according to some of the best of the medieval authorities, was sacrilege. Francesco de Lana quit work on his contraption at the drawing board. "God," he said, "would never surely allow such a machine to be successful." Francis Bacon went to jail at the urging of both church and state. And the famous English essayist, Joseph Addison, in 1713 declared that a flying machine would bring "innumerable immoralities," with lovers meeting at "midnight . . . on top of the monument," and "the cupola of St. Paul's covered with both sexes like the outside of a pigeon-house," while a boy-friend gave "chase to his mistress, like a hawk after a lark."

Rico. During the first nine months of 1952, EAL flew 8,396,429 miles in the Super-Constellations and 10,613,527 miles in Silver Falcons, besides 76,867,559 miles in its New-Type Constellations.

President Eisenhower and Governor Stevenson were carried over 25,000 charter miles by Eastern in their campaigns. Eastern also established records for the scheduled airline industry in handling large group movement of military personnel.

Eastern became the first airline to carry its millionth aircoach passenger on September 28, 1952. During the year EAL extended its coach schedules to include 17 key terminals on its 90-city system, and made available 511,165,837 air coach seat miles. On November 1 Eastern inaugurated daylight coach service between New York and Miami with three daily nonstop flights. In addition to doubling its system-wide seat capacity to Miami, the airline greatly expanded service to Puerto Rico, in establishing what amounted to "overnight commuter" service between New York and San Juan.

Flying Tiger Line

The Flying Tiger Line reported domestic freight traffic in the first eight months of 1952 at $3,896,663, a gain of 32 percent over the same period of 1951. Earnings and revenues of the line climbed to new record highs in the 1951-52 fiscal year, ended last June 30, as the air freight carrier experienced the most active business period of its history.

Revenues totaled $21,837,496, a gain of 40 per cent over the preceding year, when the company grossed $15,582,059. Net income, after provision for taxes and dividends on the 5% preferred stock, reached a new high of $1,529,000, compared to $1,399,872 in the previous year.

On May 1st, 1952, the Flying Tiger Line, together with Slick Airways and U. S. Airlines, the nation's three scheduled airfreight carriers applied to the Civil Aeronautics Board for permission to carry airmail, air parcel post and air express without subsidy and at rates based on the actual cost of rendering the service. At year-end no decision had been reached by CAB.

Frontier Airlines

Passenger and freight business for Frontier Airlines during the first six months of 1952 was considerably ahead of the same period for 1951.

Frontier boarded a total of 56,522 passengers during the first half of 1952 as compared with 46,414 in 1951, a gain of 21.7 percent.

Air freight came through with a 52.3 percent increase while air mail was off 9 percent.

Air express dropped 1.3 percent with 36,571 ton miles handled during the first half of 1952 compared with 37,078 ton miles carried in 1951.

Snow slides and blizzards greeted 1952 on Colorado's Western Slope, completely disrupting surface transportation and isolating the San Juan Basin. Frontier provided emergency mail and cargo service during the tie-up; this service resulted in air mail service for all first class mail and newspapers at no additional cost to the customer. Approximately ten thousand pounds of surface mail were handled during this period.

The severe storm conditions created demands for emergency equipment and Frontier was used to move this traffic. Snowshoes were flown in to enable rescue workers to reach stranded trucks and cars on Wolf Creek pass, between Monte Vista and Durango. A sudden demand for overshoes exhausted local supplies. Large shipments from Grand Junction and Salt Lake City took care of the needs of the stranded residents in the San Juan Basin area. Sleds were required for rescue operations, and these were flown in from various points on Frontier's system.

Hawaiian Airlines

During the period January through August 1952, Hawaiian Airlines carried 256,731 revenue passengers as compared with 234,590 revenue passengers carried during 1951. Interest in eruption of Kilauea volcano on the Island of Hawaii and increased influx of mainland tourists played a part in traffic increase.

Mail carried during first eight months of 1952 amounted to 234,496 pounds, a drop from the 319,418 pounds carried during the same months of 1951.

Cargo carried by Hawaiian was up approximately 10 percent. A total of 11,042,074 pounds of revenue cargo were carried during the first eight months of 1952 as compared to 10,106,200 pounds during the same period in 1951.

HAL innovations in 1952 included simultaneous departures of two and sometimes three aircraft and the traffic department reports an unqualified success in handling of large sports groups and mainland tour groups.

Hawaiian at present has 11 Douglas DC-3 passenger aircraft and two DC-3 cargo aircraft in service. The airline ordered six 44-passenger Convair-Liner 340's from Consolidated Vultee in 1951 and expected delivery on first of the new planes in late 1952.

Mohawk Airlines

Through October, 1952, Mohawk reported 87,090 passengers carried, as compared with 83,131 at the same period last year. In 1952, the airline received its second aviation safety award from the National Safety Council.

The following route extensions were granted during the year: the New York City to Utica-Rome service extended north to Watertown, N. Y.; authorization to operate between Albany, Utica-Rome, Syracuse, Rochester and Buffalo; authorization to serve Albany-Boston via Pittsfield, Westfield/Springfield and Worcester.

The company reported its 1952 profit, through September, at $38,229.00.

Northeast Airlines

During the month of August, 1952, Northeast carried over 60,000 revenue passengers; the first months in the company's history to reach the 60,000 mark. The Family Fare Plan accounted for the increase.

Northeast Airlines was one of three trunk line carriers that showed no fatal accident from the time the airline was established. At the time of the National Safety Council award in June, 1952, this covered nearly 19 years and over 530,000,000 passenger miles.

Northeast leased two luxurious DC-4's from Panagra through the busy summer season to supplement its own equipment and handle vacation traffic.

In addition, Northeast has on order with Consolidated Vultee Aircraft, an order for 5 new Convair 340's; 1 scheduled for delivery in April, 1953, 1 for July, 1953, 2 for September, 1953 and 1 for October, 1953.

The airline had its share of the unusual and bizarre in the way of cargoes—one of which was "seaworms" from beaches in Maine. These small, wriggling creatures, a unique sort of worm found in only a few places in the Maine waters, are evidently a most succulent morsel for game fish. They are packed live, in crates, and shipped to popular fishing spots along the Atlantic coast, to be used as bait.

For the 1952 nine-months period ending September 30, 1952, Northeast Airlines showed a net operating loss of $136,416.10.

Northwest Airlines

Outstanding among developments of Northwest Airlines during 1952 was the announcement by Croil Hunter that General Harold R. Harris, who had been vice president in charge of Pan-American's Atlantic division, had been chosen to become president of the company, taking office January 1, 1953. Mr. Hunter will become chairman of the board.

A proposed merger of Northwest with Capital Airlines, approved by the directors of both companies and the stockholders of Capital, was defeated when a group of Northwest stockholders disapproved.

Among important events in which Northwest Airlines figured during the year were: its application for additional routes in southeast Asia, which would add approximately 12,000 miles to its present 20,000-mile system;

and reopening of its London sales office, indicating a spirited bid for more European business.

Among other activities during 1952:

The airline continued its role in the Korean airlift, co ributing substantially to personnel and supplies carried to Korea.

It also inaugurated Stratocruiser service to the Orient, while maintaining other four-engine service. As a prelude to the Stratocruiser flights it carried a group of top-ranking press, radio, magazine and television representatives to the Far East.

It started all-freight service to the Orient, being the first airline to operate such service.

The institution of Stratocruiser service to the Orient by Northwest and the introduction of the non-stop Seattle-Chicago flights resulted in some new fast flight records.

On the return trip from Tokyo to the United States, Northwest Stratocruisers, — flying non-stop from Shemya to Seattle-Tacoma, — have made the flight in little more than 18 hours.

The airline's system-wide passenger traffic increased more than 20 percent during the year. This applied to domestic, Honolulu and Orient trips, with the heaviest emphasis on the domestic. Domestic revenue passenger miles increased 33 percent during the first eight months of 1952. Domestic coach revenues nearly doubled during the year. The proportion of coach revenues to total revenues increased from 26 to 34 percent.

Pan American World Airways

A year-end order of five Douglas Super-6 Clippers boosted Pan American's fleet of these advanced-type transports to 48, amounting to a total cost, including spares, of over $60-million.

Seventeen of the Super-6's are now flying on Pan American's services to Europe, Africa and on the "Orient Express" service to Asia.

The airline also ordered three Comet III jet aircraft, with delivery in 1956, with an option for seven more.

At mid-year, PAA had carried 818,987 passengers. Total ton miles revenue traffic to July, 1952, was 141,167,374, as compared with 126,-426,926 at the same time the previous year.

Panagra

In its 24th year of continuous scheduled air transportation between the Americas, Panagra (Pan American-Grace Airways) in 1952 placed in operation new Douglas DC-6B aircraft to inaugurate the lowest-cost pressurized, high-speed tourist service and set new company records in the movement of passengers and cargo.

In the first six months of the year, the pioneer U. S.-Flag airline had flown 66,456,000 revenue passenger miles and 1,165,655 freight and express ton miles, as compared to 63,854,000 revenue passenger miles and 11,111,476 express ton miles during the first six months of 1951, the company's best previous traffic year. Traffic continued its upward trend during the latter months of 1952.

Early in April, the first of Panagra's new DC-6B's was flown to Lima for a series of indoctrination and crew familiarization flights, and, on May 1st, the airline was the first to introduce these new, modern, pressurized planes on regularly scheduled coach service in South America. Replacing the DC-4's, which the airline had been using on its tourist class service, the new 70-passenger 300-mile an hour planes helped to speed up travel between Miami and Buenos Aires via the west coast of South America and across the Andes to the Argentine capital.

Coincident with the introduction of these new planes, Panagra introduced the lowest plane fares ever offered United States travelers to South America. These low-cost fares which Panagra, in conjunction with Pan American World Airways, put into effect from May to October and called its summer excursion fares brought the price of a complete around South America trip beginning and ending in New York, down to $675.

IT'S EASY!

"America has a thousand airmen capable of a non-stop flight from New York to Europe if the opportunity, the equipment and the patience and ability to plan and prepare had been theirs. After all, it is only a matter of thorough preparation and a little special training in navigation and in flying by instruments, through thick weather. That, a plane and a motor capable of doing the job, a fair amount of horse sense and a little luck are all that any good pilot needs to accomplish such a flight. The men who establish new records in aviation have no special senses or birdlike instincts not possessed by their fellow-flyers, or, for that matter, by the normal man in the street. In flying as in any other profession or art, there are and always will be men who stand at the top because of a special endeavor or devotion of purpose, but it does not mean that they are any better than those about them nor that new names and new faces will not continually rise to supplant them."

—Clarence D. Chamberlin in "Record Flights," 1928.

In the transportation of freight in 1952, Panagra surpassed all previous records.

Panagra, in July, completed the modification and standardization of its DC-6 aircraft with the installation of new R-2800 CB-16 engines and the latest Hamilton Standard high-activity propellers on all its DC-6 aircraft. These new features, together with the additional water alcohol injection equipment, furnish Panagra DC-6's with an extra 300 horsepower per engine during take-off and it also provides an additional 100 horsepower per engine for cruising, making the aircraft 15 miles an hour faster.

This conversion program not only increased the speed, safety and load factors of Panagra's DC-6's, but also improved schedule reliability performance.

As the year came to an end, Panagra was rapidly nearing completion of an airborne radio modernization program which would provide its fleet with the latest communication and navigation aids.

During the year, Panagra, in accordance with its agreement with CORPAC, the Peruvian government's airport corporation, to finance and supervise the installation of instrument landing system equipment at Limatambo Airport, Lima, Peru, completed the installation of the first major approach lighting and ILS system in South America. The entire system is powered by Westinghouse equipment and a special stand-by generating and switchgear apparatus is ready twenty-fours hours a day for emergency use.

In 1952 Panagra again received awards from both the National Safety Council and the Inter-American Safety Council for its perfect safety record without an accident or fatality to passengers or crew. This was the eighth consecutive year the airline has won the aviation safety award, having flown 884,262,000 passenger miles.

The airline also accomplished a record for regularity and dependability of service when its famous El Interamericano express departed on schedule from Buenos Aires on seventy-five consecutive days. All these departures were turnarounds after 5,000-mile southbound flights.

Piedmont Airlines

During the first nine months of 1952, passengers carried by Piedmont were 166,083, a percentage increase of 17.5 over 1951.

Piedmont's certificate of operations of a local service airline was renewed on May 26, 1952 for seven years. This is the longest renewal ever granted to a local service carrier. CAB ruled: "Although we have concluded that Piedmont should not be renewed for a period of ten years, we think the circumstances of this case warrant a period somewhat longer than five years. The record achieved by Piedmont is so outstanding among local service carriers using DC-3 equipment as to merit special recognition." Another particular point in this renewal proceeding was the fact that the Post Office Department for the first time took an affirmative stand in favor of the renewal of Piedmont's certificate. In this same proceeding, new routes were granted.

The month of August, 1952, was the largest in the company's history with 5,150,000 passenger miles flown. Piedmont's fleet of airplanes was increased in 1952 by three, making a total of thirteen in the fleet. Only DC-3's are operated in scheduled service.

Resort Airlines

A regularly scheduled U. S. International Airline, Resort, is certificated by the Civil Aeronautics Board for vacation travel exclusively. Flying from New York, Washington, Philadelphia and Miami, Resort Airlines presently takes vacationers on a one-week round-trip, to Nassau, Haiti and Havana, and a two-week round-trip, to Nassau, Haiti, Jamaica and Guatemala. Other cruises to other points are operated in season with more being added continually.

In addition to offering specially certificated vacation routes to the Caribbean, Resort Airlines is active in both military and agricultural flying. As a member of the Air Transport Association, and at the request of the Defense Department, the airline has devoted as much of its capacity as possible to the transportation of military personnel.

During 1952 Resort Airlines received from the National Safety Council the 1951 Aviation Safety Award for never having a passenger or crew fatality in all its cruise, military, or other scheduled passenger-carrying, charter-flight operations, totaling more than 100,000,000 passenger-miles.

The company began operations in December, 1945, on an experimental basis. In July, 1946, application was made to the CAB for a Certificate of Public Convenience and Necessity to carry passengers on all-expense escorted air tours to most of the pleasure resorts in the United States, in Canada, in Mexico, in Central America, and in the Caribbean. After extensive hearings before a special examiner of the CAB and the presentation of considerable economic data, including the results of experimental tours operated under temporary "exemption", the examiner recommended, on August 18, 1948, that both a domestic and an international certificate be awarded. On January 31, 1949, however, the CAB denied both applications for a certificate.

CAB actions regarding foreign transportation are subject to the approval of the President. On June 1, 1949, the CAB awarded an international certificate, stating in the order, "The President having indicated that, for reasons affecting the relations of the U. S. with foreign countries and in the interest of the national security, authority to Resort Airlines to engage in air transportation should be granted." It also reopened the proceeding for the purpose of reconsidering the application for domestic routes. The international certificate became effective August 8, 1949. No final decision regarding the domestic certificate has been rendered to date.

Slick Airways

In 1952, Slick Airways' fleet consisted of 22 C-46's and 3 DC-6A airfreighters on its regularly scheduled runs.

The Douglas-made DC-6A's, capable of carrying a payload of 30,000 pounds at a 300 mph clip, were first put in to commercial service in the spring of 1950 by Slick. Slick expected delivery of three more of these DC-6A airfreighter giants by early 1953.

As Slick licensed and operated the C-46 for the last seven years, various improvements were discovered which were made available to others who followed Slick's lead in the commercial use of the C-46. This same procedure is carried on at present with the proving of the DC-6A airfreighters—the first airplane specifically designed and built for airfreight.

Operations with the DC-6A fleet have indicated the plane can operate at approximately one cent per ton mile less than any other airfreight plane. Flying over a million miles per month on regularly scheduled runs from coast-to-coast and in and out of the southwest, Slick's average utilization is more than 8 hours per day with load factors of more than 85%.

Slick is presently carrying 75 million ton-miles of airfreight and remains the largest domestic carrier of airfreight.

A campaign on the part of Slick to encourage shippers to decrease the amount of tare ("dead weight") surrounding their shipments has brought about many in-pocket dollar savings for airfreight's customers, including government. This industrial strip-tease, whereby the shipper is encouraged to remove the heavy and expensive crating from his machinery, engine, or other commodity, has increased available airfreight volume to a great degree.

In 1952, Slick Airways intensified its noise-abatement program as a public benefit to the air industry. Also, Slick inaugurated and presently operates a Flight Engineer's School on its DC-6 equipment. Slick, with its DC-6A equipment, currently holds the coast-to-coast record—9 hours flight time coast to coast for freight.

In the spring of 1952, Slick petitioned the CAB for an amendment to its certificate of convenience and necessity, and requested permission to carry mail, air parcel post and air express, offering to carry mail, parcel post and air express at a rate of twenty-five cents per ton mile—20c per ton-mile below the lowest rate paid to the passenger airlines. As the YEAR BOOK went to press, the Board had not yet assigned a hearing date for this application.

Southern Airways

Through September, 1952, Southern had carried 89,910 passengers, an increase of approximately 25% over 1951. On July 6, 1952, Southern carried 578 passengers and had a system load factor of 52%, which was its best single day of operation.

During 1952 Southern again ranked among the first three carriers of the local service category in total ton miles of mail handled. Air express traffic increased 10% over 1951.

Southern is presently operating ten (10) DC-3 aircraft all of which will be converted to 24-passenger capacity and completely standardized by November of 1952.

On June 10, 1952, Southern celebrated its third anniversary of the inauguration of Service on Route 98. On October 25, 1952, the second anniversary of Service on the Mississippi-Valley Route from Memphis to New Orleans to Mobile was celebrated.

During 1952 Southern increased its sales activities and established one Regional and five District Sales Managers to further implement the sales program. Due to the very heavy increase in traffic at Memphis, Tennessee, Southern also opened a Reservations Office in Memphis to supplement the System's Reservations and Space Control Offices operated in Atlanta, Georgia.

Trans World Airlines

For Trans World Airlines, 1952 was a year of the utmost significance. Its international route structure was strengthened by the award of certain permanent certificates; it inaugurated trans-Atlantic tourist service, and it launched in new luxury coast-to-coast schedules the largest airliner in commercial service, the Super Constellation.

TWA also established new traffic records in 1952. By year's end an estimated 2,395,000 passengers had been flown domestically, an increase of approximately 16 percent over 1951; and an estimated 176,000 persons over international routes, more than a 22 percent increase over the preceding year. New revenue passenger mileage marks for a single month, plus a new one-day domestic mileage record, were set during August and September.

TWA airliners flew 178,636,000 passenger miles domestically in August, compared to 175,089,000 in June, the previous high. Internationally, TWA flew 51,613,000 passenger miles, against 47,670,000 in July, formerly the best monthly figure.

On September 2 TWA's domestic aircraft flew 6,669,000 passenger miles, shattering the prior best mark of 6,406,000 passenger miles flown August 29, the start of the Labor Day weekend.

In July, the Civil Aeronautics Board awarded TWA permanent rights to fly passengers and cargo from the United States to Paris and Rome by way of Ireland. In addition the CAB gave TWA a seven-year extension to provide transportation to all the cities it previously served in Europe, North Africa, the Middle East and India, plus Kuwait and the Azores.

History was made the afternoon of May 1 when a TWA Constellation with 58 passengers aboard landed at Shannon, Ireland, being the first international airline to start trans-Atlantic Sky Tourist service from the United States. The flight marked the beginning of a new era in international travel. Fares from New York to London for this low-cost aerial transportation were set at record lows of $486, round trip, on season, and $417, thrift season (November through March).

A record summer resulted. Approximately 21,000 passengers crossed the Atlantic in these low cost TWA flights between May 1 and August 31.

On the deluxe side of the air travel picture, TWA inaugurated luxury coast-to-coast travel with King Size Super Constellations in September, serving New York and Los Angeles, and New York and San Francisco, with one stop en route at Chicago. Cruising speed of the new 10,800 horsepower Super Constellation was in excess of 300 miles per hour, with a range of more than 3,250 miles.

Cargo flights to Europe were resumed by TWA in September. Four-engined C-54 Sky Freighters now depart weekly from New York for Paris. All-cargo schedules overseas had been suspended by TWA when it aided the Korean airlift with its cargo planes.

While the airline's participation in the Military Air Transport Service's Pacific shuttle was still continuing during '52, it was found possible to resume international cargo flights on a limited basis. Internationally, TWA flew a total of 8,369,148 cargo ton miles, from January through August, resulting in a 26 percent increase in revenue over 1951.

TPA Aloha Airline

TPA Aloha Airline's passenger traffic toward year-end was 36.48% ahead of 1951. The Aloha Airline carried as many passengers in the first nine months of 1952 as in all of 1951. Total TPA traffic in 1951 was 138,667.

The airline has a perfect safety record, having flown more than 75,000,-000 revenue passenger miles without mishap. Every year since commencement of scheduled operations, TPA Aloha Airline has received an annual safety award from the National Safety Council.

TPA Aloha Airline operates no coach service but does carry freight, express and the U. S. mail. Passengers, freight and express represent 89% of the Aloha Airline's gross revenues. Mail accounts for 9%. Miscellaneous services produce 2% more.

The airline operates five 28-passenger Douglas DC-3's. There is no immediate plan to replace this equipment. TPA has found no other aircraft comparably suited to its extremely short haul operations, with three-fourths of all flights 100 miles or less.

Trans-Texas Airways

Through September, Trans-Texas Airways had flown 64,269,000 revenue passenger miles; boarded 273,910 revenue passengers, flown 13,072,000 revenue plane miles; 249,981 ton-miles of mail; and 332,937 cargo ton miles.

Trans-Texas celebrated its fifth anniversary on October 11, 1952. The airline was certificated as a commercial local service carrier in November, 1946, and service was started in October of the following year.

Non-stop "Southwind" service from Corpus Christi to the "heart of the Rio Grande Valley" was instituted by Trans-Texas on July 19, coincidental with the opening of the new Miller Municipal Airport, providing "door-step" service to Mission-McAllen-Edinburg. Two more changes were made on September 1. "Westwind" commuter service began between Fort Worth-Dallas and San Angelo, and new "Speed-Wind" flights, stopping only at Tyler and Lufkin, shortened flying time between Dallas and Beaumont-Port Arthur to only one hour and fifty seven minutes.

For each full year of operation since its inauguration of passenger service, Trans-Texas Airways has been awarded the Certificate of Safe Operation by the National Safety Council. Engineering, maintenance and operations continue their efforts to modify, alter and improve the DC-3. The first Starliner has been brought out of service and is undergoing complete interior modification and redecoration. The seating capacity on each of the ten Trans-Texas DC-3 Starliners will soon be increased from 21 conventional-type seats, to an ultra-modern, more comfortable 26-passenger seating arrangement.

Trans-Texas is responsible for the maintenance of several large Army Air Fields in the State of Texas, among them being Marfa Army Air Field at Marfa-Alpine, Eagle Pass Army Air Field, at Eagle Pass, Gibbs

Field, Fort Stockton, and Aloe Field at Victoria. The majority of these fields are located on or near the International Boundary of Texas and Mexico.

In the year 1940, Trans-Texas was organized in the name of Aviation Enterprises, Ltd., and in the year 1947, the name was changed to Trans-Texas Airways. On October 11, 1947, operations were begun.

United Air Lines

Based on actual nine-months figures and estimated fourth quarter totals, 3,500,000 passengers flew aboard United Mainliners during 1952, more than 500,000 above the company's previous all-time record set in 1951. Revenue passenger miles totaled 2,430,000,000, a gain of 30 percent over 1951.

United Air Lines began its second quarter-century of operation in 1952 carrying more passengers and mail than in any previous year in the company's history.

A new all-time industry-wide mail record was established, shattering the previous record chalked up by United in wartime 1945. Mail ton miles totaled 21,866,000, a 14 percent gain over 1951, and 3 percent above the 1945 level.

Air freight rallied after a decline in 1951 to a mark of 27,360,000 ton miles, 20 per cent above last year, and just below the company's all-time record 1950 totals. Air express, at 9,419,000 ton miles, was down 4 percent. Traffic records reported a six-month net earning of \$3,782,565, compared with \$2,738,558 for the first six months of 1951.

Financing to help purchase new equipment during 1952 included sale of \$10,000,000 of debentures in February and an offering of 224,000 shares of cumulative convertible preferred stock, \$100 par value, also in February.

Highlight of the year's operations was the world inaugural in November of service by the Convair 340, or Mainliner Convair. This new twin-engined airliner made its first scheduled flights between intermediate cities on United's California route and was in operation the length of the Pacific Coast at year end.

Long-range planning in 1952 included orders for 25 Douglas DC-7's. The four-engined DC-7 will carry 62 passengers, baggage, crew and 7,000 pounds of mail, express and freight. Four flight simulators manufactured by the Curtiss Wright Corporation were also ordered by the company during the year at a cost of more than \$3,000,000. Electronically controlled, the simulators will imitate realistically virtually any aircraft maneuver and operating condition.

Fall and winter United schedules were the most extensive in company history, offering capacity virtually equal to peak summer operations.

In addition to Convairs delivered, United placed in service 12 new DC-6B Mainliners during the year.

A large part of United's record traffic and revenue continued to stem from business travel stimulated by the continuing national emergency. However, an increasing volume of vacation travel made a heavy contribution to year-around traffic. Packaged tours also grew in popularity with increases in sales as high as 60 percent being recorded on the company's Hawaiian, Southern California, and Golden West air cruises.

Along with other major carriers, United continued full p rticipation in military contract flights between the West Coast and Tokyo. By mid-1952, the company had carried a total of 15,500 troops to and from Tokyo, logging nearly 9,000,000 miles since July, 1950. Vital cargoes carried on the military airlift in this period included 200 tons of whole blood and other medical supplies, 1,700 tons of mail, 2,880 tons of freight—including 250 tons of ammunition.

The political campaign saw United flying candidates from both major parties on "prop-stop" speaking tours to all parts of the nation. Estimates place United's candidate-miles operated at more than 50,000.

United continued to install the newest aerial navigation and communication systems during 1952. Omni-range equipment has been installed on all DC-6 and DC-6B Mainliners, as well as more than half the company's DC-3's. Mainliner Stratocruisers flying the California-Hawaii route have been equipped with VOR (Very High Frequency Omni Range) since 1951, and the Convair fleet also will have this equipment. VOR makes possible the use of an infinite number of radio "beams" for instrument flying. In addition, the company placed Very High Frequency networks in operation on two route segments: Chicago-Moline-Cedar Rapids, and Portland-Seattle.

The airline now has 13,000 employees and a fleet of more than 150 Mainliners serving 78 cities on a 13,250-mile coast-to-coast Pacific Coast and California-Hawaii system. The company operates more than 250 daily flights for a total of 225,000 miles every 24 hours. At its 1952 peak, United was carrying a daily average of 11,300 passengers, 106,200 pounds of mail, 85,900 pounds of express and 183,200 pounds of freight.

CHAPTER SIX

Utility Airplanes

THE UTILITY AIRPLANE industry, which has dropped its former title of Personal Aircraft (and, earlier, "lightplane industry") produced approximately 3,200 aircraft during 1952. This is the first time since World War II that its drastically-falling production rate has been decisively reversed and this output is a healthy increase over the 2,477 utility aircraft built during 1951.

The change in name to Utility Airplanes symbolizes the metamorphosis of the light airplane from its historic role as a trainer and sport plane to one of growing economic use to society. In this case the word "utility" has come to mean an airplane that can do anything, for that is the apparently endless capacity of the light aircraft. The kind of flying done by the utility aircraft has rapidly come to be known as "general aviation," one of the officially-recognized segments (along with military and air-carrier) of aviation operations. The term "general aviation" has come to embrace such diverse yet vital activities as agricultural aviation, corporation and business flying, industrial usages, "for hire" use and, of course, training and instruction.

Personal flying, in its strictly "personal" or "pleasure" sense, was one of the least parts of general aviation in 1952. Latest available statistics illustrate the use to which the nation's fleet of active civil aircraft is being put: 30 percent is used for business or professional use, 20 percent for agricultural purposes, 20 percent for instruction, 5 percent for air-taxi and charter, 2½ percent for industrial activities and 2½ percent for air carrier service, leaving only 20 percent for purely personal or pleasurable use.

THE BALLOON BROTHERS

Joseph and Stephen Montgolfier, the French brothers who invented the balloon, faced problems not unlike those faced by the Wrights as well as modern aeronautical engineers.

Their first bag, completed in November, 1782, was oblong and had a capacity of about forty cubic feet. It was made of paper. The brothers held this over a hot flame in a high-ceilinged room and released it. It flew until it touched the ceiling.

But they soon found that they had discovered, instead of a flying machine, a rather inadequate toy. The paper in their bag leaked like a sieve. A bag big enough to lift a man would leak like a big sieve.

Make a bag of better paper? The brothers—their father owned a paper mill—had the best there was. Use some other material? What?

They were up against the first of that endless number of technical problems which haunt aviation to the present. Their problem was as difficult to lick in its time, as, say, the problem of vibration at supersonic speeds today.

They tried a number of combinations during the winter of 1782-83, finally using linen lined with paper. Their first big bag was round and ten times the size of the model—600 cubic feet.

They solved the fuel problem and lift problem by securing the bag over a pit in which they built a fire of chopped straw and wool.

The bag broke loose and went up several hundred feet.

This was on June 5, 1783, some eight months after the indoor ascension—a record for developmental work to this day.

These data also show that only one airplane in more than 40 in the United States is a multi-engine airliner.

While these figures show the numerical proportion of active aircraft engaged in these activities, the hourly-use figures present a slightly different picture. Of the total number of hours flown by actively-licensed and used aircraft in the U. S., 32 percent were flown for business and industry purposes, 22 percent were flown, respectively, for instruction and for pleasure flying, 15 percent were flown in agricultural activities and 8 percent in charter work. Thus, while more aircraft are assigned to agricultural work, they fly less total hours due to the seasonal nature of the work.

Tracing these latter figures back through the last few years it is seen that whereas the dusting and spraying activity has increased 24 percent in two years and business and industry use 18 percent, pleasure flying has decreased 34 percent and instructional flying 55 percent. It is these trends that has prompted the industry to rename itself the "Utility Airplane Industry" in place of the personal or light plane industry as in the past.

This rapid and continuing adaption of the light airplane for serious economic purposes has forged the U. S. civil aircraft fleet into a vital element of defence and commerce. For example, more multi-engined aircraft are operated by private business organizations for executive transportation than are operated by the scheduled airlines. Currently-active four-place, single-engine aircraft—all less than five years old—provide an airlift capacity of more than 7,000,000 seat-miles of transportation per hour. An index to utility aircraft activity is seen in the fact that of the total number of aircraft movements at 175 major airports in the nation, 57 percent were by utility aircraft (27 percent were by air carrier and 16 percent by military aircraft). Actually, about 80 percent of the aircraft in the general aviation fleet are utilized for purposes considered essential to the national defense and economy by government authorities.

It is this increased business and productive use of the light aircraft that is paradoxically reducing the size of the U. S. civil aircraft fleet steadily. For example, there were 92,809 civil aircraft registered with the Civil Aeronautics Administration in 1951, of which 60,921 were listed as active. In 1952 this total dropped to 88,545 of which 54,039 were considered active. The general explanation of this steady decline is the fact that by far the vast majority of inactive aircraft are pre-World War II types and most of the remainder are surplus light trainer and liaison-type aircraft. Such aircraft are either so obsolete or have proved so uneconomical and impractical for present-day duties that they have become completely inactive. Another part of the decline is the usual annual attrition rate due to accidents, irreplaceable parts and general "wear out" in service. The low production rate in recent years has been unable to offset this attrition with the result that registrations continued to decline.

THE FIRST PILOT

No sooner had the balloon been invented, than pilots began to appear, calling themselves aeronauts. The first was Jean Francois Pilatre de Rozier. (The honor almost went to a couple of nameless convicts who offered themselves in exchange for not being killed on the wheel if they survived.) Jean Francois made a captive ascent in a Montgolfier with a built-in burner, at Paris, Oct. 15, 1783. A few days later he took up the first passenger on a captive flight—Girond de Vilette, who made a number of other ascents. The first passenger on a free flight was the Marquis d'Arlandes—Nov. 21, 1783.

The trick was to build a roaring fire in the grate in the center of the passenger basket to keep the bag aloft—but not too big to set it ablaze. Let the fire die, and you crashed into a chimney, roof or tree. Let it roar, and you came down in flames. Threatened with a crash, d'Arlandes later said that he took straw and "shook it in the middle of the flame." This worked: "The next moment I felt as if I were lifted up by my armpits." But a few minutes later, the bag caught fire—"part of the machine," d'Arlandes explained calmly, "was full of round holes, several of which were of considerable size." Cords holding the basket began to smolder. The only fire-fighting equipment was a wet sponge. The cords "all held except two, which gave way." A crash landing threatened, and again they built up the fire. After narrowly missing roof tops, they landed, apparently none too soon. In the seconds it took d'Arlandes to jump clear and turn around, the balloon "was perfectly emptied and quite flattened."

There is no record that d'Arlandes flew again; once was probably enough. But de Rozier, the first to fly, was the first to die. He attempted a France to England Channel flight on June 15, 1785. Hydrogen was the favorite lift by then, but de Rozier tried to compromise with a hydrogen bag above a hot-air envelope. His theory was that with the hot air he could control vertical motion more readily. A spark exploded the hydrogen bag. De Rozier and his passenger, M. Romaine, crashed in flames, and frightened natives buried the mangled bodies almost where they fell on the rocks near the Channel shore.

The vast utility aircraft fleet of the United States stands ready for immediate use in the event of an emergency—from a flood to a "hay lift," from a drought to an enemy atom bomb attack—in any of which it may, and has often been, the only means of rapid and dependable transportation for emergency medical supplies. Just as the light liaison airplane has performed evacuation of the wounded in Korea, so, too, will the utility aircraft be ready to provide this same life-saving service for civilians. An important segment of this potential has been formalized into the Civil Air Patrol, which uses utility aircraft exclusively for its thousand-and-one services to the nation and the community. In the event of war, tens of thousands of privately-owned utility aircraft will be ready to take their place alongside our fighters and bombers as U. S. Air Power in action.

CHAPTER SEVEN

Planes in Production

AIRCRAFT production in 1952 followed closely the pattern set the year before. Many designs stayed frozen, but development on new models continued with several started in production or close to it by year end.

The big news was the continuing superiority of our combat aircraft in Korea. The loss ratio was heavy in our favor over enemy aircraft. World War II bombers appeared to be adequate for that end of the Korean detail, for the newer B-47's and B-36's continued to stay on this side of the Pacific.

Transport aircraft assembly lines kept busy with backlogs for both civilian and military markets. The "stretching" process on existing types continued which led to other modifications, but general configurations continued about the same as the year before. Jet transport design was well underway in several of the airframe companies.

Helicopters continued to make news during the year with their rescue activities in Korea. Civilian use continued strong with more helicopter mail contractors signed up than ever before.

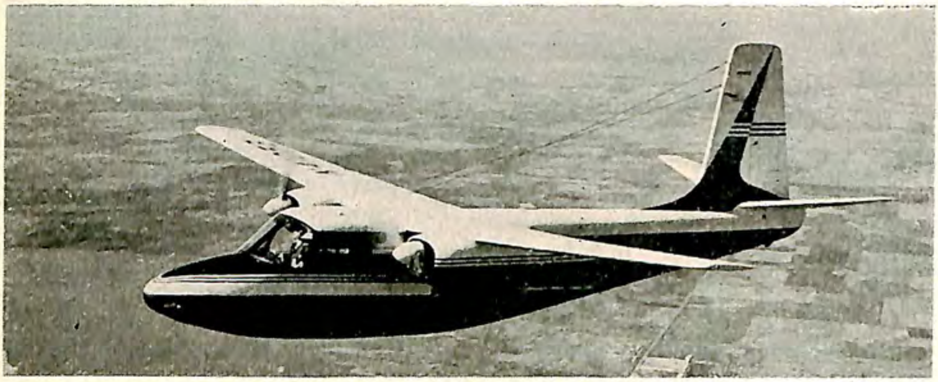
Restrictions on personal aircraft were eased a little during the year and production continued on most models. Considerable emphasis was placed on agricultural and industrial improvements. The end of the year saw what might be the forerunner of a new type personal plane when a design contract was let by the military for a light twin jet liaison plane.

All of the material in this chapter has been provided by the manufacturers and a final check by them has insured that the many facts and figures are as accurate as possible within the limits of security.

In the preparation of this section, a careful check has been made to insure that only those aircraft actually in quantity production during the year are included. For this reason, there are no prototype or experimental aircraft included.

AERO DESIGN AND ENGINEERING CO.

Oklahoma City, Okla.

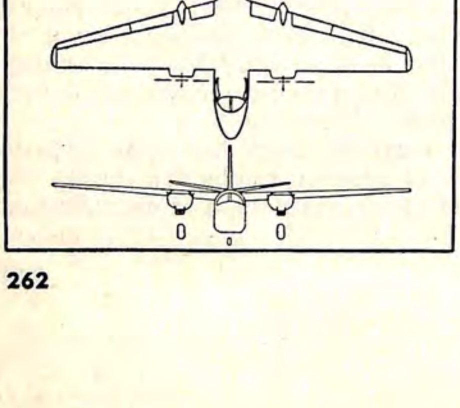


New Aero Commander

A 5 to 7 place, closed land high-wing monoplane. CAA TYPE CERTIFICATE: TC 6A1. MANUFACTURER'S MODEL DESIGNATION: 520.

DATA

POWERPLANT: Two Lycoming GO-435-C2, 260 hp. FUEL CAPACITY: 150 gal. PROPELLERS: Hartzell constant seed full feathering. FLAPS: Semi-Slotted. GEAR: Retractable tricycle.



SPECS

SPAN: 43 ft. 10 in. LENGTH: 34 ft. 2.5 in. HEIGHT: 14 ft. WEIGHTS: EMPTY, 3,650 lbs.; GROSS, 5,500; USEFUL LOAD: 1.850. WING LOADING: 11.45 lb. per hp. BAGGAGE: 350 lb..

PERFORMANCE

SPEEDS: MAXIMUM, 211 mph; CRUISING 197 mph at 10,000 ft. STALLING (full flaps power off), 60 mph; full flaps power on, 40 mph; no flaps, 67 mph). RATE of CLIMB: 400 ft. per min. SERVICE CEILING: 24,000 ft. RANGE: 850 mi.

DATA

The first production model Aero Commander rolled from the factory September 1, 1951.

Since then and until November 1, 1952, 32 of these executive models had been delivered. At the year's end, the factory of the Aero Design and Engineering Company at Tulakes airport, Oklahoma City, was producing new Aero Commanders at the rate of two a week.

The Commander's high-wing design provides several advantages besides an inherent stability, including exceptionally good visibility for passengers as well as pilots, and ease of access to the cabin.

The advantages realized through new design principles used in the Commander were dramatically demonstrated in May, 1951, when a propeller was removed from one of the engines, the plane was taxied onto the runway, taken off and flown non-stop from Oklahoma City to Washington, D. C. The Commander is available as a passenger, rescue, cargo, or executive transport.

ANDERSON, GREENWOOD AND CO.

Houston, Tex.

Anderson Greenwood AG-14L

A 2-place, closed, land, mid-wing monoplane, normal category. CAA TYPE CERTIFICATE NUMBER: 4A1. MANUFACTURER'S MODEL DESIGNATION AND DATE OF APPROVAL: 14 September 21, 1950.

DATA

POWERPLANT: Continental C-90-12FP, 90 hp. FUEL CAPACITY AND CONSUPMPTION: 23 gal., 5 gal/hr. APPROVED PROPELLER: Hartzell ground adjustable, HA-12-UF-1/L214. FAPS: trailing edge, 2 position, 45° and 23°. LANLING GEAR: long-stroke tricycle, steerable, oil and spring, dual acting brakes.

SPECS

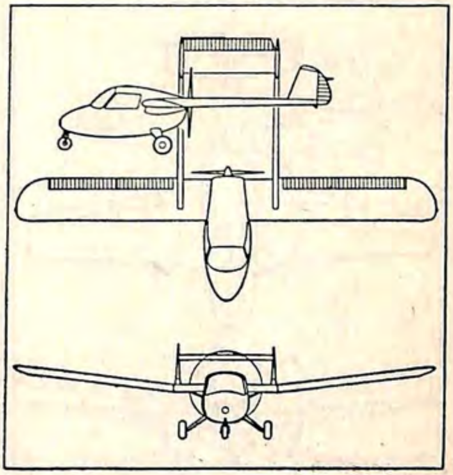
SPAN: 34 ft. 7 in. LENGTH: 22 ft. HEIGHT: 7 ft. 9 in. WEIGHTS: EMPTY, 850.; GROSS, 1400 lb.; USEFUL LOAD, 550 lb.; WING LOADING: 11.7 lb. per sq. ft., POWER LOADING: 15.5 lb. per hp.; BAGGAGE, FULL SEATS AND TANKS: 80 lb. MAXIMUM BAGGAGE: 250 lb.

PERFORMANCE

SPEEDS AT SEA LEVEL: MAXIMUM, over 120 mps; CRUISING, over 110 mph; STALLING, 57 mph; RATE OF CLIMB, over 700 ft/min.; SERVICE CEILING, over 16,000 ft.; ENDURANCE, 4 hours.

REMARKS

Initial production on the AG-14 started in late 1950. Several modifications have been added to the original production model.

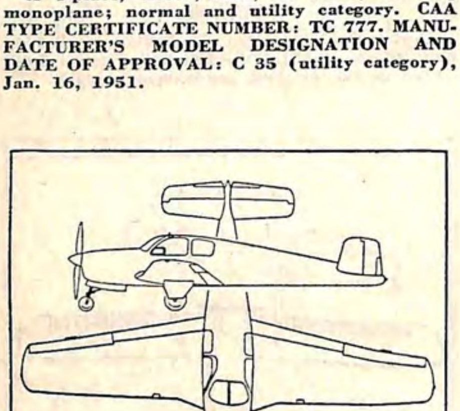


BEECH AIRCRAFT CORP.

Wichita, Kans.

Beechcraft Bonanza

A 4-place, closed, land, all metal, low-wing monoplane; normal and utility category. CAA TYPE CERTIFICATE NUMBER: TC 777. MANUFACTURER'S MODEL DESIGNATION AND DATE OF APPROVAL: C 35 (utility category), Jan. 16, 1951.



DATA

POWERPLANT: Cointinental E-185-11, 205 hp at 2,600 rpm. FUEL CAPACITM AND CONSUMPTION: 39 gal. (59 gal. with auxiliary tank). 9.5 gal. per hr. at 175 mph. OIL CAPACITY: 2½ gal. PROPELLER: Beech electrically controlled continuous variable pitch, series 215 (all metal). FLAPS: NACA slotted. GEAR: Retractable tricycle.

SPECS

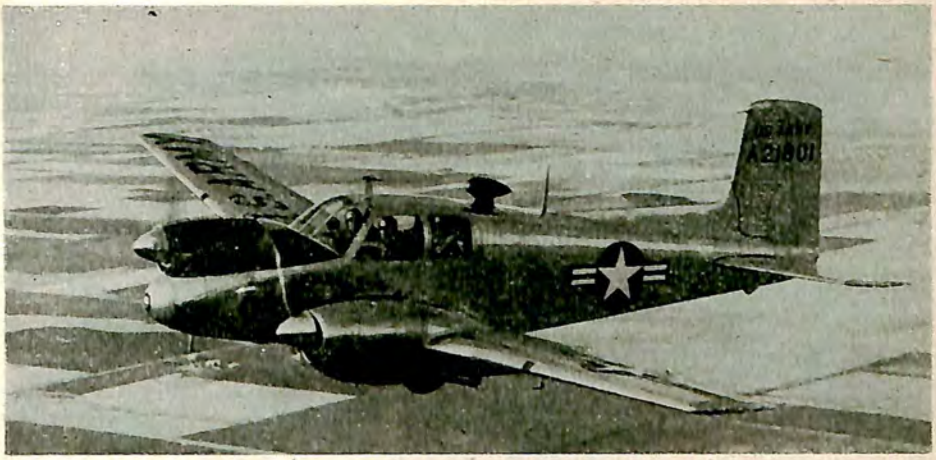
SPAN: 32 ft. 10 in. LENGTH: 25 ft. 2 in. HEIGHT: 6 ft. 6½ in. WEIGHTS: EMPTY, 1,625 lb.; GROSS, 2,700 lb.; USEFUL LOAD, 1,075 lb. WING LOADING, 15.2 lb. per sq-ft. POWER LOADING: 14.6 lb. per hp. BAGGAGE: Maximum, 270 lb.

PERFORMANCE

SPEEDS AT SEA LEVEL: MAXIMUM 190 mph; CRUISING, 175 mph at 8,000 ft., STALLING, 55 mph (with flaps). Rate of Climb: 1,100 ft. 1st min. SERVICE CEILING: 18,000 ft. RANGE: 775 mi. at 10,000 ft. at 165 mph (1180 mi. with auxiliary tank).

REMARKS

The Bonanza holds the lightplane non-stop world's distance record of 4,957.240 miles (see RECORDS). Popular with the business executive, the Bonanza has a successful feederline operational history. Over 3,400 have been manufactured.



Beechcraft Twin Bonanza

A six-place, high-performance, twin-engine, cantilever low-wing monoplane with retractable tricycle landing gear and full equipment as standard. CAA TYPE CERTIFICATE NUMBER: 5A4. MANUFACTURER'S MODEL DESIGNATION AND DATE OF APPROVAL: Model 50, May 25, 1951. FIRST FLIGHT: November 15, 1949.

DATA

POWERPLANT: Two Lycoming GO-435-C2 engines, takeoff rating 260 hp. at 3400 rmp. FUEL CAPACITY AND CONSUMPTION: 134 gal. (88 main inboard wink tanks—46 auxiliary outboard wing tanks), 22.8 gal per hr. OIL CAPACITY: 12 quarts per engine. PROPELLERS: Beechcraft Constant Speed B200-116; Beechcraft Feathering 214-101. FLAPS: NACA slotted. GEAR: Retractable tricycle.

SPECS

SPAN: 45 ft. 3.375 in. LENGTH: 31 ft. 6,468 in. HEIGHT: 11 ft. 4 in. WEIGHTS: EMPTY, 3800 lbs.; GROSS, 5500 lbs., USEFUL LOAD, 1700 lbs. WING LOADING: 19.87 lbs. per sq. ft.; POWER LOADING: 11.46 lbs. per hp. BAGGAGE: 200 lbs. maximum allowable, rear; 100 lbs. maximum allowable, forward.

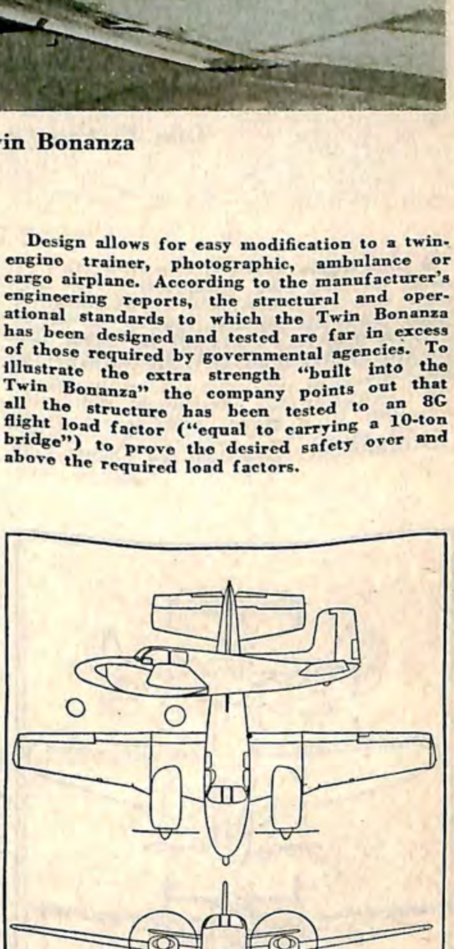
PERFORMANCE

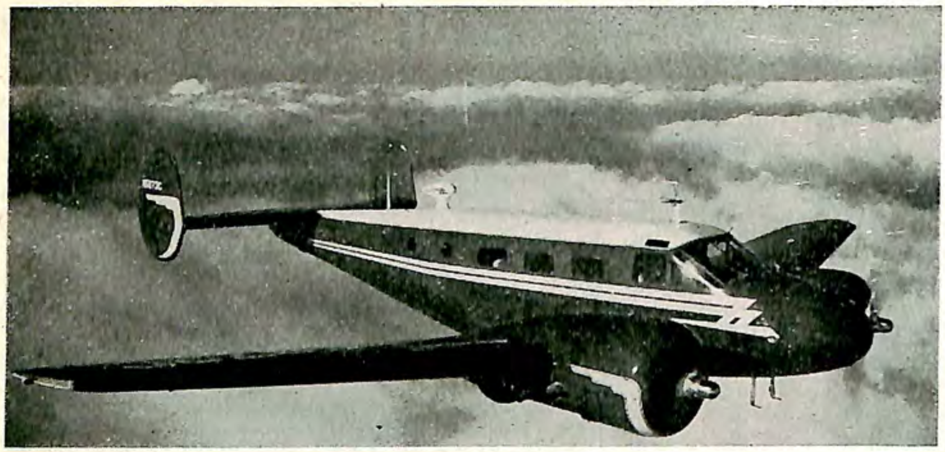
SPEED AT 2500 ft.: MAXIMUM, 202.5 mps; CRUISING, over 190 mph at 10,000 ft. at 65 percent power; STALLING, 64 mph. RATE OF CLIMB: 1500 ft. per min. SERVICE CEILING: 19,000 ft. RANGE: 1155 miles at 10,000 ft. at 50 percent power.

REMARKS

As a six-piece, high-performance, twin-engine cantilever low-wing monoplae with retractable landing gear, the Beechcraft Twin-Bonanza made its initial flight on November 15, 1949.

Design allows for easy modification to a twin-engine trainer, photographic, ambulance or cargo airplane. According to the manufacturer's engineering reports, the structural and operational standards to which the Twin Bonanza has been designed and tested are far in excess of those required by governmental agencies. To illustrate the extra strength "built into the Twin Bonanza" the company points out that all the structure has been tested to an 8G flight load factor ("equal to carrying a 10-ton bridge") to prove the desired safety over and above the required load factors.



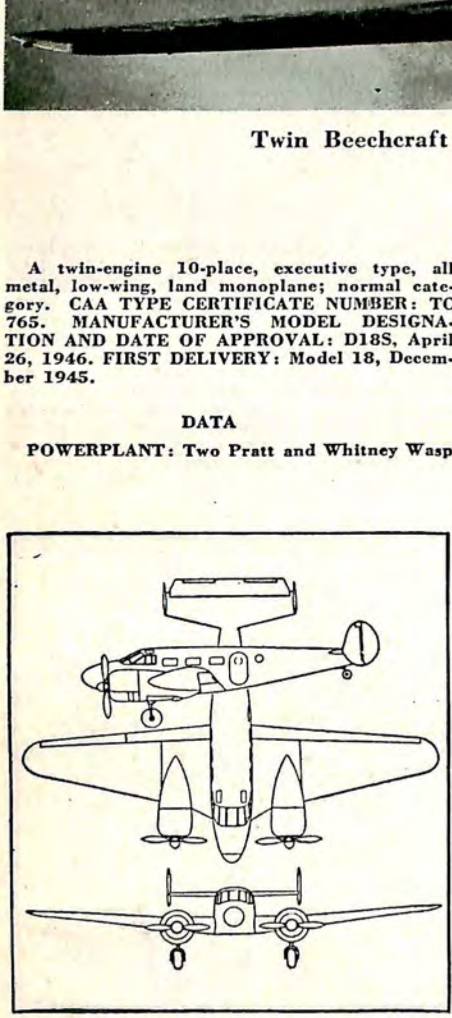


Twin Beechcraft executive transport

A twin-engine 10-place, executive type, all metal, low-wing, land monoplane; normal category. CAA TYPE CERTIFICATE NUMBER: TC 765. MANUFACTURER'S MODEL DESIGNATION AND DATE OF APPROVAL: D18S, April 26, 1946. FIRST DELIVERY: Model 18, December 1945.

DATA

POWERPLANT: Two Pratt and Whitney Wasp Jr. R-985, 450 hp at 2,300 rpm. FUEL CAPACITY AND CONSUMPTION: 206 gal.; 33 OIL CAPACITY: 17 gal. APPROVED PROPELLERS: Hamilton Standard Hydromatic 22D30. FLAPS: Plain 45 degrees. GEAR: Two wheel retractable.



SPECS

SPAN: 47 ft. 7 in. LENGTH: 33 ft. 11½ in. HEIGHT: 9 ft. 2½ in. WEIGHTS: EMPTY, 5,770 lb., hydromatic; GROSS, 8,750 lb., hydromatic; USEFUL LOAD: 2,980 lb. WING LOADING: 25.07 lb. per sq. ft. POWER LOADING: 10.92 lb. per hp.

PERFORMANCE

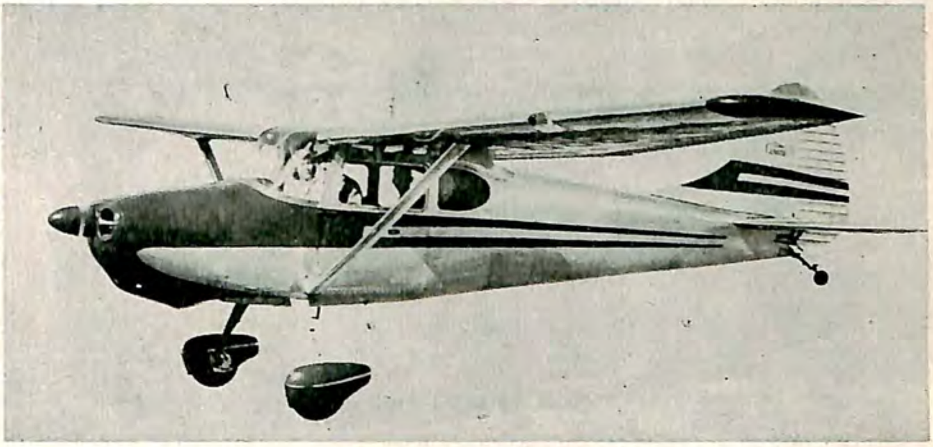
SPEEDS: MAXIMUM, 230 mps at 400 hp.; CRUISING, 211 mph at 10,000 ft. at 300 hp. RATE OF CLIMB, 1,190 ft. 1st min. (8,500). SERVICE CEILING: 20,500 ft. (8.500 lb.). RANGE: 750 to 1,500 mi. depending on fuel arrangement.

REMARKS

World-famous for its many commercial and military versions of the model 18 twin-engine transport trainer, Beech Aircraft is the world's largest producer of light transport and twin-engine trainer aircraft. More than 90 percent of the U S. bombardiers and navigators, and about 50 percent of the multi-engine pilots were trained in the more than 7,000 military versions of this model manufactured during World War II. Current commercial models have many post-wer improvements, a number of seating arrangements, and a wide selection of interior styling. More than 950 have been manufactured since V-J Day.

CESSNA AIRCRAFT CO.

Wichita, Kans.



Cessna's 1953 Model 170

A 4-plane, closed, all-metal, land or seaplane, high-wing monoplane, normal and utility category, CAA TYPE CERTIFICATE NUMBER: TC 799. MANUFACTURERS MODEL DESIGNATION AND DATE OF APPROVAL: 170B, Dec. 15, 1948.

DATA

POWERPLANT: Continental, C-145-D, 145 hp. FUEL CAPACITY AND CONSUMPTION: 42 gal., 7.5 gal per hr. OIL CAPACITY: 2 gal. APPROVED PROPELLERS: FLAPS: Slotted edge, 40°. GEAR: Fixed two-wheel, steerable tailwheel.

SPECS

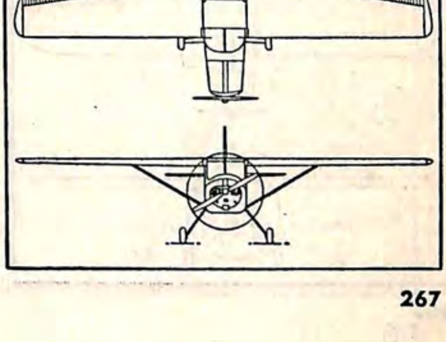
SPAN: 36 ft. LENGTH: 25 ft. HEIGHT: 6 ft. 7 in. WEIGHTS: EMPTY, 1.237 lb.; GROSS, 2,200 lb.; USEFUL LOAD, 933 lb.; MAXIMUM PAYLOAD, 691 lb. WING LOADING, 12.8 lb. per sq ft. POWER LOADING, 15.5 lb. per hp. BAGGAGE, Max. allowable 120 lbs.

PERFORMANCE

SPEEDS AT SEA LEVEL: MAXIMUM, 140 mph; CRUISING, 120 mph; STALLING, 49 (with flaps), 57 mph (without flaps). RATE OF CLIMB: 690 ft. 1st min. SERVICE CEILING 15,500 ft. RANGE: 640 mi.

REMARKS

The rear seat of the 170 can be removed in three minutes to provide added cargo space. There is a wide range of optional eqiupment including skis, seaplane floats, crosswind wheels for single strip all-wind conditions, stretcher for ambulance use, blind flight hood, spraying equipment, and provisions for oblique or vertical aerial photography and mapping. New instrument grouping on the panel, distinctive striping and elongated prop spinner are the major visible changes in the all metal four place airplane.

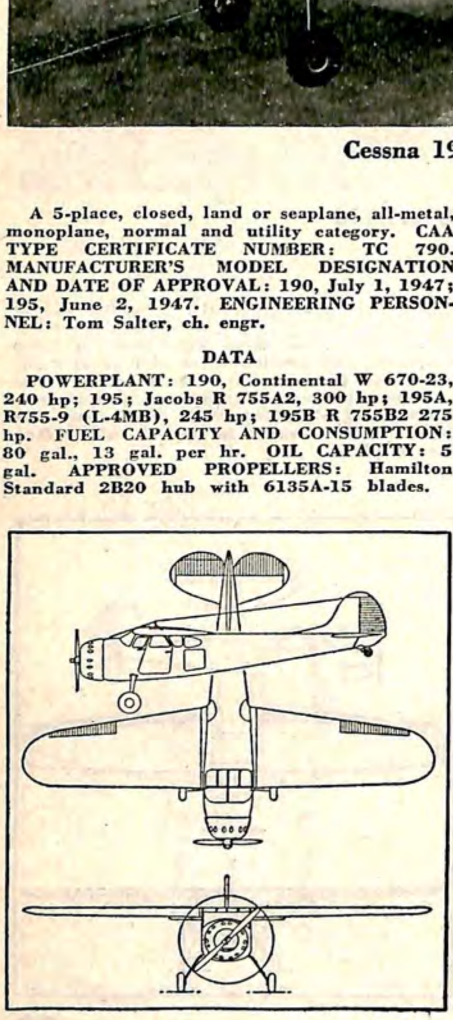


Cessna 190-195 Series

A 5-place, closed, land or seaplane, all-metal, monoplane, normal and utility category. CAA TYPE CERTIFICATE NUMBER: TC 790. MANUFACTURER'S MODEL DESIGNATION AND DATE OF APPROVAL: 190, July 1, 1947; 195, June 2, 1947. ENGINEERING PERSONNEL: Tom Salter, ch. engr.

DATA

POWERPLANT: 190, Continental W 670-23, 240 hp; 195; Jacobs R 755A2, 300 hp; 195A, R755-9 (L-4MB), 245 hp; 195B R 755B2 275 hp. FUEL CAPACITY AND CONSUMPTION: 80 gal., 13 gal. per hr. OIL CAPACITY: 5 gal. APPROVED PROPELLERS: Hamilton Standard 2B20 hub with 6135A-15 blades.



SPECS

SPAN: 36 ft. 2 in. LENGTH: 27 ft. 1 in. HEIGHT: 8 ft. WEIGHTS: EMPTY, 2,015 lb.; GROSS, 3,350 lb.; USEFUL LOAD, 1,130 lb.; MAXIMUM PAYLOAD, 810 lb. WING LEADING, 15.35 lb. per sq. ft. POWER LOADING, 13.95 lb. per hp. BAGGAGE, FULL SEATS AND TANKS: 131.5 lb.

PERFORMANCE

SPEEDS AT SEA LEVEL: MAXIMUM, 178 mph; CRUISING, 160 mph; STALLISG, 62.5 mph. RATE OF CLIMB: 1,050 ft. 1st min. SERVICE CEILING: 16,100 ft. RANGE: 750 mi.

REMARKS

The 190 and 195 are Cessna's bids for the executive type personal airplane market. Good range, roomy interior, and easy conversion to a utility model are among its qualifying features. Maintenance is claimed to be simplified by the use of a hinged mount that can be swung by removing two bolts.

195

This model is similar to the 190 with the following exceptions: LENGTH, 27 ft. 4 in.; POWERPLANT, Jacobs R755A2, 300 hp; FUEL CONSUMPTION, 15 gal. per hr.; WEIGHTS: EMPTY, 2,030 lb.; GROSS, 3,350 lb.; USEFUL LOAD, 1,115 lb.; MAXIMUM PAYLOAD, 795 lb.; POWER LOADING: 190, 13.96 lb. per hp; 195, 13.67 lb. per hp; 195A, 12.18 lb. per hp; 195B, 11.17 lb. per hp. BAGGAGE 200 lb. maximum; MAXIMUM SPEED, 181 mph; CRUISING SPEED, 165 mph. RATE OF CLIMB, 1,200 ft. 1st min.; SERVICE CEILING, 18,300 ft.

REMARKS

The armed services are using a number of these (LC-26) in air-sea rescue and bush work.

CONSOLIDATED VULTEE AIRCRAFT CORP.

San Diego, Cal.

Convair-Liner 340

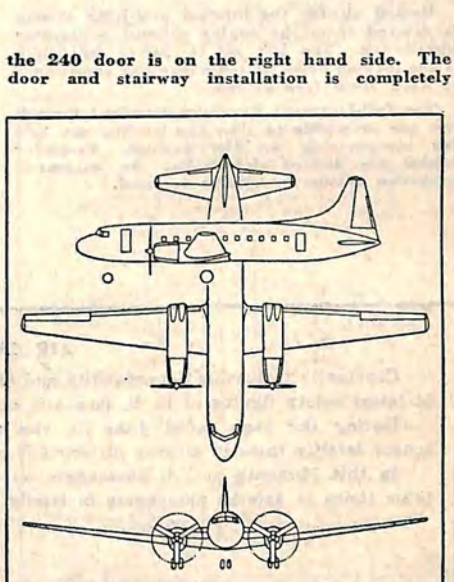
OUTSTANDING FEATURES: The pressurized Convair-Liner 340 is based on the design of the Model 240. The 340, however, is largely a new airplane, having more wing area, a longer fuselage, a higher gross weight, more powerful engines, and many interior design improvements.

A further development of the 340 was disclosed by Convair toward the end of 1952, with the announcement that a Convertible version was being offered to airlines. With a passenger capacity of 56 compared to 44 in the standard model, the Convertible offers a 27 per cent increase in payload. Installed on rails, the seats can be locked into different positions simply and quickly, providing a wide range of flexibility for carrying full loads of passengers or combination payloads of passengers and cargo.

Wingspan of the 340 is 13 ft. 7 in. greater than the 240 and wing area is 103 sq. ft. more.

Airline pilots and Convair engineers collaborated in designing the 340 flight deck. Two basic requirements for maximum safety and convenience were spaciousness and wide-angle vision.

The 340 door utilizes the same basic main-entrance door and co-acting folding stairway installed on the 240. To make the 340 more convenient for the operator, the stairway is located on the left-hand side of the plane—the 240 door is on the right hand side. The door and stairway installation is completely



hydraulic compared with the hydraulic door with air boost on the 240.

A high-pressure hydraulic system on the 340 provides power for nose-wheel steering, wing-flap operation, landing gear extension and retraction, wheel brakes, windshield wipers, main entrance door and stairway operation, and a ground blower.

The pressurization system utilizes a centrifugal type air compressor mounted on the accessory drive section of the right-hand engine. Fresh air is taken in through a ram-air inlet in the right-hand wing leading edge. It is compressed by the unit and delivered through ducting to units of the air-conditioning system where the air is modulated to the desired temperature.

The fuselage structure is designed for an ultimate differential pressure of 8.72 psi. Normal operating maximum is 4.16 psi. This pressure differential permits a sea-level cabin at an airplane altitude of 8,900 feet or a cabin altitude of 8,000 feet at an airplane altitude of 20,000 feet.

The 340's electrical system consists of a 24-28 volt single-wire installation, incorporating two 12-volt storage batteries and a generator driven by each engine.

Integral fuel tanks are designed in each wing of the 340, with a total capacity of 1750 gallons. The tanks are located between the two wing spars, outboard of the engine nacelles.

One of the unique features of the 340 powerplant installation is the use of engine exhaust augmenters which were introduced originally on the 240. Two augmenters (long tubes encased by cylindrical muffs) are located in the top of each nacelle, extending from the engine to the trailing edge of the wing.

Heated air for the thermal anti-icing system is derived from the engine exhaust augmenter installation. The hot air is ducted internally to the leading edges of the wings and empennage to keep them free of ice.

The full-featuring Hamilton Standard Propellers are reversible to slow the landing run and for maneuvering on the ground. Propeller blades are de-iced electrically. An automatic propeller feathering system is used.

The 340 is designed so that turboprop engines can be installed with a minimum of modification and expense as soon as gas turbine engines are available for commercial operation.

POWERPLANT: Two Pratt and Whitney R-2800-CB-16, two speed 18 cylinders. Take-off power (wet), 2,400 bhp at 4,000 ft. and 2,800 rpm. Take-off (dry), 2,050 bhp at 6,000 ft. and 2,700 rpm. Take-off (dry) alternate, 1,950 bhp at 8,000 ft. and 2,800 rpm. Max. continuous rating: Low blower, 1,800 bhp at 8,500 ft. and 2,600 rpm; High blower, 1,700 bhp at 14,500 ft. and 2,600 rpm. FUEL CAPACITY: 1,750 gal. APPROVED PROPELLERS: Hamilton Standard Hydromatic, 3 blades, automatic full-feathering and reversible; diameter 13 ft. 1 in.

WINGSPAN: 105 ft. 4 in. WING AREA: 920 sq. ft. LENGTH: 79 ft. 2 in. HEIGHT: 28 ft. 2 in. WEIGHTS: GROSS, 47,000 lb.; EMPTY, 28,850 lb. USEFUL LOAD: 18,150 lb.

PERFORMANCE: Maximum speed, 314 mph. Cruising speeds at 20,000 ft. with 1,200 bhp/ENG and 45,000 lb., 284 mph. RANGE: 1,260 mi. with 45,000 lb. and 1,500 lb. fuel reserve. SERVICE CEILING: 26,000 ft. TAKEOFF: 4,675 ft. at sea level and 47,000 lb. RATE OF CLIMB: 1,220 ft. per min. at sea level and 46,725 lb. FUEL CONSUMPTION: 208 gal. per hr. at normal power.

PRODUCTION on orders for approximately 175 Convair-Liner 340's is steadily increasing at Convair's San Diego plant. At the end of 1952, more than 22 airlines had ordered 340's, bringing total operators of Convair-Liner 240's and 340's to about 35. More than 30 transports were delivered during 1952. United Air Lines has ordered 50, the largest number purchased by one airline. Other purchasers include: Braniff Airways, Inc., Chicago & Southern Air Lines, Continental Air Lines, Delta Air Lines, Hawaiian Airlines, Mid-Continent Airlines, National Airlines, Northeast Airlines, Pioneer Air Lines, Aero O/Y (Finland), Aeronaves des Mexico. Avensa (Venezuela), Cia. Mexicana de Aviacion, Garuda Indonesian Airways, KLM Royal Dutch Airlines, Philippine Airlines, Servicos Aereos Cruzeiro Do Sul (Brazil), Jugoslovenski Aerotransport, Arabian- American Oil Co., The Texas Co., and Pratt & Whitney.

AIR SAFETY

Constantly increasing dependability and efficiency of modern air transports is reflected in latest safety figures of U. S. domestic scheduled airlines.

During the year ended June 30, the carriers recorded one of the lowest passenger fatality rates in airlines history (.79 per 100 million passenger miles).

In this 12-month period, passengers on domestic schedule airlines were more than three times as safe as passengers in family automobiles.

Planes,
May, 1952

DOUGLAS AIRCRAFT CO., INC.

Santa Monica, Cal.

Douglas DC-6B transport

CAA TYPE CERTIFICATE AND DATE: TC 6A4, Apr. 11, 1951.

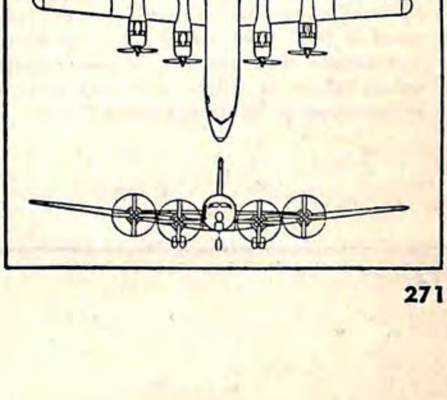
OUTSTANDING FEATURES: All of the proven features and systems of the basic DC-6, with a number of improvements are incorporated in the subsequent DC-6B version. Cabin pressurization is increased, in some models, to 25,000 ft. flight altitude with 8,000 ft. cabin altitude pressure. Increased flow of cabin air also is available at customer option. Interior configuratins range from 44 passenger luxury sleeperettes to 89 passenger high density planes.

ENGINEERING PERSOSNEL: Edward F. Burton, chief engineer; J. R. McGowen project engineer.

NOTES: First step in the evolution of the DC-6B was the prototype DC-6A Liftmaster, designed to carry either commercial or military cargoes. Fuselage of the standard DC-6 was lengthened five feet, gross weight increased to 100,000 lbs. and horsepower of the engines raised correspondingly. After flight testing and demonstrating the cargo configuration, it became apparent that the same aircraft with passenger interior accommodations would be an attractive airiner with passenger-mile operating costs even lower than the DC-6. Since January, 1951, DC-6Bs have been ordered by 17 airlines.

FLIGHT CREW: Pilot, co-pilot, flight engineer on domestic flights. Navigator and radio operator added for over-water operations.

POWERPLANT: Four Pratt and Whitney R-2800CB-16. HP at take-off, 2,400 BPH each (with CB17, 2500 BHP with water and 115 octane fuel). Normal rated power, 1,800 BHP each. **NORMAL FUEL CAPACITY:** 4,248 to 5,530 gal. **OIL CAPACITY** 140 gal. **PROPELLER:** Hamilton Standard reversible. **WING SPAN:** 117 ft. 6 in. **LENGTH:** 105 ft. 7 in. **HEIGHT:** 28 ft. 8 in. **GEAR:** Fully retractable tricycle using two sets of dual-type main wheels mounted aft of the center of gravity, and a steerable nosewheel. **WEIGHTS:**



Maximum take-off gross weight, 100,000 lb. with CB16 engines. (107,000 lb. with CB17 engines and auto-feather props); structural design landing gross weight, 85,000 b. to 88,200 lb. WING LOADING (Gross weight, 100,000 lb.): 68.4 lb. per sq. ft. (Gross weight 107,000 lb.) 74 lb. per sq. ft. POWER LOADING (Take-off power at 100,000 lb): 10.4 lb. per BHP.

PERFORMANCE: Maximum cruise power, high blower, 1,200 BHP, 323 mph. with a gross of 85,000 lb. at 22,700 ft.; 315 mph. with a gross of 90,000 b. at 22,400 ft.; and 284 mph with a gross of 101,300 lb. at 21,200 ft. Sixty percent sea level maximum continuous power at 10,000 ft.; 284 mph with 85,000 lb.; 279 mph with 90,000 lb. and 284 mph with 10,000 lb. TAKEOFF C.A.R. FIELD LENGTH: Sea level without water injection, 85,000 lb., 4,400 ft.; 90,000 lb., 5,140 ft. Sea level with water injection, 85,000 lb., 3,130 ft.; 90,000 lb., 3,600 ft.; 10,000 lb., 5,550 ft. LANDING, C.A.R. FIELD LENGTH at 85,000 lb.: Sea Level, 4,995 ft.; at 5,000 lb., 5,710 ft. SERVICE CEILING: 27,100 ft. with 85,000 lb. RANGE: 4,000 mi. with 4,248 gal. or 5,450 mi. with 5,530 gal.

DC-6B's delivered to date: American Airlines, Arabian American Oil Co., Pan American World Airways, Pan America Grace Airways, Phillipine Airlines, Royal Dutch Airlines (KLH), Scandinavian Airlines system, Swissair, United Air Lines.

DC-6B's on order: Alitalia, Canadian Pacific Airlines, Compania Mexicana de Aviocion, Continental Airlines, Inc., Linee Aeree Italiane, Sabena, Transports Aeriens Intercontinentaux DuHaroc, National Air Lines, and Western Air-Lines.

The DC-6A (Navy ;D-1—SFC-118A) is similar to the DC-6B with the following exceptions: The airplane is primarily manufactured as a cargo airplane having a payload of 30,150 pounds and a cargo space of 5,000 cu. ft. It has a forward as well as aft cargo door to permit simultaneous unloading and loading operations. The forward door is 91" long x 67" high, and the aft door is 124" long x 78" high. The interior has cargo tie-down points on a 20" grid pattern in the floor and also tiedown rings in the wall of the cabin. The cabin is pressurized to provide an 8,000 ft. cabin altitude at 20,000 ft. flight altitude. Temperatures are controllable from 40 deg. F to 85 deg. F for perishables.

Military versions being delivered for the Navy and the Air Force also include convertible features permitting their use as troop transports or hospital airplanes accomodating approximately 78 persons.

Commercial operators who have LC-6A's on order are: American Air Lines, Flying Tigers, Pan American World Airways, Royal Dutch Airlines (KLM). Sabena, Canadian Pacific Air Lines, and Slick. Deliveries have already been made to Slick Air Ways.

Power plant, detail specifications, and performance identical to DC-6B.

AVIATION QUOTES

"The threat represented by the air power of the Soviet Union has brought about an important change in this country's concept of defense. "We realize today that weakness invites aggression." We have learned that lesson the hard way. . .

"One thing is certain—we are faced with a situation that we have faced twice before in our lifetime. We were not properly prepared in 1917, and we were equally unprepared in 1941. Then, unlike today, we were a relatively safe distance from our enemies. But despite that, our lack of preparedness cost us an excess of a million lives and untold billions of dollars. Our very survival as a nation now depends upon our instant preparedness to resist aggression."

—GEN. CURTIS E. LeMAY,
Commanding General,
USAF Strategic Air Command,
June 22, 1952.

LOCKHEED AIRCRAFT CORP.

Burbank, Cal.

Lockheed Super Constellation

The Lockheed Super Constellation is the latest member of a four-engine transport family born ten years ago. It has been described as the airliner that will bridge the transition gap between piston and jet flight and is the first transport using new, more powerful compound engines. Lockheed aimed the Models 1049C (130,000 lbs.) and 1049E (133,000 lbs.) Super Constellations to carry more payload at faster speeds over greater distances at less cost than any other transport.

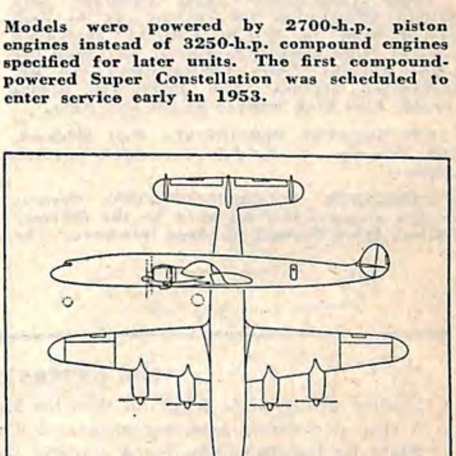
Twenty-one airlines are or soon will be equipped either with Constellations or Super Constellations along with the U.S. Air Force and Navy. Military services also use earlier Constellations for both transport and special radar purposes.

Other members of Lockheed's transport family include the Lodestar (1939) and Electra (1943). The Super Electra became the British Hudson bomber in 1938, the same year Lockheed introduced the P-38 Lightening fighter.

Lockheed aircraft date back to 1912. Among most famous models were the Vega (1927) and X-35 (1936), first pressurized plane to fly successfully in the substratosphere.

Design on the original Constellation was started in 1939. The first model, still owned by Lockheed, flew January 9, 1943. During World War II it became the C-69 military transport.

First flight of a production model of the Super Constellation was on July 14, 1951. First Models were powered by 2700-h.p. piston engines instead of 3250-h.p. compound engines specified for later units. The first compound-powered Super Constellation was scheduled to enter service early in 1953.



Present Constellation operators also flying or waiting delivery of Super Constellations include Eastern Far Lines, Air France, KLM Royal Dutch Airlines, Qantas Empire Airways Ltd., Lineas Aeropostal Venezolana, Air-India International, Trans World Airlines and Aerovias Nacionales de Colombia.

Other airlines ordering Super Constellations include Seaboard & Western Airlines Pakistan International Airlines, Trans Canada Air Lines, Braathens South American & Far East Airtransport and Iberia Lineas Aereas Espanolas.

Constellations are in use by British Overseas Airways Corp., Pan American Airways, South African Airways, Chicago and Southern Air Lines, Capital Airlines, California-Hawaii Airlines, El Al Israel Airlines and Panair do Brasil.

More than 210 Constellations are now in service. With 24 Super Constellations now operating, total orders stand in excess of 90 (as of late 1952.)

The Super Constellation will accommodate from 47 to 99 passengers. Military versions will carry 106 and crew of 4. Model 1049B Super Constellations are freight models, with payload capacity of 34,700 pounds trans-Atlantic and 37,000 pounds domestic. Its cost per ton mile is estimated at less than 5 cents. Main cargo compartment is 84 feet long, total cargo volume 5,690 cubic feet. It has cargo doors fore and aft.

The crew for domestic service includes pilot, co-pilot and flight engineer; in overseas operations, navigation and radio personnel, besides relief flight personnel, may be added.

Super Constellations first equipped with Wright C18CA1 or CB engines can be converted later to Wright C18DA1 compound engines (with exhaust turbines). Lockheed has plans whereby Super Constellations can use turbo-prop engines. Two turbo-prop planes already have been ordered by the U.S. Navy.

ENGINEERING PERSONNEL: Hall Hibbard, V.P., Engrng., C. L. Johnson, chief research engineer.

PASSENGER ACCOMMODATIONS: Various seating arrangements are used by the different airlines flying Constellation-type transports. The latest commercial Super Constellations designed call for a minimum of 47 seats and a maximum of 99; military transports can carry up to 110. Super Constellations are pressurized to maintain 5,000 ft. pressure at 20,000 crusing altitude. The new aircraft contain improved heating and refrigeration equipment.

FREIGHT FEATURES: Passenger Super Constellations will have 65 percent more cargo capacity than their companion Constellations. They will have 424 cu. ft. in the lower aft compartment and 269 cu. ft. forward. Constellations have 280 cu. ft. aft and 154 cu. ft forward.

SPECS

FLIGHT CREW: In domestic operations, pilot, co-pilot, and flight engineer; in overseas operations, a navigator-radio operator is added; on certain long-range flights, additional relief crew members are carried.

POWERPLANT: Some Super Constellations are designed to have Wright Cyclone C18CA1 engines with 2.700 hp, all will be convertible to Wright Turbo-Cyclone C18DA1 engines, specified for original installation on later models. These engines will have: FUEL CAPACITY: 6.507 gal. APPROVED PROPELLERS: Hamilton Standard 6903A. WING SPAN: 123 ft. LENGTH: 113.5 ft. HEIGHT 24.7 ft. GEAR: Tricycle, fully retractable steerable nosewheel.

WEIGHTS: EMPTY, standard interior, 68.642 lb.; GROSS: 130.000 lb. USEFUL LOAD: 61,358 lb. MAXIMUM PAYLOAD, approximately 23,750 lb. WING LOADING: 78.8 lb. per sq. ft. POWER LOADING: 10.0 lb. per hp.

PERFORMANCE

Speeds: MAXIMUM, 374 mph at 19,000 ft. CRUISING: 320-340 mph at 20,000 ft. STALLING SPEED: 94 mph at sea level. RATE OF CLIMB: 1,195 ft. per minute at sea level and maximum gross. TAKEOFF: 1,930 ft. LANDING: Over 50 ft. obstacle to a full stop, 3,180 ft. SERVICE CEILING: 27,600 ft. fully loaded. RANGE: 5,020 miles.

PRODUCTION: Manufacture of Constellation-type transport has been continuous since 1943. Commercial and military orders assure uninterrupted production at least through mid 1954.

THE GREEKS ON AIR POWER

Nothing can be more delightful than the having wings to wear!
A spectator sitting here, accommodated with a pair,
Might for instance (if he found a tragic chorus dull and heavy)
Take his flight, and dine at home; and if he did not choose to leave ye,
Might return in better humor, when the weary drawl was ended.
Introduce then wings in use—believe me, matters will be mended.

—From "The Birds," a play by Aristophanes, born 450 B. C., reprinted in U. S. AIR SERVICES, April, 1931.

THE GLENN L. MARTIN AIRCRAFT CO.

Baltimore, Md.

Martin 4-0-4, medium range transport

TYPE: Transport. **DESIGNATION:** 4-04.

DATA

POWERPLANT: Two Pratt & Whitney R-2800 CB16. **FUEL CAPACITY:** 1,350 gal. **PROPELLERS:** Hamiton Standard, 3 blade reversible. **GEAR:** Tricycle.

SPECS

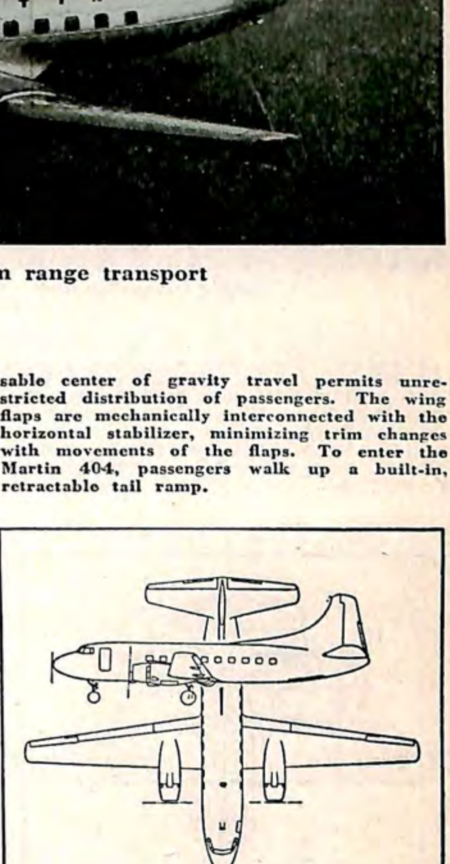
SPAN: 93 ft. 3 in. **LENGTH:** 74 ft. 7 in. **HEIGHT:** 28 ft. 6 in. **WEIGHTS:** TAKEOFF GROSS, 44,900 lb.; LANDING, 43,000 lb. **MAXIMUM PAYLOAD:** 11,592 lb.

PERFORMANCE

SPEEDS: MAXIMUM, 312 mph; CRUISING at 18,000 ft. and 12,000 bhp, 280 mph. STALLING, 81 mph. **ALTITUDES:** Maximum, 29,000 ft.; single engine, 10.400 ft. **TAKEOFF DISTANCE:** 1980 ft. **RANGE:** 1080 mi (operational).

REMARKS

The Martin 4-0-4 is a pressurized twin-engine transport airplane designed especially for short and medium distance service. Spaciousness, in terms of wide aisles, roomy seats and large windows, characterize the passenger cabin—which, besides pressurization, has sound-proofing and air conditioning on the ground as well as while airborne. Great stability and excellent all-round flight characteristics have been emphasized in the airframe design. A large permissable center of gravity travel permits unrestricted distribution of passengers. The wing flaps are mechanically interconnected with the horizontal stabilizer, minimizing trim changes with movements of the flaps. To enter the Martin 404, passengers walk up a built-in, retractable tail ramp.

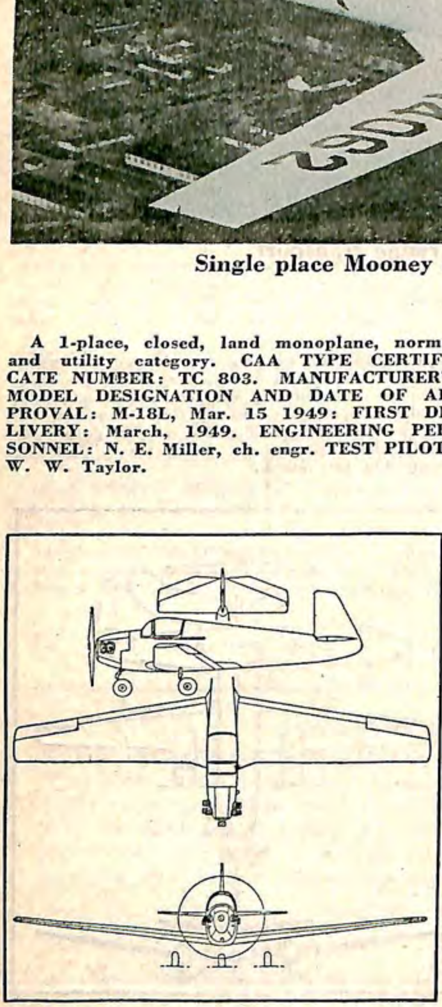


MOONEY AIRCRAFT, INC.

Wichita, Kans.

Single place Mooney features low operating cost

A 1-place, closed, land monoplane, normal and utility category. CAA TYPE CERTIFICATE NUMBER: TC 803. MANUFACTURER'S MODEL DESIGNATION AND DATE OF APPROVAL: M-18L, Mar. 15 1949: FIRST DELIVERY: March, 1949. ENGINEERING PERSONNEL: N. E. Miller, ch. engr. TEST PILOT: W. W. Taylor.



DATA

POWERPLANT: Lycoming or Continental, 65 hp. FUEL CAPACITY AND CONSUMPTION: 11 1 gal. APPROVED PROPELLERS: Sensenich Models 66CB-54 and 66CB-52 FLAPS: Slotted, 16½ degrees. GEAR: Tricycle retractable.

SPECS

SPAN: 26 ft. 10½ in. LENGTH: 17 ft. 7¼ in. HEIGHT: 6 ft. 2½ in. WEIGHTS: EMPTY, 500 lb.; GROSS, 780 lb.; USEFUL LOAD, 280 lb. WING LOADING, 8.2 lb. per sq. ft. POWER LOADING, 12 lb. per hp. BAGGAGE, FULL SEATS AND TANKS: 40 lb.

PERFORMANCE

SPEEDS AT SEA LEVEL: MAXIMUM, 138 mph; CRUISING, 125 mph; STALLING, 40 mph. RATE OF CLIMB: 1,090 ft. 1st min. SERVICE CEILING: 19,400 ft. RANGE: 390 mi.

REMARKS

300 flying hours covering approximately 36,000 miles for $674.00 which includes fuel, oil, maintenance, and insurance is claimed by the manufacturer. This figures out to about 2c per mile. The Mooney line is now complete including Model M-18LA with Lycoming engine, Model M-18C with Continental power. The Deluxe model of each includes starter, generator and position lights.

Manufacturer will sell airframe only if desired.

PIPER AIRCRAFT CORP.

Lock Haven, Pa.

Latest Cub

A 2-place, closed, land or sea, high-wing monoplane. CAA TYPE CERTIFICATE: TC 1A2. MANUFACTURER'S MODEL DESIGNATION AND DATE OF APPROVAL: PA-18, Nov. 18, 1949. There were two models of the 1952 Super Cub, 95 and 125, the agricultural model.

DATA

POWERPLANT: (95) Continental, 90 hp; (125) Lycoming 0-290-D 108 hp. FUEL CAPACITY: 18 gal. 36 gal. optional.

SPECS

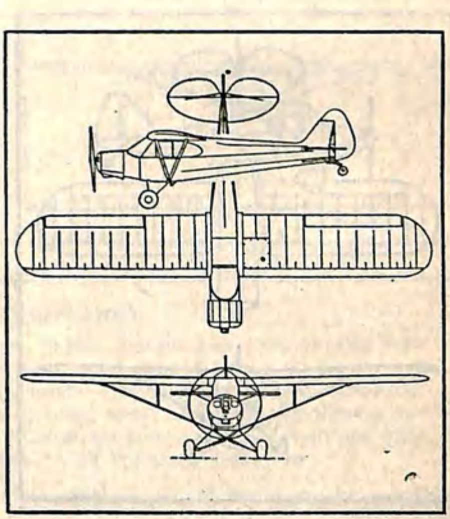
SPAN: 35.3 ft. LENGTH: 22.4 ft. HEIGHT: 6.7 ft. WEIGHTS: EMPTY (95) 800 lb.; (125) 845 lb.; GROSS: 1,500 lb. USEFUL LOAD: (95) 700 lb.; (125) 655 lb., WING LOADING: 8.4 lb per sq. POWER LOADING: (95) 16.6 lb. per hp.; (125) 12 lb. per hp.

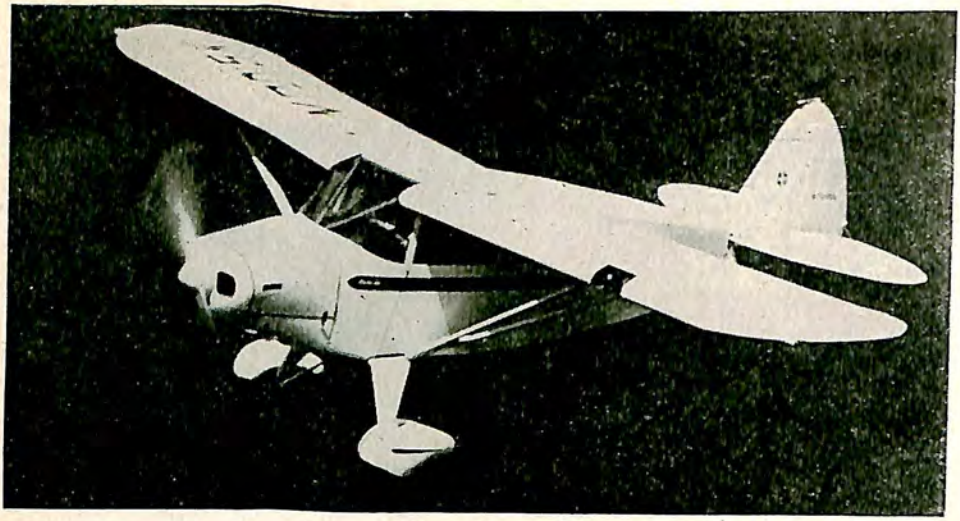
PERFORMANCE

SPEED: MAXIMUM (95) 110 mph; (125) 123 mph; CRUISING: (95) 100 mph; (125) 108 mph; STALLING: (95) 42 mph; (125) 38 mph. RATE OF CLIMB: (95) 624 ft. per min.; (125) 870 mph. SERVICE CEILING: (95) 13,500 ft.; (125) 17,100 ft. CRUISING RANGE: (95) 360 mi.; (125) 250 mi.

REMARKS

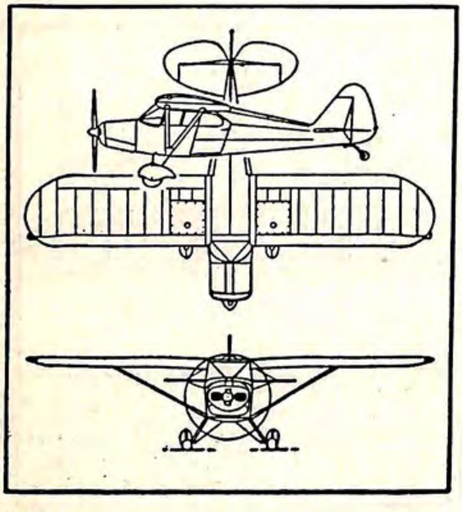
The Super Cub models for 1952 were designed for a number of jobs among them dusting and spraying, small field operations and patrol work. The 125 can leave the ground after a run only six times its fuselage length. With full flaps, it can be slowed down to 33 mph. A square center-section eliminates cross tubing for more headroom, and behind the rear seat there is a cargo hold measuring 10 cu. ft. entirely free of structure which can be enlarged to 18 cu. ft. by removing the rear seat. The army designation is L-21.





Piper Pacer

A 4-place, closed, land high-wing monoplane, normal category. CAA TYPE CERTIFICATE NUMBER: TC 1A4. MANUFACTURER'S MODEL DESIGNATION AND DATE OF APPROVAL: PA-20 Dec. 21, 1949. PA-22 (Tri-Pacer) Dec. 20, 1950.



DATA

POWERPLANT: Lycoming 0-290-D2 135 hp. FUEL CAPACITY AND CONSUMPTION: 36 gal. 7.7 gal. per hr. OIL CAPACITY: 2 gal. APPROVED PROPELLERS: Either an Aeromatic or Sensenich controllable pitch. GEAR: Fixed two wheel, steerable tailwheel. Tri-Pacer has steerable nosewheel.

SPECS

SPAN: 29.3 ft. LENGTH: 20.4 ft. HEIGHT: 74 5 in. WEIGHTS: EMPTY. 975 lb., 1,005 (Tri--Pacer); Gross: 1,950 lb.; USEFUL LOAD: 975 lb., 945 lb., (Tri-Pacer). WING LOADING: 13.2 lb. per sq. ft. POWER LOADING: 14.4 lb. per hp. BAGGAGE: 50 lb.

PERFORMANCE

SPEEDS AT SEA LEVEL: MAXIMUM, 135 mph; CRUISING, 125 mph, 123 mph (Tri-Pacer) STALLING, 48 mph (with flaps). RATE OF CLIMB: 800 ft. per min. SERVICE CEILING: 15,500 ft.

REMARKS

The Piper Pacer for 1952 came in two models, one with conventional gear and the other—the Tri-Pacer—with steerable nosewheel. The Pacers are available in three different models—Standard, Custom and Super Custom. The Super Custom Tri-Pacer, in addition to the deluxe furnishings listed for the Pacer, comes equipped with a Lear L-2 autopilot with automatic altitude control and direction finder. Addition of a nosewheel has cut about 2 mph from the performance of the conventional Pacer, otherwise the general performance and specifications are about the same.

TAYLORCRAFT, INC.

Conway, Pa.

Taylorcraft Sportsman

A 2-place, closed land and sea high-wing monoplane. CAA TYPE CERTIFICATE: TC 696.

DATA

POWERPLANT: Continental, 85 hp. FUEL CAPACITY AND CONSUMPTION: 24 gal., 5 gal. per hr. OIL CAPACITY: 1 gal. APPROVED PROPELLER: Sensenich or McCauley. GEAR: Fixed, steerable tailwheel.

SPECS

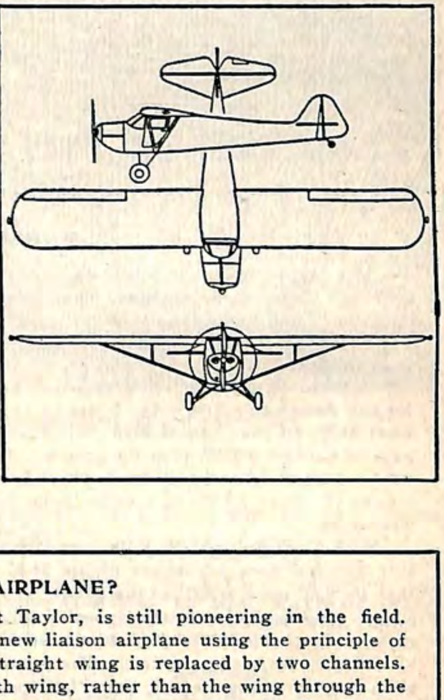
SPAN: 36 ft. LENGTH: 22 ft. HEIGHT: 6 ft. 6 in. GROSS WEIGHT: 1.500 lb. WING LOADING: 8 lb. per sq. ft. POWER LOADING: 17.5 lb. per bhp.

PERFORMANCE

SPEEDS: MAXIMUM, 120 mph; CRUISING, 110 mph. RATE OF CLIMB: 700 ft. 1st min. RANGE: 300 mi.

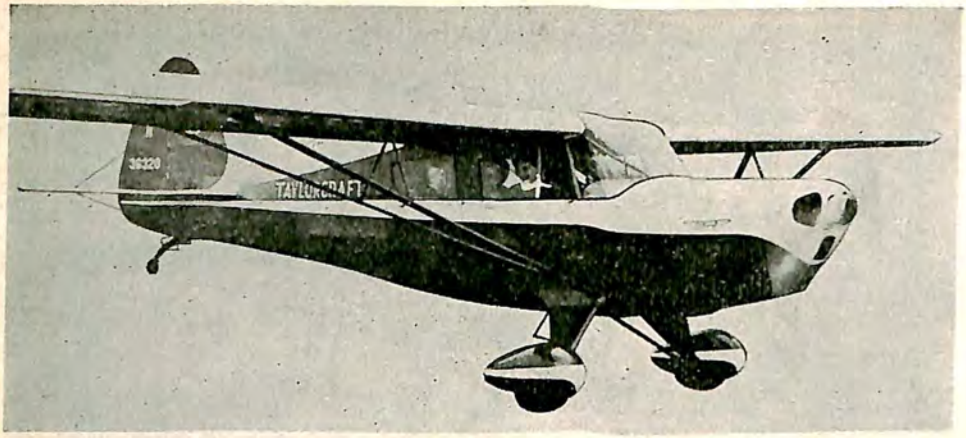
REMARKS

The Sportsman comes in three different models: Standard, Custom Deluxe and Special Deluxe.



EVERYMAN'S AIRPLANE?

The "father" of the lightplane, C. Gilbert Taylor, is still pioneering in the field. He has announced plans for development of a new liaison airplane using the principle of the Custer Channel Wing in which th usual straight wing is replaced by two channels. The propellers operate to pull the air through th wing, rather than the wing through the air. Taylor believes that this new principle is as revolutionary as flight itself and forecasts a new era in which "Everyman's airplane" will become a reality.



Taylorcraft 4-place Tourist

A 4-place, closed land and sea high-wing monoplane. CAA TYPE CERTIFICATE: TC 3A3.

DATA

POWERPLANT: Continental, 145 hp. FUEL CAPACITY AND CONSUMPTION: 40 gal., 8.5 gal. per hr. OIL CAPACITY: 2¼ gal. GEAR: fixes, steerable tailwheel.

SPECS

SPAN: 36 ft. LENGTH: 24 ft. HEIGHT: 7 ft. 1 in. GROSS WEIGHT: 2,200 lb. USEFUL LOAD: 925 lb. WING LOADING: 11.8 lb. per sq. ft.

PERFORMANCE

SPEEDS: MAXIMUM, 125 mph; CRUISING, 115 mph; LANDING, 36 mph (with flaps). RATE OF CLIMB: 700 ft. per min. RANGE: 500 mi.

REMARKS

Standard equipment includes starter, wheel pants and position lights. Optional equipment is available.

PRE-WRIGHT PROSPERITY

Aviation, aided by the invention of the balloon, was hardly a reality before economics became a major hazard. Purses were puny in the old days, the public fickle and parsimonious. Equipment was expensive, fragile and treacherous. Even Jean Pierre Francois Blanchard, who made spectacular money early in his career, was more often broke than solvent.

On Nov. 30, 1784, he set a tidy rate for passengers, charging Dr. Jeffries some $500 for the American's first ride. It lasted 81 minutes, or over $6.71 a minute. Jeffries paid some $3,500 for his Channel flight, but Blanchard picked up most of the prizes. Louis XVI gave him about $60,000, plus the promise of $6,000 a year for life. Discounting the annuity, which stopped when Louis went out of business in 1792, Blanchard could still add up an income of about $64,000 in a little more than a month, but less than a decade later he was broke.

Most of Philadelphia's 50,000 population turned out for his historic flight of Jan. 9, 1793, but few took advantage of his $2-$5 ringside tickets. Blanchard complained later that he lost some $1,500 on the event, which cost him $2,500. He failed to recoup when he set up an exhibit—"wicked people" stood beyond the reach of his cashier and threw rocks at his balloon. By June of the same year, desperate, he staged a parachute jump by a dog, a cat, and a squirrel. The jump was a success—but was witnessed, according to a contemporary report, by "few paying, but a vast concourse of non-paying spectators."

MILITARY

The following list of military aircraft includes, so far as possible, only those in production during the year. All material for this section, including pictures and 3-view drawings has been compiled from data supplied from the military or manufacturers.

BELL AIRCRAFT CORP.

HELICOPTER DIVISION

Fort Worth, Tex.

Bell H-12 can carry eight combat-equipped infantrymen

TYPE: Helictoper. DESIGNATION: (AF) H-12B.

DATA

POWERPLANT: Pratt & Whitney R-1340-55, 600 hp at takeoff. FUEL CAPACITY: 121 gal. (normal), 200 gal. (overload). OIL CAPACITY: 14 gal. GEAR: Fixed 4 wheel.

SPECS

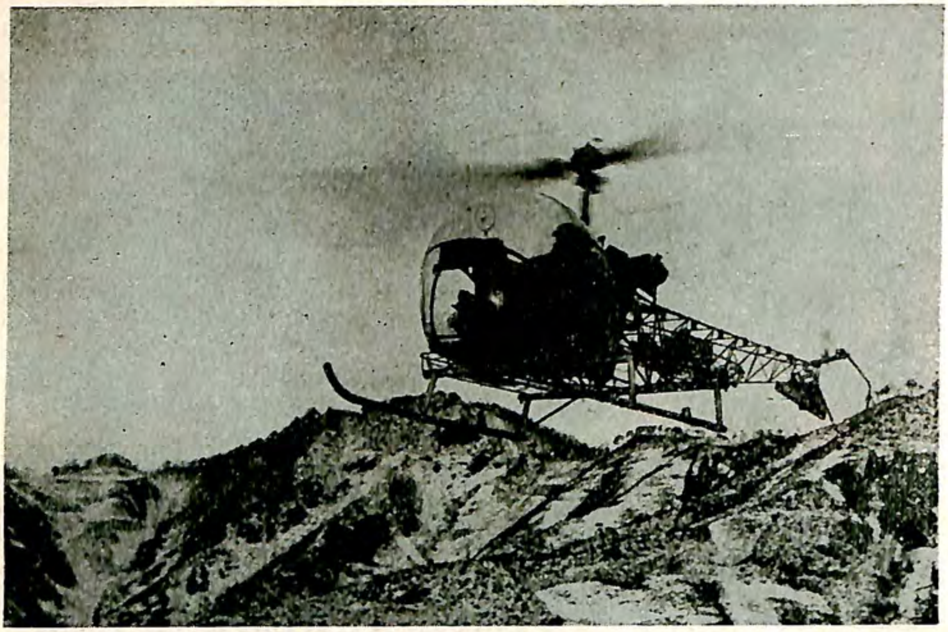
MAIN ROTOR DIAMETER: 47.5 ft. ANTI-TORQUE ROTOR DIAMETER: 8.5 ft. LENGTH: 58.8 ft. HEIGHT: 14.3 ft. WEIGHTS: EMPTY, 4,674 lb.; GROSS, 6,513 (normal), 6,800 (overlaoad). USEFUL LOAD: 1,839 lb. DISC LOADING: 36.8 lb. POWER LOADING: 12.36 lb. per bhp.

PERFORMANCE

SPEEDS AT SEA LEVEL: MAXIMUM, 120 mph; CRUISING, 85 mph. RATE OF CLIMB FULLY LOADED: 900 ft. per min. SERVICE CEILING: 10,000 ft. RANGE: 300 mi.

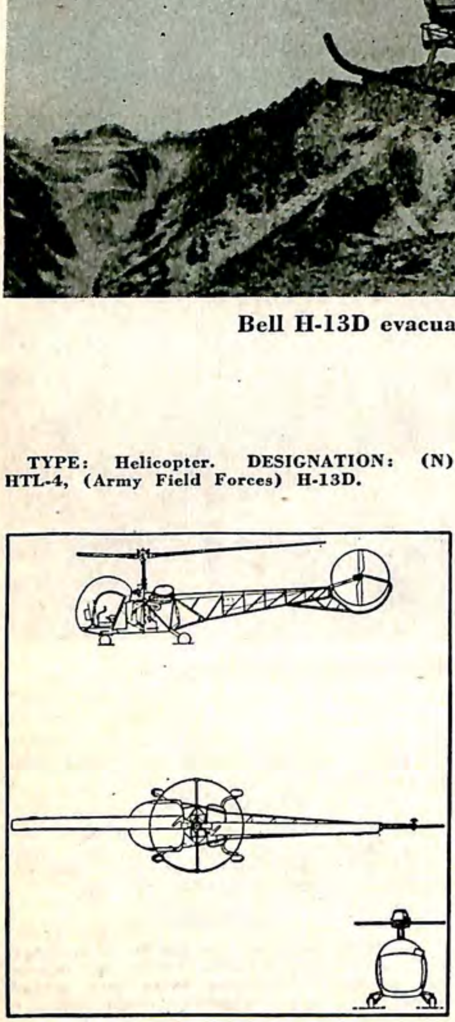
REMARKS

The H-12, built for the Air Force can carry eight fully equipped combat troops into forward line position. Unloading takes four seconds through the large removable cargo doors. In production for U. S. Air Force.



Bell H-13D evacuating Korean wounded

TYPE: Helicopter. DESIGNATION: (N) HTL-4, (Army Field Forces) H-13D.



DATA

POWERPLANT: Franklin 6V4-178-B32, 178 hp. FUEL CAPACITY: 29 gal, OIL CAPACITY: 2 gal. GEAR: Four-wheel type or twin floats.

SPECS

MAIN ROTOR DIAMETER: 35 ft. 1½ in. ANTI-TORQUE ROTOR DIAMETER: 5 ft. 9 in. LENGTH: 41 ft. 5 in. WEIGHTS: EMPTY, 1,442 lb.; GROSS, 2,204 lb.; USEFUL LOAD, 782.5 lb.; MAXIMUM PAYLOAD, 656 lb. ROTOR DISC LOADING: 2.31 lb. per sq. ft. POWER LOADING: 11¼ lb. per bhp.

PERFORMANCE

SPEEDS AT SEA LEVEL: MAXIMUM, 90 mph; CRUISING, 76 mph. RATE OF CLIMB FULLY LOADED: 1,000 ft. per min. SERVICE CEILING: 13,000 ft. RANGE: 160 mi.

REMARKS

Standard Bell design available as commercial model but is furnished Navy as HTL-4 and Army Field Forces as H-13D equipped for training, rescue, 5-place evacuation, liaison, observation, instrument training, 4-place assault and light cargo missions.

BOEING AIRPLANE COMPANY

Seattle, Washington

Boeing B-50 Superfortress

TYPE: Medium Bomber. DESIGNATION: (AF) B-50D.

DATA

POWERPLANT: Four Pratt and Whitney R-4360, 3,500 hp each at takeoff. PROPELLERS: Curtiss Electric 4-blades fully reversible full feathering GEAR: Tricycle retractable. Tractor treads have been used to test operations from unimproved landing fields.

SPECS

SPAN: 141 ft. 3 in. LENGTH: 99 ft. HEIGHT: 32 ft. 9 in. GROSS WEIGHT: 164,000 lb. BOMB LOAD: Over 28,000 lb.

PERFORMANCE

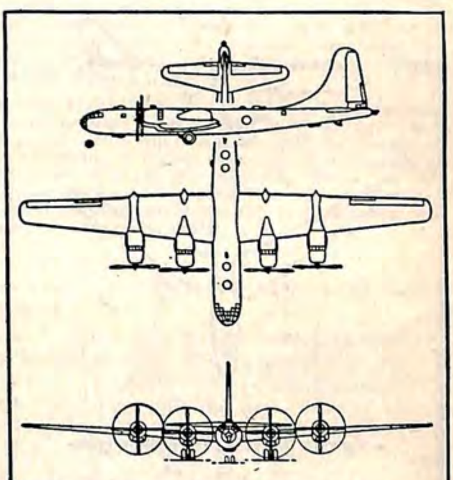
SPEEDS: MAXIMUM, over 400 mph; CRUISING SPEED, approximately 300 mph, SERVICE CEILING: Over 30,000 ft. RANGE: 4,000 mi. with 20,000 lb. bomb load.

REMARKS

Since the first one, models have included the B-50B which is the same as the A except for a stronger wing; B-50C, redesignated B-54 (later cancelled), the B-50D and the B-50H.

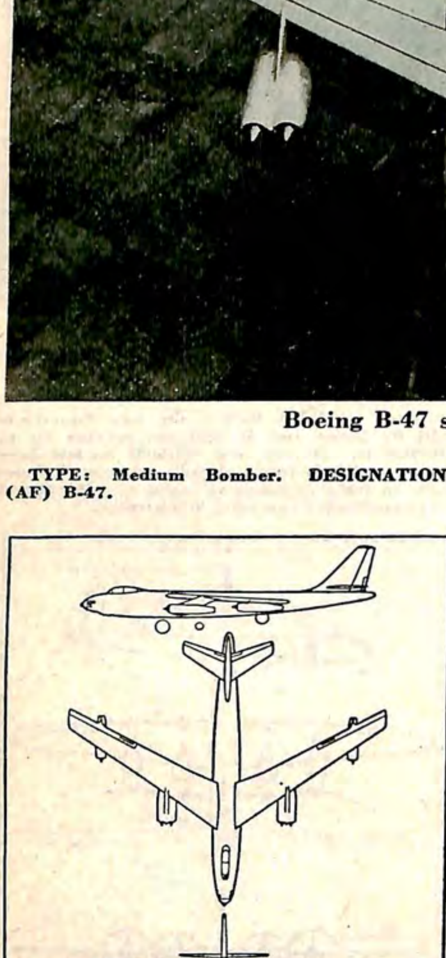
The chief difference between D and earlier models is the provision for installing either a 700 gallon droppable wing tank or 4,000 pound bomb beneath each wing. Each B-50D has been equipped as a receiver airplane under the new Boeing "Flying Boom" aerial refueling system.

The Air Force received delivery on the first modified RB-50B April 27, 1950. This model is equipped as a photographic and weather reconnissance "laboratory." Designed to handle the same missions previously taken care of by similarly modified B-29's, the new Superforts will fly faster and at altitudes ranging up to 40,000 ft. TB-50D and TB-50H models have been modified from already completed bombers to train crewmen to serve as triple-threat navigator-radar operator, bombardier.



Boeing B-47 swept-wing bomber

TYPE: Medium Bomber. DESIGNATION: (AF) B-47.



DATA

POWERPLANT: Six General Electric J-47 turbo-jets, each rated at 5,800 lb. thrust. **GEAR:** Dual main wheels in tandem with a single outrigger under inboard pod. All are retractable.

SPECS

SPAN: 116 ft. **LENGTH:** 108 ft. **HEIGHT:** 28 ft. **GROSS WEIGHT:** Over 185,000 lb. **NORMAL BOMB LOAD:** Over 20,000 lb.

PERFORMANCE

MAXIMUM SPEED: "600 mph class." **SERVICE CEILING:** Over 35,000 ft. **RANGE:** More than 3,000 miles.

REMARKS

The first XB-47 flight took place December, 1947, two years after work had started on the project. Among the features of the B-47 are the thin flexible wing which has a drooped appearance on the ground which changes to a slight dihedral in flight. Pilot, co-pilot and navigator-bombardier make up the crew, with the pilot and co-pilot riding tandem. On Feb. 8, 1949 a Stratojet set an unofficial transcontinental speed record of 3 hr., 46 min. from Moses Lake AFB, Wash. to Andrews Field, Md. averaging 607.8 mph. First production model, B-47A, was completed Mar. 1, 1950. Current B-47B was announced May 4, 1952. All other data are classified.

CESSNA AIRCRAFT CO.

Wicthita, Kans.

Cessna L-19A for Army Field Forces

TYPE: Liaison. DESIGNATION: L-19A. (Army).

DATA

POWERPLANT: Continental, 0-470-11, 190 hp, 104 mph; OBSERVATION, 46 mph. TAKE- at 2,600 rpm. FUEL CAPACITY: Two 21 gal. wing tanks.

SPECS

SPAN: 36 ft. LENGTH: 25 ft. HEIGHT: 7.5 ft. WEIGHTS: EMPTY, 1,448 lb.; GROSS: 2,100 lb. WING LOADING: 12.1 lb. per sq. ft. POWER LOADING: 11.05 lb. per hp.

PERFORMANCE

SPEEDS: CRUISING at 5,000 ft. using 29% hp, 104 mph; OBSERVATION, 46 mph. TAKE-OFF: Over a 50 ft. obstacle on a sod field, 560 ft. LAND: Over a 50 ft. obstacle on a sod field, 600 ft. RATE OF CLIMB: Sea level, 1,290 ft. per 1st min. SERVICE CEILING: 22,900 ft. ENDURANCE: With 20 gal. fuel, 3.1 hr.

REMARKS

Early in June, 1950 Cessna came out the winner in the Army Field Forces' observation reconnaissance competition, with the first order amounting to 400 planes. This has been followed by a steady stream of orders for this model. The evaluation program was divided in two parts; one at Wright-Patterson AFB for a technical evaluation by the Air Force, and the other by the Army Field Forces at Fort Bragg for the Service testing.

The L-19A Bird Dog is all-metal, has a wide door opening and ample rear cockpit and baggage space that can be used for stretcher installation. Cruising speed up to 145 mph at optimum altitude are claimed. Flaps are the high-lift type and extend rearward as they are lowered. Maximum flap travel is 60 degrees. All other data are classified.

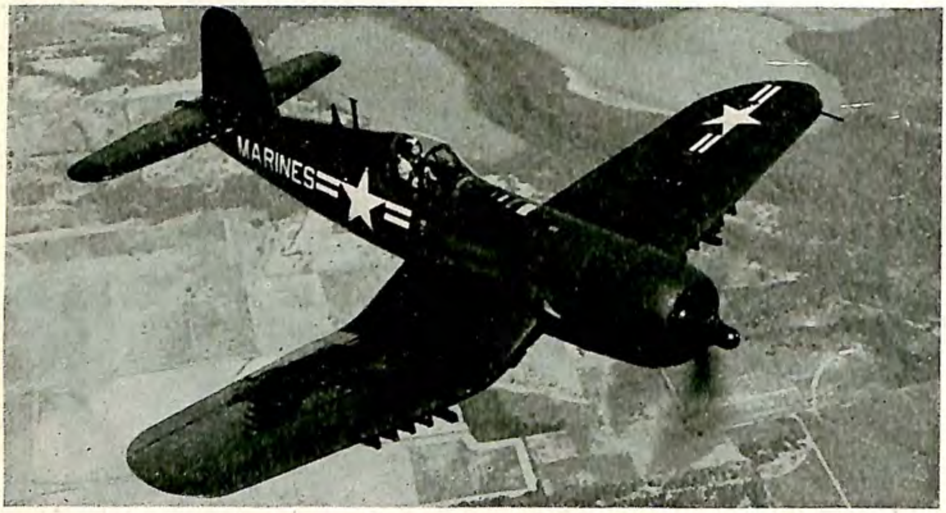
EARLY LESSON

The Army liaison airplane had its beginning in 1940 when several heavy, complex experimental types were procured for as much as $50,000 each. The following year the personal aircraft industry proved in Army maneuvers in Louisiana that "Off the shelf" production models could do the safe job at less than one-tenth the cost. More than 10,000 standard lightplanes served the armed forces throughout the world during World War II.

CHANCE VOUGHT AIRCRAFT

DIVISION OF UNITED AIRCRAFT CORP.

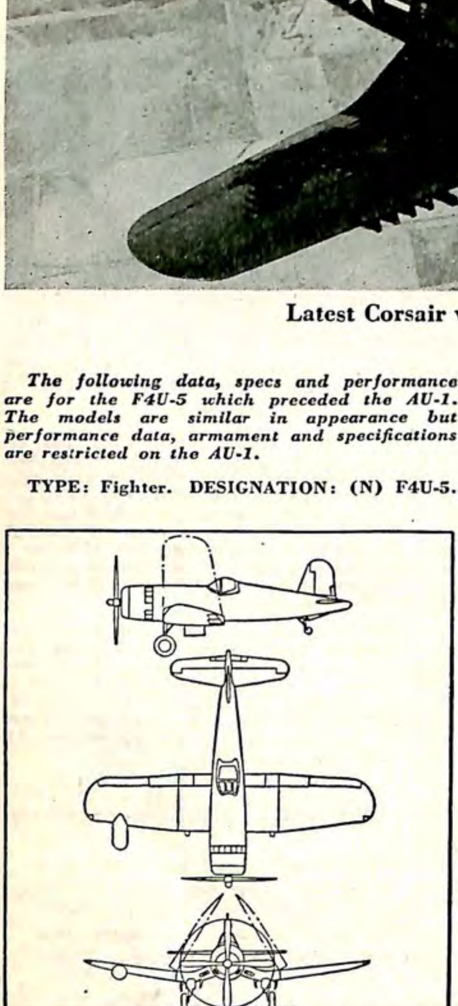
Dallas, Tex.



Latest Corsair version, The AU-1

The following data, specs and performance are for the F4U-5 which preceded the AU-1. The models are similar in appearance but performance data, armament and specifications are restricted on the AU-1.

TYPE: Fighter. DESIGNATION: (N) F4U-5.



DATA

POWERPLANT: Pratt and Whitney R-2800-32W, 2,300 hp at takeoff. FUEL CAPACITY: 234 gal. OIL CAPACITY: 33 gal. PROPELLER: Hamilton Standard, FLAPS: Slotted, 50 degree travel. GEAR: Conventional retractable.

SPECS

SPAN: 40 ft. 11¾ in. LENGTH: 34 ft. 6¼ in. HEIGHT: 14 ft. 9½ in. WEIGHTS: EMPTY. 10,099 lb.; GROSS, 13,297 lb.; USEFUL LOAD, 3,198 lb. WING LOADING, 42.35 lb. per sq. ft. POWER LOADING, 8.86 lb. per bhp.

PERFORMANCE

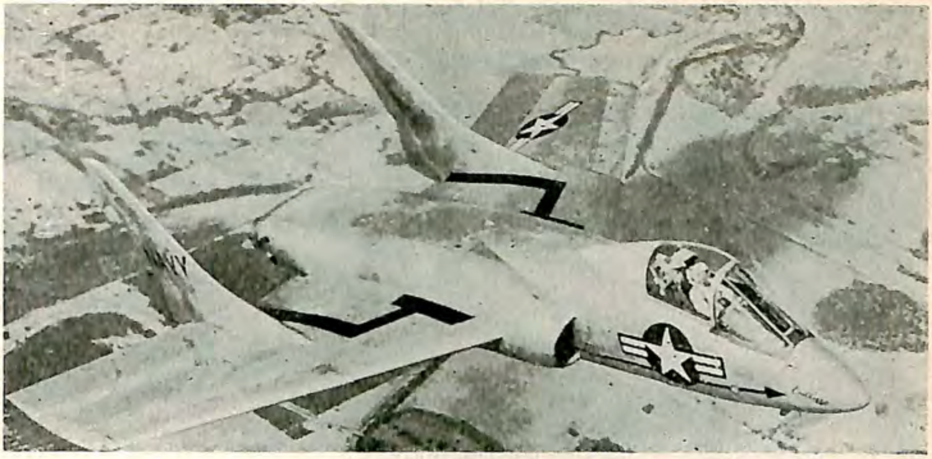
SPEEDS AT SEA LEVEL: MAXIMUM, 379 mph; CRUISING, 227 mph; STALLING, 110 mph. RATE OF CLIMB: 4,340 ft. per min. SERVICE CEILING: 41,100 ft. RANGE: 1,270 mi.

REMARKS

The Chance Vought Corsair series are the oldest fighter-bomber airplanes still being built in the United States. During 1952, seven versions of the Chance Vought Corsair were seeing action with the U. S. Navy and U. S. Marine Corps in Korea.

Latest versions of the Corsair are the AU-1 and the F4U-7, built for the French Navy under provision of the Mutual Defense Assistance Pact.

The Chance Vought AU-1 Corsair, an airplane similar in external appearance to the Chance Vought F4U-5 and designed as an answer to the close air support of ground troops in Korea, made its initial flight in January, 1952. All other data are classified.



Carrier based twin-jet Cutlass

TYPE: Fighter. DESIGNATION: (N) F7U-3.

DATA

POWERPLANT: Two Westinghouse J46-WE-2 turbo jets. GEAR: Tricycle, retractable.

REMARKS

Chance Vought Aircraft's twin-jet F7U-3 Cutlass went into quantity production in 1952.

A larger, better-equipped and harder-hitting version of the original F7U-1, the first swept-back-wing, tailless fighter to operate from an aircraft carrier, the new Cutlass was built to give the U. S. Fleet a fast shipboard fighter offering superior high altitude performance, a greater rate of climb and greater range.

Having established in the F7U-1 that the sweptback-wing tailless configuration was efficient, Chance Vought's engineers concentrated in the F7U-3 on increasing the performance and range of the earlier version. In addition to its greater range, the F7U-3 packs a heavier armament punch.

Althout it is a larger airplane than the F7U-1, there has been relatively little modification. Its top speed is cloaked by security regulations but it gets upstairs faster and has control features offering maximum maneuverability.

The F7U-3 has a dual hydraulic power control system "all the way," rather than a single power control system with a separate manual control system. Each system is completely independent of the other, offering a maximum of reliability.

The engineers went all out to provide ease of maintenance, aiming to reduce to a minimum the amount of time the fast fighter will have to spend on the deck.

The cockpit in particular was improved and large access doors on the outside of the fuselage in the console area permit work to be performed in the consoles without getting into the cockpit. Other access doors are located opposite the rudder pedals. All consoles are removable as units. The electronics and gun compartments are easily accessible.

Engine servicing procedure calls for aft removal rather than through engine access doors in the bottom of the fuselage, as in the F7U-1. The new system is expected to save engine change time.

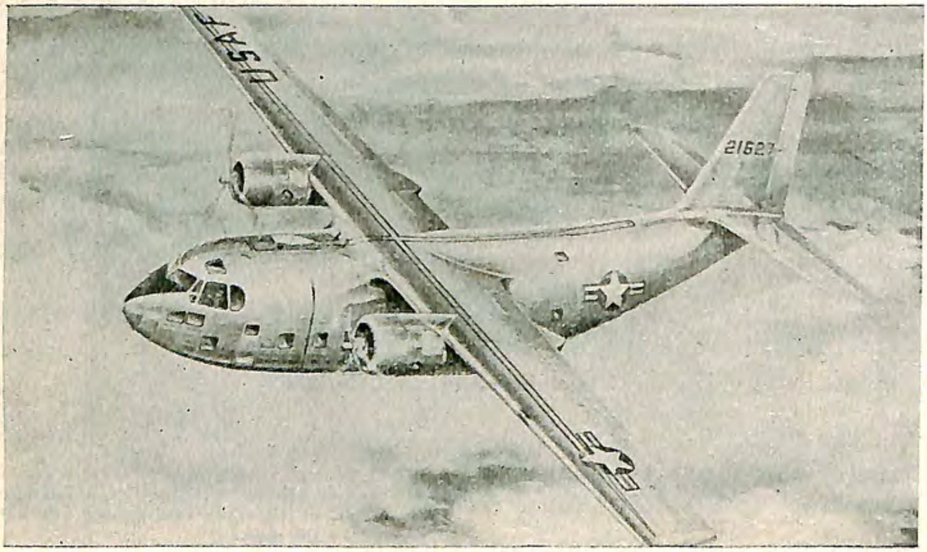
The greater weight of the F7U-3 involved a switch to a heavier nose landing gear with dual wheels. The arresting hook installation has been simplified considerably.

The Cutlass design incorporates two vertical stabilizers and rudders at the trailing edge of the wing. "Ailavators," combined ailerons and elevators, provide longitudinal and lateral control. Leading edge wing slats replace the conventional landing flaps to attain the low stalling speed essential for carrier-based aircraft.

The first production model of the F7U-1 Cutlass flew from Hensley Field March 1, 1950, as the culmination of years of development and flight testing of experimental models. Deliveries of the Navy followed. The first flight of the F7U-3 took place December 20, 1951. All other data are classified.

CHASE AIRCRAFT CO., INC.

West Trenton, N. J.

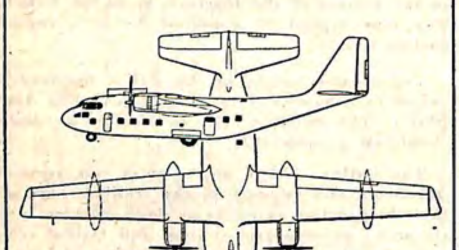


Chase troop cargo C-123B

TYPE: Cargo. DESIGNATION: (AF) C-123B.

DATA

POWERPLANT: Two Pratt & Whitney R-2800-52W, 2,300 hp each. PROPELLERS: Hamilton Standard, constant speed, full feathering, reversible 3 blades, 15 ft. 6 in. diam. FLAPS: Slotted, 60 deg. travel. GEAR: Tricycle, retractable.



SPECS

SPAN: 110 ft. LENGTH: 77 ft. 1 in. HEIGHT: 34 ft. 1 in. WEIGHTS: EMPTY, 29,906 lb.; DESIGN GROSS, 52,600 lb.; DESIGN USEFUL, 22,694 lb.; MAXIMUM USEFUL LOAD, 41,000 lb., WING LOADING, 43 lb. per sq. ft. POWER LOADING, 11.2 lb. per bhp.

PERFORMANCE

SPEEDS: MAXIMUM, 255 mph; CRUISING, 215 mph; STALLING, 75 mph. RATE OF CLIMB: 1,150 ft. per min. SERVICE CEILING: 25,000 ft. RANGE: (normal) 2,200 mi., (ferry) 4,700 mi.

REMARKS

Normal load of the C-123 is sixty-one fully equipped troops or 16,000 lb. of cargo. It has been successfully tested for evacuation and has carried fifty litter patients, twenty ambulatory patients and six medical attendants at one time.

Equipped with the integral hydraulically operated ramp and cargo door, it reduces to a minimum, time required for loading and unloading. Special loading demonstrations conducted by the Army showed that a 155 mm howitzer and ¾-ton truck as prime mover, can be completely loaded and tied down in less than two minutes. The same cargo can be unloaded in as little as one minute. All other data are classified.

CONSOLIDATED VULTEE AIRCRAFT CORP.

San Diego, Cal.

Convair RB-36H 10-engine bomber for the Air Force

TYPE: Heavy bomber. DESIGNATION: (AF) B-36D.

DATA

POWERPLANT: Six Pratt and Whitney pusher-type, R-4360-25, 3,500 hp each. "D" and "E" series also have four General Electric J-47 jets, 5,200 lb. static thrust each. These replace the Allison J-35-19 first used on the B-36. FUEL CAPACITY: 21,116 gal. carried in integral fuel tanks within the main wing box spar. OIL CAPACITY: 1,200 gal. PROPELLERS: Six Curtiss Electric, reversible, 3-bladed, 19 ft. diameter. GEAR: Tricycle, dual-wheel nose gear, 4-wheel truck main gear.

SPECS

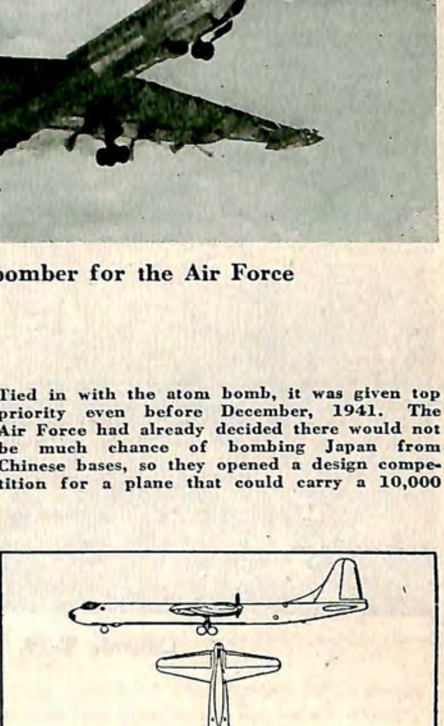
SPAN: 230 ft. LENGTH: 162 ft. HEIGHT: 46 ft. 9 in. WEIGHTS: MAX. GROSS, approx. 358,000 lb. WING LOADING, 58.3 lb. per sq-ft. POWER LOADING, 15.4 lb. per hp.

PERFORMANCE

MAXIMUM SPEED: Over 435 mph (AF figure). SERVICE CEILING: over 45,000 ft. RANGE: 10,000 mi. with 10,000 lb. bomb load. DESIGN BOMB LOAD: 10,000 lb. MAXIMUM BOMB LOAD: 84,000 lb.

REMARKS

The world's largest bomber, the B-36 Peacemaker, was designed to get anywhere and back. Tied in with the atom bomb, it was given top priority even before December, 1941. The Air Force had already decided there would not be much chance of bombing Japan from Chinese bases, so they opened a design competition for a plane that could carry a 10,000



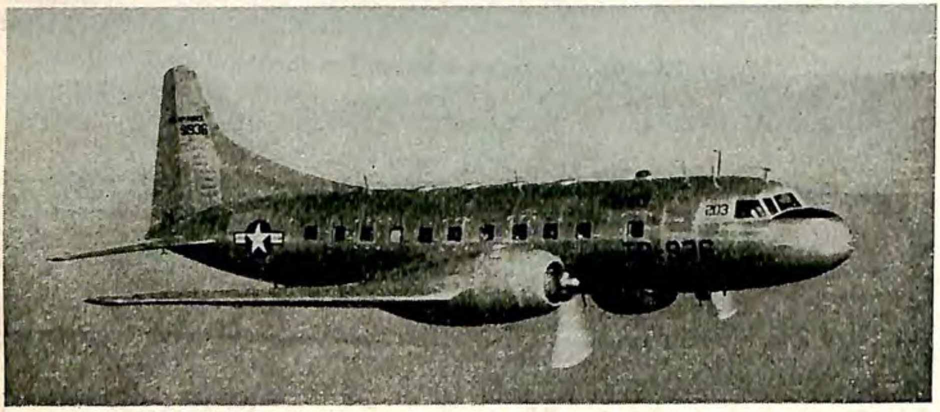
lb. bomb load, 10,000 miles. Consolidated won out with the Peacemaker. Later in the war, when Pacific bases were captured for use by B-29's, the B-36 lost its top priority rating.

This held up the first procurement contract until Aug. 19, 1944, which called for 100 B-36's. Two years later, on Aug. 8, 1946, the XB-36 made its first flight. The first production model, the YB-36, first flew Dec. 4, 1947. Both the A and B models showed up well in tests, and it was decided to continue the program. On Dec. 5, 1947, the AF approved the B-36C program. This series was to have tractor props instead of the pushers, in hope of raising top performance to over 400 mph. Inadequate cooling at altitude, and the interference to the airfoil by having six breaks on the leading edge of the wing, led to cancellation before the first plane was built. Emphasis is now on the D series, which uses four jet engines arranged in pods of two each on either wing outboard of the piston engines. The jets are cut in only on takeoff, or when increased speed is needed. Their use shortens the takeoff run to 3,500 ft., a saving of over 1,500 ft.

The plane has a pressurized nose and tail section which are connected by a pressurized tunnel. The 15 crew members can get back and fourth by pulling themselves along on a dolly in the passage. There are four bomb bays. A load of 10,000 lb. for a long mission is normal, but this can be upped to 84,000 lb. if the mission is short. Most of the guns are remotely controlled by the latest in electronic devices.

In June, 1950, RB-36 deliveries got under way. This new model is in the D series with modifications for reconnaissance work. It carries 14 cameras in the forward bomb bay including one with a 48 inch focal length. A modification program for all operational B-36's was handled by Convair in 1952, following conversion of B-36B's to the D model by adding four jet engines.

The latest B-36 production model, the B-36F, also got into production during the year. The major modification was the installation of Pratt & Whitney R-4630-50 engines increasing takeoff power per engine to 3,800 each. Production was on the F models during the year. All other data are classified.



Convair T-29, "Flying Classroom"

TYPE: Trainer. Designation: (AF) T-29B.

DATA

POWERPLANT: Two Pratt and Whitney R-2800-97, 2,400 hp each. FUEL CAPACITY: 1,500 gal. PROPELLERS: Hamilton Standard 3-blade, full featherign and reversible.

SPECS

SPAN: 91 ft. 9 in. LENGTH: 74 ft. 8 in. HEIGHT: 26 ft. 11 in. GROSS WEIGHT: 43,575 lb.

PERFORMANCE

SPEEDS: MAXIMUM 295 mph at 13,500 ft.; CRUISING, 247 mph at 20,000 ft.; STALLING, 92 mph. Endurance: 6.4 hr. at cruising. RATE of CLIMB: 20,000 ft. in 17.5 min. SERVICE CEILING: 23,500 ft.

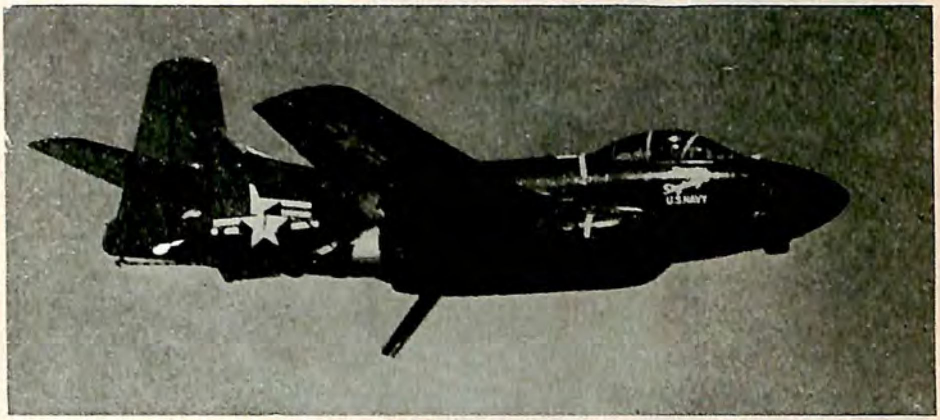
REMARKS

Dubbed the "Flying," Classroom," the T-29B is a modified version of the Convair 240 Convair Liner. It is used as a navigational bombardier trainer and carriers 14 students plus instructors and crew. Radar training equipment provides for three students with instructors. Other special equipment includes three astrodomes, 18 antennas and standard radar unit under the fuselage. The T-29B is pressurized.

A fleet of C-131A air evacuation transports, based on design of the T-29B, was ordered by the Air Force in 1952 . . . Various arrangements of litters and seats can be installed. First deliveries will be made in 1953.

DOUGLAS AIRCRAFT CO., INC.

Santa Monica, Cal.



Twin-jet Skyknight by Douglas

TYPE: Fighter. DESIGNATION: (N) F3D.

DATA

POWERPLANT: Two Westinghouse J-34 (24C). GEAR: Nose-wheel type.

REMARKS

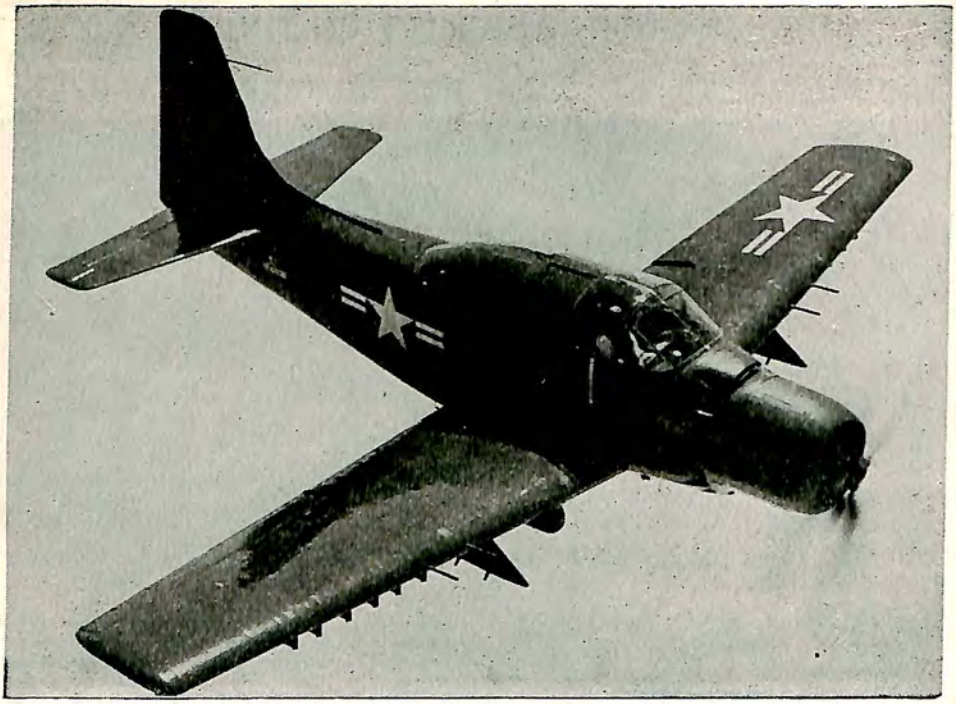
Preliminary design was begun on this two-place monoplane in Sept. 1945, and on Mar. 23, 1948, it made its first flight. During 1949 and 1950 it went into full scale production at Douglas' El Segundo Division.

The F3D Skynight is a carrier-based jet night fighter with advanced radar equipment embodying features of search, automatic gun-firing and tail warning aids. Flight tests with the F3D have demonstrated that interception of bombers in daytime or at night in all kinds of weather at altitudes of over 40,000 feet is practical with this airplane. This model can fly at high speeds for great distances, and at high altitudes, making it adaptable as an attack-fighter, long-range patrol or reconnaissance airplane or as a long-range escort fighter.

A special system of cockpit lighting to prevent glare is used. All instrument letters and numbers are etched in transparent lucite on panels lighted from the rear with a red light. Emergency pilot escape is by an underside bail-out chute similar to a slide fire escape. Speed brakes are hydraulically operated and extend outward from the fuselage just forward of the tail. All other data are classified.

SEEING EYE

During World War II a storm at sea was welcomed by surface vessels for it meant that they could carry out their operations without fear of detection by enemy aircraft. The Japanese Navy particularly took careful advantage of bad weather by carrying out their largest Naval attacks and beach landing under cover of storms while U. S. Navy carrier pilots sat disconsolately in their war rooms. But all of this will be changed in any future war with the development of all-weather carrier combat aircraft, such as the Douglas F3D *Skyknight*. This compact, rugged fighter will leave its carrier deck in the stormiest of weather safe in its thousands of pounds of special radar and communication equipment which will permit it to navigate to the enemy, detect and destroy him and come back to the carrier without the dread fear of the carrier pilot; being lost at sea. The two-man crew of the *Skyknight* is seated side-by-side so that both may observe the various radar scopes simultaneously, rather than the old arrangement of the radar operator transmitting instuctions to the pilot. The F3D carries a heavy load of fuel for long-range operations and a full complement of 20 mm cannon, bombs and rockets for offensive operations.

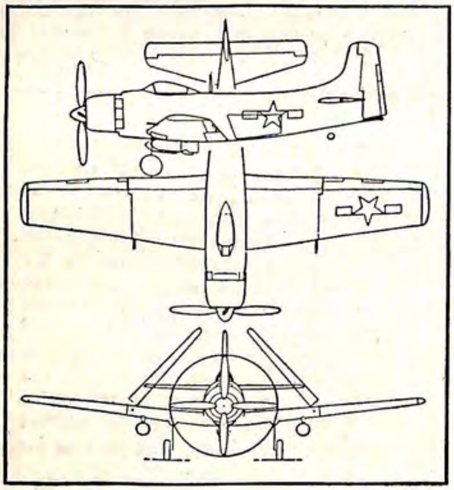


Douglas Skyraider, multi-purpose attack plane

TYPE: Attack. **DESIGNATION:** (N) AD.

DATA

POWERPLANT: One Wright Aero Corp. R3350-26W, 2,700 hp at takeoff and 2,900 rpm. **FUEL CAPACITY:** 350 gal. with provisions for two 150 gal. drop wing-tip tanks. **PROPELLER:** Aeroproducts. **GEAR:** Conventional retractable.



SPECS

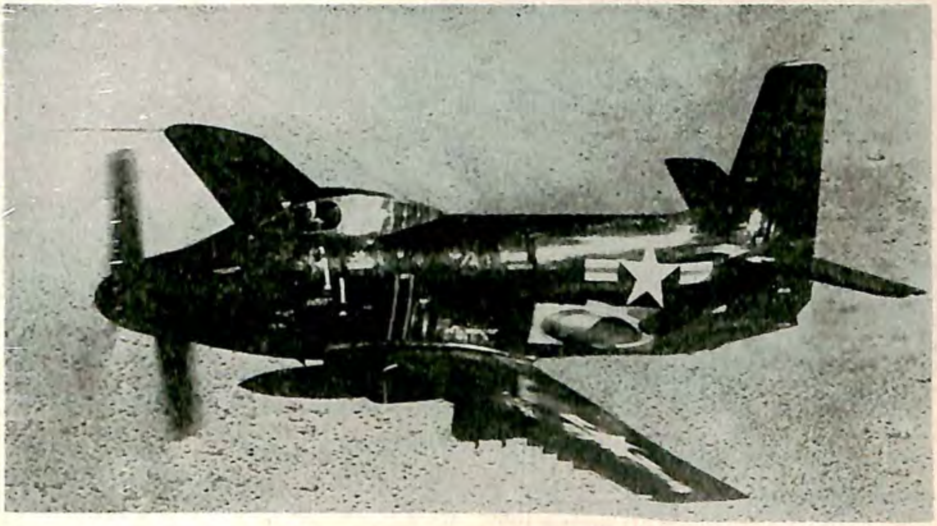
SPAN: 50 ft. 3/16 in. **LENGTH:** 38 ft. 10 in. **HEIGHT:** 15 ft. 7½ in. **WEIGHTS:** EMPTY, 10,950 lb.; GROSS, 16,667 lb.

REMARKS

AD Skyriders have been produced at Douglas' El Segundo Division, including AD-1's, -2's -3's -4's and -5's. Numerous versions have been designed and produced, ranging from attack-dive bombers, night attack, radar counter-measures, airborne early warning, and anti-submarine to target towing utility types. Although the basic AD is a single place airplane, the Q and N versions have accommodations for an additional radar operator, and the W version can carry two additional crew members.

The versatile AD airplane, now standard on all carriers, was on the scene in Korea and among the first to enter combat, and was used in close support of ground troops.

The latest in the skyraider line is the AD-6. All other data are classified.



Skyshark for carrier operation

TYPE: Attack. DESIGNATION: A2D-1.

DATA

POWERLANT: Allison T40. GEAR: Conventional retractable.

REMARKS

The A2D Shyshark is the latest in the Douglas-El Segundo series of carrier attack airplanes. The first American attack airplane to use turbo-prop power plant, this new model will outstrip all its predecessors in performance.

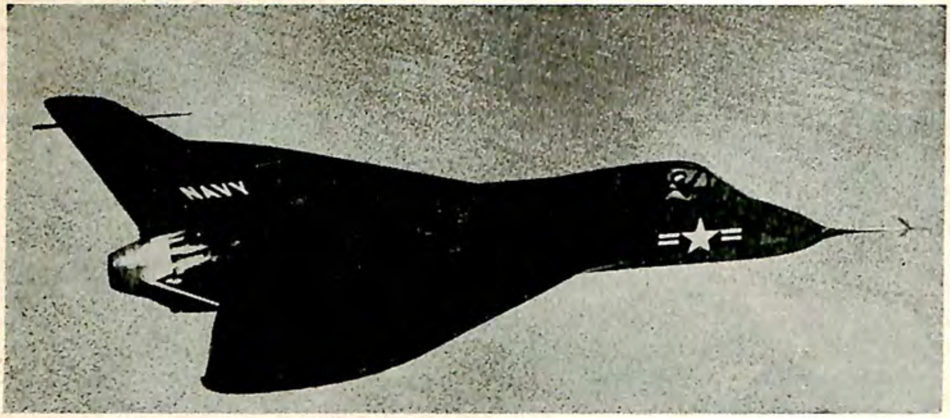
The Skyshark incorporates the latest design innovations to the highest efficiency and the greatest safetv. The pilot location as far forward as possible permits maximum vision. The cockpit has been designed for increased resistance to crash loads. Cabin pressure and cooling are provided by an expansion turbine type system. A Douglas developed upward ejecting seat permits safe escape at this airplane's high speeds.

The A2D Skyshark is unique in its combination of an extremely short takeoff, an unusually high operating altitude, a high speed approaching that of jet fighters, and an unusually high load carrying ability. These characteristics make it particularly well suited as a general purpose, carrier-based attack or ground support aircraft.

This model was successfully flown for the first time on May 26, 1950 and is in production at Douglas' El Segundo Division. All other data are classified.

BALLOON-BORNE LINDBERGH

Jean Pierre Francois Blanchard, who got into aviation trying to build a heavier-thanthan-air model and made history flying hydrogen bags, was first to cross the Channel. He flew it from Dover to France on Jan. 7, 1785, with Dr. John Jeffries. The couple had a good first hour, with fair tail winds, but began to climb at mid-Channel, swelling the balloon. They untied the neck of their bag and lost altitude, but forgot to retie the opening, and neary crashed. Ballast went overboard, plus a few other heavy items. The balloon rose—then started to settle again. The frantic fliers tossed out everything that wasn't nailed down, including clothing. The balloon ascended to some height, where the men shivered in the cooling air. Again the bag began to settle—this time over land—but so rapidly as to threaten a crash in trees. Narrowly missing, it landed undamaged.



Douglas F4D Skyray

TYPE: Interceptor. DESIGNATION: F4D (N).

DATA

POWERPLANT: One Westinghouse J40. WINGS: Modified Delta.

REMARKS

Designed for the Navy by Douglas Aircraft company, El Segundo Division, the F4D Skyray is a high altitude, high speed jet interceptor developed for carrier operation.

With unique, modified delta wings and powered by an advanced type jet engine the Skyray is capable of climbing rapidly, after being catapulted from a carrier deck, to intercept enemy attackers before they reach strategic offensive positions.

The F4D meets the Navy's needs for an interceptor able to operate at high and low speeds for carrier take-offs and landings.

This model was successfully flown for the first time on January 23, 1951. All other data are classified.

HELICOPTER

Shortly before leaving his Far Eastern command, Gen. Matthew B. Ridgway paid tribute to the role of the helicopter in Korea. Writing to the American Helicopter Society, he said:

"Please pass on . . . my great respect for the designers, manufacturers, pilots and maintenance crews of American helicopters. Together they have made a proud contribution, nowhere more conspicuous than in Korea. The innumerable command and liaison missions flown under all types of weather conditions and the like number of search and rescue missinons and flights for the evacuation of wounded, involving as they have many acts of conspicuous gallantry under fire and courage and determination of the highest order at other times, are a source of great pride to us all in the Far East Command."

Planes,
July, 1952

Douglas C-124 Globemaster cargo transport

TYPE: Cargo DESIGNATION: C-124C.

DATA

POWERPLANT: Four Pratt and Whitney R-4360-63, 3,800 hp at takeoff. FUEL CAPACITY: 11,000 gal. OIL CAPACITY: 330 gal. PROPELLERS: Curtiss Electric 3-blade, reversible. FLAPS: Douglas full span, deflector vane, double slotted 40 degrees. GEAR: Tricycle, dual main and nosewheel.

SPECS

SPAN: 174 ft. LENGTH 130 ft. .05 in. HEIGHT: 48 ft. 3.6 in. WEIGHTS: EMPTY, 100,821 lb.; DESIGN GROSS, 175,000 lb.; DESIGN USEFUL LOAD, 74,179 lb.; DESIGN PAYLOAD, 50,000 lb. WING LOADING: 69.7 lb. per sq. ft. POWER LOADING 11.5 lb. per bhp.

PERFORMANCE

Performance figures for the C-124C are restricted. The following are for the C-124A.

SPEEDS: MAXIMUM, 298 mph at 20,800 ft.; CRUISING, 264 mph at 13,600 ft.; STALLING, 99.5 mph with 160,000 lb. gross; RATE OF CLIMB AT SEA LEVEL, 800 ft. per min. with 175,000 lb. gross. SERVICE CEILING FULLY LOADED: 22.050 ft. RANGE: 6,280 ft.

REMARKS

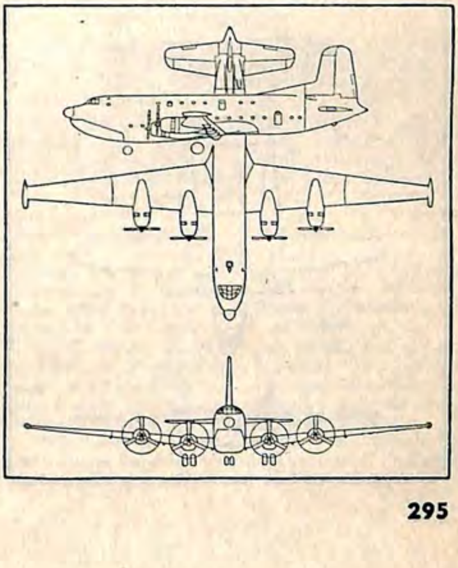
The C-124C is a new model in the Douglas Aircraft Company's C-124 series of cargo and troop transports being delivered under AF contracts. It continues to be the largest airplane in production in its category.

It is equipped to handel pieces of cargo as large as 130 in. wide by 140 in. high through the opening in the nose (which will accommodate 94 percent of all Air Force and Ground Force equipment). A hydraulically operated ramp to the door provides a 17- degree slope for easy loading. The ramp can be varied in width to accommodate vehicles of different trend. It is stowed in the fuselage nose below the crew compartment.

There is another loading door amidships in the underside of the fuselage which can take cargo measuring 89 in. wide, 155 in. long and 85 in. high. This cargo hold is stressed for 16,000 lb. Loading is speeded by the use of an electrically operated elevator. A folding upper deck, hinged at the fuselage, is divided into segments and is supported by stanchions. With the upper deck in position a truck can back into the nose opening and load both the upper and lower levels at the same time. Included in the loading facilities are two electrically powered traveling cranes, each able to lift 8,000 lbs.

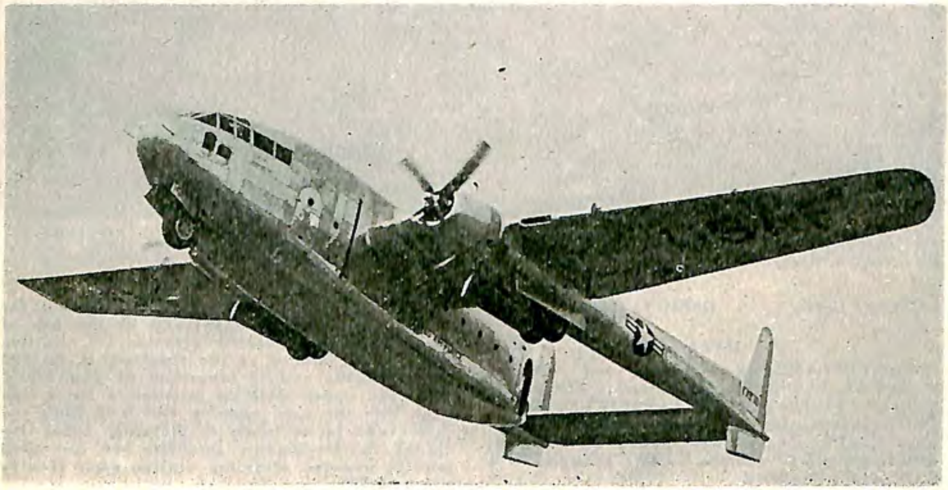
The Globemaster can be converted into a two-deck troop carrier able to carry 200 troops and their equipment, or as a hospital plane, 127 litter patients and their attendants.

Quantities of both the eariler C-124A and the current C-124C models have been ordered by the AF and are doing world-wide service in diversified fields for MATS, SAC and TAC. All other data are classified.



FAIRCHILD AIRCRAFT DIVISION

Hagerstown, Md.
Park Ridge, Ill.

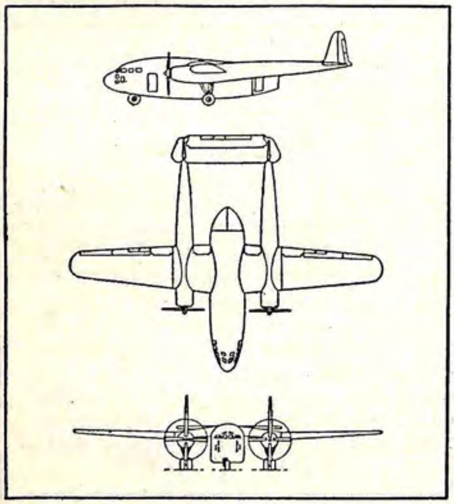


Standard troop-carrier, Fairchild C-119F

TYPE: Cargo and Troop Carrier. DESIGNATION: (AF) C-119F; (N) R4Q-2.

DATA

POWERPLANT: Two Wright R-3350-30 WA, 3,500 hp at takeoff. FUEL CAPACITY: 2,624 gal. in four tanks. OIL CAPACITY: 120 gal. in two tanks. PROPELLERS: Hamilton-Standard, four-bladed reversible. FLAPS: Slotted. GEAR: Tricycle, hydraulically retractable.



SPECS

SPAN: 109.3 ft. LENGTH: 86.5 ft. HEIGHT: 26.5 ft. WEIGHTS: MAXIMUM GROSS, 73, 150 lb. WING LOADING: 50.5 lb. per sq. ft. at maximum gross. POWER LOADING: 10.4 lb. per bhp at maximum gross, maximum power.

PERFORMANCE

SPEEDS: MAXIMUM, 293 mph at combat weight; STALLING: 108 mph at maximum gross with flaps. RATE OF CLIMB: 1,200 feet per minute at maximum gross at military power. SERVICE CEILING: 30,200 feet at combat weight, military power. RANGE: Combat range with 17,250 pounds cargo, 1,725 mi. Ferry range, standard, 3,694 mi.

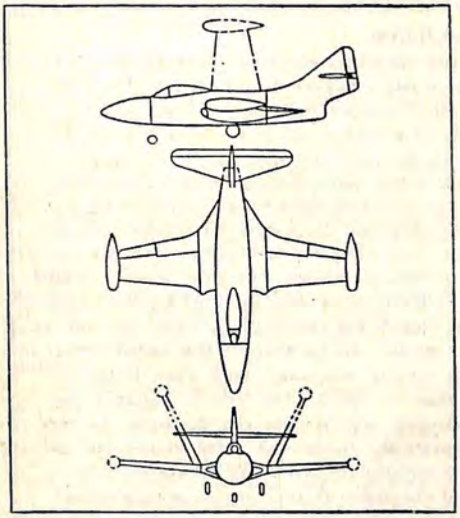
REMARKS

A new Packet with detachable cargo unit was completed on June 20, 1950. Dubbed the Pack-Plane, it will carry a detachable pod or pack that can be loaded before being hoisted into position against the bottom of the fuselage. Design specifications call for a loaded gross of 64,000 lb., a useful load of 23,535 lb., and a cargo capacity of 2,700 cu. ft. The Pack Plane (XC-120) was test flown on Aug. 11, 1950 by chief test pilot Richard Henson. 3-view is C-119C.

GRUMMAN AIRCRAFT ENGINEERING CORP.

Bethpage, L. I., N. Y.

Navy's Grumman Panther



TYPE: Fighter. DESIGNATION: (N) F9F-5.

DATA

POWERPLANT: Pratt & Whitney turbojet J48-P-4 in the F9F-5. Thrust is rated at well over 5,500 lb. GEAR:: Tricycle.

REMARKS

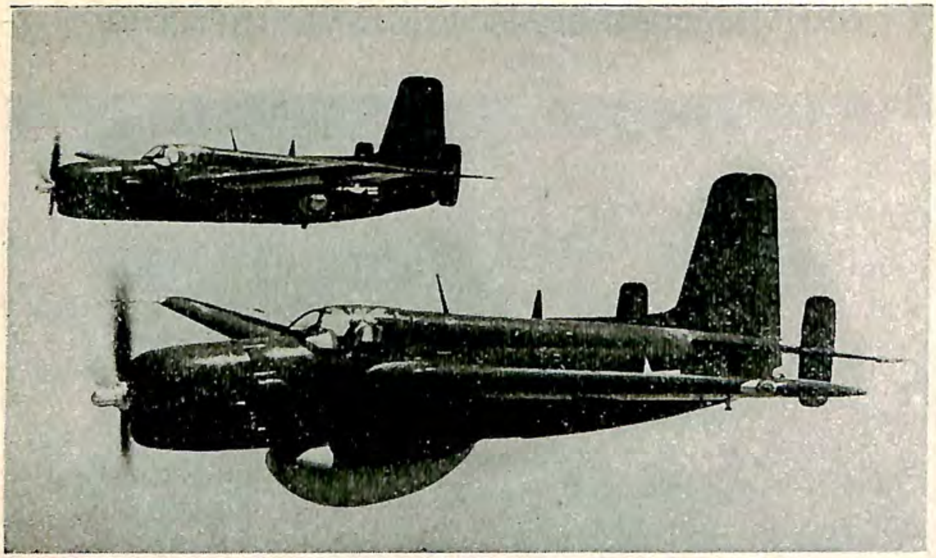
The first experimental Panther was powered with the Rolls Royce Nene turbojet and flew in late 1947. The XF9F-3, with an Allison J-33A engine, first flew Aug. 16, 1948.

The Panther is the 600 mph class and is designed for carrier operation without a catapult assist. It has the Grumman square wing tips which fold upward, and also features a wing whose leading edge moves in conjunction with the wing flaps in landing and takeoff. Known as the "droop snoot," it provides added lift and improved stall characteristics. The cockpit has been designed around the standards determined by Naval medical studies as being most ideal from the standpoint of physical and psychological requirements of pilots.

C. H. Meyer handled most of the test flying.

The new -5 Panther is basically the same design as its predecessors, main improvements being a thinner wing and tail areas and the more powerful Pratt and Whitney J-48 engine.

The Panther is the first Naval jet fighter to be used in combat, having seen action in Korea during the year. All other data are classified.



Grumman AF-2W (bottom) and AF-2S in "hunter-killer" formation

TYPE: Attack. DESIGNATION: (N) AF-2S and 2W.

DATA

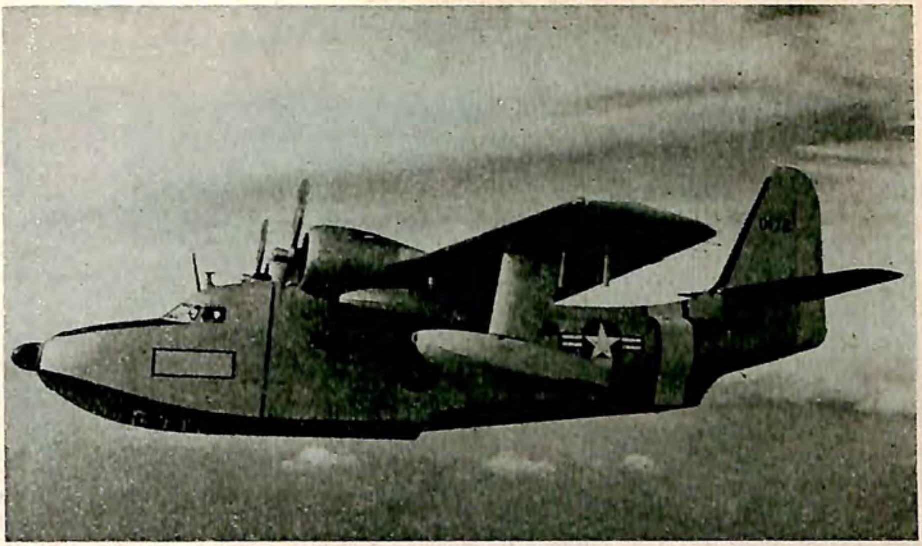
POWERPLANT: Pratt and Whitney, R-2800, 2,250 hp. PROPELLER: Hamilton Standard. GEAR: Conventional.

REMARKS

Claimed the largest single-engined aircraft in the world, the Guardian operates from carrier decks. The Navy says this plane's "mission will be to seek out and destroy enemy submarines." Most of the test flying was done by William Cochran. It carries the latest in submarine radar equipment. Armament details and other data are classified.

HUNTER-KILLER

The idea of the "hunter-killer" team of two airplanes working together was born not as a shrewd new concept of anti-submarine warfare but as the solution to the problem of carrying all the required equipment in one high-performance airplane. Grumman engineers saw clearly that an airplane capable of carrying all of the search gear, the offensive weapons and the fuel for the range necessary would be entirely too large for carrier operation so they simply split the load in half and divided it up between two airplanes. Thus, the AF-2W airplane carriers the powerful, long-range search radar and the other special detection equipment needed to seek out the enemy submarine. Flying nearby is the AF-2S, the "killer" member of the team armed with bombs, depth charges, torpedoes and aircraft cannon for disposing of the submarine. In this manner, both aircraft have the high speed for escape and the huge fuel capacity required for 10-15 hour search missions, something a single airplane could not accomplish. The prototype Guardian featured an auxiliary turbojet engine in its tail to provide the added thrust for escape following submarine attack but this feature was abandoned when it became necessary to concentrate more on long range than on speed. The new Guardian represents the beginning of an era in which the airplane will replace the destroyer as the prime anti-submarine weapon. In this new concept the range and speed of the search-attack team is increased many times and using an aircraft carrier as a base its field of surveillance is partically limitless. It's the third dimension in this desperate underwater-surface-air trrangle of foes.



Grumman Albatross for the Air Rescue Service of the USAF

TYPE: Transport and utility. DESIGNATION: (AF) SA-16A, (N) UF.

DATA

POWERPLANT: Two Wright R-1820-76 engines, 1,425 hp at takeoff. PROPELLERS: Hamilton Standard, 3 blade. GEAR: Tricycle retractable.

SPECS

SPAN: 80 ft. LENGTH: 61 ft. 4 in. HEIGHT: 24 ft. 5 in. SPEEDS: MAXIMUM, 270 mph; CRUISING, 225 mph.

The Albatross claims a "first" in aviation history—the only airplane in production that successfully operates from land, water, ice or snow. Previously, a complete gear change would be necessary for an airplane to operate from these different surfaces.

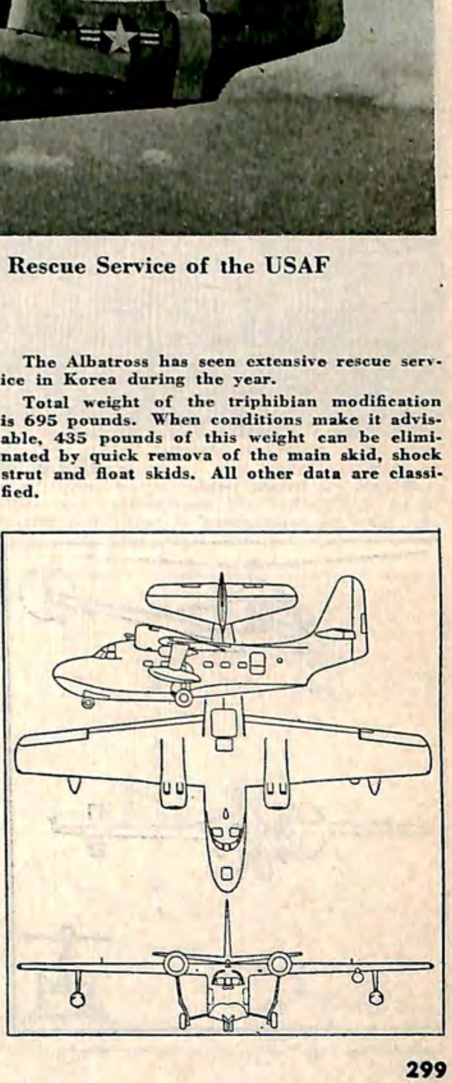
The Air Rescue Service of the USAF conceived the idea of one airplane with triphibian landing features. The Air Material Command laid down the specifications, and Grumman undertook the design and development of the airplane.

Successful snow tests were conducted in Feb. and Mar. 1951.

The Abatross was originally produced as a utility amphibian under an experimental contract from the U. S. Navy. The majority of the production models, however, are delivered to the Air Rescue Service of the Air Force. A smaller amount go to the Navy and Coast Guard.

The Albatross has seen extensive rescue service in Korea during the year.

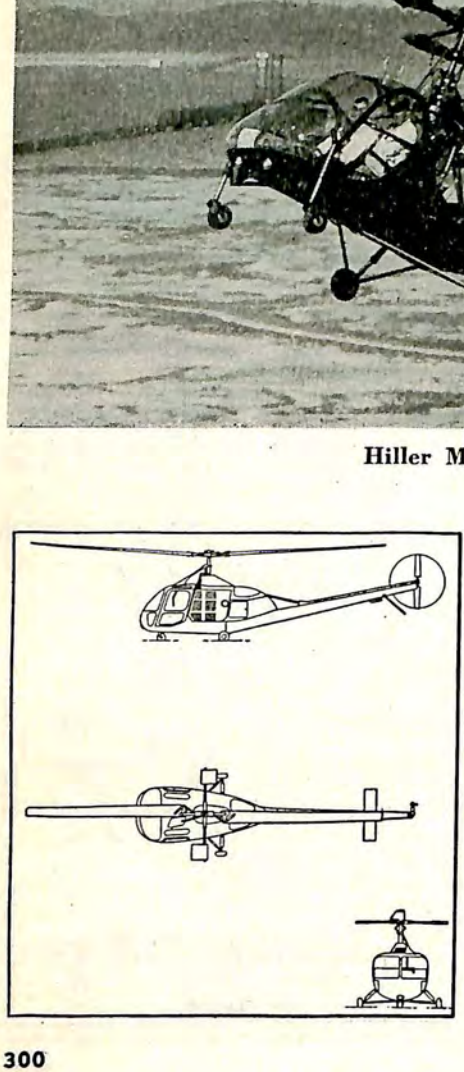
Total weight of the triphibian modification is 695 pounds. When conditions make it advisable, 435 pounds of this weight can be eliminated by quick remova of the main skid, shock strut and float skids. All other data are classified.



HILLER HELICOPTERS

Palo Alto, Cal.

Hiller Model H-23



TYPE: Helicopter. DESIGNATION: (AF) H-23A.

DATA

POWERPLANT: Franklin 6V4-178-B33, 178 hp at 3,000 rpm at sea level. FUEL CAPACITY: 27 gal.

SPECS

MAIN ROTOR DIAMETER: 35 ft. LENGTH: 38.7 ft. HEIGHT: 9.5 ft. FUSELAGE WIDTH: 4.9 ft. (max.) WEIGHTS: GROSS, 2,400 lb.; EMPTY, 1,697 lb.; USEFUL LOAD, 703 lb.

PERFORMANCE

SPEEDS: MAXIMUM, 84 mph; CRUISING, 76 mph. RATE OF CLIMB: 745 ft. per min. HOVERING CEILING: 4,700 ft. ABSOLUTE CEILING: 11,000 ft. RANGE: 210 mi.

REMARKS

Besides the H-23A, there are three other models in the Hiller line. They are: HTE-1, similar to the H-23 except for minor modifications, HTE-2 (Navy training model) and H-23B (Army utility model) whose major difference is a Franklin 6V4-200-C33, 200 hp at 3,100 rpm at sea level. The 3-view shown here is of the civilian model 360, no longer in production, but whose general configuration is the same as the military models described herein.

KAMAN AIRCRAFT CORP.

Windsor Locks, Conn.

Kaman HTK-1 for the Navy

TYPE: Helicopter. DESIGNATION: (N) HTK-1. CAA TYPE CERTIFICATE: TC 1H3.

DATA

POWERPLANT: Lycoming 0-435-X, 190 hp. FUEL CAPACITY AND CONSUMPTION: 40 gal., 12 gal. per hr. OIL CAPACITY: 3 gal. GEAR: Tricycle.

SPECS

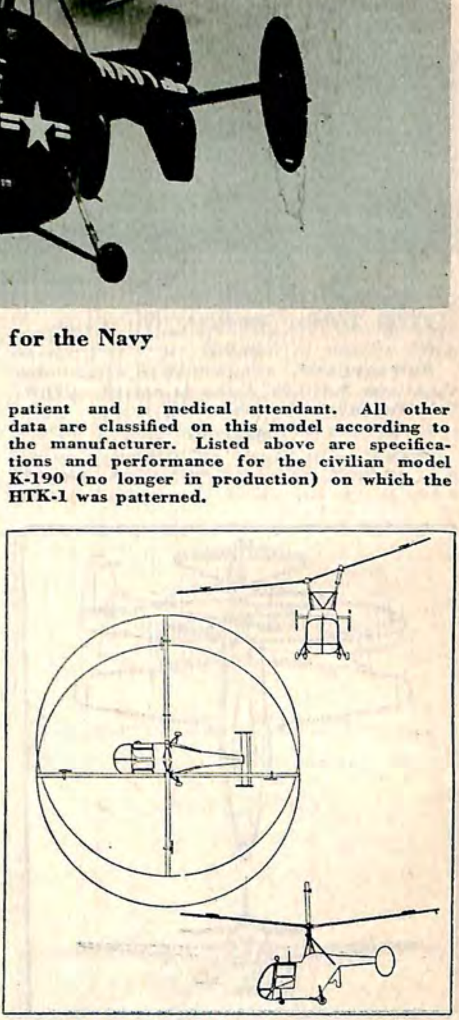
MAIN ROTOR DIAMETER: 38 ft. LENGTH: 23 ft. HEIGHT: 11 ft. WEIGHTS: EMPTY, 1,750 lb.; GROSS, 2,500 lb.; USEFUL LOAD, 800 lb. ROTOR DISC LOADING: 1.9 lb. per sq. ft. POWER LOADING: 13.3 lb. per bhp.

PERFORMANCE

SPEEDS AT SEA LEVEL: MAXIMUM, 75 mph; CRUISING, 70 mph. RATE OF CLIMB FULLY LOADED: 700 ft. per min. SERVICE CEILING FULLY LOADED: 10,000 ft. RANGE: 194 mi.

REMARKS

In 1951 Kaman Aircraft placed in production the type HTK-1 helicopter for the U. S. Navy. The HTK-1 is 3-place, powered by a 240 hp Lycoming engine. It was designed primarily as a trainer with dual controls and two side-by-side seats with a jump seat behind the pilot. Either set of controls can be removed to carry a lit'e- internally. As an aerial ambulance the HTK-1 will carry a pilot, litter patient and a medical attendant. All other data are classified on this model according to the manufacturer. Listed above are specifications and performance for the civilian model K-190 (no longer in production) on which the HTK-1 was patterned.



LOCKHEED AIRCRAFT CORP

Burbank, Cal.

Lockheed T-33 jet trainer

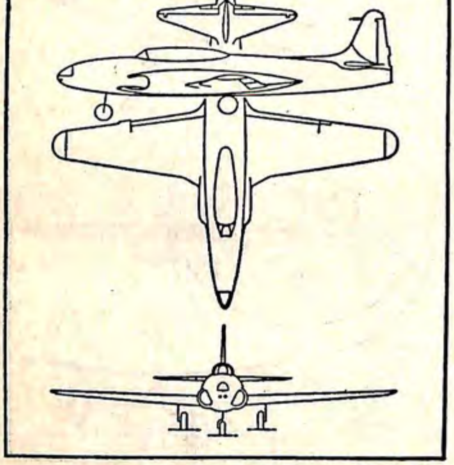
TYPE: Trainer. DESIGNATION: T-33A.

DATA

POWERPLANT: Allison J-33-35, model 400 C-13, over 5,200 lb. thrust at takeoff. GEAR: Tricycle, fully retractable.

SPECS

SPAN: 38 ft. 10½ in. LENGTH: 37 ft. 8 in. HEIGHT: 11 ft. 8 in. WEIGHTS: EMPTY, 8,400 lb.; Gross, 15,000 lb.; USEFUL LOAD,



6,358 lb. WING LOADING: 60.8 lb. per sq. ft. POWER LOADING: 3.3 lb. per lb. of thrust.

PERFORMANCE

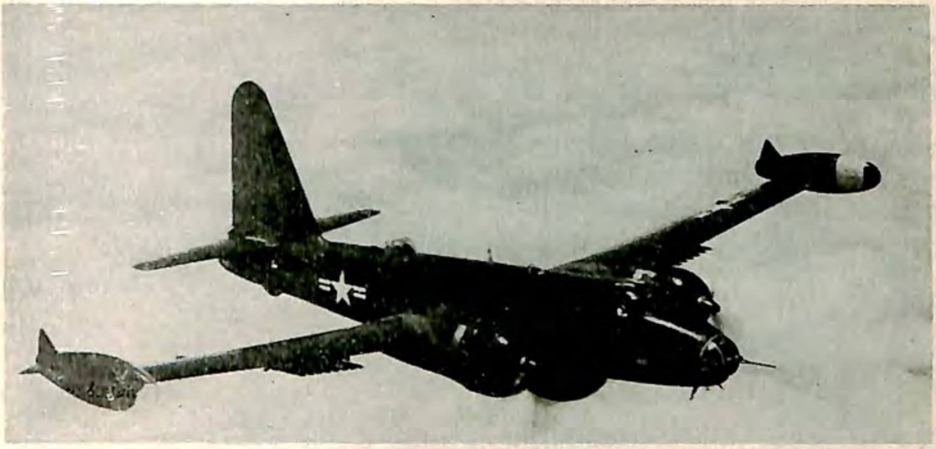
SPEEDS: MAXIMUM, 600 mph class. RATE OF CLIMB: 5,525 ft. per min. SERVICE CEILING: over 44,000 ft. fully loaded. RANGE: Capable of carrying out range missions assigned to conventional long-rang fighter planes. ARMAMENT: Two 50 cal. machine guns and two 1,000 lb. bombs on wings.

REMARKS

When single place, jet propelled aircraft became operational in the military services, the transition training of pilots became important because of the higher speeds and new techniques involved. Experiments were conducted using an F-80 aircraft arranged so that an instructor could ride behind the pilot. The necessity for providing a second standard cockpit soon became apparent, and an F-80 was modified by lengthening the fuselage to accommodate the second cockpit. This arrangement proved satisfactory, and with other improvements in the T-33A (TV-2) aircraft was put into production in March, 1948. 1952 production rates were increased to meet required schedules.

In addition to being the standard jet trainer for the U. S. Air Force, T-33s have been used to train pilots from the following eight NATO countries: Holland, France, Belgium, Turkey, Greece, Denmark, Norway and Portugal. Also, T-33s are now being manufactured in Canada by Canadair, Ltd., under license from Lockheed.

Under provisions of the Mutual Defense Assistance Program, the Lockheed jet trainer has been delivered to the following member nations: Turkey, Greece, Canada and Belgium. Holland and Italy are also listed to receive T-33s.



Radar-equipped Lockheed Neptune

TYPE: Patrol. DESIGNATION: (N) P2V-5.

DATA

POWERPLANT: Two Wright R-3350-30W, 3,250 hp (dry) and 3,700 hp (wet) for take-off. FUEL CAPACITY: 4,700 gal. PROPELLERS: Hamilton Standard 2460-85 2J1703-365. GEAR: Tricycle retractable.

SPECS

SPAN: 100 ft. LENGTH: 81 ft. 6.8 in. HEIGHT: 28 ft. 1 in. WEIGHTS: EMPTY, 41,754 lb.; GROSS, 76,152 lb.; USEFUL LOAD, 30,279 lb. WING LOADING: 76 lb. per sq. ft.

PERFORMANCE

SPEEDS AT SEA LEVEL: MAXIMUM, 312 mph; STALLING, 109 mph (power off at full gross). RATE OF CLIMB: 1,640 ft. per min. at sea level and gross weight. SERVICE CEILING: 28,000 ft. fully loaded. RANGE: 4,750 mi.

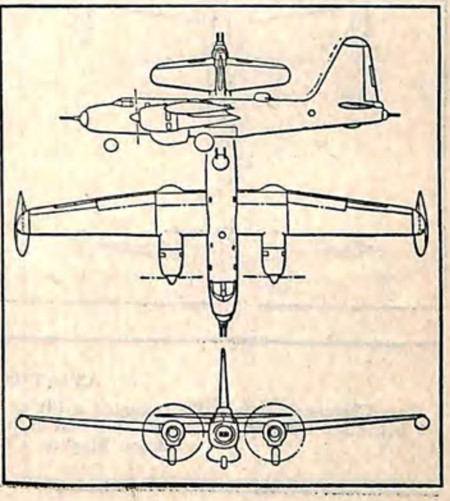
REMARKS

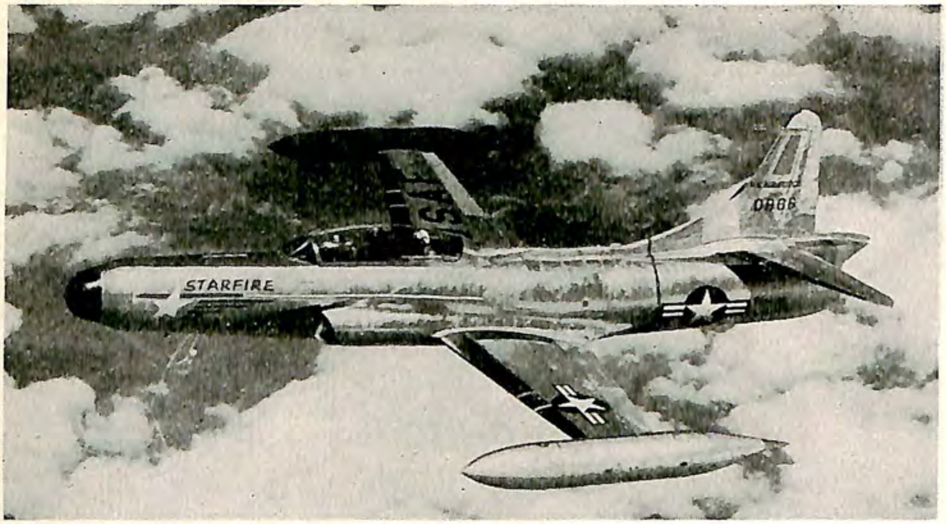
The P2V-5 is the newest version of the U. S. Navy's Neptune. The Neptune series has been in service since 1945.

The third Neptune built established a long-distance flight record which still stands—11,236 miles nonstop without refueling, from Perth, Australia. to Columbus, O. Carrying specialized radar and electronics instruments, the P2V was developed to meet the snorkle submarine threat. Compound engines were first introduced on the P2V.

The P2V-5 closely resembles its predecessors, the chief visible difference being the added nose turret and larger center-mounted tiptanks. Other models have included the P2V-1 with R-3350-8 engines rated at 2,300 hp; P2V-2 with R-3350-24W engines rated at 2,500 hp; the P2V-3 with R-3350-26W engines rated at 2,700 hp; the P2V-4 has the same powerplant as the -5. Another version is the P2V-6 which is equipped for either anti-submarine duty or mine laying. P2V's are designed to operate from carriers with JATO assist.

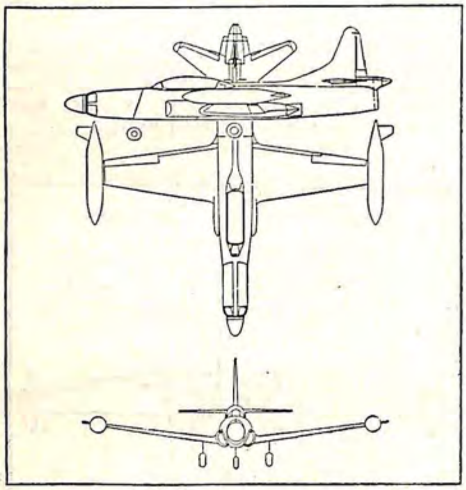
Under the Mutual Defense Assistance Pact and release of certain key U. S. equipment to friendly nations, both Great Britain and Australia have received the first of their P2V fleets. All other data are classified.





Lockheed F-94C two-place jet interceptor

TYPE: Interceptor and Night Fighter (2-place). DESIGNATION: (AF) F-94C Starfire.



DATA

POWERPLANT: P&W 1-48-P-5 6250. lb. thrust at takeoff plus afterburner. GEAR: Tricycle retractable.

SPECS

SPAN: 37 ft. 6 in. LENGTH: 41 ft. 5 in. HEIGHT: 13 ft. 7 in. MAXIMUM GROSS TAKE-OFF WEIGHT: over 20,000 lbs.; USEFUL LOAD: 24 2.75-in. internal rockets in nose; wing pods for rockets can also be used.

PERFORMANCE

SPEEDS: more than 600 mph; SERVICE CEILING: over 45,000 ft. fully loaded.

REMARKS

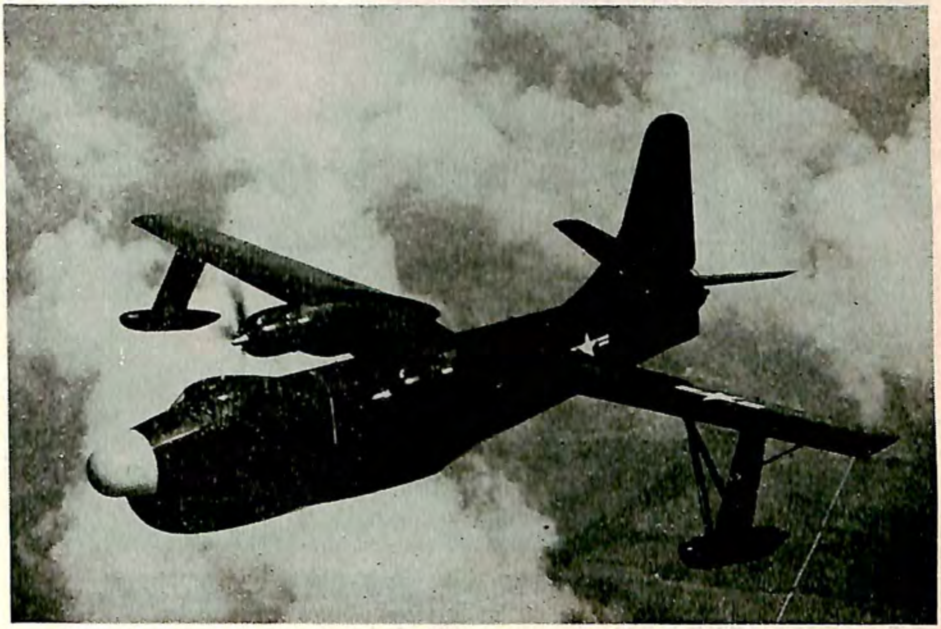
F-94C Starfire has many changes over earlier F-94A and B models, including improved electronics making it a highly atuomatic interceptor. Unique innovation is housing of main armament of 24 rockets in nose. Uses thin straight wing, swept-back tail. F-94C is latest development of original mass-produced jet, the F-80 Shooting Star, first jet to see combat in Korea. F-94C ordered in substantial quantities. All other data are classified.

AVIATION CONTRACT

Clarence Chamberlin reported a bit of contract savvy when he reported shortly after his flight to Europe: "Fly first and fight afterwards—if necessary."
—Record Flights, Clarence D. Chamberlin, Dorrance & Co., Inc.

THE GLENN L. MARTIN AIRCRAFT CO.

Baltimore, Md.



Martin's patrol plane, the P5M

DATA

POWERPLANT: Two Wright Model 3350-30 engines. PROPELLERS Hamilton Standard 4. bladed, Model 34E60, reversible.

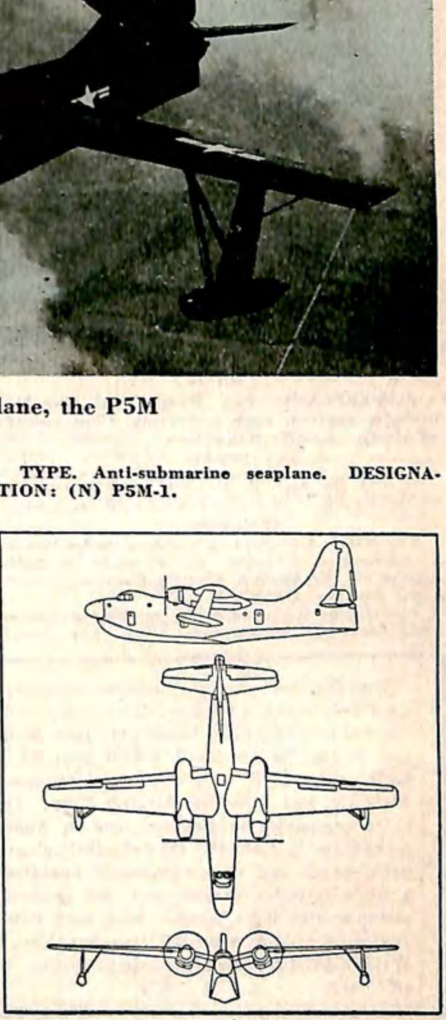
SPECS

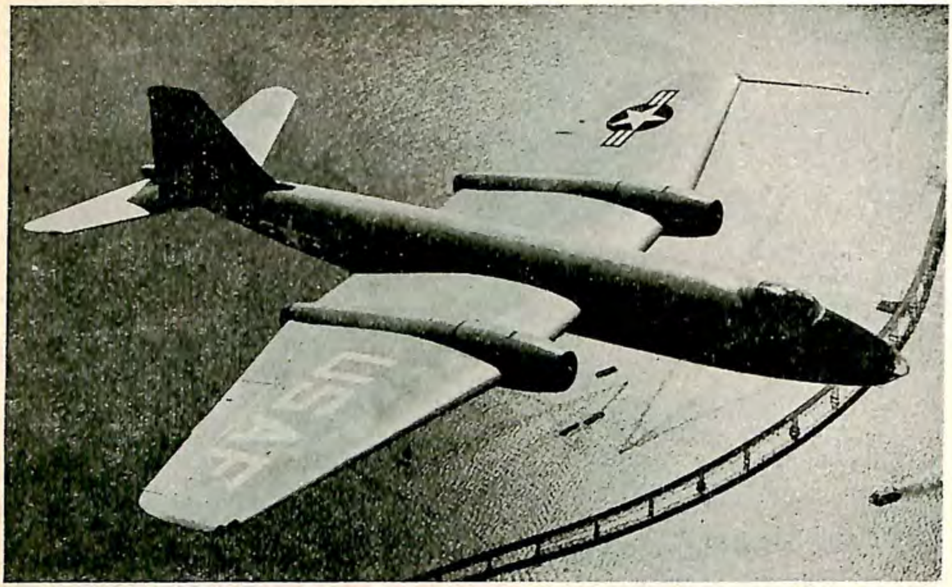
SPAN: 118 ft.; AREA: 1,406 sq. ft.; LENGTH: 95 ft. Height: 35 ft. 2 in. GROSS WEIGHT: over 70,000 lbs.

REMARKS

The Martin Marlin is a medium range, twin-engine seaplane intended primarily for anti-submarine patrol duty. The P5M-1 is equipped with the latest Navy all-weather, day-and-night electronic devices for tracking suspected targets. Within its two nacelle bomb bays and on the wings, the Marlin carries a variety of torpedoes, rockets and/or mines. A gun turrent is located in the tail. An important feature of the aircraft is the long after-body hull designed for rough water operations. The hull makes take-offs and landings easier under adverse sea conditions—and has reduced aerodynamic drag by fairing of the main step. Another item of special interest is the hydroflap, or underwater rudder, installed for greater maneuverability in taxiing. All other data are classified.

TYPE. Anti-submarine seaplane. DESIGNATION: (N) P5M-1.





Martin-built Canberra

TYPE: Night intruder bomber. DESIGNATION: (AF) B-57A.

DATA

POWERPLANT: Two Wright J-65 Sapphire turbojet engines, each producing 7200 pounds of thrust. GEAR: Tricycle.

SPECS

SPAN: 64 ft.; WING AREA: 960 sq. ft.; LENGTH: 65 ft. 6 in.; HEIGHT: 15 ft. 7 in.

REMARKS

The Martin Company is building under license a substantial quantity of a night intruder version of the English Electric Company's Canberra for the USAF.

Two Canberras were flown to Martin during 1951 for study and familiarization. The second trip from Aldergrove, Northern Ireland, to Gander, Newfoundland, set a speed record for westward crossing of the Atlantic of 4 hours, 18 min. 24.4 secs.

On August 26, 1952, a British Canberra made the first round trip flight across the Atlantic between the same points in a single day. Elapsed time was 10 hours, 3 mins., 28.28 secs. The return leg of the trip set a new eastward crossing record of 3 hours, 25 mins., 18.13 secs.

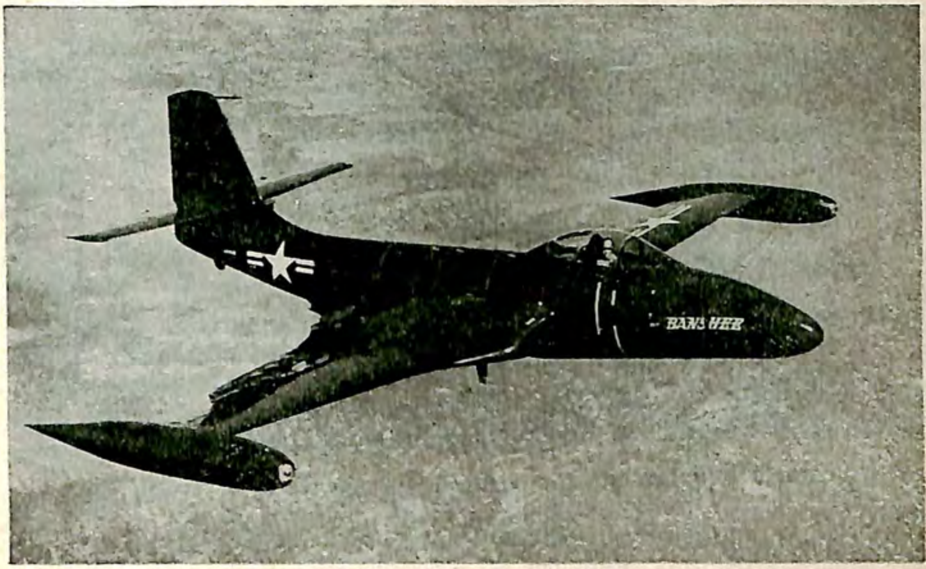
Visually, the Canberra is characterized by its unusually broad wing, and its clean, smooth lines. In flight it is highly maneuverable at both low and high altitudes.

By September 30, 1952, production of the USAF B-57A was well under way and first flight was expected during 1953. All other data are classified.

The decision for an American company to produce this British airplane smashed a quarter-century precedent, for not since 1917 had an American company launched a production program for a foreign military design. During World War I the Curtiss Aeroplane and Motor Co. produced the British SE-5 and nearly 5,000 de Havilland DH-4's were built in the U. S. by a variety of companies, principally the Dayton-Wright Co., Fisher Body Co. and Standard Aircraft Corp. The Canberra is in vast quantity production by three companies in England, one in Australia and negotiations are being made for its production in Canada. Its principal advantages are maneuverability, good high-altitude performance and very economical operating characteristics. The USAF B-57A model is a night-intruder version and will generally replace the World War II Douglas B-26 piston-engine light bomber now used extensively in the fighting in Korea. Its British engine, the Armstrong-Siddeley Sapphire, is also being produced in this country as the Wright J65 turbojet. Like the airplane, this engine is characterized by high operating efficiency.

McDONNELL AIRCRAFT CORP.

St. Louis, Mo.



McDonnell twin-jet Banshee

TYPE: Fighter. DESIGNATION: (N) F2H-2.

DATA

POWERPLANT: Two Westinghouse J-34 turbojets, approximately 3,000 lb. thrust each. FUEL: Over 5,000 lb. in five self-sealing internal tanks. GEAR: Tricycle retractable.

SPECS

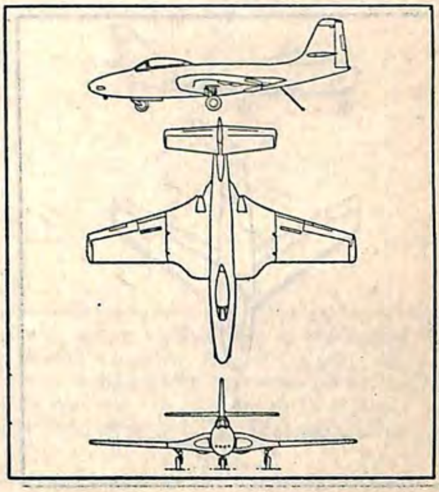
SPAN: 41 ft. 7.4 in. LENGTH: 40 ft. 1-8 in. HEIGHT: 14 ft. GROSS WEIGHT: Approximately 14,000 lb.

PERFORMANCE

MAXIMUM SPEED: Reported close to 600 mph. RATE OF CLIMB: Over 9,000 ft. per min. CEILING: Approximately 48,000 ft. RANGE: Over 2,000 mi. (max.)

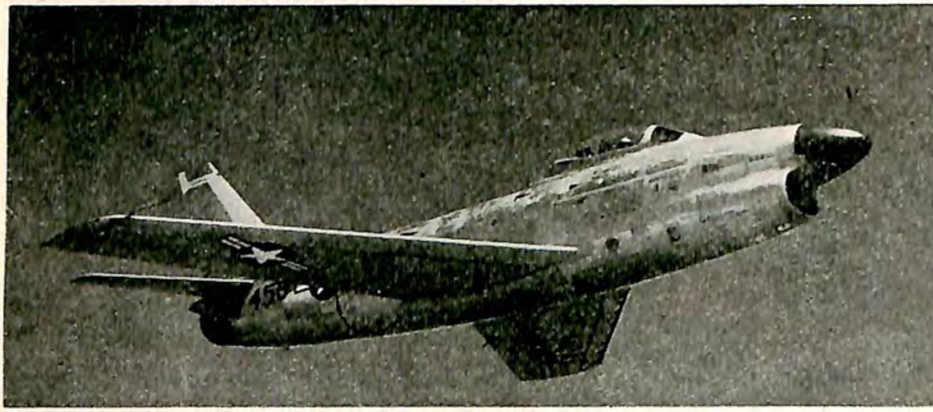
REMARKS

Banshee is Navy's fastest and hightest-flying service fighter now in carrier use throughout the fleet. It has been produced in a wide variety of models including the F2H-2N, night-fighter version, and the F2H-2P, photo-reconnaissance model. Latest model is the F2H-3, which features an extended fuselage, to house additional fuel, and search radar equipment in the nose. The F2H-2 has been in combat in Korea for more than a year and has established an enviable record as a rugged, effective ground-support fighter. It has not been sent north to MiG Alley but Naval experts claim it able to take care of itself against the Communist fighter. Nearing production is the new XF3H-1 Demon, a bigger, more powerful version powered by a Westinghouse J40 engine. This version will also be built by TEMCO Aircraft Co., Dallas, Tex. All other data are classified.



NORTH AMERICAN AVIATION, INC.

Los Angeles, Cal.

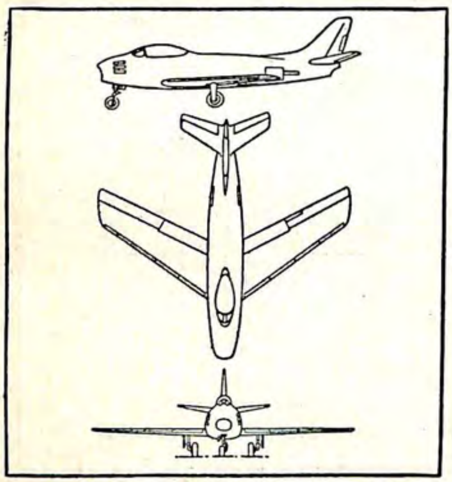


North American's F-86D Sabre holds world speed record

TYPE: Fighter Interceptor. DESIGNATION: (AF) F-86D.

DATA

POWERPLANT: General Electric J-47-GE-17, 5,800 lb. thrust plus afterburner. GEAR: Tricycle, retractable, steerable nosewheel.



SPAN

SPAN: 37 ft. LENGTH: 40 ft. HEIGHT: 15 ft. WEIGHT: 18,000 lb.

PERFORMANCE

SPEEDS: Set official worlds record of 699.92 mph, Nov. 19, 1952, and unofficial record of 710 mph, Feb. 11, 1949. SERVICE CEILING: Over 45,000. TACTICAL RADIUS: Over 500 mi.

REMARKS

The F-86D model is virtually a new design of the famed Sabre and incorporates search radar in the nose and an afterburner in the tail. A regular, combat-equipped F-86D smashed the world's speed record late in the year by averaging 699.92 mph over an official F.A.I. course. Navy now uses the FJ-2 Fury version of the F-86F with folding wings, deck arrester hook and catapult fittings for carrier use. The F-86E and F-86F models were in production during the year. All production versions of F-86D feature the NAA-developed flying tail in which stabilizer and elevator are a single, controllable surface. The F-86E Sabre in Korea has run up a remarkable 8-to-1 ratio over Communist MiG-15 fighters. Three view is F-86F. All other data are classified.

Carrier-based North American AJ-2P Savage

TYPE: Photo-Reconnaissance. DESIGNATION: (N) AJ-2P.

DATA

POWERPLANT: Two Pratt & Whitney Double Wasp R-2800-48 and one Allison J33-A-10 turbojet engine. GEAR: Tricycle retractable.

SPECS

SPAN: 75 ft. LENGTH: 65 ft. 50,000 lb. GROSS WEIGHT:

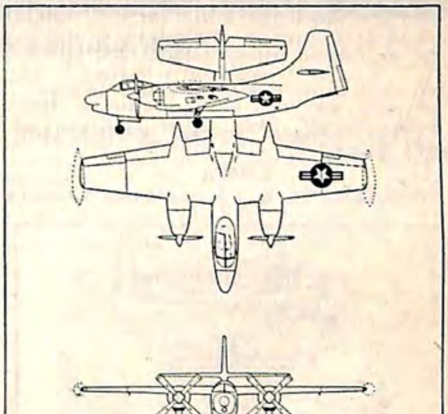
PERFORMANCE

SPEED AT SEA LEVEL: Approx. 425 mph. SERVICE CEILING: 40,000 ft. RANGE: more than 3,000 miles.

REMARKS

The AJ-2P pictured above is a photo-reconnaissance version of the AJ-1.

The AJ-1 was designed as a carrier-based bomber to deliver the atom bomb. Its jet engine is located in the aft fuselage and is used only periodically for takeoff, speed over the target, escape from pursuing airplanes. The outer wing panels fold vertically, the fin folds to starboard for shipboard accommodation. Crew of three rides in pressurized cabin. First group of AJ-1's in service, Squadron VC-5 at N.A.S. Norfolk, completed carrier qualification tests in Oct., 1950. Second group of AJ's to go into carrier operation was Composite Squadron VC-6 of Heavy Attack Wing 1, aboard the Midway. All other data are classified.



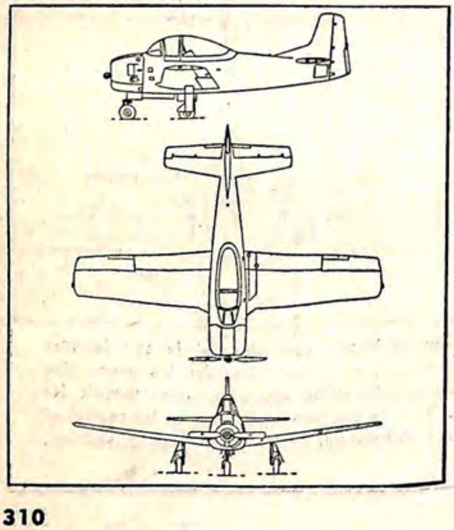
The Savage is the first in a new generation of heavy aircraft and is the largest combat plane ever placed in operational service aboard a carrier. Despite its great size and weight, however, pilots report that its excellent handling characteristics permit its use aboard carriers without special precautions. It was the first airplane to be produced at the new North American Aviation facility near Columbus, Ohio. A turboprop version, the XA2J-1, is now undergoing tests.

North American advanced trainer T-28

TYPE: Advanced trainer. DESIGNATION: (AF) T-28A.

DATA

POWERPLANT: One Wright 7 cyl., R-13001A 800 hp. FUEL CAPACITY: 177 gal. PROPELLER: Aero Products, 2-bladed, constant speed. GEAR: Tricycle, hydraulically retractable.



SPECS

SPAN: 40.6 ft. LENGTH: 32 ft. HEIGHT: 12.7 ft. WEIGHTS: EMPTY, 5,780 lb.; GROSS, NORMAL 7,339 lb.; GROSS, MAXIMUM TAKE-OFF, 7,808 lb. WING LOADING, 27.1 lb. per sq. ft. POWER LOADING, 9.17 lb. per hp.

PERFORMANCE

SPEEDS: MAXIMUM (at 5,900 ft.) 288 mph; CRUISING, 190 mph; STALLING, 72 mph; RATE OF CLIMB, 2,060 ft. per. min. SERVICE CEILING: 25,600 ft. RANGE: 1,008 mi.

REMARKS

The T-28 is one of the first U. S. training planes to use a tricycle gear. Additional improvements include a 12½ degree visibility over the nose (11 degrees is required), lowered and more streamlined canopy, easier accessibility for maintenance (there is an access port directly back of the engine nacelle underneath the fuselage), and special lighting on the instrument panel for use of the "view-lighter" for simulated instrument flying.

The Navy has ordered into production the T28, which is powered by a Wright R-1820 engine rated at 1425 horsepower. Its speed will be 343 mph.

PLANES IN PRODUCTION

NORTHROP AIRCRAFT, INC.

Hawthorne, Cal.

Northrop Scorpion F-89D, all-weather interceptor

TYPE: All-weather interceptor. DESIGNATION: (AF) F-89D.

DATA

POWERPLANT: Two Allison J35 turbo-jets with afterburners carried in separate nacelles on the lower section of the fuselage. GEAR: Tricycle retractable.

SPECS

SPAN: Approximately 56 ft. 2 in. LENGTH: Approximately 53 ft. 4 in. HEIGHT: Approximately 17 ft., 7 in. GROSS WEIGHT: Over 40,000 lb.

PERFORMANCE

MAXIMUM SPEED: 600 mph range. OPERATIONAL CEILING: Over 40,000 ft.

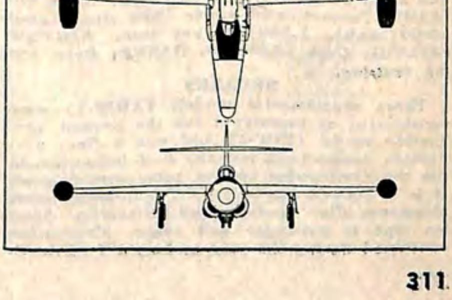
REMARKS

Newest in the F-89 series of all-weather interceptors is the all-rocket armed F-89D. Large numbers of 2.75 folding fin aircraft rockets carried in wing tip launching pods make the new Scorpion the U. S. Air Force's most heavily armed fighter-type aircraft..

Use of the wing tip launchers provides improved dispersal of rockets, since two sources of firepower are used instead of a single concentrated source. Firing of rockets from wing tips does not interfere with the vision of its crew of pilot and radar observer at the critical moment of interception and engine air intakes are not exposed to smoke and debris produced by rocket firing.

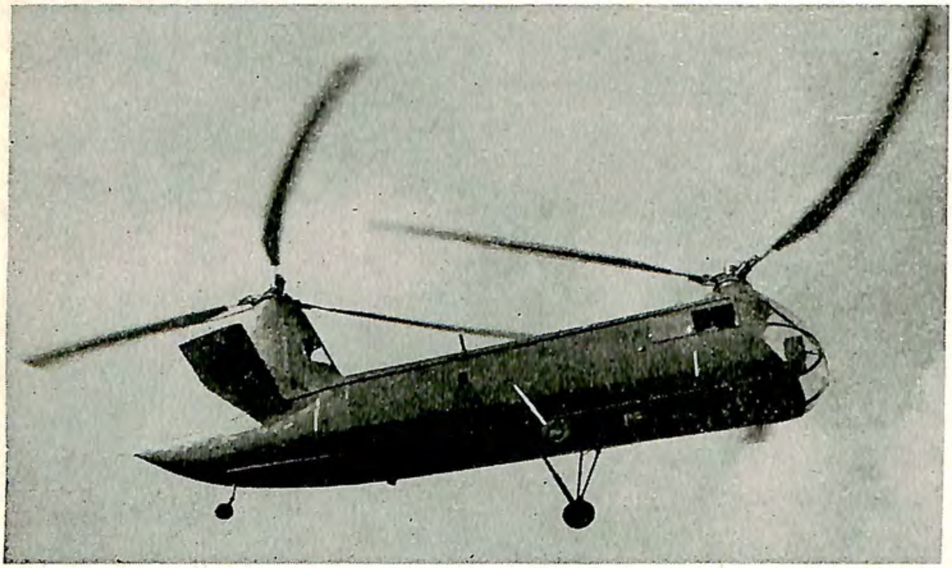
The F-89D is equipped with advanced electronic aiming and automatic triggering devices coupled with the latest radar and electronic navigational equipment, enabling it to locate, intercept and destroy enemy aircraft in any type of weather or at night.

Standard Scorpion features retained on the F-89D include: upswept tail that gives the Scorpion its name; thin, straight wing; 'decelerons,' combination ailerons and dive brakes; pressurized air-conditioned cockpit equipped with ejection seats; and power-operated, jettisonable canopy. R. L. Black was project engineer. All other data are classified.



PIASECKI HELICOPTER CORP.

Morton, Pa.



Navy shipboard helicopter, Piasecki Retriver

Type: Helicopter. **DESIGNATION:** (N) HUP-1, (AF) H-25.

DATA

POWERPLANT: Continental R-975-34, 525 hp at takeoff. **FUEL CAPACITY:** 100 gal. **GEAR:** Tricycle.

SPECS

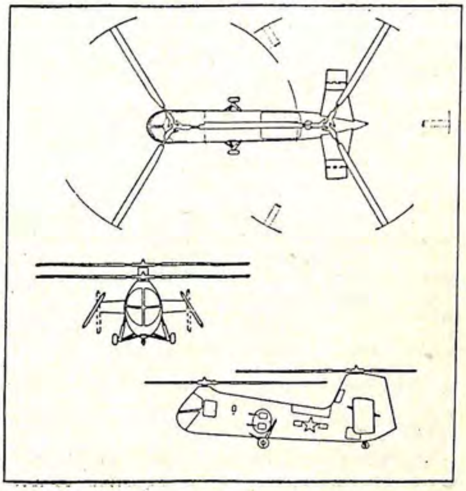
LENGTH: 31 ft. 7 in. **HEIGHT:** 12 ft. 6 in. **WEIGHTS:** EMPTY, 3,966 lb.; NORMAL GROSS, 5,355 lb.; OVERLOAD GROSS, 5,355 lb.

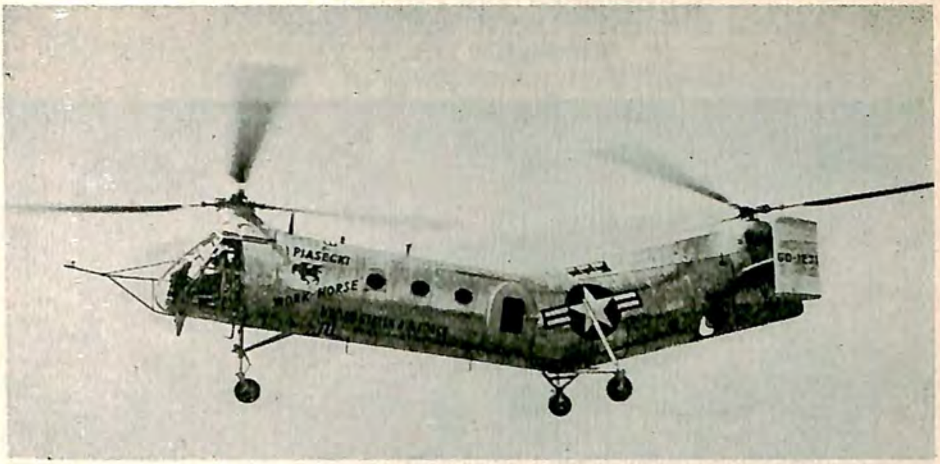
PERFORMANCE

SPEEDS AT SEA LEVEL: MAXIMUM, over 125 mph; CRUISING, over 100 mph. **RATE OF CLIMB:** Normal rated power (best climb speed 50-60 mph), 1,200 ft. per min. **SERVICE CEILING:** Over 12,000 ft. **RANGE:** Over 400 mi. cruising.

REMARKS

Three experimental models (XHJP-1) were constructed as prototypes for the present production model (HUP-1) and won a Navy production contract. It was the first helicopter to use the overlapping tandem rotor arrangement. It is a 5-place, single engine, semi-monocoque, aluminum alloy fuselage land helicopter. Service type is passenger and cargo. Production continued during the year under navy contract.





Piaseck, Tandem Rotor H-21

TYPE: Helicopter. **DESIGNATION:** (AF) H-21.

REMARKS

The H-21A is an Air Force 10 to 20 place, tandem-rotored, single engine rescue and utility helicopter. Power is a Wright R-1820-103 engine with a take-off rating of 1,425 hp. The engine drives two 44 ft. diameter rotors through drive shafts and reduction transmissions.

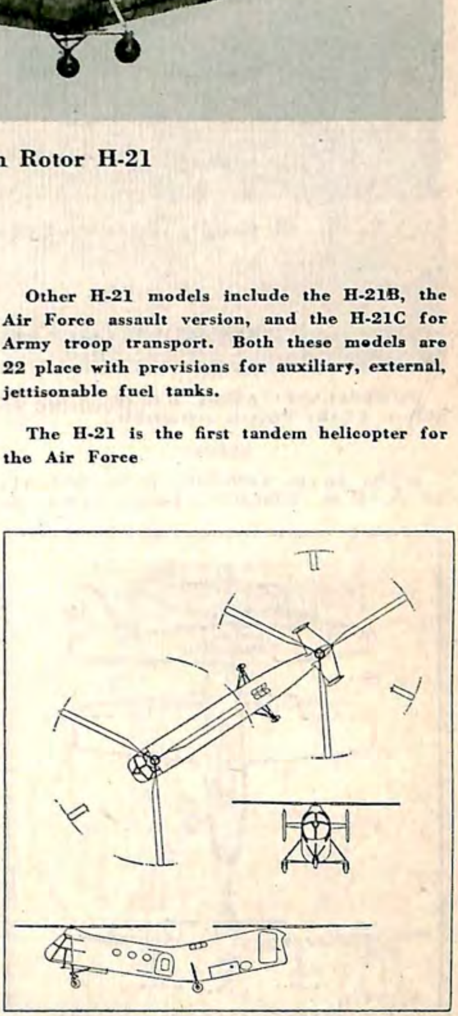
The fuselage is all metal stressed skin, monocoque. The cockpit has side-by side seating with the pilot sitting on the right. There are dual controls and an autopilot.

Cabin dimensions are 20 ft. long x 5 ft. 6 in. wide x 5 ft. 6 in. high or 615 cu. ft. This area can accommodate 12 litters or 20 troop seats. There is a main entrance door on the left side at the aft end of the cabin and a rescue door and rescue facilities with a swinging boom type rescue hoist immediately behind the pilot at the forward end of the cabin.

The fixed wheel landing gear includes provisions for the installation of flotation gear for land, swamp and water landings. The model also can come equipped with complete winterization items.

Other H-21 models include the H-21B, the Air Force assault version, and the H-21C for Army troop transport. Both these models are 22 place with provisions for auxiliary, external, jettisonable fuel tanks.

The H-21 is the first tandem helicopter for the Air Force



REPUBLIC AVIATION CORP.

Farmingdale, L. I., N. Y.

Republic Thunderjet equipped for mid-air refueling

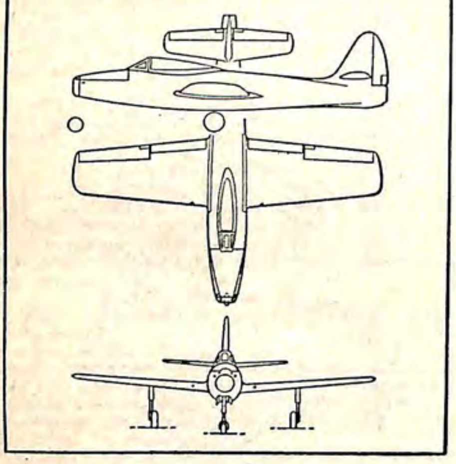
TYPE: Fighter. DESIGNATION: (AF) F-84G.

DATA

POWERPLANT: Allison J-35-29. 5,600 lb. thrust. GEAR: Tricycle retractable.

SPECS

SPAN: 36 ft. LENGTH: 38 ft. HEIGHT: 12 ft. 6 in. WEIGHTS: Empty, 11,000 lb.



GROSS, as a fighter (no external fuel tanks), 15,000 lb.; as a fighter-bomber (external fuel tanks), over 18,000 lb.

PERFORMANCE

MAXIMUM SPEED: Over 630 mph. SERVICE CEILING: Over 45,000 ft. RANGE: 1,000 miles-plus with external tanks.

REMARKS

The F-84G, current production model of the Thunderjet series, has a 10 percent increase in power over the F-84E, combat-tested predecessor from which it differs only in prossession of single-point, in flight refueling equipment, automatic pilot, refined ejector configuration, and additional access doors. Maintenance and accessibility features include retractable battery-lift, hinged gun deck, guide rails, snap-on electrical leads, throttle disconnects for rapid engine change. Wing tip tanks have aerodynamic fins allowing the plane to go through maneuvers usually restricted when carrying external tanks. Cockpit pressurized and air-conditioned.

Firepower includes six .50 caliber machine guns and standard fixed equipment, 32 five-inch HVARs or two 11.5-inch HVVARs and 16 five-inch HVAHs. Napalm bombs: Two 1,000 lb. bombs and 18 five-inch HVARs. Various combinations possible. There were two mass overseas flights of F-84G's during the year, both by the 31st Fighter-Escort Wing. One was from Turner AFB, Albany, Georgia to Japan (10,670 miles) and the other made up of 58 planes from California to Hawaii. In flight refueling was from Boeing KB-29. All other data are classified.

SIKORSKY AIRCRAFT

DIVISION OF UNITED AIRCRAFT CORP.

Bridgeport, Conn.

Sikorsky 10-place helicopter

TYPE: Helicopter. DESIGNATION: (AF) H-19A, (N) HRS-1.

DATA

POWERPLANT: Pratt & Whitney Wasp R-1340 S3H2 600 hp. FUEL CAPACITY AND CONSUMPTION: 180 gal., 36 gal. per hr. GEAR: Quadricycle.

SPECS

MAIN ROTOR DIAMETER: 53 ft.; LENGTH 41 ft. 8½ in.; HEIGHT: 14 ft. 8 in.; WEIGHT EMPTY: 4,395 lb.; GROSS: 6,800 lb.; USEFUL LOAD: FUL LOAD: 2,405 lb.

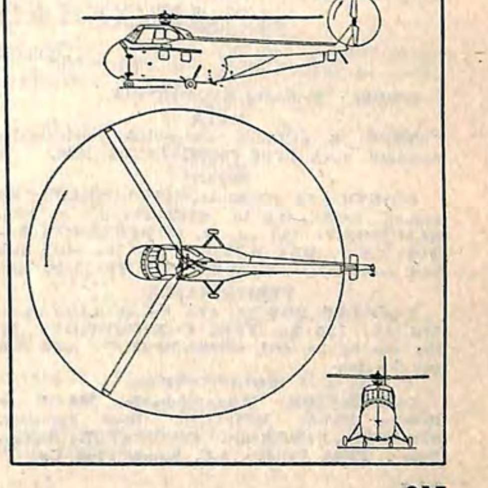
PERFORMANCE

SPEEDS AT SEA LEVEL: HIGH SPEED: 110 mph; CRUISING: 86 mph; MAXIMUM RATE OF CLIMB AT SEA LEVEL: 1,130 ft. per min.; SERVICE CEILING: 13,500 ft.; RANGE: (with reserve) 477 mi.

REMARKS

The H-19 is a 10-place, closed, land helicopter fitted for rescue cargo and passenger transportation.

The HRS-1 was used by the Marines to land an entire fully-equipped battalion on a Korean hilltop during late 1951. Twelve took part, completing the mission in six hours without a casualty.



CHAPTER EIGHT

Engines in Production

The following list of aircraft engines includes only those in production during the year. Unless otherwise noted the specifications are the manufacturers'.

AEROJET ENGINEERING CORP.

Azusa, Cal.

MODEL: 14AS-1000 (Jato Motor).

DATA

Type: Solid propellant rocket.

SPECS

DIAMETER: 10.25 in. LENGTH: 35.4 in. EMPTY WEIGHT: 120 lb. LOADED WEIGHT: 200 lb.

PERFORMANCE

RATING: 1,000 lb. thrust, or 330 hp, for a duration of 14 sec.

EQUIPMENT

Jato motor consists of a steel cylinder closed on fore end with exhaust nozzle, igniter and safety diaphragm located on aft end. Thrust is transmitted through three mounting lugs welded on the cylinder to the aircraft attachment fittings.

REMARKS

The 14AS-1000 Jato motor is CAA-certificated and its use on the Douglas DC-3 and Douglas DC-4 airplanes has been approved by CAA for commercial airline operation.

MODEL: Liquid rocket engine (Aerobee).

DATA

TYPE: Liquid bi-propellant rocket, gas or chemically pressurized.

SPECS

DIAMETER: 15 in. LENGTH: 130 in.

EQUIPMENT

Assembly consists of a cylindrical section which contains the oxidizer, fuel and pressurizing tanks. The pressure regulator and rocket motor are attached to the tank section.

REMARKS

This rocket powerplant is used to propel the Aerobee high-altitude sounding rocket.

AIRCOOLED MOTORS, INC.

Syracuse, N. Y.

MODEL: Franklin 6AG4-185B12.

DATA

TYPE: 6 cylinder, air-cooled, horizontally opposed. CAA TYPE CERTIFICATE: 238.

SPECS

LENGTH: 40 19/32 in. FUEL GRADE: 80 octane. BORE: 4.5 in. STROKE: 3.5 in. DISPLACEMENT: 335 cu. in. COMPRESSION RATIO: 7.5:1. DRY WEIGHT: 360 lbs. with hub and accessories. WEIGHT PER HP: 1.86 lbs.

PERFORMANCE

TAKE-OFF POWER. 183 hp at 3.100 rpm. CRUISE: 135 hp. FUEL CONSUMPTION: .51 lbs. per hp hr. OIL CONSUMPTION: .002 lbs. per hp hr.

EQUIPMENT

CARBURETOR: Marvel-Schebler MA4-5 or Bendix PS5-C. IGNITION: Dual Scintilla. STARTER: Delco-Remy. GENERATOR: Delco-Remy. FUEL PUMP: A.C. Spark Plug Co.

MODEL: Franklin 6A4-165-B3.

DATA

TYPE: 6 cylinder, air-cooled, horizontally opposed. CAA TYPE CERTIFICATE: 238.

SPECS

LENGTH: 37 13/32 in. FUEL GRADE: 80 octane. BORE: 4.5 in. Stroke: 3.5 in. DISPLACEMENT: 335 cu. in. COMPRESSION RATIO: 7:1. DRY WEIGHT: 324 lb. with hub and accessories. WEIGHT PER HP: 1.97 lb.

PERFORMANCE

TAKE-OFF POWER: 165 hp at 2.800 rpm. CRUISE: 124 hp at 2.800 rpm. FUEL CONSUMPTION: .5 lb. per hp hr. OIL CONSUMPTION: .002 lb. per hp hr.

EQUIPMENT

CARBURETOR: Marvel-Schebler MA4-5 or Bendix PS5-6. IGNITION. Dual Scintilla S6N21. STARTER: Delco-Remy. GENERATOR: Delco-Remy. FUEL PUMP: AC.

MODEL: Franklin 4A4-100-B3.

DATA

TYPE: 4 cylinder, air-cooled, horizontally opposed. CAA TYPE CERTIFICATE: 239.

SPECS

LENGTH: 27 15/16 in. FUEL GRADE: 80 octane. BORE: 4.5 in. STROKE: 3.5 in. DISPLACEMENT: 225 cu. in. COMPRESSION RATIO: 7:1. DRY WEIGHT: 230 lb. with hub and accessories. WEIGHT PER HP: 2.3 lb.

PERFORMANCE

TAKE-OFF POWER: 100 hp at 2,550 rpm. CRUISE: 75 hp at 2,300 rpm. FUEL CONSUMPTION: .5 lb. per hp hr. OIL CONSUMPTION: .002 lb. per hp hr.

EQUIPMENT

CARBURETOR: Marvel-Schebler MA3SPA. IGNITION: Dual Eisemann LA-4. STARTER: Auto Lite or Delco-Remy. GENERATOR: Auto Lite or Delco-Remy. FUEL PUMP: A. C. Spark Plug Co.

MODEL: Franklin 6V4-200-C32, C33.

DATA

TYPE: 6 cylinder, air-cooled, horizontally opposed. CAA TYPE CERTIFICATE: 244.

SPECS

LENGTH: 29 1/32 in. FUEL GRADE: 91 octane. BORE: 4.5 in. STROKE: 3.5 in. DISPLACEMENT: 335 cu. in. COMPRESSION RATIO: 8.5:1. DRY WEIGHT: 333 lb. with hub and accessories. WEIGHT PER HP: 1.66 lb.

PERFORMANCE

TAKE-OFF POWER: 200 hp. FUEL CONSUMPTION: .52 lb. per hp hr. OIL CONSUMPTION: .002 lb. per hp hr.

EQUIPMENT

CARBURETOR: Marvel-Schebler MA4-5 or Bendix PS5-C. IGNITION: Dual Scintilla S6-RN21. STARTER: Delco-Remy. GENERATOR: Delco-Remy. FUEL PUUMP: Weldon.

REMARKS

This model was designed for helicopter installations.

MODEL: Franklin 6V4-178-B32 and B-33.

DATA

TYPE: 6 cylinder. air-cooled. horizontally opposed; 178 hp; CAA TYPE CERTIFICATE: 244.

SPECS

LENGTH: 34¾ in. FUEL GRADE: 80 octane. BORE: 4.5 in. STROKE: 3.5 in. DISPLACEMENT: 335 cu. in. COMPRESSION RATIO: 7:1. DRY WEIGHT: 308 lb. with hub and accessories. WEIGHT PER HP: 1.73 lb.

PERFORMANCE

TAKE-OFF POWER: 178 hp. FUEL CONSUMPTION: .52 lb. per hp hr. OIL CONSUMPTION: .002 lb. per hp hr.

EQUIPMENT

CARBURETOR: Marvel-Schebler MA4-5 or Bendix PS5-C. IGNITION. Dual Scintilla S6RN21. STARTER: Delco-Remy. GENERATOR: Delco-Remy. FUEL PUMP: Weldon.

MODEL: Franklin 6A4-150-B3.

DATA

TYPE: 6 cylinder, air-cooled, horizontally opposed. CAA TYPE CERTIFICATE: 238.

SPECS

LENGTH: 37⅜ in. FUEL GRADE: 80 octane. BORE: 4.5 in. STROKE: 3.5 in. DISPLACEMENT: 335 cu. in. COMPRESSION RATIO: 7:1. DRY WEIGHT: 321 lb. with hub and accessories. WEIGHT PER HP: 2.14 lb.

PERFORMANCE

TAKE-OFF POWER: 150 hp at 2,600 rpm. CRUISE: 113 hp at 2,350 rpm. FUEL CONSUMPTION: .5 lb. per hp hr. OIL CONSUMPTION: .002 lb. per hp hr.

EQUIPMENT

CARBURETOR: Marvel-Schebler MA-3SPA. IGNITION: Dual Eisemann LA-6 or Scintilla S6RN21. STARTER: Delco-Remy. GENERATOR: Delco-Remy. FUEL PUMP: A. C. Spark Plug Co.

MODEL: Franklin 6V6-245-B16F.

DATA

TYPE: 6 cylinder, air-cooled, horizontally opposed. CAA TYPE CETIFICATE: 258.

SPECS

LENGTH: 39 7/32 in. FUEL GRADE: 80 octane. BORE: 4.75 in. STROKE: 4 in. DISPLACEMENT: 425 cu. in. COMPRESSION RATIO: 7.5:1. DRY WEIGHT: 353 lb. with hub and accessories. WEIGHT PER HP: 2.26 lb.

PERFORMANCE

TAKE-OFF POWER: 245 hp at 3,275 rpm. FUEL CONSUMPTION: .52 lb. per hp hr. OIL CONSUMPTION: .002 lb. per hp hr.

EQUIPMENT

CARBURETOR: Bendix PS-7BD. IGNITION: Dual Eisemann LA-6.

REMARKS

Used in Sikorsky helicopters.

ALLISON DIVISION
GENERAL MOTORS CORP.

Indianapolis, Ind.

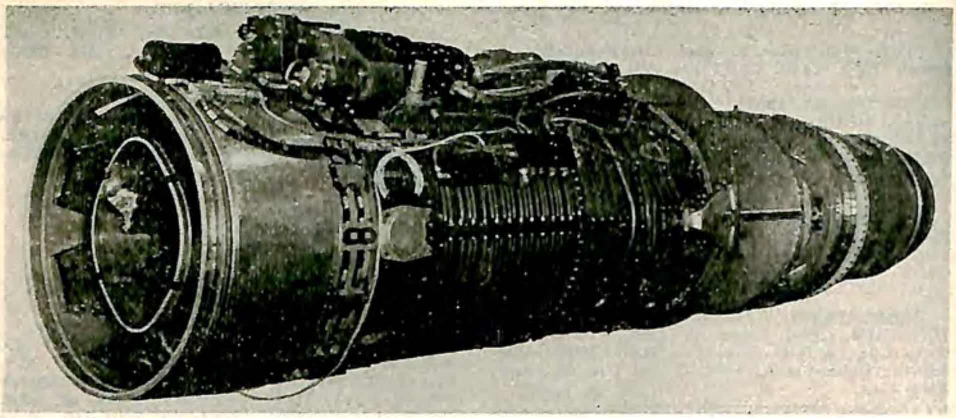
MODEL: J-33-A-16.
TYPE: Centrifugal-flow turbojet.

SPECS

DIAMETER: 49.5 in LENGTH: 99.25 in. WEIGHT: 1,945 lb. FUEL GRADE: AN-F-48.

REMARKS

All other data restricted. Used in Grumman F9F-4 Panther.



Allison J-71 turbojet

MODEL: J71.
TYPE: Axial-flow turbojet.

SPECS

DIAMETER: 37 in. LENGTH: 179 in. WEIGHT: 3,650 lb.

PERFORMANCE

All performance data are classified.

REMARKS

The new J17 series turbo-jet engines are the latest development of the axial flow multi-stage compressor engine made by Allison. This series of super jets is the most powerful ever released for production. The new engine has 16 axial stages of compression with a 3 stage turbine. It is an all-weather engine, incorporating de-icing features and has substantially improved fuel economy. The engine features a cannular combustion section. There are 10 individual inner cans within the single outer can and compressed air flows from the outer section to the inner lines for combustion.

Entirely independent of external oil supply, the J71 has its own complete oil system. It also has its own hydraulic system to operate a variable-area jet nozzle and retractable air inlet screens.

MODEL J33-A-35.
TYPE: Centrifugal-flow turbojet.

SPECS

DIAMETER: 49.5 in. LENGTH: 107 in. WEIGHT: 1,820 lb. COMPRESSION RATIO: 4.41:1. AIR MASS FLOW: 87 lb. per sec. EXHAUST TEMP.: 1,265 deg. F. FUEL GRADE: J-P3. FUEL CONSUMPTION: 1.14 lbs. per lb. per hr.

PERFORMANCE

TAKE-OFF: 5,400 lb. at 11,750 rpm with water injection, 4,600 lb. at 11,750 rpm dry. NORMAL: 3,900 lb. at 11,250 rpm. CRUISE: 3,160 lb. at 10,575 rpm.

REMARKS

Used in Lockheed T-33 and TO-2 two-seat jet trainers.

MODEL: J35-A-33.
TYPE: Axial-flow turbojet.

SPECS

DIAMETER: 37 in. LENGTH: 146 in. WEIGHT: 2,230 lb. COMPRESSION RATIO: 5.1:1. AIR MASS FLOW: 90 lb. per sec. EXHAUST TEMP.: 1,340 deg. F. FUEL GRADE: JP 3. FUEL CONSUMPTION: .088 lbs. per lb. per hr.

PERFORMANCE

TAKE-OFF: 5,600 lb. at 8,000 rpm. NORMAL: 4,990 lb. at 7,650 rpm. CRUISE: 4,410 lb. at 7,400 rpm.

REMARKS

Afterburner equipped. Used in Northrop F-89D all-weather Scorpion.

MODEL: J35-A-29.
TYPE: Axial-flow turbojet.

SPECS

DIAMETER: 37 in. LENGTH: 146 in. WEIGHT: 2,305 lb. COMPRESSION RATIO: 5.1:1. AIR MASS FLOW: 90 lb. per sec. FUEL GRADE: JP-3. FUEL CONSUMPTION: 1.03 lbs. lbs. per lb. per hr.

PERFORMANCE

TAKE-OFF: 5,600 lb. at 8,000 rpm. NORMAL: 4,900 lb. at 7,650 rpm. CRUISE: 4,410 lb. at 7,400 rpm.

REMARKS

Used in Republic F-84G long-range Thunderjet fighter.

MODEL: T38-A-4.

SPECS

DIAMETER: 40 in. LENGTH: 149 in. WEIGHT: 1,650 lb. AIR MASS FLOW: 30 lb. per sec. COMPRESSOR: 17-stage axial. TURBINE: 4-stage axial. FUEL GRADE: Mil-F-5624. FUEL CONSUMPTION: 0.603 lbs. per lb. per hr. OIL CONSUMPTION: 2.5 lb. per hp hr.

PERFORMANCE

TAKE-OFF: 2,750 ESHP at 14,300 rpm.

REMARKS

Used in Convair Turbo-Liner, first U. S. turboprop-powered transport.

MODEL: T40-A-6, -10.

TYPE: Axial-flow turboprop.

SPECS

LENGTH: 185 in. WIDTH: 45 in. HEIGHT: 45 in. WEIGHT: 2,575 lb. COMPRESSOR: 19-stage, axial-flow. TURBINE: 4-stage, axial-flow. AIR MASS FLOW: 60 lb. per sec. FUEL GRADE: AN-F-48A. FUEL CONSUMPTION: 0.603 lb. per hp. hr. OIL CONSUMPTION: 4 lb. per hr.

PERFORMANCE

TAKE-OFF: 5,500 ESHP at 14,300 rpm.

REMARKS

Model -6 is used in Douglas A2D Skyshark carrier bomber and North American A2J-1. The model -10 is similar, except for relocation of accessories, and is used in the Convair R3Y flying boat.

MODEL: T40-A-4 (500)

TYPE: Axial-flow turboprop.

SPECS

LENGTH: 248 in. WIDTH: 43 in. HEIGHT: 31 in. WEIGHT: 2,618 lb. COMPRESSOR: 17-stage, axial-flow. TURBINE: 4-stage, axial-flow. AIR MASS FLOW: 60 lb. per sec. FUEL GRADE: AN-F-28. FUEL CONSUMPTION: 0.640 lb. per hp. hr. OIL CONSUMPTION: 4 lb. per hr.

PERFORMANCE

TAKE-OFF: 5,500 ESHP at 14,300 rpm.

REMARKS

Used in Convair XP5Y-1, prototype of R3Y transport flying boat.

CONTINENTAL MOTORS CORPORATION

Muskegon, Mich.

MODEL: A65-8F.

DATA

TYPE: 4 cylinder, air-cooled, horizontally opposed. CAA TYPE CERTIFICATE: 205.

SPECS

LENGTH: 30.41 in. FUEL GRADE: 73 octane. BORE: 3.875 in. STROKE: 3.625 in. DISPLACEMENT: 171 cu. in. COMPRESSION RATIO: 6.3:1 DRY WEIGHT: 176 lb. with hub and accessories. WEIGHT PER HP: 2.7 lb.

PERFORMANCE

TAKE-OFF POWER: 65 hp at 2,350 rpm. CRUISE: 53 hp at 2,150 rpm. FUEL CONSUMPTION: .49 lb. per hp hr.

EQUIPMENT

CARBURETOR: Stromberg NA-S3B. IGNITION: Eisemann AM4 or J. I. Case 4-CAM. FUEL PUMP: A. C. Spark Plug Co.

MODEL: C85-12F.

DATA

TYPE: 4 cylinder, air-cooled, horizontally opposed. CAA TYPE CERTIFICATE: 233.

SPACE

LENGTH: 32 in. FUEL GRADE: 73 octane. BORE: 4.062 in. STROKE: 3.625 in. DISPLACEMENT: 188 cu. in. COMPRESSION RATIO: 6.3:1. DRY WEIGHT: 182 lb. with hub and accessories. WEIGHT PER HP: 2.14 lb.

PERFORMANCE

TAKE-OFF POWER: 85 hp at 2,575 rpm. CRUISE: 63 hp at 2,400 rpm. FUEL CONSUMPTION: 5.4 gal. per hr.

EQUIPMENT

CARBURETOR: Bendix-Stromberg NA-S3A1. IGNITION: Scintilla S4LN-21. STARTER: Delco-Remy. GENERATOR: Delco-Remy. FUEL PUMP: A. C. Spark Plug Co.

MODEL: C90-12F.

DATA

TYPE: 4 cylinder, air-cooled, horizontally opposed. CAA TYPE CERTIFICATE: 252.

SPECS

LENGTH: 31¼ in. FUEL GRADE: 80 octane. BORE: 4.062 in. STROKE: 3.875 in. DISPLACEMENT: 200.91 cu. in. COMPRESSION RATIO: 7:1. DRY WEIGHT: 186 lb. with hub and accessories. WEIGHT PER HP: 2.07 lb.

PERFORMANCE

TAKE-OFF POWER: 90 hp at 2,475 rpm. CRUISE: 68 hp at 2,350 rpm. FUEL CONSUMPTION: .52 lb. per hp hr.

EQUIPMENT

CARBURETOR: Bendix-Stromberg NA-S3A1. IGNITION: Scintilla S4LN-21. STARTER: Delco-Remy. GENERATOR: Delco-Remy. FUEL PUMP: A. C. Spark Plug Co.

MODEL C125-2.

DATA

TYPE: 6 cylinder, air-cooled, horizontally opposed. CAA TYPE CERTIFICATE: 236.

SPECS

LENGTH: 41 in. FUEL GRADE: 73 octane. BORE: 4.062 in. STROKE: 3.625 in. DISPLACEMENT: 282 cu. in. COMPRESSION RATIO: 6.3:1. DRY WEIGHT: 257 lb. with hub and accessories. WEIGHT PER HP: 2.05 lb.

PERFORMANCE

TAKE-OFF POWER: 125 hp at 2,550 rpm. CRUISE: 98 hp at 2,400 rpm. FUEL CONSUMPTION: .5 lb. per hp hr.

EQUIPMENT

CARBURETOR: Marvel MA-3SPA. IGNITION: Scintilla C6LN-21. STARTER: Delco-Remy. GENERATOR: Delco-Remy. FUEL PUMP: A. C. Spark Plug Co.

MODEL: C145-2.

DATA

TYPE: 6 cylinder, air-cooled, horizontally opposed. CAA TYPE CERTIFICATE: 253.

SPECS

LENGTH: 41 in. FUEL GRADE: 80 octane. BORE: 4.062 in. STROKE: 3.875 in. DISPLACEMENT: 301.37 cu. in. COMPRESSION RATIO: 7:1. DRY WEIGHT: 265 lb. WEIGHT PER HP: 1.77 lb.

PERFORMANCE

TAKE-OFF POWER: 145 hp at 2.700 rpm; CRUISE: 108 hp at 2,450 rpm; FUEL CONSUMPTION: .5 lb. per hp hr.

EQUIPMENT

CARBURETOR: Marvel MA-3SPA. IGNITION: Scintilla S6LN-21. STARTER: Delco-Remy. GENERATOR: Delco-Remy. FUEL PUMP: A. C. Spark Plug Co.

MODEL: E185.

DATA

TYPE: 6 cylinder, air-cooled, horizontally opposed. CAA TYPE CERTIFICATE: 246.

SPECS

LENGTH: 46.66 in. FUEL GRADE: 80 octane. BORE: 5 in. STROKE: 4 in. DISPLACEMENT: 471 cu. in. COMPRESSION RATIO: 7:1. DRY WEIGHT: 350 lb. WEIGHT PER HP: 1.89 lb.

PERFORMANCE

TAKE-OFF POWER: 205 hp at 2.600 rpm. CRUISE: 130 hp at 2.050 rpm. FUEL CONSUMPTION: .5 lb. per hp hr.

EQUIPMENT

CARBURETOR: Bendix-Stromberg PS-5C. IGNITION: Scintilla S6LN-21. STARTER: Provisions for direct cranking starter. GENERATOR: Delco-Remy. FUEL PUMP: Thompson or Romec. This engine also available with full AN accessory section.

MODEL: E-225.

DATA

TYPE: 6 cylinder, air-cooled. horizontally opposed. CAA TYPE CERTIFICATE: 267.

SPECS

LENGTH: 48.4 in. FUEL GRADE: 80/86 octane. BORE: 5 in. STROKE: 4.00 in.

PERFORMANCE

TAKE-OFF POWER: 225 hp at 2,650 rpm. CRUISE: 170 hp at 2,400 rpm. FUEL CONSUMPTION: 5 lb. per hp hr.

EQUIPMENT

CARBURETOR: Bendix-Stromberg PS-5C. IGNITION: Scintilla S6LN-21. STARTER: Eclipse Type 397-13. GENERATOR: Delco-Remy. FUEL PUMP: Romec. This engine also available with full AN accessory section.

MODEL O-315.

DATA

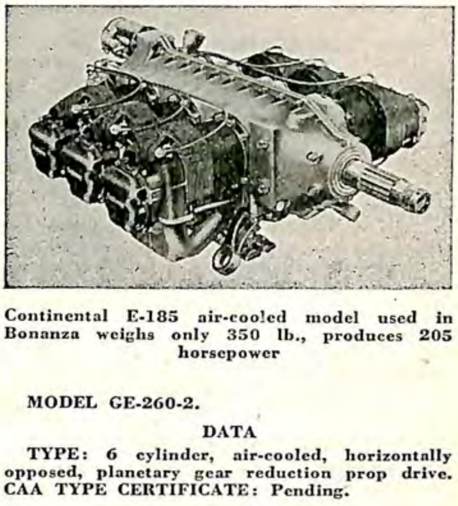
TYPE: 4 cylinder, air-cooled, horizontally opposed.

SPECS

FUEL GRADE: 80/86 octane. BORE: 5 in. STROKE: 4 in. DISPLACEMENT: 315 cu. in. COMPRESSION RATIO: 7:1. DRY WEIGHT: 287 lbs. WEIGHT PER HP: 1.91 lbs.

PERFORMANCE

NORMAL RATED POWER: 150 hp at 2,600 rpm. CRUISE: 115 hp at 2400 rpm. FUEL CONSUMPTION: .5 lb. per hp hr.



Continental E-185 air-cooled model used in Bonanza weighs only 350 lb., produces 205 horsepower

MODEL GE-260-2.

DATA

TYPE: 6 cylinder, air-cooled, horizontally opposed, planetary gear reduction prop drive. CAA TYPE CERTIFICATE: Pending.

SPECS

LENGTH: 50.4 in. FUEL GRADE: 80/86 octane. BORE: 5 in. STROKE: 4 in. DISPLACEMENT: 471 cu. in. COMPRESSION RATIO: 7:1. DRY WEIGHT: 431 lbs. WEIGHT PER HP: 1.66 lbs.

PERFORMANCE

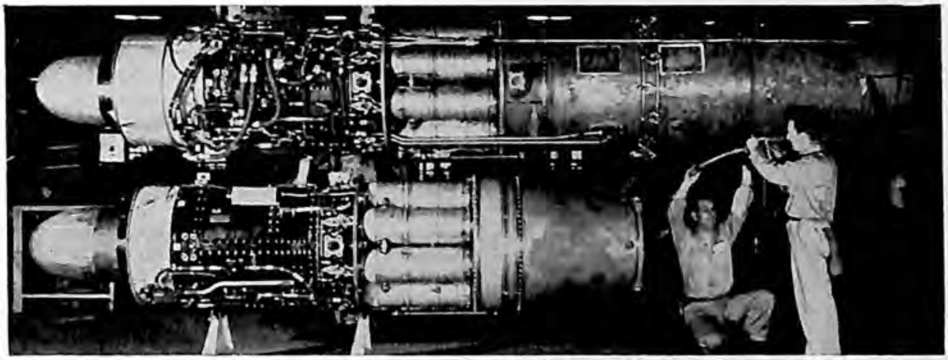
TAKE-OFF POWER: 260 hp at 3,100 rpm. CRUISE: 195 hp at 2,700 rpm. Prop drive reduction ratio .69:1. FUEL CONSUMPTION: .5 lb. per hp hr.

EQUIPMENT

CARBURETOR: Bendix-Stromberg PS-5C. IGNITION: Scintilla S6LN-21. STARTER: Eclipse. GENERATOR: Delco-Remy. FUEL PUMP: Romec. This engine also available with full AN accessory section.

GENERAL ELECTRIC CO.

Schenectady, N. Y.



General Electric J47-GE-17 with afterburner compares length with standard J47-GE-11 model below

MODEL: J47-GE-13.

DATA

TYPE: Axial-flow turbojet.

SPECS

WEIGHT: 2,500 lb. (approx.). FRONTAL AREA: 7.35 sq. ft. LENGTH: 144 in. DIAMETER: 36.75 in. COMPRESSOR: 12 stage axial flow. COMPRESSION RATIO: 5:1. TURBINE: single stage. INLET AIR FLOW: 90 lb. per sec. FUEL GRADE: AN-F-58 or 100/130 gasoline.

PERFORMANCE

TAKE-OFF THRUST: Over 5,200 lb. at 7,950 rpm at sea level. NORMAL RATING: 4,320 lb. at 7,370 rpm. CRUISE RATING: 3,700 lb. at 7,000 rpm.

MODEL: J47-GE-17, 23, 25, 27.

The -17 engine is the standard production model redesigned to reduce its use of strategic materials by using substitute materials wherever possible. This redesign resulted in a saving of about 20 percent in special metals used previously. In addition, the engine is equipped with a long afterburner assembly. This auxiliary unit provides a substantial increase in thrust for short periods by the injection of raw fuel into the hot tailpipe gases, resulting in additional fuel consumption. The -23, 25, and 27 engines feature special anti-icing equipment and a special ignition system making starts possible at altitudes of more than 50,000 ft. Thrust is over 5,800 lb.

MODEL: J73.

DATA

TYPE: Axial-flow turbojet.

SPECS

DIAMETER: 36.75 in. LENGTH: 146 in.

PERFORMANCE

STATIC THRUST: In excess of 5,800 lb. dry Afterburner thrust has been estimated at 14,000 lb. by some experts not in on the development or production of this model.

REMARKS

Formerly J47-GE-21, design is virtually new engine with cannular type combustion chamber arrangement, all-weather and self-contained electronic control equipment.

JACOBS AIRCRAFT ENGINE CO.

Pottstown, Pa.

MODEL: R-775A Series.

DATA

TYPE: 7 cylinder, air-cooled. CAA TYPE CERTIFICATE: 237.

SPECS

DIAMETER: 44 in. LENGTH: 39.5 in. FUEL GRADE: 80 octane. BORE: 5.25 in. STROKE: 5 in. DISPLACEMENT: 757 cu. in. COMPRESSION RATIO: 6:1. DRY WEIGHT: 505 lb. WEIGHT PER HP: 1.68 lb.

PERFORMANCE

TAKE-OFF POWER: 300 hp at 2,200 rpm. FUEL CONSUMPTION: .45 lb. per hp hr. OIL CONSUMPTION: .010 lb. per hp hr.

EQUIPMENT

CARBURETOR: Bendix-Stromberg NA-B7A. IGNITION: 1 Scintilla VMN-7DF5, 1 Scintilla W67A distributor with coil. STARTER: Eclipse. GENERATOR: Eclipse.

REMARKS

Used in Cessna 195 aircraft.

LYCOMING-SPENCER DIVISION
AVCO MFG. CORP.
Williamsport, Pa.

MODEL: 0-235-C1.

DATA

TYPE: 4 cylinder, air-cooled, horizontally opposed; 115 hp. **CAA TYPE CERTIFICATE:** 223.

SPECS

LENGTH: 29.56 in. **FUEL GRADE:** 80 octane. **BORE:** 4.375 in. **STROKE:** 3.875 in. **DISPLACEMENT:** 233.3 cu. in **COMPRESSION RATIO:** 6.75:1. **DRY WEIGHT:** 236 lb. with hub and accessories. **WEIGHT PER HP:** 2.05 lb.

PERFORMANCE

TAKE-OFF POWER: 115 hp 2,800 rpm. **CRUISE:** 86 hp at 2,350 rpm. **FUEL CONSUMPTION:** .52 lb. per hp hr. **OIL CONSUMPTION:** .012 lb. per hp hr.

EQUIPMENT

CARBURETOR: Marvel - Schebler MA-3A. **IGNITION:** Dual Scintilla S4LN-21. **STARTER:** Delco-Remy. **GENERATOR:** Delco-Remy.

MODEL: GO-435-C2

DATA

TYPE: 6-cylinder, horizontally-opposed, geared, air-cooled. **APPROVED TYPE CERTIFICATE** No. 228.

SPECS

LENGTH: 39.57 in. **HEIGHT:** 29.59 in. **WIDTH:** 33.12 in. **BORE:** 4.875 in. **STROKE:** 3.875 in. **DISPLACEMENT:** 434 cu. in. **COMPRESSION RATIO:** 7.3:1. **WEIGHT:** 432 lb. **FUEL GRADE:** 91/98.

PERFORMANCE

TAKE-OFF Power: 260 hp at 3,400 rpm. **RATED POWER:** 240 hp at 3,000 rpm. **FUEL CONSUMPTION:** 0.47 lb. per hp. hr.

EQUIPMENT

CARBURETOR: Marvel Schebler MA-4-5. **MAGNETOS:** Scintilla SF6LN-8. **SPARK PLUGS:** Autolite SH-2K.

MODEL: 0-435-A.

DATA

TYPE: 6 cylinder, air-cooled, horizontally opposed. **CAA TYPE CERTIFICATE:** 228.

SPECS

LENGTH: 38.10 in. **FUEL GRADE:** 80 octane. **BORE:** 4.875 in. **STROKE:** 3.875 in. **DISPLACEMENT:** 434 cu. in. **COMPRESSION RATIO:** 6:5:1. **DRY WEIGHT:** 392 lb. with hub and accessories. **WEIGHT PER HP:** 2.06 lb.

PERFORMANCE

TAKE-OFF POWER: 190 hp at 2,550 rpm. **CRUISE:** 145 hp at 2,300 rpm. **FUEL CONSUMPTION:** .52 lb. per hp hr. **OIL CONSUMPTION:** .0012 lb. per hp hr.

EQUIPMENT

CARBURETOR: Marvel Schebler MA-4-5 **IGNITION:** Dual Scintilla SFGLN-8. **STARTER:** Delco-Remy. **GENERATOR:** Delco-Remy.

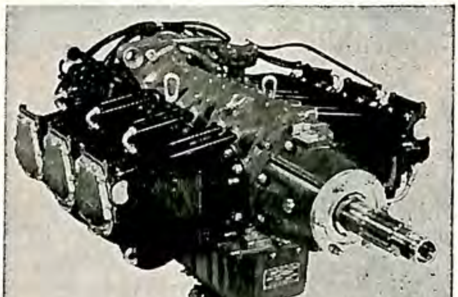
MODEL: 0-290-D.

DATA

TYPE: 4-cylinder, horizontally-opposed, direct-drive, air-cooled. **APPROVED TYPE CERTIFICATE** No. 229.

SPECS

LENGTH: 29.56 in. **HEIGHT** 22.81 in.



Lycoming GO-435-C2

WIDTH: 32.32 in. **BORE:** 4.875 in. **STROKE:** 3.875 in. **DISPLACEMENT:** 289 cu. in. **COMPRESSION RATIO:** 6.50:1. **WEIGHT:** 255 lb. **FUEL GRADE:** 80 octane.

PERFORMANCE

TAKE-OFF POWER: 130 hp at 2,800 rpm. **RATED POWER:** 125 hp at 2,600 rpm. **FUEL CONSUMPTION:** 0.49 lb. per hp. hr.

EQUIPMENT

CARBURETOR: Marvel-Schebler MA-3SPA. **MAGNETOS:** Scintilla S4LN-20/21. **STARTER:** Delco-Remy. **GENERATOR:** Delco-Remy.

PRATT & WHITNEY AIRCRAFT
DIVISION OF UNITED AIRCRAFT CORP.
East Hartford, Conn.

MODEL: Twin Wasp D Series, (R-2000).

DATA

TYPE: 14 cylinder, air-cooled, radial. **CAA TYPE CERTIFICATE:** 230.

SPECS

DIAMETER: 49.1 in. **LENGTH** 59.66 in. **FUEL GRADE:** 100/130. **BORE:** 5.75 in. **STROKE:** 5.5 in. **DISPLACEMENT:** 2,004 cu. in. **COMPRESSION RATIO:** 6.5:1. **DRY WEIGHT:** 1605 lb., maximum.

PERFORMANCE

TAKE-OFF: 1,450 at 2,700 rpm and 2,800 ft. **NORMAL RATED POWER:** 1,200 hp at 2,550 rpm and 6,400 ft.

EQUIPMENT

CARBURETOR: Stromberg PD-12F13. IGNITION: two Scintilla SF-14LN-8.

REMARKS

Powers Douglas C-54 military transport, workhorse of World War II, the Berlin Airlift and the Trans-Pacific Airlift in support of the Korean campaign.

MODEL: Double Wasp CA and CB series, (R-2800)

DATA

TYPE: 18 cylinder, air-cooled, radial. CAA TYPE CERTIFICATES: 231 and 264.

SPECS

DIAMETER: 52.8 in. LENGTH: 81.40 in. FUEL GRADE: 100/130 or 108/135. BORE: 5.75 in. STROKE: 6 in. DISPLACEMENT: 2,804 cu. in. COMPRESSION RATIO: 6.75 to 1. DRY WEIGHT: 2,390 lb., maximum.

PERFORMANCE

TAKE-OFF POWER: 2,400 hp at 2,800 rpm at 4,000 ft. with water injection; 2,050 hp at 2,700 rpm at 6,000 ft. dry. NORMAL RATED POWER: 1,800 hp at 2,600 rpm at 8,500 ft.

EQUIPMENT

CARBURETOR: Stromberg PR-58E5. IGNITION: Scintilla DLN-10 low tension.

REMARKS

The CA series includes the -3, -15, and -18 models. The CB series includes the -3, -4, -16 and -17 models. Essential differences are in supercharger gear ratios and weights. Most other parts are interchangeable. Military versions of the Double Wasp power the following production aircraft: Beech T-36, Bell XHSL-1 helicopter, Chase C-123 transport, Convair T-29 trainer, Douglas C-118A cargo, Grumman AF-2S and -2W hunter-killer teams, North American AJ-1 carrier bomber and Vought F4U-5N and AU-1 fighter-bombers. Commercial versions power the Convair 240 and 340 transports, Douglas DC-6, -6A, and -6B transports and Martin 2-0-2A and 4-0-4 transports.

MODEL: Wasp Major CB Series, (R-4360).

DATA

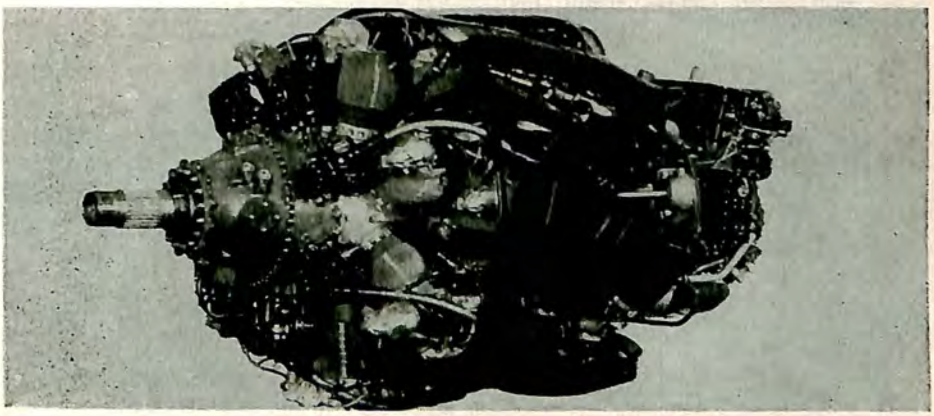
TYPE: 28 cylinder, air-cooled, radial. CAA TYPE CERTIFICATE: 247.

SPECS

DIAMETER: 55 in. LENGTH: 96.5 in. FUEL GRADE: 108/135. BORE: 5.75 in. STROKE: 6 in. DISPLACEMENT: 4,363 cu. in. COMPRESSION RATIO: 6.7:1. DRY WEIGHT: 3,682 lb.

PERFORMANCE

TAKE-OFF POWER: 3,500 hp at 2,700 rpm and 500 ft. (with water); 3,250 hp at 2,700 rpm and 700 ft. (without water). NORMAL RATED POWER: 2,650 hp at 2,550 rpm at 5,500 ft.



Pratt & Whitney Wasp Major is world's largest piston engine

EQUIPMENT

CARBURETOR: Stromberg PR-100B3. IGNITION: 4 Scintilla S14RN-15 low tension.

REMARKS

Wasp Major is used on Boeing B-50 bomber (4), Convair B-36 bomber (6), Boeing C-97 transport (4), Douglas C-124 transport (4), Convair C-99 transport (6), Fairchild C-119 Packet (2) and the Boeing Stratocruiser commercial transport (4). Development versions of the engine have already produced more than 4,000 hp, the most powerful reciprocating engine in the world.

MODEL. Turbo-Wasp JT-6B (J42).

DATA

TYPE: Centrifugal-flow turbojet. CAA TYPE CERTIFICATE No. 260.

SPECS

DIAMETER: 49.5 in. LENGTH: 103.25 in. FRONTAL AREA: 13.36 sq. ft. COMPRESSOR: Double-sided, single-stage, centrifugal. TURBINE: axial-flow, single-stage. TAILCONE: Stainless steel outer cone, fixed inner cone. COMBUSTORS: nine through-flow can-type. WEIGHT: 1,729 lb. FUEL GRADE: 100/130 gasoline.

PERFORMANCE

TAKE-OFF THRUST: 5,750 lb. at 12,300 rpm at sea level with water injection; 5,000 lb. dry. NORMAL RATED THRUST: 4,000 lb. at 11,600 rpm. INLET AIR FLOW: 88 lb. per sec. TAILPIPE TEMPERATURE: 1,365 deg. F at take-off thrust. SPECIFIC THRUST: 300 lb. per sq. ft. frontal area. SPECIFIC WEIGHT: 0.431 lb. per lb. thrust.

EQUIPMENT

IGNITION: Two BG igniter plugs with integral fuel nozzels. FUEL PUMP: Lucas. FUEL CONTROL: Bendix.

REMARKS

The J42, which powers the Grumman F9F-2 Panther, has been authorized by the Navy for 1,000 hours between major overhauls, the first jet engine in the world to attain this mark.

MODEL: Turbo-Wasp PT-2 (T34).

DATA

TYPE: Axial-flow turboprop.

SPECS

DIAMETER: 30.39 in. LENGTH: 155 in. COMPRESSOR: 13-stage axial-flow. TURBINE: three-stage, axial-flow. PROPELLER REDUCTION GEAR: two-stage, 11:1 ratio. WEIGHT: 2,520 lb. FUEL: Kerosene, gasoline or special jet fuel.

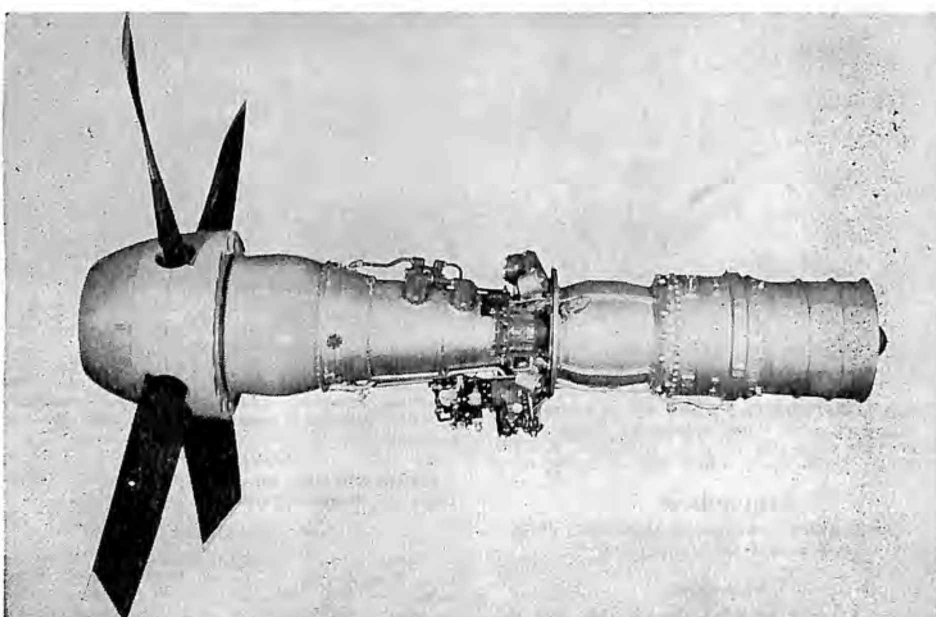
PERFORMANCE

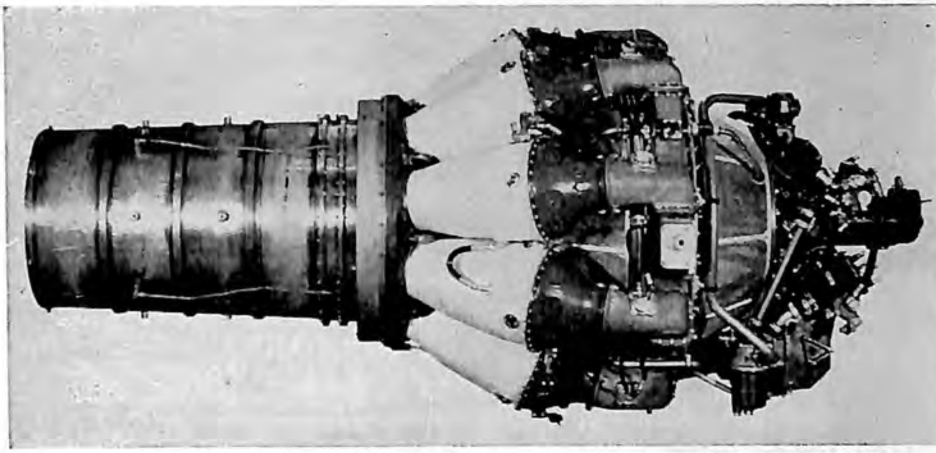
TAKE-OFF POWER: 5,700 hp. FUEL CONSUMPTION: 0.62 lb. hp hr.

REMARKS

The T34 will be installed in two Lockheed R7V-2's for Navy testing program and in the Douglas YC-124B for the Air Force.

Pratt & Whitney T34 powers DouglasYC-124B Globemaster





J42 Turbo-Wasp, delivering 5,000 lb. thrust dry, powers Grumman F9F-2 Panther

MODEL: Turbo-Wasp JT-7 (J48).

DATA

TYPE: Centrifugal-flow turbojet.

SPECS

DIAMETER: 50.25 in. LENGTH: 106.75 in. COMPRESSOR: double-sized, single-stage, centerifugal-flow. TURBINE: axial-flow, single-stage. WEIGHT: 2,000 lb. FUEL: Kerosene, gasoline or special jet fuel.

PERFORMANCE

STATIC THRUST: 6,250 lb. dry. Thrust is greatly increased using water injection and afterburning but augmented ratings are still classified.

REMARKS

The J48 powers the Grumman F9F-5 Panther and the swept-wing F9F-6 Cougar now going into service with the Navy and the Lockheed F-94C all-weather interceptor for the Air Force.

MODEL: Turbo-Wasp JT-3 (J57).

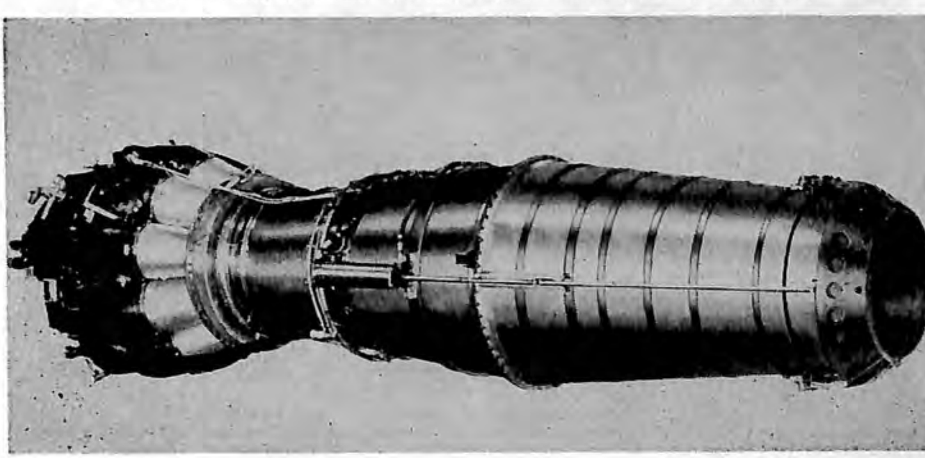
DATA

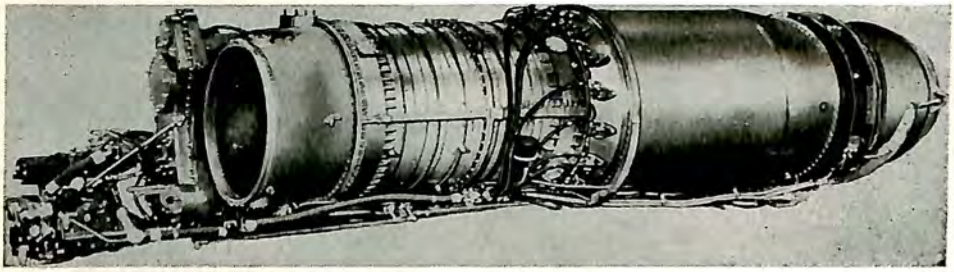
TYPE: Axial-flow turbojet.

REMARKS

Specifications and performance are still classified other than mention that engine is in the 10,000 lb. thrust class. It powers the Boeing B-52 long-range bomber and the Convair YB-60 swept-wing jet version of the familiar B-36.

Pratt & Whitney J48 with afterburner gives added thrust for emergency





Westinghouse J40 is used in McDonnell F3H fighter

WESTINGHOUSE ELECTRIC CORP.
AVIATION GAS TURBINE DIVISION
Philadelphia, Pa.

Model: J34-WE-34.
TYPE: Axial-flow turbojet.

SPECS

DIAMETER: 24 in. LENGTH: 120 in. TURBINE: two stage, axial-flow. COMPRESSOR: 11-stage, axial-flow. FUEL GRADE: AN-F-84 gasoline. WEIGHT: 1,233 lb.

PERFORMANCE

TAKE-OFF: 3,250 lb. NORMAL: 2,650 lb.

REMARKS

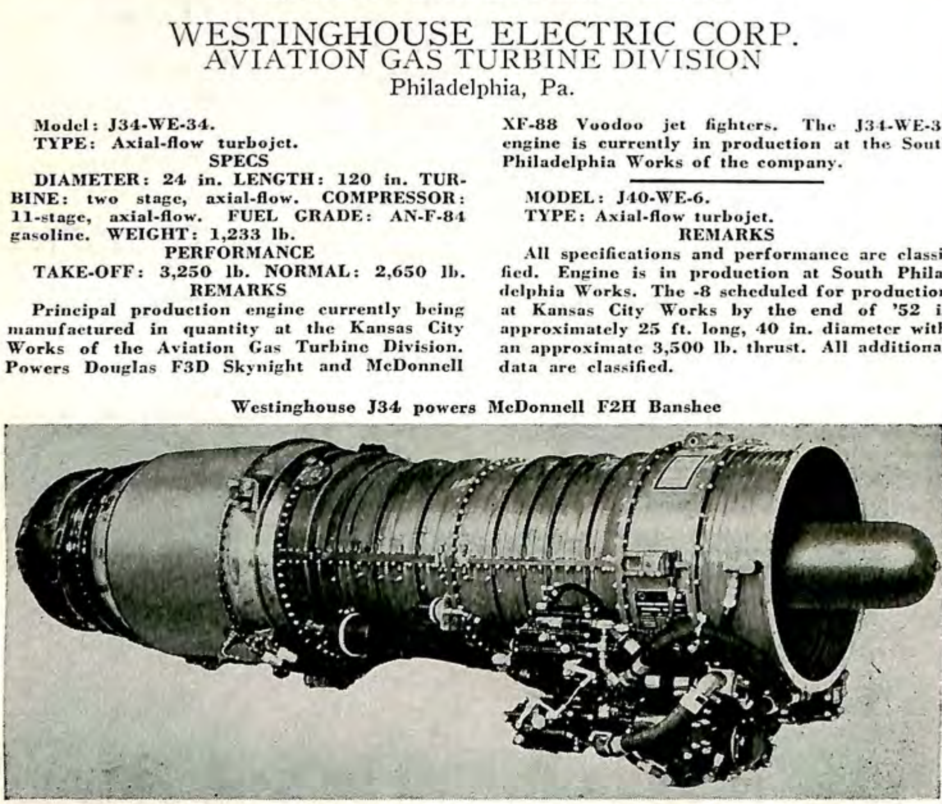
Principal production engine currently being manufactured in quantity at the Kansas City Works of the Aviation Gas Turbine Division. Powers Douglas F3D Skynight and McDonnell XF-88 Voodoo jet fighters. The J34-WE-34 engine is currently in production at the South Philadelphia Works of the company.

MODEL: J40-WE-6.
TYPE: Axial-flow turbojet.

REMARKS

All specifications and performance are classified. Engine is in production at South Philadelphia Works. The -8 scheduled for production at Kansas City Works by the end of '52 is approximately 25 ft. long, 40 in. diameter with an approximate 3,500 lb. thrust. All additional data are classified.

Westinghouse J34 powers McDonnell F2H Banshee



WRIGHT AERONAUTICAL CORP.
Wood-Ridge, N. J.

MODEL: R-1300-1.

DATA

TYPE: 7 cylinder, air-cooled, radial.

SPECS

LENGTH: 48.12. FUEL GRADE: 91/98 octane. BORE: 6.125 in. STROKE: 6.312 in. DISPLACEMENT: 1,300 cu. in. COMPRESSION RATIO: 6.2:1. DRY WEIGHT: 1,045 lb. WEIGHT PER HP: 1.28 lb.

PERFORMANCE

TAKE-OFF POWER: 800 hp at 2,600 rpm. CRUISE: 420 hp. FUEL CONSUMPTION: .48 lb. per hp hr. OIL CONSUMPTION: .015 lb. per hp hr.

EQUIPMENT

CARBURETOR: Stromberg PD9F1. IGNITION: Dual Bosch SF-7LU-2.

PERFORMANCE

TAKE-OFF POWER: 2,700 hp at 2,900 rpm. NORMAL RATED POWER: 1,900 hp. FUEL CONSUMPTION: .43 lb. per hp hr. OIL CONSUMPTION: .020 lb. per hp hr.

EQUIPMENT

CARBURETOR: Stromberg PR58U1. IGNITION: Dual Bosch DF 18LU-3.

REMARKS

The R-3350-30W is a compound version of the R-3350-26W using three small turbines driven by exhaust gas and connected by fluid couplings to the crankshaft. This increases the take-off power to 3,250 hp. Ignition system is Scintilla DLN-9; the carburetor, Stromberg PR58T1.

MODEL: 736C9HD3 (R-1820-76A).

DATA

TYPE: 9 clyinder, air-coled, radial. CAA TYPE CERTIFICATE: 243.

MODEL: 749C18BD1 (R-3350-24W).

DATA

TYPE: 18 cylinder, air-cooled, radial. CAA TYPE CERTIFICATE: 218.

SPECS

LENGTH: 78.52 in. FUEL GRADE: 100/130. BORE: 6.125 in. STROKE: 6.3125 in. DISPLACEMENT: 3,350 cu. in. COMPRESSION RATIO: 6.5:1. DRY WEIGHT: 2,884 lb. WEIGHT PER HP: 1.1 lb.

PERFORMANCE

TAKE-OFF POWER: 2,500 hp at 2,800 rpm. CRUISE: 1,470 hp at 2,300 rpm. FUEL CONSUMPTION: .46 lb. per hp hr. OIL CONSUMPTION: .015 lb. per hp hr.

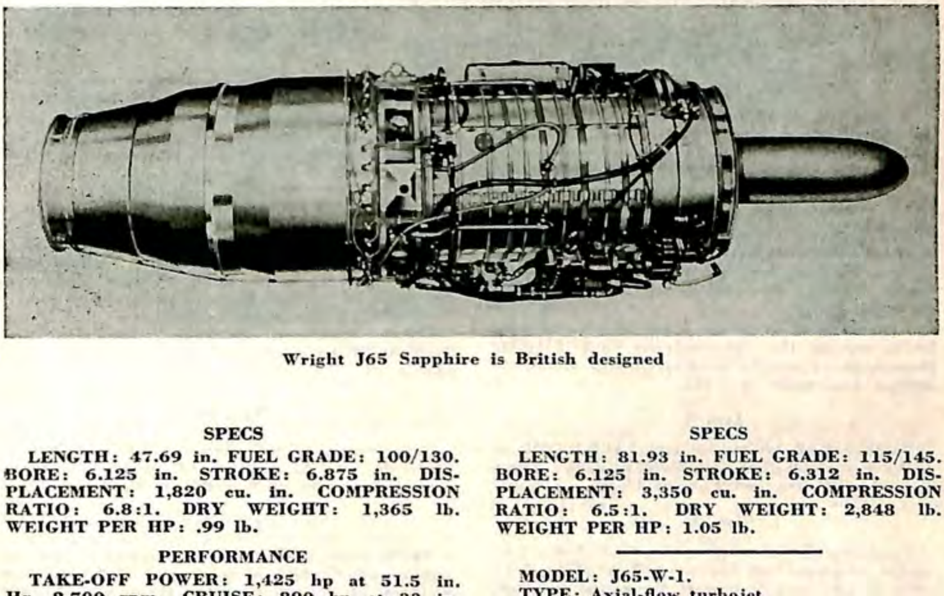
EQUIPMENT

IGNITION: Scintilla DLN-9. CARBURETOR: Bendix No. 135091 direct fuel injection.

MODEL: R-3350-26W.

DATA

TYPE: 18 cylinder, air-cooled, radial.



Wright J65 Sapphire is British designed

SPECS

LENGTH: 47.69 in. FUEL GRADE: 100/130. BORE: 6.125 in. STROKE: 6.875 in. DISPLACEMENT: 1,820 cu. in. COMPRESSION RATIO: 6.8:1. DRY WEIGHT: 1,365 lb. WEIGHT PER HP: .99 lb.

PERFORMANCE

TAKE-OFF POWER: 1,425 hp at 51.5 in. Hg. 2,700 rpm. CRUISE: 890 hp at 33 in. Hg., 2,300 rpm. FUEL CONSUMPTION: .46 lb. per hp hr. at 60% power. OIL CONSUMPTION: .020 lb. per hp hr. at 89% power.

EQUIPMENT

CARBURETOR: Stromberg PD12K14. IGNITION: Dual Scintilla S9LU-5.

REMARKS

This engine is the latest in a long line of 1820 cu. in power-plants that were first introduced more than ten years ago. This model is also built with 2-speed spuercharger and optional reduction gear ratios.

SPECS

LENGTH: 81.93 in. FUEL GRADE: 115/145. BORE: 6.125 in. STROKE: 6.312 in. DISPLACEMENT: 3,350 cu. in. COMPRESSION RATIO: 6.5:1. DRY WEIGHT: 2,848 lb. WEIGHT PER HP: 1.05 lb.

MODEL: J65-W-1.

TYPE: Axial-flow turbojet.

SPECS

DIAMETER: 37.3 in. LENGTH: 133.85 in. WEIGHT: 2,500 lb. FRONTAL AREA: 6.78 sq. ft. FUEL CONSUMPTION: 0.915 lb. per lb. per hr.

PERFORMANCE

TAKE-OFF: 7,220 lb.

REMARKS

Built under licence from Armstrong-Siddeley, the Sapphire turbojet is slated for use in the Martin-built Canberra intruder, the Republic F-84F swept-wing Thunderjet and other new aircraft.

1952 DAY BY DAY CHRONOLOGY

(NOTE: The following chronology is condensed principally from *American Aviation Daily*, only daily in the aviation field; published by American Aviation Publications, Inc., Wayne W. Parrish, Editor.)

JANUARY

Jan. 2

A Sikorsky H-19-helicopter completes 1,800-mile flight from Great Falls, Mont., to Ladd AFB, Fairbanks, Alaska, in five days—probably longest flight ever made by rotary wing craft.

Jan. 4

Air Transport Association urges Government support and funds in jet transport development.

Trans World Airlines' vice president E. O. Cocke predicts five daily trans-Atlantic tourist flight by 1953.

International air travel is up 25 percent over 1950, reports the International Civil Aviation Organization; world's airlines carried about 39-million passengers in 1951.

Jan. 8

North American's turbo-prop XA2J-1 (Allison T-40) completes first test flight in Calif., flown by Robert Baker and Charles Poage.

Jan. 9

President Truman stresses need for "particular emphasis on air power" until at least 1954 in his annual state of the union message.

An electro-thermal de-icing system for helicopter rotor blades, designed by Bell Aircraft Corp. and built by B. F. Goodrich Co., successfully passes Navy tests.

Jan. 11

There are now four turbo-prop powered aircraft in the U.S.: the Convair XP5Y-1 flying boat, the Douglas A2D attack bomber, the North American XA2J-1, and the Convair Turbo-Liner—all powered either by Allison T-38 or T-40 engines.

Current rate of defense spending is between $3-billion and $3.5-billion a month.

Jan. 15

Douglas Aircraft Co. announces two versions of its DC-7 (Wright R-3350 turbo-compound): domestic version carrying 4,512 gal. of fuel and grossing 116,800 pounds; and overseas version carrying 6,600 gals. and grossing 122,-200 pounds.

Jan. 21

Fiscal 1953 defense budget totals $52.3-billion with $14.5-billion going to aircraft manufacturing firms ($14.1-billion for procurement of piloted aircraft and related items; $452-million for guided missiles.)

North American Aviation completes first Navy AJ-2P (Allison J-33) photo reconnaissance plane.

Jan. 22

American Airlines' Convair 240 crashes at Elizabeth, N. J., killing 29 people including former Secretary of War Robert P. Patterson.

Jan. 24

Preliminary agreements are signed by the directors of Braniff Airways and Mid-Continent Airlines, to merge the two lines with Braniff as the surviving line.

Labor Department predicts 625,000 will be working for aircraft and parts manufacturers by April, 1952.

Jan. 30

Ford Motor Co. receives $30-million Air Force contract to build 10,000 pound thrust Pratt & Whitney J-57 jet engines.

Navy confirms existence of Douglas XA3D carrier-based attack bomber. The plane is a twin-jet, swept wing with engines slung under the wing in pods.

Jan. 31

Harry K. Coffey is elected president of the National Aeronautic Association; Joseph T. Geuting, Jr. is named chairman of the executive board.

FEBRUARY

Feb. 1

A Republic F-84G Thunderjet remains aloft at Edwards AFB, Calif., for 12 hours, 5 minutes, probably record duration for a jet fighter.

Feb. 5

Of $18-billion obligated by Department of Defense for military purposes during the first half of fiscal 1952, the Air Force obligated $7.6-billion, the Navy $5.5-billion and the Army $4.9-billion.

Sperry Gyroscope Co., receives Air Force order for its airborne engine analyzer, boosting its total backlog to over 2,000.

U.S. Weather Bureau investigates possibility of using television to help determine visibility for airline pilots approaching airports.

Feb. 11

National Airlines Douglas DC-6 crashes at Elizabeth, N. J., killing 31 (27 in plane; 4 on ground).

Feb 18

President asks for $1.6-millon for jet transport testing by CAA.

The Air Coordinating Committee recommends development of helicopters for commercial service.

Feb. 20

Lt. Gen. James H. Doolittle named to head group to study methods of relieving airport congestion near big cities.

Prototype of Navy's new sweptwing North American FJ-2 (GE J-37) jet fighter makes first test flight in California.

Feb. 29

Republic Aviation Corp. designs mobile refueling system for rocket engine fueling in interceptor fighters. The Republic unit is a 12½ ton service truck, with a 900 gallon tank in rear to contain liquid oxygen, and a 700 gallon tank forward for the water-alcohol mixture.

General Electric Co., designs new high-sensitivity automatic pilot, designated G-3.

MARCH

Mar. 3

Gen. Joseph T. McNarney (USAF, Ret.) is elected president of Consolidated Vultee Aircraft Corp. succeeding LaMotte T. Cohu who will become vice chairman of the board.

March 4

Shipments of complete civilian aircraft were off 30% during 1951 as compared with 1950; engine shipments up 6%, according to a CAA-Bureau of Census joint report.

Aircraft Industries Association predicts that engine, propeller and airframe builders, previously in 11th place in employment of manufacturing manpower, will jump to second (and possibly first) place by the end of this year.

Mar. 12

Of a total of $21.3-billion defense procurement funds obligated the first seven months of fiscal '52, the USAF obligated $8.5-billion, the Department of Defense reports.

Mar. 18

Two Republic F-84 Thunderjets land in Neubiberg, Germany, after a 2,800-mile flight without refueling—believed to be the longest sustained jet fighter flight in history. The jets crossed seven countries, averaged 585 mph, and were in the air 4 hr. 48 min.

Mar. 20

North American Aviation's AJ-2P carrier-based photo-reconnaissance plane (P&W R-2800 & Allison J-33) makes first flight, staying aloft 39 minutes.

Mar. 28

North American Aviation delivers its first F-86F Sabre (General Electric J-47-GE27) to the Air Force. The new Sabre flies at more than 650 mph, has a combat radius over 600 miles, and maximum service ceiling of over 45,000 feet.

First Convair-Liner 340 is delivered to United Air Lines.

APRIL

Apr. 1

Navy announces plans to produce three new guided missile types for service next year: The Terrier I (Consolidated Vultee); The Regulus (Chance Vought); and The Sparrow I (Douglas Aircraft).

Apr. 2

Former Defense Mobilizer Charles Wilson reports jet production is up one third in three months and will be doubled during 1952.

Apr. 11

U. S. international and overseas airlines in 1951 flew more than 2.5-billion revenue passenger miles with 2,050,529 revenue passengers, for gains of 15% and 20% respectively over record gains in 1950.

A Grumman Widgeon specially modified to incorporate a hull with a 12½ to 1 beam ratio, highest ever used in a flight aircraft, is successfully test flown by Edo Corporation, College Point, N. Y.

Apr. 18

Second of the Air Force's eight jet intercontinental bombers, the Consolidated Vultee YB-60 (swept-wing version of the B-36, powered by Pratt & Whitney J-57 engines, makes its first test flight at Carswell AFB, Fort Worth, Tex., staying aloft one hour and six minutes.

Apr. 21

A new terminal omni-range design which will sell for $5,000 to $7,500, as compared with over $90,000 for a regular omni-range installation, is designed and built by the Air Navigation and Traffic Control division of the Air Transport Association.

O. A. Wheelon, production design engineer of the Douglas Aircraft Co., is awarded the Wright Brothers medal for a published analysis of the use of titanium in aircraft construction.

Apr. 23

U. S. international and overseas airlines report $15.5-million net operating income for 1951.

President Truman nominates Jack Garrett Scott, Washington attorney, as Undersecretary of Commerce for Transportation.

Glenn L. Martin Co. delivers first fleet model of its P5M anti-submarine flying boat to the Navy.

Apr. 30

For the first time in aviation history, air passenger-miles (10,679,281,000) in 1951 exceeded the total passenger-miles traveled in Pullman cars (10,224,714,000).

MAY

May 1

Defense Department and Office of Defense Mobilization set up Production Policy Advisory Commission with Harold Vance, Chairman. The Commission will advise the two agencies on long-range production policy, current schedules and steps to overcome production problems.

Transcontinental lightplane record is set by Max Conrad in a Piper Pacer, traveling from Los Angeles to New York (2,461 mi.) non-stop in 24 hr. 54 min.

Trans World Airlines lands first tourist-trip passengers from America in Paris. International air travel expected to double as result of bargain fares.

May 6

Air Force and Army award large production orders to Piasecki Helicopter Corp. for three large versions of their H-21 transport helicopter (Wright R-1820-103 Cyclone 9).

May 9

Production of a lightweight airborne radar unit, which will permit pilots to see a close-up of a selected area, has been announced by the Radio Corp. of America and the Navy. The RCA unit has a range up to 200 miles, with controls that can be set to cover 5, 10, 30, 100 or 200 nautical miles.

May 12

Air Force releases details on two new jet super-bombers, the Convair YB-60 and the Boeing YB-52, Both planes feature swept-wing design, with a sweep angle of approximately 35 degrees.

May 14

B. F. Goodrich Co. completes test program on new jet aircraft tire, which can sustain landings at speeds up to 250 mph.

May 15

Coast Guard establishes first Organized Reserve Aviation Training Program.

Air Force plans to build a $2.3-million aerial reconnaissance laboratory at Rome Air Development Center, Griffiss AFB, Rome, N. Y., to study and develop techniques of photography, weather and electronics.

May 23

Pacific air lift is acclaimed greatest air lift effort of all time, exceeding best efforts of Berlin air lift, says Adm. Emory S. Land, ATA president.

May 27

Aerojet Engineering Corp. awards Ryan Aeronautical Co. a contract for production of rocket engine components developed by Aerojet.

May 28

Fairchild C-119H, newer and larger version of Flying Boxcar, makes first flight from Hagerstown, Md., remaining aloft 2 hr. 30. min. and landing at a speed of 63 knots.

JUNE

June 5

Jacobs Aircraft Engine Co. develops new, high-speed helicopter design, Model 105.

USAF summary shows North American F-86 jet fighter maintaining better than an 8-1 superiority ratio over Russian MiG-15 in air-to-air combat over Korea.

June 9

Supersonic Gloster GA-5 jet is ordered into priority production to become standard NATO fighter plane.

June 27

Northrop Aircraft begins six-month training course in guided missiles.

June 30

President Truman signs bill authorizing $19-million appropriation for construction and new equipment at NACA laboratories.

JULY

July 15

Rear Adm. Thomas S. Combs, Navy BuAer chief, announces first ship-to-surface guided missile to be placed in service this year.

July 17

Adm. DeWitt C. Ramsey, AIA president, foresees desperate situation for military aircraft production due to continuing steel strike.

Navy announces 1,238 mph top speed for Douglas D-558-2 Skyrocket, world's fastest plane, at Edwards AFB, Calif.

July 21

Minneapolis-Honeywell is awarded Air Force order for helicopter autopilot earmarked for initial use in Piasecki H-21.

July 30

Braniff Airways, Mid-Continent Airlines vote approval of merger to take place in August.

AUGUST

Aug. 1

Two Sikorsky H-19 helicopters complete first trans-Atlantic helicopter crossing and break non-stop distance record for rotary wing aircraft.

Aug. 13

Bell X-2 (Curtiss-Wright XLR-25-CW-1 rocket engine), Air Force special research plane expected to fly faster than 1,238 mph, flies at Edwards AFB, Calif., although not under power.

Douglas Aircraft Company reports that its transports (DC-3, DC-4 and DC-6 series) have flown 53.3-billion mils, amounting to 2-million trips around the world.

Aug. 15

CAA predicts that U. S. airlines will be carrying about 40-million passengers a year by 1960, close to double the figure attained in the boom year of 1951.

Col. David C. Schilling, USAF, receives Air Force Association's 1952 Flight Award for leading mass flight of 58 Republic F-84 Thunderjets from U. S. to Japan in July.

Aug. 16

Mid-Continent Airlines and Braniff Airways merge under Braniff to become sixth-ranking domestic air carrier in the U. S.

Aug. 19

Carrier suitability tests for four jet fighters successfully completed aboard USS Midway off Atlantic coast. Planes were North American FJ-2 Fury; Chance-Vought F7U-3 Cutlass; Grumman F9F-6 Cougar; McDonnell F2H-3 Banshee.

Aug. 28

Appointment of an aircraft production "czar" urged by Senate Preparedness Subcommittee (headed by Sen. Lyndon B. Johnson, D., Tex.).

Air Force fiscal '53 air base program plans spending more than $220-million on 36 municipal airports.

SEPTEMBER

Sept. 2

Boeing Airplane Co. is first major U. S. transport builder to announce plans to build a commerical jet transport. Boeing president indicates prototype will be ready for demonstration in the summer of 1954.

Sept. 3

Westinghouse Electric Corp. announces new version of the J-40 engine which, the company said, "develops thrust equivalent to approximately 25,000 horsepower at today's jet flight speeds."

American Airlines sets traffic record flying 10,000,000 passenger miles in a single day.

U. S. plans to contribute over half of $400-million aircraft production program for European plants.

Sept. 10

Aircraft, engine and propeller manufacturers report backlog totaling $14.1-billion as of June 30th, a 5 percent jump over the first quarter backlog, and 53 percent rise over June 30, 1951.

International airlines will do 250 percent more revenue flying than they did five years ago, and will carry 45 million passengers during 1952, Sir William P. Hildred, director general of IATA, predicts.

Sept. 15

American Helicopter Co. demonstrates its XH-26 "Jet-Jeep" helicopter for the Army at Torrance, Calif.

Sept. 18

More than 10,000 planes have been delivered to the military services by the U. S. aircraft industry since the outbreak of war in Korea, Adm. DeWitt C. Ramsey, president of the Aircraft Industries Association, reports.

OCTOBER

Oct. 2

North American Aviation creates eight-man group to study development and possible construction of three commercial aircraft, including a jet transport.

At least 20 new military aircraft are scheduled to make initial flights during the next 15 months.

Oct. 3

Flying Tiger Line begins operation of Navy contract service with departures from Oakland and Philadelphia.

Boeing XB-52 makes first flight.

Oct. 6

Douglas completes engineering work on DC-7 transport, and begins tooling and fabrication.

Lockheed Aircraft Corp. develops new plastic with applications in aircraft field.

F-86 Sabre increases superiority margin over Russian MiG-15 to 10 MiG's destroyed for each F-86 lost.

Oct. 13

Air Research & Development Command opens European Research Office with headquarters in Brussels, Belgium.

Oct. 15

Donald W. Nyrop resigns as chairman of Civil Aeronautics Board.

Adm. DeWitt C. Ramsey, AIA president, urges that CAA accept foreign airworthiness standards in granting certification to foreign jet transports.

Oct. 17

Navy receives first twin-engined type flight simulator designed by the Engineering and Research Corp. and built by Technical Products, Inc.

Oct. 20

Douglas X-3, new type jet aircraft design, completes first flight at Edwards AFB, Calif.

Oct. 21

Oswald Ryan is named to succeed Donald W. Nyrop as CAB chairman for remainder of 1952.

Oct. 23

Giant Hughes XH-17 jet-powered helicopter completes official first flight at Culver City, Calif.

NOVEMBER

November 7

Announcement is made of a new pattern of operation to be put into effect at Newark Airport, scene of several accidents last winter.

November 10

L. Welch Pogue, Former CAB chairman, predicts that 1953 will see first scheduled helicopter passenger and freight service.

November 13

Pan-American Airlines President Juan T. Trippe urges "an end to U. S. giveaways to Europe and a step-up in U. S. tourist travel abroad" as answer to "dollar gap" between American and European economies.

November 14

American, British authorities announce new carrier flight deck arrangement; "canted" or "angled" deck designed to prevent landing planes from crashing into parked aircraft.

Cessna XL-19B, world's first turbo-prop lightplane, flies at Cessna Wichita plant.

November 18

F-86H Sabre undergoes engineering tests; first flight tests on new model scheduled for Edwards AFB, Calif.

November 19

F-86D, North American all-weather interceptor, piloted by Capt. J. Slade Nash, sets new speed record of 699.92 mph in California speed run.

DECEMBER

Navy announces cutbacks affecting Douglas AD Skyraider, North American FJ-2 Fury, and Grumman F96-6 Cougar; cuts to be made at end of currently-scheduled production.

December 3

Republic delivers first production model of F-84F, swept-wing version of the Thunderjet, to Air Force.

December 10

Adm. Emory S. Land is re-elected president of Air Transport Association at Washington meeting.

December 11

AIRCRAFT YEAR BOOK GOES TO PRESS.

BIOGRAPHICAL BRIEFS

To include the names of all who are outstanding in current aviation activities in this section would expand it to a book. We have therefore been faced with the difficult problem of setting arbitrary limits, governed by space. If, as a result, we have omitted anyone who should have been included, we are extremely sorry—and hope that our readers will inform us of it for correction in future editions.

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ADAMS, Joseph P., government executive born in Seattle, Wash., Nov. 15, 1907; member Civil Aeronautics Board; Colonel, Marine Corps Reserve aviation. Address: 2367 King Place, N. W., Washington 7, D. C.

ADAMS, Russell Baird, economist and administrator born in Wheeling, W. Va., Dec. 28, 1910; aviation consultant to Secretary of State. Address: Silver Spring, Md.

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ADLER, Ernest Jr., engineer born in Hardin, Mont., June 6, 1915; president, All American Aircraft, Inc. Address: Long Beach, Cal.

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ANDERSON, Orvil A., Air Force officer born in Springfield, Utah, May 2, 1895; Major General (permanent). Address: Maxwell Air Force Base, Alabama.

ANDERSON, Samuel Egbert, Air Force officer born in Greensboro, N. C., Jan. 6, 1906; Major General (permanent). Address: Com. Gen. 8th Air Force, Carswell AFB, Tex.

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YOUNG, Ora W., government official born in Greenville, O., Mar. 25, 1893; regional administrator, region one, Civil Aeronautics Administration. Address: Federal Bldg., International Airport, Jamaica, L. I., N. Y.

YEASTING, John O., aircraft executive born in Helena, Ohio, Dec. 1, 1905; vice president, comptroller, Boeing Airplane Co. Address: Box 3107, Seattle 14, Wash.

YOUNG, Raymond W., mechanical engineer born in St. Joseph, Mo., Apr. 9, 1899; President and general manager, Reaction Motors, Inc. Address: Box 85, Hohokus, N. J.

ZACHAROFF, Lucien, editor and publisher, *Payload* and *The Air Shipper*. Address: Box 246, Madison Square, New York 10, N. Y.

ZIMMER, V. C., aviation executive born in Great Bend, Kans., Oct. 29, 1905; director of industrial security, Consolidated Vultee Aircraft Corp. Address: 1201 Virginia Way, La Jolla, Cal.

ZIPP, Harold W., aircraft engineer born in Lincoln, Neb., Sept. 10, 1906; staff engineer, office vice president engineering. Boeing Airplane Co. Address: 8710 Overlake Dr., Bellevue, Wash.

ZISCH, W. E., general manager, Aerojet Engineering Corp. Address: Azusa, Cal.

ZOOK, Jack, aviation executive born in Wellston, O., Oct. 5, 1918; assistant sales manager, administrative, Cessna Aircraft Co. Address: 5800 Pawnee Rd., Wichita 15, Kan.

ZWICKY, Fritz, Dr., born in Varna, Bulgaria, Feb. 14, 1898; director of research, Aerojet Engineering Corp. Address: Azusa, Calif.

Foreign Chronology, Pre-Wright

150 B.C.—Principle of jet propulsion discovered by Hero with his Aeolipile, Alexandria, Egypt.

1496—Mechanical flying machine designed by Leonardo da Vinci, Milan, Italy.

1766—Hydrogen properties discovered by Henry Cavendish, Clapham Common, England.

1782, Nov.—Hot-air balloon constructed by Joseph Michel and Etienne Jacques Montgolfier, France.

1783, Aug. 27—Hydrogen balloon ascends, no passengers; released by J. A. C. Charles, Paris, France.

1783, Oct. 15-19—Jean Jacques Pilatre de Rozier makes first ascent by man in a Montgolfier hot-air captive balloon, Paris, France.

1783, Nov. 21—Pilatre de Rozier and the Marquis d'Arlandes make first free ascent by man in Montgolfier hot-air balloon, Paris, France.

1783, Dec. 1—First free hydrogen balloon ascent by J. A. C. Charles, French physicist, also credited with invention of first barometer, valve, and ballast.

1784, June 4—First woman aeronaut, Mme. Thible, ascends in a Montgolfier free balloon, Lyons, France.

1793—Balloon parachute descent by Jean Pierre Blanchard, Basle, Switzerland.

1804, July 24—First escape by parachute from aircraft disaster made by Kuparento, at Warsaw, Poland.

1842, Sept. 29—British patent to Henson on his "first complete description of a mechanical aeroplane." (It has all elements of modern airplane save ailerons.)

1848, June 30—First engine-driven aeroplane to fly—a steam model—is produced by John Stringfellow.

1852, Sept. 24 — Steam-powered airship designed and flown by Henri Giffard, Paris to Trappe.

1855 — Glider flight by Jean Marie Le Bris, near Douarnenez, France.

1858—First aerial photographs made by Tournachon (Nadar) from balloon. On Oct. 23, 1858, patent issued covering his system of aerial photography.

1866, June 27—F. H. Wenham's paper before the Aeronautical Society of Great Britain establishes the advantage of high aspect ratio and superposed wings, patenting biplane construction.

1870, May 21—British patent to Harte discloses wings whose rear edges are hinged, resembling the modern aileron. The 1868 patent of Boulton also expounds the three-torque principle.

1870, Sept. 23 - Jan. 28, 1871—Airmail and passengers flown out of besieged Paris. Propaganda by air introduced.

1871—Wind tunnel designed by F. H. Wenham for Aeronautical Society of Great Britain.

1872, Dec. 13, 14—Gas-engined airship designed and demonstrated by Paul Haenlein, Brunn, Austria.

1883, Oct. 8—Electric-powered airship flight by Albert and Gaston Tissandier, Auteuil, France.

1884—Horatio Phillips patents airfoil shapes, after wind tunnel tests which showed superiority of curved surfaces.

1884, Aug. 9 — Electric-powered airship round-trip flight by Renard and Krebs, Meudon-Paris.

1891—Possibility of soaring on rigid arched wings demonstrated by Otto Lilienthal.

1893, Feb. 16—The Maxim airplane lifts off its track, a weight of nearly 6,000 lbs. In 1894 a revised machine flies along a track 200 feet with crew of three. It weighs 8,000 lbs.

1896, June 22—Octave Chanute begins his glider experiments.

1896, Aug. 28-29—Gasoline-powered airship exhibited by Hans Wolfert, Berlin.

1897, Nov. 3—All-metal airship built by David Schwartz, Tempelhof Field, Berlin.

1898, Sept. 18—Santos Dumont airship flown, Bagatelle, France.

1898, June 30—Ascents are made by the one U. S. Army balloon at Santiago, Cuba. The balloon is old and is badly damaged by enemy fire.

1900, July 2—First Zeppelin ascent, Lake Constance, Germany.

1903, Aug. 31—About this date one Torres exhibits a model for the radio control of vessels, then considered applicable also to airships—a guided missile.

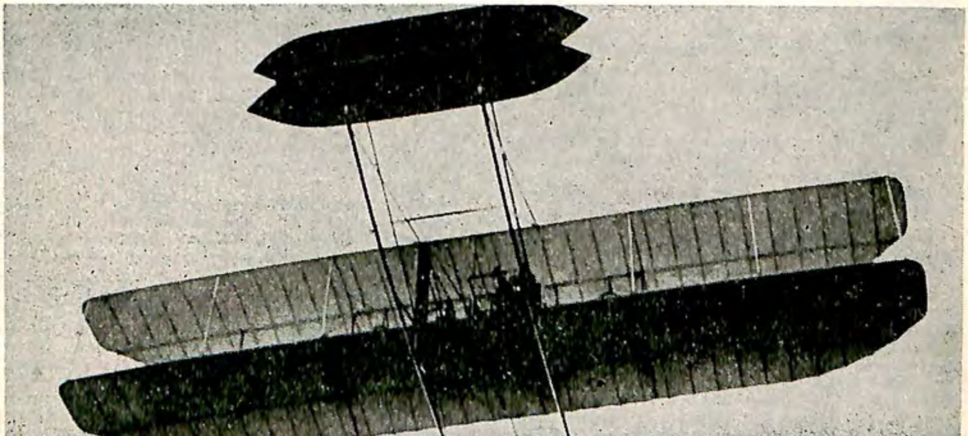
A CHRONOLOGY of U. S. AVIATION

The following chronology has been compiled and edited by Ernest L. Jones, (Lt. Col., ret.), civilian historian with the Air Historical Office, U. S. Air Force.

Although this chronology has been expanded considerably over previous editions, it still represents only brief excerpts from Colonel Jones' vast store of air data. Space has forced us to deal only with the highlights.

We are deeply indebted—as is aeronautics in the United States—to Colonel Jones for his thorough knowledge of aeronautics in this country and the generosity with which he shares it.

Orville Wright in 1 hr. 2¼ min. flight over Ft. Meyer, Va., Aug., 1908



United States Chronology

1784, Jan. 16—Airborne troops proposed by Benjamin Franklin in reporting on the first balloon ascents.

1784, July 17—First U. S. balloon flight in Peter Carnes' captive balloon, Baltimore, Md.

1784, Nov. 30—First ascent by an American abroad, by Dr. John Jefferies, physician, with French aeronaut Blanchard, at London. On Jan. 7, 1785, they make the first Channel crossing by air.

1793, Jan. 9—Balloon flight by Jean Pierre Blanchard from Philadelphia, Pa., to Woodbury, N. J. (Letter from George Washington carried on this flight.)

1837, Sept. 18—First parachute demonstration in America when John Wise drops animals from a balloon at Philadelphia.

1838, Aug. 11—John Wise safely lands with his parachuted balloon at Easton, Pa.

1840, Sept. 8—Col. John H. Sherburne urges Secretary of War to use night balloons to locate Seminoles.

1842, Oct. 22—John Wise proposes to capture Vera Cruz by air.

1844, Oct. 16—America's first air patent to Muzio Muzzi on direction of balloons.

1845, Sept. 18—Rufus Porter proposes steam airship line, New York-California, to carry goldseekers at $100 a trip. Stock sales unsatisfactory. His 1849 booklet illustrates a jet-propeller passenger rocket.

1859, July 1—World record balloon trip, 809 miles, St. Louis to Henderson, N. Y., by John Wise and three companions.

1859, Aug. 16—Airmail carried by John Wise in balloon flight from Lafayette to Crawfordsville, Ind.

1860, Aug. 21—Capt. E. B. Hunt, Corps of Engineers, U.S.A., advocates balloon telegraphy.

1860, Oct. 13—Successful aerial photos taken by William Black from a balloon, Boston, Mass.

1861, June 10—Military flight by James Allen, First Rhode Island State Militia, in balloon over Washington, D. C.

1861, June 18—Balloon telegraph demonstrated by T. S. C. Lowe. (Message to Abraham Lincoln.)

1861, June 22-24—Military reconnaissance by T. S. C. Lowe and Army officers from balloon using telegraph, over Arlington and Falls Church, Va. Military air observation continues into 1863.

1861, Aug 3—Civilian aeronaut La Mountain inaugurates aircraft carrier operations with his war balloon. Lowe follows.

1861, Sept. 24—Air artillery adjustment from Lowe's Army ballon near Washington.

1861, Nov. 7—Helicopter proposed for Union Army. After experiments, a machine is partly built before Appomattox ends the project.

1862, Mar. 9—War helicopter bomber designed and urged by William C. Powers of Mobile, Ala.

1866, May 25—Solomon Andrews' airship maneuvers over New York with 4 passengers.

1873, Oct. 7—Unsuccessful trans-Atlantic flight by W. H. Donaldson, Alfred Ford and George A. Lunt in balloon, *Graphic*, from Brooklyn, N. Y., to New Canaan, Conn.

1877—Prof. William H. Pickering, Harvard University, begins experiments with model helicopters. In 1903 a rabbit is sent aloft.

1880—Thomas A. Edison conducts helicopter experiments for James Gordon Bennett.

1883, Mar. 17—First of a series of glider flights by John Joseph Montgomery, Otay, Cal.

1885, Jan. 7—Russell Thayer, C. E., a graduate of West Point, urges on Secretary of War Robert T. Lincoln a compressed-air airship of his design. No action.

1887, Jan. 30—Thomas E. Baldwin makes his first parachute jump at San Francisco.

1886, July—W. E. Irish, publisher of *Aeronautical World*, proposes balloon radio.

1887—American altitude record made by aeronaut Moore and Prof. H. A. Hazen of U. S. Signal Service, at St. Louis; 15,400 feet, in balloon of St. Louis *Post Dispatch*.

1890, July 31—During the month, L. Gathmann, of Chicago, explodes a shell at high altitude in attempt to produce rain.

1890, Oct. 1—President Harrison approves legislation creating the Weather Bureau and reestablishing the Signal Corps which is charged with collection and transmission of information, among other duties. Military aeronautics is then considered as among such means, and Army aeronautics is revived.

1892, Oct. 10—Balloon section is being organized with each telegraph train by Chief Signal Officer, General A. W. Greely, who anticipates military airships and airplanes.

1892, Nov. 5—Wingless aerial torpedo suggested by Prof. A. F. Zahm.

1893, Aug. 1-4—International Conference on Aerial Navigation held at Chicago; Octave Chanute, Chairman; Dr. A. F. Zahm, Secretary.

1893, Oct. 9—The Chief Signal Officer, General Greely reports the purchase of a Lachambre balloon for the Signal Corps balloon section. First ascents since the war are made at the Chicago exposition from Oct. 31, 1893.

1896, Apr. 29—First American wind tunnel begins operation at M.I.T.

1896, May 6—Steam-powered airplane model flown by Samuel Langley, Washington, D. C.

1898, Apr. 29—War and Navy Departments examine Langley's work, approve, and Board of Ordnance and Fortification makes two allotments of $25,000 each to build his airplane.

1898, Dec. 22—The Secretary of War approves a Fort Myer site for barracks, officer quarters, administration building and a balloon house to concentrate Signal Corps schools at one point.

1901, Sept. 1—Simon Newcomb, Ph.D., LL.D., writes in *McClures* for September: "The first successful flyer will be the handiwork of a watchmaker and will carry nothing heavier than an insect."

In December, Rear Admiral Melville, USN says in the *North American Review:* "A calm survey . . . leads the engineer to pronounce all confident prophecies at this time for future success as wholly unwarranted, if not absurd."

1902, Sept. 15—A. Leo Stevens sails his airship *Pegasus* over Manhattan Beach in a race with Edward C. Boyce in the latter's Santos Dumont airship.

1903, Mar. 23—Orville and Wilbur Wright

apply for patent on their flying machine. (Patent issued May 22, 1906.)

1903, Dec. 8—Samuel Langley's flying machine, piloted by Charles Manly, plunges in the Potomac and is wrecked on its second test, Washington, D. C.

1903, Dec. 17—First sustained controllable flight of powered heavier-than-air machine by Orville and Wilbur Wright, Kitty Hawk, N. C.

1904, Aug. 3—Circuit flight in airship (Curtiss motor) by Capt. Thomas S. Baldwin at Oakland, Cal.

1904, Wright brothers make 104 flights, covering 20 miles. British representative visits the Wrights in November.

1905, Jan. 18—Wright brothers open negotiations with U. S. War Department for disposition of their invention. Correspondence is had through 1907.

1905, Apr. 29—Daniel Maloney begins series of glides with Montgomery glider, taking off from captive balloon. Later killed.

1905, Aug. 5—Charles K. Hamilton begins series of kite flights, towed by cars and boats.

1905, Sept. 26-Oct. 5—Wright brothers make 55 flights, the longest being 24 miles in 38 min. 3 sec. Frank S. Lahm, in France, obtains report on Wrights' flying from Ohio relative. French remain skeptical. In October the French government is negotiating along with British.

1905—Lt. Frank P. Lahm becomes first Army balloon pilot.

1906, Jan. 13-20—First indoor aero exposition, New York.

1906, Mar.—French and British visit Wright brothers at Dayton.

1906, Sept. 30—First Bennett international balloon race won by Lt. F. P. Lahm—Paris to England.

1906, Dec. 1-8—Second indoor air exhibition of Aero Club of America.

1907, June 8—Building devoted exclusively to aeronautics dedicated at Jamestown (Va.) Exposition.

1907, Aug. 1—Aeronautical Division established. Army Office of Chief Signal Officer.

1907, Sept. 2—Walter Wellman airship *America* fails in polar attempt.

1907, Sept. 30—Ornithopter of H. C. Gammeter, multigraph inventor, lifts temporarily.

1907, Oct. 1—Aerial Experiment Association formed by Dr. A. Graham Bell, F. W. Baldwin, J. A. D. McCurdy, Glenn H. Curtiss and Thomas E. Selfridge.

1907, Oct. 3—Record altitude of 23,110 feet by U. S.- Weather Bureau meterological kite.

1907, Oct. 18—Air bombing prohibition signed at second Hague conference.

1907, Oct. 21—Second Bennett international balloon race, St. Louis, won by Oscar Erbsloh of Germany. Airship races are held Oct. 22-23.

1907, Oct. 28-29—International Aeronautic Congress held in New York.

1907, Oct. 28—Admiral C. M. Chester urges anti-submarine airships and shipboard airplanes at International. Aeronautic Congress.

1907, Dec. 6—Seven-minute towed flight from motor boat tug in Dr. Bell's kite, flown by Lt. T. E. Selfridge.

1907, Dec. 16—Chief Signal Officer advertises for airship bids, resulting in purchase of Baldwin airship.

1907, Dec. 23—Chief Signal Officer advertises for airplane bids, after visit of Wrights.

1908, Feb. 10—First Army plane contract signed by Signal Corps with Wright Brothers. (Other contracts signed with A. M. Herring and J. F. Scott.)

1908, Mar. 12—First Aerial Experiment Association's plane, *Red Wing*, flown by F. W. Baldwin. Later, three other machines fly.

1908, May 6-18—Wright brothers renew flying preliminary to delivery of Army airplane. Charles Furnas is first airplane passenger.

1908, May 13—Balloon radio reception demonstrated by Signal Corps.

1908, May 31—G. H. Curtiss Manufacturing Company announces planes for sale.

1908, June 10—Aeronautical Society formed in New York and Morris Park Airfield shortly obtained—first of kind in U.S.

1908, June 20—Anthony radio-controlled airship model demonstrated.

1908, July 4—*Scientific American* Trophy awarded Glenn H. Curtiss for first public flight of one kilometer circuit in his biplane, *June Bug*, Hammondsport, N. Y.

1908, July 17—First air ordinance passed by Kissimmee, Fla., with registration and regulation.

1908, Aug. 8—Demonstration flights under French syndicate control begin near LeMans, France, by Wilbur Wright, continuing through December, making a number of astounding records. Training of students follows.

1908, July 31-Aug. 8—Henri Farman of France makes first exhibition airplane flights in U.S.

1908, Aug. 22—First Army Baldwin airship accepted.

1908, Sept. 17—First plane fatality, killing Signal Corps Lt. Thomas E. Selfridge and severely injuring Orville Wright, in delivery of first Army airplane, Fort Myer, Va.

1908, Dec. 28—Matthew B. Sellers makes several flights with 7 hp quadroplane.

1909, Jan. 22—Commercial airplane, built by Glenn Curtiss, sold to Aeronautic Society of New York.

1909, April 16-28—Wilbur Wright delivers an airplane in Italy and teaches pupils.

1909, June 10—President Taft presents Aero Club of America medal to Wright brothers. Congressional medal presented at a celebration at Dayton, June 17-18.

1909, June 26—Glenn H. Curtiss demonstrates at the Aeronautical Society's meet, Morris Park, New York, the machine ordered Jan. 22. Further flights are made at the Society's meet July 5, before removal of the machine to Mineola and the instruction of member Charles F. Willard.

1909, July 17—Curtiss flies 52 mins. in longest U.S. flight except Wrights and wins *Scientific American* trophy for second time. On this success in the Mineola flights the Aero Club of America names him as America's entry in the Bennett international race.

1909, Aug. 22-29—Glenn H. Curtiss wins first Bennett international airplane race and other events of first International Flying meet, Rheims, France. Speed: 45.7 mph.

1909, Aug. 25—First Army airfield leased at College Park, Md.

1909, Aug. 28—After instruction by Glenn H. Curtiss and subsequent practice in the machine contracted by the Aeronautical Society, Charles F. Willard gives his first exhibition at

Scarsborough Beach, Toronto—America's first exhibition pilot. His exhibitions continue over several years.

1909, Sept. 7-Oct. 15—At Berlin, Orville Wright makes flights under German contract, with more records.

1909, Sept. 30—Inception of Wright-Curtiss patent litigation.

1909, Sept. 30—Emile Berliner describes a proposed guided missile.

1909, Oct. 3—At Zurich, Switzerland, E. W. Mix wins the Bennett International balloon race the second time for America.

1909, Oct. 4—Wilbur Wright makes sensational flight, Governors Island to Grant's Tomb and return. Glenn H. Curtiss makes a short flight Sept. 29 and Oct. 3.

1909, Oct. 7—Glenn H. Curtiss flies his first exhibition at St. Louis. Chicago is next. The same month, Charles K. Hamilton and Otto Brodie learn to fly, followed by others. An exhibition company is formed and Curtiss returns to his development work.

1909, Oct. 8-Nov. 5—First Army aviators taught to fly by Wilbur Wright, College Park, Md.: Lt. Frank P. Lahm, Lt. Frederic E. Humphreys, and Lt. B. D. Foulois.

1909, Nov. 27—Anti-aircraft firings begin at Sandy Hook by Ordnance Department.

1909, Nov. 22—The Wright Co. formed with $1,000,000 capital. In 1914, Orville Wright buys the company back. On Oct. 13, 1915, a syndicate buys the company and adds the Simplex Co. In 1916 it becomes the Wright-Martin Co.

1910, Jan. 10-20—First flying meet held at Los Angeles; Louis Paulhan, of France, the star performer.

1910, May 29—Record flight from Albany to New York by Glenn Curtiss, 142.50 mi. in 2 hr., 50 min.

1910, Mar. 25—Wright patent condemnation urged by William M. Page, attorney for C. F. Bishop, president, Aero Club of America.

1910, June 13—Charles K. Hamilton flies New York-Philadelphia and return for N. Y. *Times* and Philadelphia *Public Ledger* and $10,000 prize—149.5 miles in flying time 3 hr. 27 min.; elapsed time, 6 hr. 57 min.

1910, June 13-[illegible]—First show of Wright exhibition team, In[illegible]napolis, Ind. where Walter Brookins is star and makes new records. Exhibitions by single pilots or groups continue about the country until the Wright exhibition business is discontinued in Nov. 1911.

1910, June 30—Dummy bomb demonstration made by Glenn H. Curtiss to Army and Navy officers.

1910, Aug. 4—Plane-ground radio demonstrated by E. N. Pickerill.

1910, Aug. 8—Tricycle landing gear installed by Lt. B. D. Foulois on Army Wright at San Antonio.

1910, Aug. 27—Air-land plane radio used by J. A. D. McCurdy, Sheepshead Bay, N. Y.

1910, Sept. 2—First American woman pilot solos: Blanche Stuart Scott. First exhibition at Fort Wayne, Oct. 22.

1910, Oct. 8-10—Former President Theodore Roosevelt is flown at St. Louis exhibition by Arch Hoxsey.

1910, Oct.14-16—Wellman airship, *America*, abandons trans-Atlantic trip after some 800 miles.

1910, Oct. 22-31—Second Bennett international airplane race won by C. G. White (Bleriot) at 61 mph during Belmont Park meet where numerous records are made.

1910, Nov. 14—First battleship takeoff by Eugene Ely from U.S.S. *Birmingham* in Hampton Roads, Va.

1910—Night flights by Walter R. Brookins

Lindbergh and his Ryan "Spirit of St. Louis"

(Montgomery, Ala., Apr. 18) and Charles Hamilton (Camp Dickenson, Nashville, Tenn., June 21-26).

1911, Jan. 7—Didier Masson flies Los Angeles-San Bernardino to deliver *Times* newspapers. Mail and papers delivered Feb. 17 by Fred J. Wiseman.

1911, Jan. 7-25—Dive bombing, aerial photography, airplane radio demonstrated by Army officers in San Francisco meet.

1911, Jan. 27-28—Lieut. T. G. Ellyson, U.S.N., is first U.S. naval aviator when he takes his Curtiss off at San Diego during Curtiss exhibitions.

1911, Jan. 30—J. A. D. McCurdy attempts Key West-Havana flight but lands in water ten miles short and is rescued by Navy destroyer. In 1913 Domingo Rosillo makes the entire distance.

1911, Feb. 17—Curtiss flies tractor seaplane from North Island to cruiser *Pennsylvania*. Plane hoisted on board and return flight later made.

1911, Mar. 3—Lt. B. D. Foulois and P. O. Parmalee fly record cross-country Laredo-Eagle Pass, Tex., 106 mi. in 2 hr. 10 min. in Wright plane loaned Army by R. J. Collier. Messages dropped en route, radio received and sent.

1911, Mar. 13—Capt. W. Irving Chambers, U.S.N., is assigned the Bureau of Navigation to devote exclusive efforts to naval aeronautics.

1911, Mar. 31—About this date Missouri National Guard Signal Corps establishes air section and members taught flight and ballooning.

1911, May 8—First Navy airplane ordered, Curtiss Triad, amphibian. By July the three 1911 planes of the Navy are delivered—Curtiss A-1, A-2; Wright B-1.

1911, May 13—Lieuts. H. H. (Hap) Arnold and Thomas DeWitt (Tommy) Milling complete flying training at Wright School: 7th and 8th Army pilots.

1911, June 7—Lieut. John P. Kelley, Med. Res. Corps, assigned Army School at College Park—first U. S. air medical officer.

1911, June 8—Connecticut state air regulation is first state air law.

1911. June 21—Short-lived Aeronautical Manufacturers Assn'n. incorporated; Ernest L. Jones, president.

1911, June 30-July 11—Boston-Washington flown by Harry N. Atwood. Charles K. Hamilton flies with him most of way—longest continuous air journey to this date.

1911, July 1—Third Bennett plane race won for U. S. by Charles T. Weyman (Nieuport-Gnome 100) at 78 mph.

1911, July 31—During the month, Frank E. Boland begins flying his tailless, allegedly non-infringing airplane.

1911, Aug. 5—Lincoln Beachy wins over Eugene Ely and Hugh Robinson in New York-Philadelphia race for Gimbel $5000 purse. Elapsed time: 1 hr. 50 min. 18 sec.; one stop for fuel.

1911, Aug. 14-25—Harry N. Atwood flies St. Louis-New York. 1155 miles by route; longest cross-country flight to this date.

1911. Aug. 20—World altitude record set at 11,642 ft. by Lincoln Beachy in Curtiss biplane.

1911, Sept. 4—Earle L. Ovington (Bleriot-Gnome 70) wins over Lieut. T. D. Milling (Burgess-Wright-Wright 30) in 160-mile tri-state race during Boston meet, in 3 hr. 6 min. 22 sec.

1911, Sept. 7—Lt. T. G. Ellyson, U.S.N., demonstrates shipboard launching by taking off from aerial cable at Hammondsport, N. Y.

1911, Sept. 17-Nov. 5 — Transcontinental flight by Calbraith P. Rodgers from New York to Pasadena, Calif.—3,390 mi., 49 days.

1911, Sept. 23-30—Earle L. Ovington appointed Airmail Pilot No. 1, flying mail from Nassau Boulevard to Mineola, L. I., N. Y.

1911, Sept. 30—Lt. H. H. Arnold is "stunt man" for the lead in pioneer air movies at Nassau Boulevard meet where Army pilots compete.

1911, Oct. 9—Demonstration of Tarbox automatic pilot made before officers at College Park. Other similar inventions follow.

1911, Oct. 10—Bombsighting and dropping device demonstrated by Riley Scott, College Park, Md.

1911, Oct. 19-Feb. 12, 1912—Eastbound transcontinental flight of Robert G. Fowler (Wright B), Los Angeles-Pablo Beach, Fla., 2520 mi. in 116 days.

1911, Oct. 24—Orville Wright makes soaring record of 9 min. 45 sec. at Kitty Hawk.

1912, Feb. 12—Frank T. Coffyn takes automatic movie aerials over New York harbor.

1912, Feb. 17—First pilot physical exam published by U. S. Army.

1912, Mar. 1—Attached type parachute jump by Bert Berry from Benoist pusher plane, St. Louis.

1912, Apr. 16—First U. S. licensed woman pilot, Harriet Quimby, flies English Channel. (Killed at Boston Aviation Meet, July 1.)

1912, May 24—Paul Peck makes American duration record of 4 hr. 23 min. 5 sec. in biplane with Berliner Gyro engine.

1912, May 30—Death of Wilbur Wright by typhoid.

1912, June 7-8—Machine gun fired from Wright biplane by Capt. Charles DeForest Chandler, College Park, Md.

1912, July 2—Vaniman airchip *Akron* crashes off Atlantic City in renewed trans-Atlantic attempt.

1912, July 31—Plane launched from sea wall by catapult, Navy Lt. T. G. Ellyson in Curtiss AH-3.

1912, Aug. 12—First Army tractor plane, Burgess, received; flown by Lts. H. H. Arnold and Roy C. Kirtland from Marblehead, Mass.

1912, Oct. 6—In night flight, Lt. J. H. Towers, U.S.N., (Curtiss A-2) makes world seaplane duration record, 6 hr. 10 min. 35 sec. at Annapolis; American record for any plane.

1912, Oct. 8—First Navy physical exam for pilots published by Bureau of Medicine and Surgery.

1912, Oct. 9—First competition for Mackay Trophy won by Lt. H. H. Arnold.

1912, Nov. 5-13—First U. S. airplane artillery adjustment, Ft. Riley, Kans., Lt. H. H. Arnold and observer Lt. Follett Bradley.

1912, Nov. 6-Dec. 15—Antony Jannus (Benoist seaplane Roberts 2-cycle 100 hp) flies Omaha-New Orleans, with mail and merchandise, carrying passengers at stops en route—1835 mi., flying time: 31 hr. 43 min.

1913, Jan. 13-Mar. 31—Air parcel post flight, Boston-New York, by Harry M. Jones (Wright B).

1913, Feb. 11—James Hay bill in Congress

inaugurates the project of a separate air service.
1913, Feb. 13—Langley Field Aerodynamical Laboratory project inaugurated.
1913, Apr. 27—First cross-Isthmus flight by Robert G. Fowler and cameraman R. A. Duhem, Panama-Cristobal. Publication of story and pictures results in arrest.
1913, May 10—Didier Masson and bomber Dean attack Mexican federal gunboats in Guayamas Bay. A number of other Americans fly for Villa in this and subsequent years.

1913, May 28—Lt. T. D. Milling and Lt. W. C. Sherman make 2-man duration and distance record of 4 hr. 22 min. and 220 miles (Burgess tractor-Renault 70), Texas City-San Antonio.
1913, May 30—About this date is instituted M.I.T.'s aerodynamics course under Asst. Naval Constructor Jerome C. Hunsaker.

1913, June 20—First Naval aviator killed when Ensign W. D. Billingsley is thrown from seaplane.
1913, July 19—Sky writing initiated by Milton J. Bryant over Seattle.
1913, Oct. 12—Eighth Bennett international balloon race won for U. S. for fourth time at Paris by R. H. Upson and R. A. D. Preston, landing in England.
1913, Nov. 27—First exhibition loop by Lincoln Beachy in Curtiss biplane, Coronado, Cal.
1913, Dec. 4—Tactical Air Unit, First Aero Squadron, set up as provisional organization, San Diego, Cal.
1913, Dec. 12—Wright pilot Oscar Brindley reports at San Diego as Army's first civilian instructor. Scores of others subsequently employed through 1918.
1913, Dec. 31—Orville Wright demonstrates automatic pilot; awarded Collier Trophy.

1914, Jan. 1—First scheduled airline begins operations with Benoist flying boat between St. Petersburg and Tampa, Fla.; Tony Jannus, pilot.
1914, Jan. 31—During the month first U. S. Navy air station established at Pensacola, following temporary camps at San Diego and Annapolis, 1911-1912.
1914, Feb. 17—Seaplanes and flying boats classed as "vessels" by the Department of Commerce and the license No. 1 is issued to Antony Jannus.
1914, Feb. 24—Army Board condemns all pusher type airplanes.
1914, Apr. 15—Electric self starter fitted to Anzani 200-hp engine of Collier flying boat.

1914, June 23—Curtiss' Wanamaker trans-Atlantic flying boat tested. With outbreak of World War I the project is abandoned.

1914, July 2—Lawrence Sperry wins French War Dept. prize for "stable airplane" flown by early automatic pilot over Seine River in Paris.
1914, July 18—Aviation Section of Signal Corps created by Congress, authorizing 60 officers and students and 260 enlisted men.

1914, Dec. 1-16 — Two-way plane-ground radio demonstrated by Lt. H. A. Dargue and Lt. J. O. Mauborgne, Manila, P. I.
1915, Mar. 3—National Advisory Committee for Aeronautics established by Congress.
1915, May 14—Contract let for first Navy airship D-1 to Connecticut Aircraft Co. In July is contracted a floating airship shed.
1915, June 22—Wisconsin State Forester,

The record-breaking Bellanca "Columbia"

E. M. Griffith, flown by Jack Vilas, in first air forest patrol.
1915, Sept. 17—Joseph Dolgos of Philadelphia demonstrates air incendiary bombs.
1916, Feb. 9—Cpl. A. D. Smith (Martin S-Hall Scott 125) makes world seaplane duration record of 8 hr. 42 min.
1916, Feb. 12—Invitation for bids on airmail issued by Post Office in Massachusetts and Alaska.
1916, Mar. 15—First Aero Squadron, under command of Capt. B. D. Foulois, begins operations at Columbus, N. M., with Gen. Pershing's Punitive Expedition.
1916, Apr. 5—The Governors Island Training Corps organized by Philip A. Caroll.
1916, Apr. 14—A power-driven turret is proposed without result by Col. F. P. Cobham.
1916, June 3—National Defense Act increases strength of Aviation S. C. from 60 to 148 officers over 5-year period. President may fix increase of enlisted men from old figure of 260.
1916, June 18—U. S. aviator H. Clyde Balsley shot down. (Member of Lafayette Escadrille, flying for France.)
1916, Aug. 29—First U. S. Coast Guard Aviation Division organized.
1916, Oct. 2—Allocation airship development to Army or Navy raised by Chief Signal Officer. Rigids later assigned Navy.
1916, Nov. 2—Chicago-New York commercial airmail line asked by Glenn Muffly. Sponsored by New York *Times*, Victor Carlstrom flies mail demonstration, Nov. 2-3.
1916, Nov. 14—More than 60 civilians are

to Curtiss contract school at Newport News, Va. beginning this date and before Apr. 6, 1917. Others are sent to Curtiss school at Miami. Gen. Mitchell learns to fly here at this period.
1916, Nov. 18-20—Group National Guard cross-county flight under Capt. R. C. Bolling from New York to Princeton, N. J. and return. On Dec. 30, another is made to Philadelphia.
1916, Nov. 19-20—Ruth Law flies her 1914 Curtiss pusher Chicago-New York, with 2 stops en route, for new cross-country record.
1916, Dec. 17—To this date the Aero Club of America has certified 636 airplane pilots. In addition are many other pilots who have

never flown for the Aero Club certificate. On Dec. 31, the Army has graduated 122 pilots since 1909.

1916, Dec. 18—Non-exclusive licenses are offered by Wright-Martin Aircraft Corp. on royalty basis. Terms are considered prohibitory and in 1917 Congress appropriates $1,000,000 to acquire basic patents. Solution is the cross-license agreement of the Aircraft Manufacturers Association.

1917, Feb. 13—Capt. Francis T. Evans, U.S.-M.C., loops and spins a seaplane at Pensacola.

1917, Feb. 15—Aircraft Manufacturers Association completes organization.

1917, Apr. 6—U. S. declares war on Germany.

1917, Apr. 6—Official strength of the Aviation Section, S. C., is 131, including regular and reserve. Of these, 112 are airplane pilots or student pilots. Enlisted strength is given variously from 1087-1800. At armistice the figures are: total officers, 20,708 (pilots and student pilots, 12,449); enlisted, 174,315.

Airplane strength, "less than 300." Produced in U. S., Apr. 6, 1917—Nov. 1, 1919: 13,894; received from Allies, 5,229; total: 19,123.

1917, May 10—Arrangements made for eight ground schools for theoretical training Reserve officer candidates.

1917, May 16—Aircraft Production Board created. Superseded by the Aircraft Board Oct. 1. Dissolved May 19, 1919.

1917, May 23—French Premier Ribot asks U.S. to furnish 5,000 pilots, 50,000 mechanics, 4,500 planes for active service by spring 1918.

1917, May 29—Liberty engine project inaugurated. An 8-cylinder Liberty is flown in an L.W.F., July 25. The 12-cylinder production Liberty follows in December.

1917, June 1—Barlow robot bomber urged. Armistice ends project.

1917, July 13—Fiske torpedo plane tested with dummy missile. Experiments continue.

1917, July 24—First great U. S. air appropriation, $640,000,000. Act also provides for increase in organization of Aviation Section, S. C.

1917, July 27—Secretary of Navy authorizes a Naval Aircraft Factory at Philadelphia.

1917, July 27—First British DH-4 arrives to be the first American service plane put into production, with Liberty engine. First American DH-4 completed is flown Oct. 29 by civilian test pilot H. M. Rinehart.

1917, Aug. 5—Original First Aero Squadron leaves Columbus, N.M. for overseas under Maj. Ralph Royce.

1917, Aug. 13—First AEF squadron program calls for 89 wings and 508 squadrons. One wing equals six squadrons (5 airplanes, 2 balloons). A brigade comprises two or more wings.

1917, Sept. 5—Bristol fighter project started. Condemned July 20, 1918, after 27 planes are built.

1917, Sept. 22—Montgomery heirs sue Wright-Martin Aircraft Corp. for infringement. Suit withdrawn June 6, 1921. Suit of same date against U. S. is dismissed May 28, 1928.

1917, Oct. 16—Airplane to airplane radiophone conversation is demonstrated.

1917, Oct. 18—McCook Field established as Signal Corps Experimental Laboratory.

1917, Oct. 18—Aviation Medical Research Board established by Signal Corps.

1917, Nov. 15—J. Newton Williams' helicopter proposal results in recommendation of N.A.C.A. for Government prize of $20,000, not accomplished.

1917, Nov. 21, Robot bomber demonstrated to Army and Navy officers.

1917, Nov. 27—Brig. Gen. B. D. Foulois made Chief of Air Service, AEF.

1917—Gen. William Mitchell claimed as first officer to fly over enemy lines.

1918, Jan. 19—U. S. School of Aviation Medicine begins operations under Signal Corps Maj. William H. Wilmer, Hazelhurst Field, Mineola, L. I., N. Y.

1918, Feb. 28—Under President Wilson's proclamation, licenses are required for civilian pilots or owners; more than 800 are issued.

1918, Mar. 8—Maj. Edward C. Schneider and Maj. James L. Whitney, in simulated altitude flight, reach artificial altitude of 34,000 ft. in 24 min. at Signal Corps, Mineola, N. Y. laboratory.

1918, Mar. 11—First D.S.C. awarded Army air service personnel goes to Lt. Paul Baer of 103rd Squadron for his performance this date.

1918, Mar. 14—Two pilots of First Pursuit Group (95th Squadron) go on patrol.

1918, May 9—Flight Surgeons are organized at flying fields.

1918, May 11—U. S.-built DH-4 Liberty planes received by AEF.

1918, May 15—Congress establishes Air Mail Flyer's Medal of Honor. First award is to M. F. Freeburg, 1932.

1918, May 15—Regular airmail service flown by Army between New York and Washington, D. C.

1918, May 20—Army aeronautics severed from Signal Corps; two departments created: Bureau of Military Aeronautics and Bureau of Aircraft Production.

1918, June 26—A trans-Atlantic flight is urged by Gen. William L. Kenly, Director Military Aeronautics as "most necessary." On Aug. 8, Roy N. Francis is assigned to study project. Experiments continue to 1919 when Navy's NC4 makes the flight.

1918, July 4—Plan to distribute tons of propaganda by balloon over Germany this day fails attainment. Previously extended experiments had been conducted and contracts let.

1918, Aug. 2—First DH Liberty patrol by 135th Aero Squadron.

1918, Aug. 17—First Martin bomber flown at Cleveland by Thomas Eric Springer.

1918, Sept. 7—First U. S. demonstration of troop transport by air.

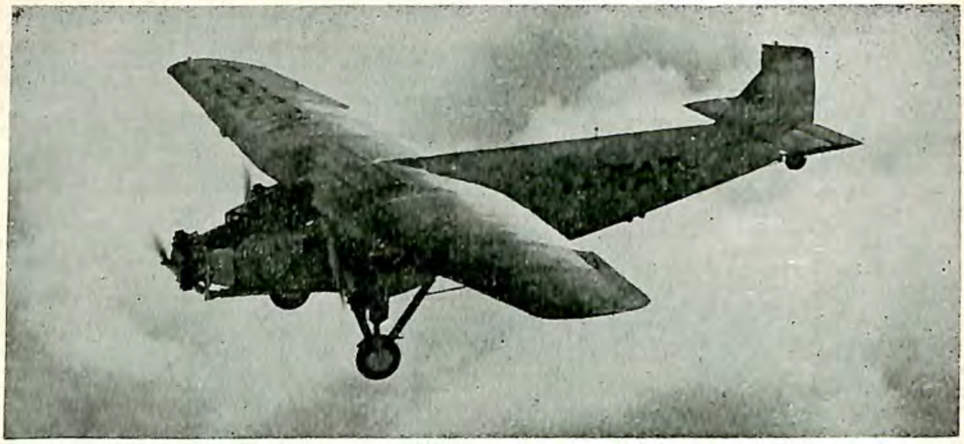
1918, Sept. 12-13—Greatest air concentration of history at St. Mihiel under Gen. William Mitchell—1481 planes.

1918, Sept. 16—German attached type parachutes being in use at least as early as May 1, 1918, the AEF cables need and suggests Floyd Smith, test pilot, prosecute development. Smith develops free type 'chute. Leslie L. Irving makes first free jump Apr. 28, 1919.

1918, Sept. 18—Altitude of 28,899 ft. reached by Maj. R. W. Schroeder.

1918, Sept. 25—First Congressional Medal of Honor awarded for air activity voted 1st Lt. Edward V. Rickenbacker of 94th Aero Squadron.

1918, Sept. 26—First phase of Meuse-Argonne attack.



Ford Tri-Motor established the airlines as a mode of travel

1918, Sept. 28—Pilotless airplane maneuvered from another airplane by radio, after some months of experiment. Various automatic pilots and radio controllers tried over the years.

1918, Oct. 2—First successful flights of Army's guided missile. Its prototype had been flown by H. M. Rinehart in July, substituting for the explosive load and the automatic controls.

1918, Oct. 3—Flight refueling demonstrated by Lt. Godfrey L. Cabot, U.S.N.R., continuing into 1920.

1918, Oct. 12—Use of oxygen tanks ordered all pilots over German lines.

1918, Oct. 25—Charles E. Hughes reports on his investigation of dishonesty in aircraft production.

1918, Nov. 11—Armistice signed.

1918, Dec. 4—First Army trans-continental flight made by Major Albert D. Smith's group of JN4 planes, San Diego-Jacksonville-New York-San Diego. Major Smith's plane alone completes the full round trip.

1919, Jan. 2—Maj. Gen. Charles T. Menoher becomes Director of Air Service.

1919, Jan. 21-30—Army second transcontinental flight; Major T. C. Macauley (DH-4 Liberty), Ft. Worth-San Diego-Miami-Ft. Worth. Repeated in April.

1919, Jan. 24—At Issoudun, France, 1st Lt. Temple M. Joyce (Morane) makes 300 consecutive loops.

1919, Mar. 3—U. S.-Canada airmail flown by Edward Hubbard in Boeing seaplane, Type C.

1919, Apr. 26—Lt. Comdr. H. B. Grow, U.S. N. in F5L flying boat makes non-stop endurance record: 20 hr. 10 min.

1919, Apr. 28—Leslie L. Irving makes first free type manually operated airplane parachute jump over McCook Field. (See 9/16/18).

1919, May 8-31—Trans-Atlantic crossing by Lt. Albert C. Read and crew from Rockaway Beach, N. Y., to Plymouth, England, in NC-4, 53 hr. 58 min.

1919, May 14—Navy airship C-5 makes American non-stop record of 25 hr. 50 min., Montauk Pt., L. I. to St. Johns, N.F.

1919, May 18—In first trans-Atlantic takeoff, H. C. Hawker and McKenzie Grieve alight in ocean 1200 miles and 14½ hours out with engine trouble. Rescued.

1919, May 19—First award of DFC made to M/Sgt. Ralph W. Bottriell for first jump by Army personnel with free-type 'chute.

1919, June 1—First organized and sustained forest fire patrol inaugurated at Rockwell.

1919, June 14—First non-stop Atlantic crossing by Capt. John Alcock and Lt. A. W. Brown (Vickers-2 Rolls 375) St. Johns to Clifden, Ireland: 1890 mi. in 16 hr. 12 min.

1919, June 28—Treaty of peace with Germany signed at Versailles.

1919, July 1—Aerial fish patrols inaugurated at San Diego by Comdr. E. W. Spencer, Jr., U.S.N.

1919, July 2-6—First airship ocean crossing, British R-34, E. Fortune. Scotland, to Mitchel Field, N. Y., 3270 mi. in 108 hr. 12 min.; Lt. Comdr. L. Lansdowne, U.S.N. on board. Return made July 9-12, Col. William M. Hensley, representing Air Service.

1919, Aug. 14—Airmail from Aeromarine flying boat to White Star liner, *Adriatic*.

1919, Aug. 27-29—New York-Toronto race of military and civilian pilots.

1919, Aug. 28-Sept. 19—Lawson "air liner," 26-passenger, twin Liberty biplane, makes demonstration trip Milwaukee-Washington via Chicago, New York and other cities. It returns Sept. 25-Nov. 6.

1919, Sept. 1—Dive bombing demonstrated about this date at Aberdeen Proving Ground.

1919, Sept. 16—Flood relief provided by four JN4D's from Corpus Christi to stranded inhabitants.

1919, Sept. 18—Roland Rohlfs (Curtiss triplane-K12 Curtiss 400) makes world altitude record of 31,420 ft.

1919, Oct. 8-31—Army transcontinental reliability and endurance test New York-San Francisco and return. Forty-four compete

westbound; 15 eastbound. Ten planes make round trip.

1919, Oct. 30—Reversible pitch propeller tested at McCook Field, Dayton, Ohio.

1919, Nov. 12-June, 1920—Six Navy F-5L's cruise New York to West Indies and return, covering 12,731 nautical miles.

1920—Moon eclipse observed by Lts. J. H. Tilton and W. H. Cushing of Rockaway Naval air station from height of some three miles.

1920, Feb. 27—World altitude record of 33,113 feet set by Maj. R. W. Schroeder (Le Pere-Liberty).

1920, Mar. 29-Apr. 22—Marine Corps group flight Washington-San Domingo and return, 4842 miles.

1920, June 7—Lt. John H. Wilson makes unofficial world parachute jump record of 19,800 ft.

1920, June 4—Army Reorganization Bill approved, creating Air Service in Army.

1920, July 7—F-5L Navy seaplane flown by radio compass from Hampton Roads, Va., to *U.S.S. Ohio*, at sea.

1920, July 15-Oct. 20—New York-Alaska flight; Capt. St. Clair Street, 1st Lt. Clifford Nutt, 2nd Lts. Ross C. Kirkpatrick, Eric H. Nelson and C. E. Crumrine, Sgts. James Long and Joseph E. English, Capt. Howard Douglas, advance officer; Mitchel Field, N. Y., to Nome and return.

1920, Sept. 8—Transcontinental mail route, combination plane-train, New York-Chicago-San Francisco, completed.

1920, Nov. 1—U. S. international passenger service started by Aeromarine West Indies Airways between Key West, Fla., and Havana, Cuba.

1920, Nov. 25—1st Lt. C. C. Moseley (Verville-Packard 600) wins first Pulitzer race at 156.54 mph; 24 contestants finish, 13 others start but do not finish.

1920, Dec. 13-14—Navy balloon of Lts. L. A. Kleer, Walter Hinton and S. A. Farrell land beyond Moose Factory, Ont., after 25 hours, 852 miles from start at Rockaway, N. Y.

1921, Feb. 18—First U. S. airplane parachute escape by C. C. Eversole, airmail pilot.

1921, Feb 22-23—Night airmail flown by Jack Knight from North Platte, Neb., to Chicago, Ill.

1921, Feb. 24—Lt. W. D. Coney completes transcontinental flight, San Diego-Jacksonville, 2180 mi. in 22 hr. 27 min.; 57 hr. 24 min. elapsed time.

1921, Mar. 23—Lt. A. G. Hamilton drops 23,700 ft. by parachute, Chanute Field.

1921, June 21—Navy F5L planes sink German sub U-117 in demonstration.

1921, July 18-21—Sinking of captured German cruiser, *Frankfurt*, and battleship, *Ostfriesland*, by U. S. bombs proves vulnerability of naval craft to aerial attack.

1921, Aug. 10—Navy Bureau of Aeronautics formed with Rear Admiral W. A. Moffett as Chief.

1921, Sept. 28—New world altitude record of 34,508 ft. set by Lt. J. A. Macready.

1921, Nov. 5—Bert Acosta (Curtiss Navy-C12 Curtiss 400) wins Pulitzer race at 176.7 mph.

1921, Nov. 12—Refueling in air: Earl S. Daugherty transfers *Wesley May* with can of gasoline from wing of another plane.

1921, Nov. 15—Italian airship *Roma* makes initial ascent in U. S. at Langley Field.

1921, Dec. 1—Helium airship, Navy dirigible C-7, flown from Hampton Roads, Va. to Washington, D. C.

1921, Dec. 29—World endurance record of 26 hr. 18 min. 35 sec. made at Roosevelt Field by Edw. Stinson and Lloyd Bertaud (CJL6 BMW 185).

1922, Jan. 1—Underwriters Laboratories starts registration of aircraft for benefit of insurance companies.

1922, Jan. 1—Aeronautical Chamber of Commerce organized, New York, with I. M. Uppercu, president.

1922, Feb. 21—Airship *Roma* destroyed.

1922, Mar. 20—Airplane carrier *U.S.S. Langley*, commissioned at Norfolk, Va.

1922, June 16—Helicopter demonstrated by Henry Berliner, Washington, D. C.

1922, July 14—Aeromarine Airways starts Detroit-Cleveland flying boat service.

1922, Aug. 5-7—Lt. Clayton Bissell completes first model airway flight, Washington-Dayton-Washington.

1922, Aug. 16—Sperry airway light beacon demonstration, McCook Field.

1922, Sept. 4-5 — Transcontinental speed flight by Lt. James H. Doolittle, Pablo Beach, Fla.-San Francisco, Cal., in 22 hr. 35 min. elapsed time.

1922, Sept. 14-23—Transcontinental Army airship flight with Maj. H. A. Straus commanding crew of Capt. G. W. McEntire and others, from Langley Field, Va. to Arcadia, Cal.

1922, Oct. 5-6—World endurance record, 35 hr. 18 min. 30 sec., Rockwell Field, by Lts. J. A. Macready and O. G. Kelly (Fokker T2 Liberty 375).

1922, Oct. 14—Lt. R. L. Maughan wins Pulitzer race at 206 mph (Army Curtiss-D12 Curtiss 375).

1922, Oct. 18—World speed record of 222.97 mph set by Brig. Gen. William Mitchell in Curtiss racer.

1922, Oct. 23—American Propeller Co. demonstrates reversible propeller at Bolling Field.

1922, Dec. 18—Army's De Bothezat helicopter makes first successful flight, 1 min. 42 sec., Dayton, Ohio.

1923, Mar. 29—Lt. R. L. Maughan makes world speed record 236.58 mph (Curtiss R6-Curtiss 465), Dayton, Ohio.

1923, Apr. 16-17—World duration—distance records by Lts. J. A. Macready and O. G. Kelly (Fokker T2 Liberty 375), 36 hr. 4 min. 34 sec., 2516.55 miles.

1923, May 2-3—Cross-country non-stop flight by Lts. J. A. Macready and Oakley G. Kelly in Fokker T-2, from New York to San Diego, 2,520 miles in 26 hr. 50 min. 3 sec.

1923, Aug. 27-28—Lts. L. H. Smith and J. P. Richter (DH-4E Liberty 400) made world duration-distance refueled records: 3293.26 miles, 37 hr, 15 min. 14.8 sec.; Rockwell Field.

1923, Sept. 5—Smoke screen demonstrated by Thomas Buck Hine during naval bombing maneuvers, Cape Hatteras, N. C.

1923, Sept. 5—Langley Field bombers sink naval vessels *New Jersey* and *Virginia*.

1923, Oct. 6—Lt. A. S. Williams, U.S.N. wins Pulitzer race (Curtiss R2C1-D12 Curtiss 460) at 243.68 mph.

1923, Oct. 25-27—Barling bomber makes series weight-carrying records with greatest weight 3000 kg.; duration, altitude records, 1 hr. 19 min. 11.8 sec., 5,344 ft.

1923, Nov. 4—Lt. A. J. Williams, U.S.N. (Curtiss R2C1-D12A Curtiss 500) makes world speed record 266.59 mph.

1923, Dec. 18—For $100,000 the Christmas Aeroplane Co. assigns its aileron patent to U. S. Government.

1924, Jan. 16—Navy airship *Shenandoah* tears loose from mast in storm and rides it out during the night.

1924, Feb. 21—Alaskan airmail flown by Carl B. Eielson from Fairbanks to McGrath.

1924, Feb. 22—Lt. J. A. Macready (Lepere-supercharged Liberty 400) reaches 41,000 ft. indicated altitude.

1924, Apr. 6-Sept. 28—Round-the-world flight by Lts. Smith, Nelson, Arnold, and Harding, Seattle to Seattle, 26,445 miles, 175 days (368 hours flying time).

1924, June 2—Lt. James T. Neely and storm-riding meteorologist Dr. C. L. Meisinger, Weather Bureau, killed by lightning in balloon near Monticello, Ill.

1924, July 1—Through transcontinental airmail service begun by U. S. Post Office.

1924, Oct. 4—Lt. H. H. Mills wins Pulitzer trophy (Verville Sperry-Curtiss HC D12A) at 216.55 mph.

1924, Oct. 7-25—Navy airship *Shenandoah* makes record cross-country cruise over 7080 miles in 235 hr. 01 min. Air hours total of 422 hr. 23 min. includes time moored.

1924, Oct. 12-15—U. S. Navy's German airship *ZR3 (Los Angeles)* makes fourth aircraft Atlantic crossing, Friedrichshafen - Lakehurst, in delivery under reparations.

1924, Oct. 29—Fog dispersal by electrified silica and sand demonstrated at Bolling Field.

1925, Jan. 29—Eclipse pictures and astronomic data secured at high altitudes by Air Service pilots.

1925, Feb. 2—Kelly Bill signed by President Coolidge authorizing private contract air transport of mail.

1925, Apr. 7—Navy carrier *Saratoga* launched.

1925, May 21-July 6—Amundsen-Ellsworth polar flight.

1925, July 15—Dr. A. Hamilton Rice Expedition, first to employ planes in exploration, returns from Amazon; Lt. Walter Hinton, pilot, in Curtiss Seagull.

1925, Aug. 4-22—MacMillan polar expedition, with Navy assistance.

1925, Aug. 5—Seven American pilots leave Paris to fly for the French in the Riff campaign in Africa. Others follow to a total of 17 pilots, 5 observers.

1925, Aug. 31-Sept. 8—In Navy's attempted San Francisco-Honolulu flight, Commander John Rodgers and crew (PN9-2 Packard 500 flying boat) alight short of mark, making non-stop cross-country seaplane record of 1,841 miles.

1925, Sept. 3—Navy dirigible, *Shenandoah*, collapsed in storm over Ava, O., killing 14 of 43 on board.

1925, Sept. 12—Morrow Board appointed by President Coolidge. (Laid down U. S. air policy.)

1925, Oct. 12—Lt. Cyrus Bettis wins 6th Pulitzer race (Curtis R3C1-V1400 Curtiss 619) at 248.97 mph.

1925, Oct. 26—Lt. J. H. Doolittle wins 8th International Schneider Seaplane Trophy race in first contest in America (Curtiss R3C2—V1400 Curtiss 619) at 232.57 mph.

1925, Dec. 17—Gen. William Mitchell found guilty of violating 96th Article of War; had risked insubordination by demanding unrestricted use of air power. Sentenced five years suspension of rank, pay and command. Resigned.

1926, Jan. 18—A $2,500,000 air promotion fund established by Daniel Guggenheim.

1926, Jan. 29—Lt. J. A. Macready (XCO5A-Liberty 400) makes American altitude record: 38,704 ft.

1926, Feb. 11—Strip bombing tests made at Kelly Field.

1926, Apr. 16—First cotton dusting plane purchased by Department of Agriculture.

1926, Apr. 30—Capt. G. H. Wilkins and Lt. Carl B. Eielson complete third round trip Fairbanks-Pt. Barrow-Fairbanks.

1926, May 8-9—Flight over North Pole by

Boeing 247—one of the First Modern Streamlined Transports

Richard Byrd, navigator, and Floyd Bennett, pilot, in Fokker monoplane.

1925, May 21-July 6—Amundsen-Ellsworth bile airship *Norge* crosses Pole in voyage Spitzbergen-Teller, Alaska in 71 hours.

1926, May 20—Air Commerce Act (Bingham-Parker Bill) signed by President Coolidge; Aeronautics Branch, Department of Commerce, established.

1926, May 30—Bennett international balloon race, Brussels, brought to America by the win of W. T. Van Orman and W. W. Morton in Goodyear III balloon. Capt. H. C. Gray, Air Service, second.

1926, July 2—Army Air Service renamed Army Air Corps.

1926, July 2—First reforesting by airplane, Hawaii.

1926, July 14—Armstrong seadrome model demonstrated at Wilmington, Del. to Air Service.

1926, Aug. 18—Metal-clad airship contract let at not over $300,000.

1926, Aug. 25—JN training plane dropped by parachute, San Diego Naval Air Station.

1926, Dec. 7—Airway beacon erected by Aeronautics Branch, Department of Commerce, on Chicago-Dallas route.

1926, Dec. 21-May 2 ('27)—Mass amphibian good will flight from San Antonio, Tex. through Mexico, Central and South America and West Indies, under Maj. H. A. Dargue.

1927, Mar. 9—American balloon altitude record of 28,508 ft. made by Capt. H. C. Gray.

1927, Apr. 12—New American duration record of Clarence D. Chamberlin and B. B. Acosta (Bellanca-15 Wright 200) 51 hr. 11 min. 25 sec.

1927, May 4—Record balloon altitude attempt by Capt. H. C. Gray, 42,470 ft.

1927, May 15-19 — Greatest concentration since World War I (109 planes) in maneuvers under Brig. Gen. J. E. Fechet.

1927, May 20-21—Non-stop trans-Atlantic solo flight by Charles A. Lindbergh, New York-Paris, 3,610 miles, 33 hr. 30 min. (13th aircraft to make completed crossing.)

1927, May 25—Outside loop demonstrated by Lt. James H. Doolittle.

1927, June 4—First nonstop flight to Germany, Clarence D. Chamberlin and passenger (Bellanca-15 Wright 200), 3,911 miles, 43 hr. 49 min. 33 sec.

1927, July 25—World airplane altitude record by Lt. C. C. Champion, U. S. N. (Wright-P & W 425 supercharged) 38,484 ft.

1927, Aug. 16-17—A. C. Goebel and Lt. W. V. Davis, U. S. N. (Travelair-15 Wright 200) win Dole Oakland-Honolulu race One team finishes. Two teams lost.

1927, Sept. 1—Air express operations begun by American Railway Express and major airlines.

1927, Sept. 10—Bennett international balloon race, Dearborn, Mich., won by E. J. Hillard and A. G. Schlosser with 745 miles; 15 contestants.

1927, Oct. 12—Wright Field dedicated.

1928, Feb. 3-Dec. 28—Lt. H. A. Sutton conducts a series of spin tests; awarded Mackay Trophy.

1928, Mar. 1-9—Transcontinental amphibian flight by Army Lt. Burnie R. Dallas and civilian Beckwith Havens in Loening.

1928, Mar. 28-30—Edw. A. Stinson and George Holderman (Stinson-Wright 200) make endurance record of 53 hr. 36 min. 30 sec.

1928, Apr. 12-13—First non-stop westbound North Atlantic airplane crossing made by Baron G. von Huenefeld, Capt. Hermann Koehl and Maj. James Fitzmaurice (Junker-Junker 280/310 metal cabin land monoplane) from Baldonnel, Ireland to Greenly Island, N.F., 2,070 miles in 37 hours.

1928, Apr. 15-21 — First eastbound Arctic crossing made by Capt. G. H. Wilkins and Lt. C. B. Eielson (Lockheed-Wright 225) Pt. Barrow-Green Harbor, Spitzbergen, 2,200 miles, 20 hr. 20 min.

1928, May 24—Gen. Umberto's airship is over the Pole in trip from Spitzbergen. It is wrecked May 25, with loss of lives of crew and rescuers.

1928, May 31-June 8—First U. S.-Australian flight, by Capt. C. Kingsford-Smith, Capt. C. T. P. Ulm, H. W. Lyon and James Warner (F7 Fokker-3 Wright 200) Oakland-Brisbane, 7,410 miles; 83 hr. 19 min.

1928, June 11-12—Mexico-Washington flight by Capt. Emilio Carranza (Bryan-Wright 200).

1928, June 17-18—First woman to fly Atlantic, Amelia Earhart with Wilmer Stultz, pilot, from Trepassey Bay, N.F., to Burryport, England, in trimotored Fokker, 2,140 miles, 20 hr., 40 min.

1928, July 30-31—Twenty-second Bennett international balloon race, Detroit, won by Capt. W. E. Kepner and Lt. W. O. Fareckson; 460 miles, 43 hr.

1928, Sept. 19—First Diesel engine to power heavier-than-air craft; designed by I. M. Woolson, manufactured by Packard Motor Car Co.; flight-tested at Utica, Mich.

1928, Oct. 19—Parachute troop demonstration at Brooks Field.

1928, Nov. 11—First Antarctic flight made by Lt. C. B. Eielson and Sir Hubert Wilkins (Lockheed-Wright 22). Other flights subsequently.

1928, Nov. 23-Dec. 30—New York-Girardot, Colombia, flight by Capt. Benjamin Mendez, 4,600 miles.

1928, Dec. 19—Autogiro flight by Harold F. Pitcairn, Pitcairn Field, Willow Grove, Pa.

1929, Jan. 1-7—Refueling endurance record set by Maj. Carl Spaatz and Capt. Ira C. Eaker, Lt. Elwood R. Quesada, Lt. Harry A. Halverson, S/Sgt. Roy W. Hooe in 150 hr., 40 min., 51 sec.

1929, Apr. 3—Floyd Smith trap-door parachute demonstrated.

1929, Apr. 30—Jack Barstow makes duration glider record of 15 hr. 13 min. at Point Loma, Cali.

1929, June 28-29—Round transcontinental flight by Capt. Frank M. Hawks (Lockheed-P & W) in 40 hr. 4 min. 32 sec. Capt. E. G. Harper repeats the performance July 11-26.

1929, July 13-30—World endurance record of 420 hr. 17 min. by Forrest O'Brien and Dale Jackson (Curtiss Robin-Curtiss 70).

1929, July 18-20 — N. Y.-Alaska flight by Capt. Russ G. Hoyt. Return flight ends at Edmonton, after covering 6,000 miles out of 8,469 itinerary.

1929, Aug. 5-6—Group transcontinental flight of 9 Keystone bombers under Major Hugh J. Knerr.

1929, Sept. 24—Demonstration by Lt. James H. Doolittle results in Guggenheim report blind flying solution.

1929, Oct. 21—Air Ambulance Service organized by Colonial Flying Service and Scully Walton Ambulance Co., New York.

1929 — Bennett international balloon race won by W. T. Van Orman and aide, 341 miles, 9 contestants.

1930, Mar. 15—Glider, piloted by Capt. Frank Hawks, released from seaplane, Port Washington, N. Y.

1930, Apr. 6—Transcontinental glider in tow, piloted by Capt. Frank Hawks; San Diego to New York; 2,860 miles in 36 hr., 47 min.

1930, May 20—Dirigible-launched Vought observation plane, flown by Lt. Comdr. Charles A. Nicholson from *U.S.S. Los Angeles* to *U.S.S. Saratoga*, Lakehurst, N. J.

1930, June 4—New world altitude record of 38,560 ft. set by Navy Lt. Apollo Soucek, Anacostia, Md.

1930, June 11-July 4—World endurance record of 553 hr. 41 min. 30 sec. established by John and Kenneth Hunter (Stinson-Wright 200).

1930, July 21-Aug. 17—Refueling endurance record raised to 647 hr., 28 min. by Forrest O'Brien and Dale Jackson in a Curtiss Robin, St. Louis, Mo.

1930, July 22—German air mail plane catapulted 250 miles out en route to New York; 198 such ship-shore flights 1929-1938.

1930, Sept. 1 — Bennett international balloon race again won for U. S. by W. T. Van Orman and aide, 542 miles.

1931, Feb. 14-19—Lts. W. W. Lite, Clement McMullen fly New York-Buenos Aires, 6,870 miles, 5 days, 5 hours elapsed time; 52:15:00 flying.

1931, Mar. 30—Airplane-airship mail transfer at Scott Field.

1931, Apr. 10—Airship sub-cloud observation car demonstration by Lt. W. J. Paul.

1931, May 25-28—World endurance record, non-refueled, set by Walter E. Lees and F. A. Brossi, Bellanca, Packard Diesel 225 hp; 85 hr., 32 min., 38 sec., Jacksonville, Fla.

1931, May 14-28—Transcontinental autogiro flight by John M. Miller, from Philadelphia to San Diego.

1931, June 4—Rocket glider flown by William G. Swan; remained aloft for 30 min. with 10 rockets, Atlantic City, N. J.

1931, June 23-July 1—World flight by Wiley Post and Harold Gatty (Lockheed-PW 550), New York-Harbor Grace-Berlin-Moscow-Irkutsk-Khabarovsk-Solomon Beach-Fairbanks-Edmonton-Cleveland-New York, in 14 hours. 8 days 16 hours, 16,500 miles.

1931, July 25-26—Glider duration record of 16 hr. 38 min. by 2nd Lt. John C. Crain, Honolulu.

1931, Oct. 3-5—Trans-Pacific non-stop airplane flight by Clyde Pangborn and Hugh Herndon, Samushiro Beach, Japan, to Wenatchee, Wash.

1931, Oct 3-5—Herndon and Pangborn (Bellanca-PW 420) left New York July 28 on world trip and had reached Japan Aug. 6, abandoning attempt to better Post-Gatty record.

1931, Oct. 6-9—Navy bomber tests on *U.S.S. Pittsburgh* in Chesapeake Bay.

1931, Nov. 3—Dirigible, *Akron*, carried record number of 207 persons in flight over New York and Philadelphia.

1931, Dec. 17-18—Glider duration record of 21 hr. 34 min. by Lt. Wm. A. Cocke, Honolulu.

1932, May 9—First solo blind flight, by Capt. Albert F. Hegenberger, Wright Field, Dayton, O.

1932, May 20-21—Amelia Earhart soloes across Atlantic, St. Johns, New Brunswick to Londonderry, Ireland, in Wasp-powered Lockheed Vega.

1932, Aug. 25—First woman to complete non-stop transcontinental flight, Amelia Earhart, Los Angeles to Newark.

1932, Dec. 1—Teletypewriter weather map service inaugurated by Department of Commerce.

1933, Jan. 19 — Rocket guided by sound waves from enemy aircraft proposed.

1933, Jan. 23 — Steam airplane project launched by Great Lakes Aircraft and General Electric Co. Later Besley brothers fly their steam airplane.

1933, Apr. 4—Navy dirigible, *Akron*, crashes into sea, killing 73; Comdr. Herbert V. Wiley, commanding.

1933, May 3-26 — Airborne troop logistics part of West Coast maneuvers, with 283 aircraft.

1933, July 15-22—Solo round-the-world flight by Wiley Post in Lockheed Vega monoplane, *Winnie Mae*, in 7 days, 18 hr., 49 min.

1933, Sept. 4—World speed record for land planes set at 304.98 mph by James R. Wedell in Wasp-powered Wedell-Williams racer.

1933, Nov. 20-21—World balloon altitude record set at 61,237 ft. by Lt. Comdr. T. G. W. Settle and Maj. C. L. Fordney over Akron, O.

1934, Jan. 10-11—Longest non-stop over-water mass flight completed by six P2Y-1 Navy flying boats under command of Lt. Comdr. Knefler McGinnis, San Francisco to Honolulu.

1934, Feb. 9 — Postmaster General Farley cancels certain mail contracts. Air Corps flies the mail Feb. 19-Mar 10; Mar. 19-May 5.

1934, June 12—Howell commission to study airmail act and report on all phases of aviation by Feb. 1, 1935.

1934, Dec. 31—War Department announces instruction governing GHQ Air Force organization and operation.

1935, Jan. 3—Antarctic flight by Ellsworth and Kenyon (Northrop-PW 600).

1935, Feb. 12—Navy dirigible, *Macon*, crashes into sea, killing 2.

1935, June 12-Aug. 14—Washington-Alaska-Washington flight (Douglas Amphibian-2 Wasps) in test of practicability of such flight with standard equipment and as any ordinary flight. Capt. Hez McClellan and crew of two.

1935, Aug. 15—Will Rogers and Wiley Post killed in take-off crash near Point Barrow, Alaska.

1935, Nov. 11—Balloon altitude record of 72,394 ft. by Capt. O. A. Anderson and Capt. Albert Stevens.

1935, Nov. 21-Dec. 5—Antarctic flights renewed by Ellsworth and Kenyon (Northrop-PW 600).

1935, Nov. 22-29—Trans-Pacific airmail flight by Capt. Edwin C. Musick, Pan American Airways, from San Francisco to Honolulu, Midway Island, Wake Island, Guam and Manila, in Martin *China Clipper*.

1936, June 7—All-instrument transcontinental flight by Maj. Ira C. Eaker, between New York and Los Angeles.

1936, Sept. 10-Oct. 20—Regular trans-Atlantic flying boat service by Deutsche Lufthansa. (Dornier twin Diesel engine 600.) Continued in 1937 and 1938.

1936, Sept. — Trans-Atlantic round-trip flight by Henry (Dick) Merrill and Harry Richman, New York to London and return.

1937, May 6—German dirigible, *Hindenburg*, burned on mooring, killing 36, Lakehurst, N. J.

1937, May 20-July 3—Amelia Earhart Putnam and Fred Noonan lost in Pacific in round-the-world attempt.

1937, June 25—Non-stop transcontinental amphibian flight by Richard Archbold in PBY-1, Catalina, from San Diego to New York.

1937, July 3-Sept. 3—Regular trans-Atlantic service test by Pan American Airways. Imperial Airways also similarly operate July 5-Aug. 2 and continue in 1938.

1937, Aug. 12—In joint coast defense exercise, Navy patrol planes locate target ship *Utah* 300 miles off San Francisco; Air Corps planes attack.

1937, Aug. 23—Wholly automatic landings made, "first in history," at Wright Field by Capt. Carl J. Crane with 2 passengers; awarded DFC.

1938, Feb. 15-27—Miami-Buenos Aires-Miami flight of 6 bombers under Lt. Col. Robert Olds, for inauguration President Ortiz.

1938, Feb. 26—Government acquires monopoly on helium by purchasing production facilities at Dexter, Kan.

1938, Apr. 22—Capt. E. V. Rickenbacker purchases Eastern Air Lines from North American Aviation, Inc., for $3,500,000.

1938, June 23—Civil Aeronautics Authority with five members, an administrator, and a three-man Safety Board, created under Civil Aeronautics Act signed by President. This supersedes Aeronautics Branch, Department of Commerce.

1938, July 10-14—Howard Hughes and crew of four fly short northern course around world in 3 days, 19 hr., 8 min.

1938, July 17-18—Douglas (Wrong-Way) Corrigan flies from New York to Ireland in nine-year-old Curtiss Robin.

1938, Aug. 3-12—Miami-Bogota-Miami goodwill flight of 3 bombers under Major Vincent J. Meloy.

1938, Aug. 10-11 — First Berlin-New York nonstop flight by Capt. Alfred Henke and crew (Focke-Wulf Condor 200), 4,577 miles, 24 hr. 54 min.

1938, Aug. 22—Civil Aeronautics Act becomes effective.

1939, Feb. 4-6—Langley Field-Santiago Red Cross flight by Major C. V. Haynes in XB bomber with medicinal supplies.

1939, Mar. 5—Non-stop airmail system by pick-up demonstrated by Norman Rintoul and Victor Yesulantes in Stinson Reliant planes, Coatesville, Pa.

1939, Apr. 3—The National Defense Act, providing for aerial rearmament, signed by President Roosevelt.

1939, Apr. 17—Inclined runways for assisted takeoff studied by Air Corps Board.

1939, May 20—North Atlantic airmail service begun by PAA between Port Washington, L. I., the Azores, Portugal and Marseille, France.

1939, June 27—Bill authorizing Civilian Pilot Training Program signed by President.

1939, Sept. 1-3—Germany invades Poland. England and France declare war on Germany.

1940, Mar. 26—U. S. commercial airlines complete a full year of flying without a fatal accident or serious injury to a passenger or crew member.

1940, July 1—Air Safety Board abolished with its functions delegated to the Civil Aeronautics Board. Civil Aeronautics Administration transferred to Department of Commerce.

1940, Sept. 23—House committee asks $80 million for airport development, in $500 million program; $40 million voted.

1941, Mar. 17—Milwaukee renames its airport as General Mitchell Field.

1941, Apr. 15—First officially-recorded rotor helicopter flight in western hemisphere, Vought-Sikorsky VS-300A, piloted by Igor I. Sikorsky; flight time, 1 hr., 5 min., 14.5 sec., Stratford, Conn.

1941, May—Barrage balloon defense transferred from Air Corps to Coast Artillery.

1941, June 5—Ferry Command, for delivery of planes to Britain, organized by Army Air Corps.

1941, June 20—Army Air Force, comprising office of Chief of Air Corps and Air Force Combat Command, created.

1941, June—First woman to ferry bomber across Atlantic, Jacqueline Cochran, Canada to British Isles.

1941, Sept. 5—Mass trans-Pacific flight of heavy bombers completed by nine Army B-17 Flying Fortresses.

1941, Dec. 7—Pearl Harbor.

1942, Apr. 8—First flight of Ferry Command over Himalayan "Hump" made by Lt. Col. William D. Old, between Assam, India and Kunming, China.

1942, Apr. 18—First bombing attack on Japanese mainland by 16 B-25 Mitchell bombers from Navy carrier, *Hornet*; Lt. Col. James H. Doolittle commanding.

1942, May 4-9—Battle of Coral Sea.

1942, June 20—Ferry Command redesignated Air Transport Command under Maj. Gen. Harold L. George.

1942, June 3-7—Battle of Midway.

1942, June 17—AAF tow planes successfully pick up gliders in tests at Wright Field.

1942, Aug. 17—First official bombing raid of Eighth Air Force, 12 Flying Fortresses, Brig. Gen. Ira C. Eaker commanding, Rouen, France.

1942, Sept.—Fifty American Eagle squadron pilots, RAF, all Americans, transferred to Eighth Air Force. (Fourth Fighter Group.)

1942, Oct. 1—Jet plane built and flown by Robert M. Stanley; Bell Airacomet (XP-59A), Muroc Dry Lake, Cal.

1943, Mar. 1-4—Battle of Bismarck Sea.

1943, Mar. 19—Lt. Gen. Henry H. Arnold, commanding general of the AAF, advanced to full four-star general, the first in air history.

1943, June 24—World's longest parachute drop, 40,200 ft., made by Lt. Col. W. R. Lovelace at Ephrata, Wash.

1943, June 11—First ground victory by air power when Pantelleria, Italy, surrenders unconditionally to Lt. Gen. Carl Spaatz. First case in history of a well-fortified citadel being defeated without aid of ground forces.

1943, Oct.—World's longest freight line opened by Capt. J. L. Okenfus and crew of five in 28,000-mile round-trip flight, Ohio to India.

1944, June—Army Air Force reaches peak with 78,757 aircraft.

1945, May 8—War in Europe ends.

1945, Aug. 6—Atomic bomb dropped on Hiroshima from B-29, *Enola Gay*, under command of Col. Paul W. Tibbets, Jr.

1945, Aug. 14—Japan's surrender ends World War II.

1945, Sept. 28-Oct. 4—Round-the-world air service begun by Air Transport Command, Douglas C-54E, Globester, 9 passengers, 23,147 miles in 149 hr., 49 min.

1946, Jan. 26—Jet-propelled P-80, flown by Col. William H. Councill, sets non-stop transcontinental record of 4 hr., 13 min., 26 sec., between Long Beach, Cal., and New York.

1946, Mar. 12—First commercial helicopter license granted by Civil Aeronautics Administration for Bell 2-place Model 47.

1946, Mar. 22—First American-built rocket to escape earth's atmosphere, reaches 50-mile height. Constructed by Douglas.

1946, July 21—The McDonnell XFH-1 Phantom is first U.S. jet to operate from carrier, *U.S.S. Franklin D. Roosevelt*.

1946, Aug. 6—Two B-17 radio-controlled bombers with stand-by crews, fly non-stop, Hilo, Hawaii, to Muroc Lake, Cal.

1947, Feb. 28—Lt. Col. Robt. E. Thacker and Lt. John M. Ard, in a North American F-82 (Rolls Royce V-1650) fly longest known flight by fighter aircraft, Honolulu to N. Y., 4,968 miles in 14 hr. 31 min. 50 sec.

1947, July 18—Air Policy Commission established by President.

1947, July 26—Army-Navy Merger Bill signed by President, making Department of Air Forces co-equal with Army and Navy, and creating Department of Defense.

1947, Oct. 17—First faster-than-sound flight by Capt. Charles E. Yeager in rocket-powered Air Force research plane, Bell XS-1, betters 760 mph. (Not announced officially until June 10, 1948.)

1948, June 18—Air parcel post system established by Congress; to begin Sept. 1.

1948, June 26—Berlin Airlift begins "Operation Vittles" with Douglas C-47's carrying 80 tons of supplies the first day. During first five months, Airlift tops cargo volume of all U.S. airlines by flying 93,000,000 ton-miles.

1948, July 1—Air Transport Command and Naval Air Transport Service consolidated as Military Air Transport Service (MATS) under command of Air Force Chief of Staff.

1948, Sept. 15—U. S. Air Force recaptures world speed record with North American F-86 jet fighter traveling 670.981 mph, flown by Maj. Richard L. Johnson.

1948—Northrop's YB-49 Flying Wing, first eight-jet bomber in the U.S. Air Force, makes longest jet-propelled flight on record of approximately 3,400 miles at average speed of 382 mph.

1949, Jan. 7—Air Force announces a new unofficial climbing speed record set by the Bell X-1 at Muroc Air Force Base with Capt. Charles E. Yeager at the controls, climbing more than 13,000 ft. per min., compared with 8-10,000 ft. per min. for jet planes.

1949, Jan. 14—Capt. William Odom, flying a specially modified Beechcraft Bonanza, sets a new lightplane distance record, crossing from Honolulu to Oakland, Cal.

1949, Feb. 7—Eastern Air Lines reports new transcontinental speed record for transport aircraft set Feb. 5 by new-type Lockheed Constellation on delivery flight from Los Angeles to La Guardia Field in 6 hr. 17 min. 39-2/5 sec.

1949, Feb. 8—Boeing XB-47 jet bomber sets cross-country speed record to Andrews Field, Washington, D. C. from Moses Lake, Wash. in 3 hr. 46 min.

1949, Mar. 2—Air Force completes the first nonstop round-the-world flight in history, as a Boeing B-50 bomber, *Lucky Lady II*, lands at Carswell AFB, Ft. Worth, Tex. at 9:30 CST, after a 94-hour trip; piloted by Capt. James Gallagher, assisted by a crew of 13, the B-50 flew a total of 23,452 miles at an average speed of 249 mph. Four refueling contacts were made with B-29 tankers.

1949, Mar. 8—New world distance record for light planes set by Capt. William Odom in a Beechcraft *Bonanza*, flying 5,273 miles from Honolulu to Teterboro, N. J., in 36 hr. 2 min.

1949, May 3—The Martin *Viking*, 45-ft. research rocket, is fired successfully at White Sands Proving Ground, Las Cruces, N. M., reaching an altitude of 51½ miles and a speed of 2,250 mph.

1949, May 6—Sikorsky S-52-1 helicopter sets new international speed record of 122.75 mph.

1949, Oct. 3—Navy jet-rocket special research plane, the Douglas D-558-II Skyrocket, reaches a top speed of slightly over 700 mph at an altitude of 25,000 ft. in test flight at Muroc, Cal.

1950, Jan. 3—Jacqueline Cochran sets new official F.A.I. 500 kilometer closed course record flying a North American F-51 (Packard-built Merlin V1650) at 444 mph.

1950, Jan. 22—Paul Mantz sets new transcontinental record flying a North American P-51 Mustang (Allison) from Burbank, Calif. to La Guardia Field, N. Y. in 4 hr. 52 min. 58 sec.

1950, Feb. 9—Navy Lockheed P2V Neptune (Wright 3350) patrol bomber completes 5,156-mile flight in 25 hr. 57 min.

1950, Mar. 31—Ana Louisa Branger, flying a Piper Cub Special powered by a Continental C-90-8F engine, sets official new lightplane international altitude record of 24,504 feet.

1950, Sept. 5—North American Aviation announces successful completion of tests at Edwards AFB in which heavy bombs were dropped for first time at speeds over 500 mph with a B-45 Tornado (GE-J47).

1950, Sept. 22—Col. David C. Schilling and Lt. Col. William D. Ritchie fly London-New York nonstop with three in-flight refuellings in two Republic F-84E (Allison J-35A-17) jet fighters. (Schilling completed flight; Ritchie bailed out over Newfoundland and was later rescued by helicopter.)

1950, Nov. 10 — A Lockheed F-80 shoots down a Russian-built MIG-15 in first jet aerial combat, Korea.

1951, Jan. 17—Convair RB-36D reconnaissance bomber makes 51 hr. 20 min. non-stop flight without refueling.

1951, Feb. 2—First successful air-to-air refueling of a U.S. jet bomber is carried out by a North American RB-45C Tornado and a Boeing KB-29P tanker at Edwards AFB, Calif.

A CHRONOLOGY OF U. S. AVIATION

1951, Apr. 24—Piper Super Cub, piloted by Mrs. Ana Louisa Branger, sets an international altitude record of 26,820 feet in the minus 1,103-pound category.

1951, May 15—Max Conrad sets non-stop lightplane record in Piper Pacer (125 hp Lycoming), crossing the country in 23 hr. 4 min. 31 sec.

1951, Aug. 8—Navy's Martin Viking VII sets new altitude record for single stage missiles, flying 135 miles up from White Sands Proving Ground, N. M., reaching a top speed of 4,100 mph.

1951, Aug. 18—North American F-86A Sabre jet, piloted by Col. Keith K. Compton, flies from Edwards AFB, Calif., to Detroit, Mich., in 3 hr. 27 min. 56 sec. at an average speed of 553.761 mph.

1952, Jan. 2—A Sikorsky H-19 helicopter completes 1,800-mile flight from Great Falls, Mont., to Ladd AFB, Fairbanks, Alaska, in five days—probably the longest flight ever made by rotary wing craft.

1952, Mar. 18—Two Republic F-84 Thunderjets land in Neubiberg, Germany, after a 2,800 mile flight without refueling—believed to be the longest sustained jet fighter flight in history. The jets crossed seven countries, averaged 585 mph, and were in the air 4 hr. 48 min.

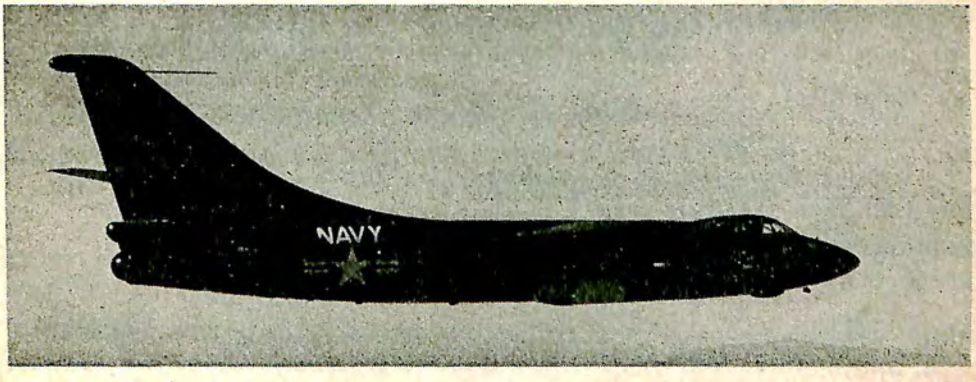
1952, Apr. 30—For the first time in aviation history, air passenger-miles (10,679,281,000) in 1951 exceeded the total passenger-miles traveled in Pullman cars (10,224,714,000).

1952, May 10—Transcontinental lightplane record is set by Max Conrad in a Piper Pacer, traveling from Los Angeles to New York (2,461 mi.) non-stop in 24 hr. 54 min.

1952, Aug. 1—Two Sikorsky H-19 helicopters complete first trans-Atlantic helicopter crossing and break non-stop distance record for rotary wing aircraft.

1952, Nov. 19—New record set by North American F-86D (GE J-47 GE-17) Sabre jet, piloted by Capt. J. Slade Nash, flying at 699.92 mph. (Previous world speed record—670.981 mph.)

Douglas XA3D-1 is world's fastest, highest-flying and heaviest carrier combat plane. It is designed for the new Forrestal-class carriers.



OFFICIAL RECORDS

The Federation Aeronautique Internationale, Paris, France, better known as the FAI, currently composed of the national aero clubs of thirty-two nations, is the governing body of the world for official aircraft records and sporting aviation contests. The FAI was organized in Paris in October, 1905, by representatives from Belgium, France, Germany, Great Britain, Italy, Spain, Switzerland, and the United States. Representing the FAI in the United States is the National Aeronautic Association, organized in 1922.

The rules for all official world and international aircraft records are proposed initially by the various national aero clubs who are members of FAI. Later they are evaluated by the International Sporting Aviation Commission of FAI and then submitted, for final approval, to the delegates of the many national aero clubs who attend each annual FAI conference. Developed over a period of forty-four years, the rules are markedly complete. All attempts to establish official aircraft records must meet identical FAI standards.

NAA also rules on the best national performances and on many records of strictly national interest, such as inter-city speed times of transport aircraft.

FAI-NAA rules have these goals: (1) an equal opportunity to every competitor, (2) competent, unbiased judging, and (3) scientifically accurate records.

The NAA Contest Board enforces FAI-NAA regulations in the United States.

OFFICIAL F.A.I. WORLD AIR RECORDS

Note: International Records are now designated World Class Records by F.A.I.

MAXIMUM SPEED OVER A 1.864 MI. COURSE .... 699.92 mph.
Capt. James S. Nash, USAF, Nov. 19, 1952 (subject to F.A.I. confirmation as we went to press).

MAXIMUM SPEED IN A CLOSED CIRCUIT .... 635.686 mph.
Col. Fred J. Ascani, U.S.A.F., United States.
Detroit-Wayne Major Airport, August 17, 1951.

DISTANCE IN A STRAIGHT LINE .... 11,235.600 mi.
Comdr. Thomas D. Davies, USN.; Comdr. Eugene P. Rankin, USN.; Comdr. Walter S. Reid, USN.; Lt. Comdr. Ray A. Tabeling, USN.; United States, Sept. 29 - Oct. 1, 1946.

DISTANCE IN CLOSED CIRCUIT .... 8,854.308 mi.
Lt. Col O. F. Lassiter, pilot; Capt. W. J. Valentine, co-pilot and USAF crew, Tampa Fla., Aug. 1-3, 1947.

ALTITUDE .... 72,394.795 ft.
Capt. Orvil Anderson and Capt. Albert Stevens, United States, Nov. 11, 1935.

OFFICIAL F.A.I. INTERNATIONAL AND NATIONAL "CLASS" RECORDS

AIRPLANES—(Class C) Group II

RECIPROCATING ENGINES

DISTANCE, CLOSED CIRCUIT

International Record .... 8,854.308 mi.
Lt. Col. O. F. Lassiter, pilot; Capt. W. J. Valentine, co-pilot; Capt. William D. Bailey, Capt. F. O. Hinckley, 1st Lt. A. J. Orillon, 1st Lt. R. L. Lewis, M/Sgt. J. J. Blancio, T/Sgt. J. R. Sanders, S/Sgt. J. Gauthier, and M/Sgt. R. B. Corey, crew: USAAF, United States, Boeing B-29 monoplane, 44-84061, 4 Wright 3350-57A engines of 2,200 hp each, MacDill Field, Tampa, Fla., Aug. 1 - 3, 1947.

National (U.S.) Record .... Same as above.

DISTANCE IN A STRAIGHT LINE

International Record .... 11,235.600 mi.
Comdr. Thomas D. Davies, USN.; Comdr. Eugene P. Rankin, USN.; Comdr. Walter S. Reid, USN.; and Lt. Comdr. Ray A. Tabeling, USN; United States, Lockheed P2V-1 monoplane, 2 Wright R-3500 engines of 2,300 hp each, from Pearce Field, Perth, Australia, to Port Columbus, Columbus, O., Sept. 29 - Oct. 1, 1946.

National (U.S.) Record .... Same as above.

ALTITUDE

International Record .... 56,046 ft.
Mario Pezi, Italy, Caproni 161 biplane, Piaggio XI R.C. engine, Montecelio, Oct. 22, 1938.

National (U.S.) Record .... 47,910 ft.
Maj. F. F. Ross, pilot; Lt. D. M. Davis, co-pilot; Lt. C. B. Webster, Lt. L. B. Barrier, F/O Pamphille Morrissette, Sgt. W. S. George, crew; USAAF, Boeing B-29 monoplane, 4 Wright R-3350-23 A 2,000 hp engines, Harmon Field, Guam, M. I., May 15, 1946.

MAXIMUM SPEED OVER A 86.411 MI. MEASURED COURSE

International Record .... 469.220 mph.
Fritz Wendel, Germany, Messerschmitt B. F. 109R, Daimler Benz 601 1,000 hp engine, Augsburg, Apr. 26, 1939.

National (U.S.) Record .... 412.002 mph.
Jacqueline Cochran, North American F-51 monoplane, Packard built Rolls Royce Merlin 1,450 hp engine, Thermal, Cal., Dec. 17, 1947.

MAXIMUM SPEED AT HIGH ALTITUDE

International Record .... 464.374 mph.
Jacqueline Cochran, United States, North American F-51 low wing monoplane, Packard built Rolls Royce Merlin 1,450 hp engine, near Indio, Cal., Apr. 9, 1951.

National (U.S.) Record .... Same as above.

SPEED FOR 62.137 MI. WITHOUT PAYLOAD

International Record .... 436.995 mph
Jacqueline Cochran, United States, North American F-51, Rolls Royce Merlin 1,450 hp engine. Desert Center-Mt. Wilson course, Dec. 29, 1949.

National (U.S.) Record .... Same as above.

SPEED FOR 310.685 MI. WITHOUT PAYLOAD .... No official record.

SPEED FOR 621.369 MI. WITHOUT PAYLOAD

World Class Record .... 431.094 mph
Jacqueline Cochran, United States, North American F-51, Packard Rolls Royce Merlin 1,450 hp engine. Start and finish near Palm Springs, Cal., May 24, 1948.

National (U.S.) Record .... Same as above.

International Record .... 469.549 mph.
Jacqueline Cochran, United States, North American F-51, Packard Rolls Royce Merlin 1,450 hp engine. Coachella Valley, Cal., Dec. 10, 1947.

National (U.S.) Record .... Same as above.

SPEED FOR 1,242.739 MI. WITHOUT PAYLOAD

International Record .... 447.470 mph.
Jacqueline Cochran, United States, North American P-51 monoplane, Packard built Rolls Royce Merlin Engine of 1,450 hp near Palm Springs, Cal., May 22, 1948.
National (U.S.) Record .... Same as above.

SPEED FOR 3,106.849 MI. WITHOUT PAYLOAD

International Record .... 338.392 mph.
Capt. J. E. Bauer, pilot; Capt. J. E. Cotton, co-pilot; M/Sgt. Angel Queses, T/Sgt. Richard McDonald and Cpl. Raymon Koss, crew; USAAF, United States, Boeing B-29 monoplane, 4 Wright R-3350-23A engines of 2,200 hp each, Dayton, O., June 28, 1946.
National (U.S.) Record .... Same as above.

SPEED FOR 6,213.698 MI. WITHOUT PAYLOAD

International Record .... 273.195 mph.
Lt. Col. O. F. Lassiter, pilot; Capt. W. J. Valentine, co-pilot; Capt. William D. Bailey; Capt. F. O. Hinckley, 1st Lt. A. J. Orillon, 1st Lt. R. L. Lewis, M/Sgt. J. J. Blancio, T/Sgt. J. R. Sanders, S/Sgt. J. Gauthier, S/Sgt. R. B. Corey, crew; USAAF, United States, Boeing B-29 monoplane, 4 Wright R-3350-57A engines, 2,200 hp each, Wright Field, Dayton, O., July 29 - 30, 1947.
National (U.S.) Record .... Same as above.

WITH PAYLOAD OF 2,204.622 LB.

ALTITUDE

International Record .... 47,910.009 ft.
Maj. F. F. Ross, pilot; Lt. D. M. Davis, co-pilot; Lt. L. B. Barrier, Lt. C. B. Webster, F/O Pamphille Morrissette and Sgt. W. S. George, crew; USAAF, United States, Boeing B-29 monoplane, 4 Wright 2,000 hp engines, Harmon Field, Guam, M.I., May 15, 1946.
National (U.S.) Record .... Same as above.

SPEED FOR 621.369 MI.

International Record .... 325.713 mph.
Furio Niclot, Italy, Breda 88, 2 Piaggio XI R. C. 40B, 1,000 hp engines, Dec. 9, 1937.
National (U.S.) Record .... 259.398 mph.
Capt. C. S. Irvine and Capt. P. H. Robey, USAAC pilots; Capt. C. J. Crane and Lt. P. G. Miller, USAAC, Boeing YB-17A monoplane, 4 Wright 840 hp engines, Dayton, O., Aug. 1, 1939.

SPEED FOR 1,242.739 MI.

International Record .... 365.649 mph.
Lt. E. M. Grabowski, pilot; Lt. J. J. Liset, co-pilot; M/Sgt. D. P. Kelly, Cpl. F. M. Polmotier, and Cpl. O. W. Lambert, crew; USAAF, United States, Boeing B-29 monoplane, 4 Wright 2,200 hp engines, Dayton, O., May 17, 1946.
National (U.S.) Record .... Same as above.

SPEED FOR 3,106.849 MI.

International Record .... 338.392 mph.
Capt. J. E. Bauer, pilot; Capt. J. E. Cotton, co-pilot; M/Sgt. Angelo Queses, T/Sgt. Richard McDonald and Cpl. Raymon Koss, crew; USAAF, United States, Boeing B-29 monoplane, 4 Wright R-3350-23A engines of 2,200 hp each, Dayton, O., June 28, 1946.
National (U.S.) Record .... Same as above.

WITH PAYLOAD OF 4,409.244 LB.

ALTITUDE

International Record .... 46,522.217 ft.
Col. E. D. Reynolds, pilot; Capt. B. P. Robson, co-pilot; Lt. J. G. Barnes, Lt. Theodore Madden, Lt. K. H. Morehouse, S/Sgt. W. C. Flynn and Cpl. A. L. Lentowski, crew; USAAF, United States, Boeing B-29 monoplane, 4 Wright 2,000 hp engines, Harmon Field, Guam, M.I., May 13, 1946.
National (U.S.) Record .... Same as above.

SPEED FOR 621.369 MI.

International Record .... 369.692 mph.
Lt. E. M. Grabowski, pilot; Lt. J. J. Liset, co-pilot; M/Sgt. D. P. Kelly, Cpl. F. M. Polmotier, and Cpl. O. W. Lambert, crew; USAAF, United States, Boeing B-29 monoplane, 4 Wright 2,200 hp engines, Dayton, O., May 17, 1946.
National (U.S.) Record .... Same as above.

SPEED FOR 1,242.739 MI.

International Record .... 365.649 mph.
Lt. E. M. Grabowski, pilot; Lt. J. J. Liset, co-pilot; M/Sgt. D. P. Kelly, Cpl. F. M. Polmotier, and Cpl. O. W. Lambert, crew; USAAF, United States, Boeing B-29 monoplane, 4 Wright 2,200 hp engines, Dayton, O., May 17, 1946.
National (U.S.) Record .... Same as above.

SPEED FOR 3,106.849 MI.

International Record .... 338.392 mpn.
Capt. J. E. Bauer, pilot; Capt. J. F. Cotton, co-pilot; M/Sgt. Angelo Queses, T/Sgt. Richard McDonald and Cpl. Raymon Koss, crew; USAAF, United States, Boeing B-29 monoplane, 4 Wright 2,200 hp engines, Dayton, O., June 28, 1946.
National (U.S.) Record .... Same as above.

WITH PAYLOAD OF 11,023 LB.

ALTITUDE

International Record .... 45,252.534 ft.
Lt. T. P. Tobinson, pilot; Lt. Lloyd A. Lee, co-pilot; Lt. D. B. Gleicher, Lt. A. W. Armistead, Lt. R. M. Beattie, Lt. F. J. Royce, F/O R. F. Johnson and Mario R. Genta, crew; USAAF, United States, Boeing B-29 monoplane, 4 Wright 2,000 hp engines, Harmon Field, Guam, M.I., May 14, 1946.
National (U.S.) Record .... Same as above.

SPEED FOR 621.369 MI.

International Record .... 369.692 mph.
Lt. E. M. Grabowski, pilot; Lt. J. J. Liset, co-pilot; M/Sgt. D. P. Kelly, Cpl. F. M. Polmotier, and Cpl. O. W. Lambert, crew; USAAF, United States, Boeing B-29 monoplane, 4 Wright 2,200 hp engines, Dayton, O., May 17, 1946.
National (U.S.) Record .... Same as above.

SPEED FOR 1,242.739 MI.

International Record .... 365.649 mph.
Lt. E. M. Grabowski, pilot; Lt J. J. Liset, co-pilot; M/Sgt. D. P. Kelly, Cpl. F. M. Polmotier, and Cpl. O. W. Lambert, crew; USAAF, United States, Boeing B-29 monoplane, 4 Wright 2,200 hp engines, Dayton, O., May 17, 1946.
National (U.S.) Record .... Same as above.

SPEED FOR 3,106.849 MI.

International Record .... 266.023 mph.
Lt. Col. R. G. Ruegg, pilot; Lt. Col. Carl P. Walter, co-pilot; 2nd Lt. J. E. Wetzel, M/Sgt. William Cunningham and M/Sgt. R. L Hilton, crew; USAAF, United States, Boeing B-29 monoplane, 4 Wright 2,200 hp engines, Dayton, O., June 21, 1946.
National (U.S.) Record .... Same as above.

WITH PAYLOAD OF 22,046 LB.

ALTITUDE

International Record .... 41,561.597 ft.
Capt. A. A. Pearson, pilot; Lt. V. L. Dalbey, co-pilot; Lt. R. S. Strasburg, Lt. L. E. Bork, Cpl. J. T. Collins and Cpl. Joseph Friedberg, crew; USAAF, United States, Boeing B-29 monoplane, 4 Wright 2,200 hp engines, Harmon Field, Guam, M.I., May 8, 1946.
National (U.S.) Record .... Same as above.

SPEED FOR 621.369 MI.

International Record .... 357.731 mph.
Capt. J. D. Bartlett, pilot; Lt. William Murray, co-pilot; M/Sgt. C. M. Youngblood, Cpl. D. J. Shrader and Cpl. R. F. Wilden, crew; USAAF, United States, Boeing B-29 monoplane, 4 Wright 2,200 hp engines, Dayton, O., May 19, 1946.
National (U.S.) Record .... Same as above.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SPEED FOR 1,242.739 MI.

International Record .... 357.035 mph.
Capt. J. D. Bartlett, pilot; Lt. William Murray, co-pilot; M/Sgt. C. M. Youngblood, Cpl. D. J. Shrader and Cpl. R. F. Wilden, crew; USAAF, United States, Boeing B-29 monoplane, 4 Wright 2,200 hp engines, Dayton, O., May 19, 1946.

National (U.S.) Record .... Same as above.

SPEED FOR 3,106.849 MI.

International Record .... 266.023 mph
Lt. Col. R. G. Ruegg, pilot; Lt. Col. Carl P. Walter, co-pilot; 2nd Lt. J. E. Wetzel, M/Sgt. William Cunningham and M/Sgt. R. L. Hilton, crew; USAAF, United States, Boeing B-29 monoplane, 4 Wright 2,200 hp engines, Dayton, O., June 21, 1946.

National (U.S.) Record .... Same as above.

WITH PAYLOAD OF 33,069 LB.

ALTITUDE

International Record .... 39,520.918 ft
Col. B. H. Warren, pilot; Maj. J. R. Dale, Jr., co-pilot; Lt. W. D. Collier, M/Sgt. Gordon S. Fish, S/Sgt. V. H. Worden and Sgt. Thomas H. Hall, crew; USAAF, United States, Boeing B-29 monoplane, 4 Wright 2,200 hp engines, Harmon Field, Guam, M.I., May 11, 1946.

National (U.S.) Record .... Same as above

SPEED FOR 621.369 MI. .... No official record.

SPEED FOR 1,242.739 MI. .... No official record

SPEED FOR 3,106.849 MI. .... No official record

GREATEST PAYLOAD CARRIED TO AN ALTITUDE OF 6,561,666 FT.

International Record .... 33,435 lb.
Col. B. H. Warren, pilot; Maj. J. R. Dale, Jr., co-pilot; Lt. W. D. Collier, M/Sgt. Gordon S. Fish, S/Sgt. V. H. Worden and Sgt. Thomas H. Hall, crew; USAAF, United States, Boeing B-29 monoplane, 4 Wright 2,200 hp engines, Harmon Field, Guam, M.I., May 11, 1946.

National (U.S.) Record .... Same as above.

CIRCUIT OF THE WORLD .... No official record.

AIRPLANES—(Class C) Group I

JET ENGINES

DISTANCE, CLOSED CIRCUIT .... No official record.

DISTANCE IN A STRAIGHT LINE .... No official record.

ALTITUDE

International Record .... 59,445.359 ft.
John Cunningham, Great Britain, de Havilland 100 Vampire Mark I aircraft powered with a de Havilland Ghost 2/2 T.G. 278 jet engine, producing a thrust of 4,300 lb., at Hatfield, Hertfordshire, Mar. 23, 1948.

National (U.S.) Record .... No official record.

MAXIMUM SPEED

International Record .... 699.92 mph.
Capt. James S. Nash, USAF, North American F-86D, General Electric J-47-17, near Salton Sea, Cal., Nov. 19, 1952. (Subject to F.A.I. confirmation as we went to press)

National (U.S.) Record .... Same as above.

SPEED FOR 62.137 MI. WITHOUT PAYLOAD

World Class Record .... 635.685 mph.
Col. Fred J. Ascani, USAF, North American F-86E, General Electric J-47, Detroit Wayne Major Airport, Romulus, Mich., Aug. 17, 1951.

National (U.S.) Record .... Same as above.

SPEED FOR 310.685 MI. WITHOUT PAYLOAD .... No official record.

SPEED FOR 621.369 MI. WITHOUT PAYLOAD

International Record .... 510.925 mph.
J. Reginald Cooksey, Great Britain, Gloster Meteor F. 8, VZ 496, 2 Rolls Royce Derwent 3,500 lb. thrust jet engines, Moreton Valence, Campo Ness Course, May 12, 1950.

National (U.S.) Record .... 462.970 mph.
Lt. John J. Hancock, USAAF, Lockheed P-80 monoplane Allison J.33 jet engine, Dayton, O., May 19, 1946.

SPEED FOR 1,242.739 MI. WITHOUT PAYLOAD

International Record .... 440.298 mph.
Lt. John Hancock, USAAF, United States, Lockheed P-80 monoplane, Allison J-33 jet engine, Dayton, O., May 19, 1946.

National (U.S.) Record .... Same as above.

SPEED FOR 3,106.849 MI. WITHOUT PAYLOAD .... No official record.

SPEED FOR 6,213.698 MI. WITHOUT PAYLOAD .... No official record.

WITH PAYLOAD OF 2,204.622 LB.

ALTITUDE .... No official record.

SPEED FOR 621.369 MI.

International Record .... 410.431 mph.
Lt. Col. T. P. Gerrity, pilot; Capt. Wm. Rickert, co-pilot, USAAF, United States, Douglas XA-26F monoplane, 2 Pratt and Whitney R-2800, 2,000 hp and 1 General Electric I-16 jet engine, Dayton, O., June 20, 1946.

National (U.S.) Record .... Same as above.

SPEED FOR 1,242.739 MI. .... No official record.

SPEED FOR 3,106.849 MI. .... No official reoord

CLIMB TO 9,842.5 FT.

World Class Record .... 1 min., 15.5 sec
Richard Bellingham, Great Britain, Gloster Meteor Mark 8 W.A. 820, two Armstrong Siddeley Sapphire Mark 2 jet engines, Moreton Valence airport, Gloucestershire, Aug. 31, 1951.

National (U.S.) Record .... No official record

CLIMB TO 19,685 FT.

World Class Record .... 1 min., 50.0 sec
Richard Bellingham, Great Britain, Gloster Meteor Mark 8 W.A. 820, two Armstrong Siddeley Sapphire Mark 2 jet engines, Moreton Valence airport, Gloucestershire, Aug. 31, 1951.

National (U.S.) Record .... No official record

CLIMB TO 29,527.5 FT.

World Class Record .... 2 min., 27.0 sec
Richard Bellingham, Great Britain, Gloster Meteor Mark 8 W.A. 820, two Armstrong Siddeley Sapphire Mark 2 jet engines, Moreton Valence airport, Gloucestershire, Aug. 31, 1951.

National (U.S.) Record .... No official record.

CLIMB TO 39,370 FT.

World Class Record .... 3 min., 09.5 sec.
Richard Bellingham, Great Britain, Gloster Meteor Mark 8 W.A. 820, two Armstrong Siddeley Sapphire Mark 2 jet engines, Moreton Valence airport, Gloucestershire, Aug. 31, 1951.

National (U.S.) Record .... No official record.

LIGHT AIRPLANES—(Class C-1.a)

FIRST CATEGORY (AIRCRAFT WEIGHING LESS THAN 1,102.3 LB., IN FLYING ORDER)

DISTANCE IN A CLOSED CIRCUIT, WITHOUT REFUELING

World Class Record ____ 1,242.74 mi.
Albert Revillon, France, Minicab, Type G-Y 20, Continental 65 hp engine; gross weight 499.5 kilograms, Toussus-le-Noble-Tour-Bourges course, May 10, 1952.

National (U.S.) Record ____ No official record.

AIRLINE DISTANCE

World Class Record ____ 1,361.485 mi.
Robert C. Faris, United States, Mooney M-18-L, Lycoming 65 hp engine; gross weight 476.73 kilograms, from Wichita, Kan. to Montpelier, Vt., Aug. 9, 1952.

National (U.S.) Record ____ Same as above.

ALTITUDE

World Class Record ____ 27,152 ft.
Mrs. Ana L. Branger, Venezuela, Piper Super Cub, Model PA-18, Lycoming 0-290-D 125 hp engine, Hybla Valley Airport, Alexandria, Va., Apr. 10, 1951.

National (U.S.) Record ____ No official record.

SPEED FOR 62.137 MI. IN A CLOSED CIRCUIT

World Class Record ____ 126.223 mph
A. L. Cole, Great Britain, Comper Swift, gross weight 902 lb., Pobjoy R 80 hp engine, Wolverhampton, June 17, 1950.

National (U.S.) Record ____ No official record.

SPEED FOR 310.685 MI. IN A CLOSED CIRCUIT

World Class Record ____ 115.611 mph.
Albert Revillon, France, Minicab, Type G-Y 20, Continental 65 hp engine; gross weight 499.5 kilograms, Toussus-le-Noble-Tour-Bourges course, May 10, 1952.

National (U.S.) Record ____ No official record.

SPEED FOR 621.369 MI. IN A CLOSED CIRCUIT

World Class Record ____ 115.442 mph.
Albert Revillon, France, Minicab, Type G-Y 20, Continental 65 hp engine; gross weight 499.5 kilograms, Toussus-le-Noble-Tour-Bourges course, May 10, 1952.

National (U.S.) Record ____ No official record.

SPEED FOR 1,242.74 MI. IN A CLOSED CIRCUIT

World Class Record ____ 113.979 mph.
Albert Revillon, France, Minicab, Type G-Y 20, Continental 65 hp engine; gross weight 499.5 kilograms, Toussus-le-Noble-Tour-Bourges course, May 10, 1952.

National (U.S.) Record ____ No official record.

LIGHT AIRPLANES—(Class C-1.b)

SECOND CATEGORY (ALL AIRCRAFT WITH A TOTAL WEIGHT, IN FLYING ORDER, BETWEEN 1,102.3 AND 2,204.6 LB.)

DISTANCE IN A CLOSED CIRCUIT WITHOUT REFUELING

World Class Record ____ 1,244.799 mi.
Joseph G. Garnier, France, Nord 1203, Regnier 135 hp engine; gross weight 999.05 kilograms, Lyon-Bron—Corbas-Montelimar-Ancone course, Apr. 23, 1952.

National (U.S.) Record ____ No official record.

AIRLINE DISTANCE

World Class Record ____ 2,462.330 mi.
Maximillian A. Conrad, United States, Piper Pacer, Lycoming 0-290-D 125 hp engine; gross weight 998.4 kilograms, Los Angeles, Cal. to New York, N. Y., Apr. 30-May 1, 1952.

National (U.S.) Record ____ Same as above.

ALTITUDE

World Class Record .... 30,203 ft.
Miss Caro Bayley, United States, Piper Super Cub, Lycoming 0-290-D 125 hp engine; gross weight 1,118 lbs., Miami, Fla., Jan. 4, 1951.
National (U.S.) Record .... Same as above.

SPEED FOR 62.137 MI. IN A CLOSED CIRCUIT

World Class Record .... 192.839 mph.
R. R. Paine, Great Britain, Miles Hawk Speed Six, de Havilland Gipsy Major 205 hp engine; gross weight 1,843 lb., at Wolverhampton, June 17, 1950.
National (U.S.) Record .... No official record.

SPEED FOR 310.685 MI. IN A CLOSED CIRCUIT

World Class Record .... 164.231 mph.
Miss Marie Nicolas, France, Norecrin, Regnier engine; gross weight 2,082 lb., Montpellier-Frejorgues course, Dec. 5, 1951.
National (U.S.) Record .... No official record.

SPEED FOR 621.369 MI. IN A CLOSED CIRCUIT

World Class Record .... 163.287 mph.
Miss Marie Nicolas, France, Norecrin, Regnier engine; gross weight 2,082 lb., Montpelier-Frejorgues course, Dec. 5, 1951.
National (U.S.) Record .... No official record.

SPEED FOR 1,242.74 MI. IN A CLOSED CIRCUIT

World Class Record .... 142.058 mph.
Joseph G. Garnier, France, Nord 1203, Regnier 135 hp engine; gross weight 999.05 kilograms, Lyon-Bron—Corbas-Montelimar-Ancone course, Apr. 23, 1952.
National (U.S.) Record .... No official record.

LIGHT AIRPLANES—(Class C-1.c)

THIRD CATEGORY (ALL AIRCRAFT WITH A TOTAL WEIGHT, IN FLYING ORDER, BETWEEN 2,204.6 AND 3,858 LB.)

AIRLINE DISTANCE

International Record .... 4,957.240 mi.
William P. Odom, United States, Beech Bonanza Model 35 airplane, take-off weight 3,858 lb., Continental E-185-1 engine, from Honolulu, Hawaii to Teterboro, N. J., Mar. 7 - 8 (G.M.T.), 1949.
National (U.S.) Record .... Same as above.

ALTITUDE .... No official record.

SPEED FOR 62.137 MI. IN A CLOSED CIRCUIT

World Class Record .... 222.846 mph.
Leonardo Bonzi, Italy, SAI.7 Ambrosini, deHavilland Gipsy Queen 240 hp engine, gross weight 3,197 lb., Point X-Fiumicino-Vaianica-Anzio Course, Dec. 21, 1951.
National (U.S.) Record .... No official record.

SPEED FOR 310.685 MI. IN A CLOSED CIRCUIT

World Class Record .... 156.475 mph.
Nikolai Kouznetzov, U.S.S.R. YAK-18, M.11 FR-1 160 hp engine, gross weight 2,491 lb., Touchino-Skhodnia course, Oct. 11, 1951.
National (U.S.) Record .... No official record.

SPEED FOR 621.369 MI. IN A CLOSED CIRCUIT

World Class Record .... 216.114 mph.
Leonardo Bonzi, Italy, SAI.7 Ambrosini, deHavilland Gipsy Queen 240 hp engine, gross weight, 3,197 lb., Fiumicino-Chiesa Antignano-Tauerna Pagliavone Course, Dec. 21, 1951.
National (U.S.) Record .... No official record.

SPEED FOR 1,242.739 MI. IN A CLOSED CIRCUIT

World Class Record .... 158.932 mph.
Paul Burniat, Belgium, Beechcraft Bonanza, Continental 185 hp engine, gross weight 3,586 lb., Keerbergen-Ostende-Gosselies-Bierset Course, June 8, 1952.
National (U.S.) Record .... No official record.

LIGHT AIRPLANES—(Class C-1.d)

FOURTH CATEGORY (ALL AIRCRAFT WITH A TOTAL WEIGHT, IN FLYING ORDER, BETWEEN 3,858.1 AND 6,613.9 LB.)

AIRLINE DISTANCE .... No official record.

ALTITUDE .... No official record.

SPEED FOR 62.137 MI. IN A CLOSED CIRCUIT

International Record .... 322.789 mph.
Miss R. M. Sharpe, Great Britain, Vickers Supermarine Spitfire 5B, gross weight 5,626 lb., Rolls Royce Merlin 55 M 1,280 hp engine, Wolverhampton, June 17, 1950.
National (U.S.) Record .... No official record.

SPEED FOR 310.685 MI. IN A CLOSED CIRCUIT

World Class Record .... 292.881 mph.
Y. D. Forostenco, U.S.S.R., YAK II, A.C.H. 650 hp engine, gross weight 4,916 lb., Touchino-Skhodnia course, July 12, 1951.
National (U.S.) Record .... No official record.

SPEED FOR 621.369 MI. IN A CLOSED CIRCUIT

World Class Record .... 274.825 mph.
Nicolay Golovanov, U.S.S.R., YAK II, ACH-21 engine, gross weight 5,251 lb., Skhodnia-Kourgane-Orel-Skhodnia course, Aug. 26, 1951.
National (U.S.) Record .... No official record.

SPEED FOR 1,242.739 MI. .... No official record.

LIGHT AIRPLANES—(Class C-1.e)

FIFTH CATEGORY (ALL AIRCRAFT WITH A TOTAL WEIGHT. IN FLYING ORDER, BETWEEN 6,613.9 AND 9,920.8 LB.)

AIRLINE DISTANCE .... No official record.

ALTITUDE .... No official record.

SPEED FOR 62.137 MI. IN A CLOSED CIRCUIT

International Record .... 328.447 mph.
P. G. Robarts, Great Britain, Vickers Supermarine Spitfire 8 trainer, gross weight 7,474 lb., Rolls Royce Merlin 66 168 hp engine, Wolverhampton, June 17, 1950.
National (U.S.) Record .... No official record.

SPEED FOR 310.685 MI. IN A CLOSED CIRCUIT .... No official record.

SPEED FOR 621.369 MI. .... No official record.

SPEED FOR 1,242.739 MI. .... No official record.

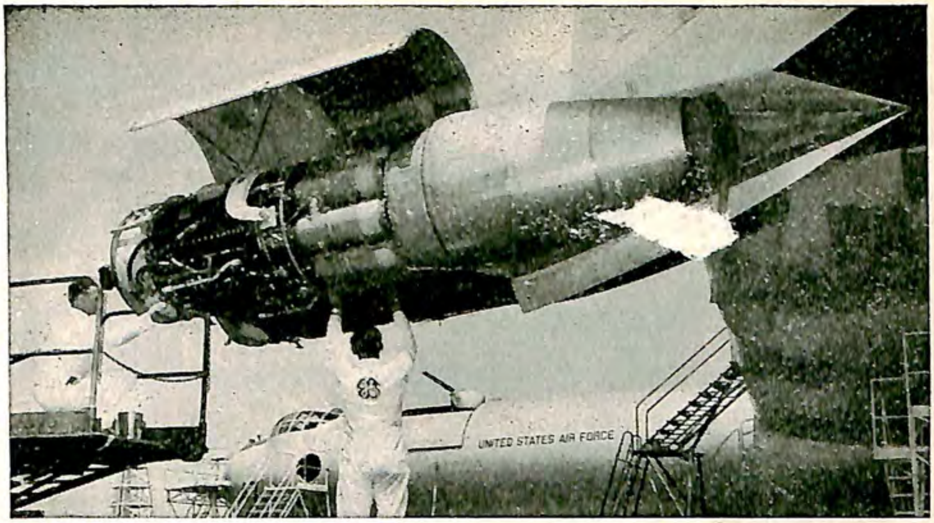
SEAPLANES—(Class C-2)

DISTANCE, CLOSED CIRCUIT

International Record .... 3,231.123 mi.
Mario Stoppani and Carlo Tonini, Italy, Cant Z I-LERO seaplane, 3 Alfa Romeo 126 RC.34 750 hp engines, May 27-28, 1937.
National (U.S.) Record .... 1,569 mi.
Lts. B. J. Connell and H. C. Rodd, Pn-10, 2 Packard 600 hp each, San Diego, Cal., Aug. 15 - 16, 1927.

AIRLINE DISTANCE

International Record .... 5,997.462 mi.
Capt. D. C. T. Bennett and First Officer L. Harvey, pilots; Great Britain, Short-Mayo Mercury seaplane, 4 Napier Rapiers J.I. 370 hp engines, from Dundee, Scotland to near Fort-Nolloth, S. Africa, Oct. 6-8, 1938.
National (U.S.) Record .... 3,281.402 mi.
Lt. Comdr. Knefler McGinnis, USN, Lt. J. K. Averill, USN, NAP T. P. Wilkinson, USN, Pilots; C. S. Bolka, A. E. J. Dionne and E. V. Sizer, crew; Navy XP3Y-1 seaplane, 2 Pratt and Whitney 825 hp engines, from Cristobal Harbor, C. Z. to San Francisco Bay, Alameda, Cal., Oct. 14-15, 1935.


UNITED STATES AIR FORCE

ALTITUDE

International Record .... 44,429.04 ft.
Col. Nicola Di Mauro, Italy, Caproni 161 seaplane, (biplane), Piaggio XI RC 100 engine, at Vigna di Valle, Sept. 25, 1939.

National (U.S.) Record .... 38,559.594 ft.
Lt. Appollo Soucek, USN, Apache, Pratt and Whitney 425 hp engine, supercharged, at Washington, D. C., June 4, 1929.

MAXIMUM SPEED

International Record .... 440.681 mph.
Francesco Agello, Italy, M.C. 72 seaplane, Fiat A.S. 6 engine at Lake Garda, Italy, Oct. 23, 1934.

National (U.S.) Record .... 245.713 mph.
Lt. James H. Doolittle, USAF, Curtiss R3C-2, Curtiss V-1400, 600 hp engine, Bay Shore, Baltimore, Md., Oct. 27, 1925.

SPEED FOR 62.137 MI. WITHOUT PAYLOAD

International Record .... 391.072 mph.
Guglielmo Cassinelli, Italy, Macchi C. 72 seaplane, 2,400 hp Fiat AS 6 engine, Falconara-Pesaro permanent course, Oct. 8, 1933.

National (U.S.) Record .... 241.679 mph.
Lt. G. T. Cuddihy, USN, Curtiss R3C-2, Curtiss V-1500, 700 hp at Norfolk, Va., Nov. 13, 1926.

SPEED FOR 310.685 MI. WITHOUT PAYLOAD .... No official record.

SPEED FOR 621.369 MI. WITHOUT PAYLOAD

International Record .... 250.676 mph.
M. Stoppani and G. Gorini, pilots; Ing. Luzzatto and E. Accomolli, passengers; Italy, Cant Z 509 seaplane, 3 Fiat A80 RC 41 1,000 hp engines, Mar. 30, 1938.

National (U.S.) Record .... 165.040 mph.
Maj. Gen. Frank M. Andrews, pilot; J. G. Moran and H. O. Johnson, crew; Martin BO12-A seaplane, 2 Pratt and Whitney 700 hp Hornet engines, Aug. 24, 1935.

SPEED FOR 1,242.739 MI. WITHOUT PAYLOAD

International Record .... 246.351 mph.
M. Stoppani and G. Gorini, pilots; Ing. Luzzatto and E. Accomolli, passengers; Italy, Cant Z 509 seaplane, 3 Fiat A80 RC 41 1,000 hp engines, Mar. 30, 1938.

National (U.S.) Record .... 157.319 mph.
Edwin Musick, Boris Sergievsky and Charles A. Lindbergh, Sikorsky S-42 Seaplane, 4 Pratt and Whitney 670 hp Hornet enines, Aug. 1, 1934.

SPEED FOR 3,106.849 MI. WITHOUT PAYLOAD

International Record .... 191.534 mph.
Mario Stoppani and Carlo Tonini, Italy, Cant Z I-LERO seaplane, 3 Alfa Romeo 126 RC.34 750 hp engines, May 27-28, 1937.

National (U.S.) Record .... No official record.

SPEED FOR 6,213.698 MI. WITHOUT PAYLOAD .... No official record.

WITH PAYLOAD OF 2,204.622 LB.

ALTITUDE

International Record .... 34,084.577 ft.
Nicola di Mauro and Mario Stoppani, Italy. Cant Z. 506 B. seaplane, 3 Alfa Romeo RC.55 700 hp engines, at Monfalcone, Nov. 12, 1937.

National (U.S.) Record .... 26,929.080 ft.
Boris Sergievsky, Sikorsky S-48 seaplane, 2 Pratt and Whitney Hornet, 575 hp each, at Bridgeport, Conn., July 21, 1930.

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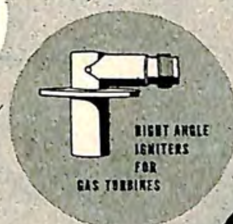

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SPEED FOR 621.369 MI.
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M. Stoppani, and G. Gorini, pilots; Ing. Luzzatto and E. Accomolli, passengers; Italy, Cant Z 509 seaplane, 3 Fiat A80 RC 41 1,000 hp engines, Mar. 30, 1938.
National (U.S.) Record .... 165.040 mph.
Maj. Gen. F. M. Andrews, pilot; J. G. Moran and H. C. Johnson, crew; Martin B-12-A seaplane, 2 Pratt and Whitney 700 hp Hornet, engines, Aug. 24, 1935.

SPEED FOR 1,242.739 MI.
International Record .... 246.351 mph.
M. Stoppani and G. Gorini, pilots; Ing. Luzzatto and E. Accomolli, passengers; Italy Cant Z 509 seaplane, 3 Fiat A80 RC 41, 1,000 hp engines, Mar. 30, 1938.
National (U.S.) Record .... 157.319 mph.
Edwin Musick, Boris Sergievsky and Charles A. Lindbergh, Sikorsky S-42 seaplane, 4 Pratt and Whitney 670 hp Hornet engines, Aug. 1, 1934.

SPEED FOR 3,106.849 MI.
International Record .... 191.534 mph.
Mario Stoppani and Niccola di Mauro, Italy, Cant Z 506-B seaplane, 3 Alfa Romeo 126 RC.34 750 hp engines, May 27-28, 1937.
National (U.S.) Record .... No official record.

WITH PAYLOAD OF 4,409.244 LB.

ALTITUDE
International Record .... 29,366.737 ft.
Mario Stoppani and Nicola di Mauro, Italy, Cant Z 506-B seaplane, 3 Alfa Romeo 700 hp engines, at Monfalcone, Nov. 3, 1937.
National (U.S.) Record .... 19,709.259 ft.
Boris Sergievsky S-38 seaplane, 2 Pratt and Whitney 424 hp Wasp, engines, at Stratford, Conn., Aug. 11, 1930.

SPEED FOR 621.369 MI.
International Record .... 250.676 mph.
M. Stoppani and G. Gorini, pilots; Ing. Luzzatto and E. Accomolli, passengers; Italy, Cant Z 509 seaplane, 3 Fiat A80 RC 41 1,000 hp engines, Mar. 30, 1938.
National (U.S.) Record .... 157.580 mph.
Edwin Musick, Boris Sergievsky and Charles A. Lindbergh, Sikorsky S-42 seaplane, 4 Pratt and Whitney 670 hp Hornet engines, Aug. 1, 1934.

SPEED FOR 1,242.739 MI.
International Record .... 246.351 mph.
M. Stoppani and G. Gorini, pilots; Ing. Luzzatto and E. Accomolli, passengers; Italy, Cant Z 509 seaplane, 3 Fiat A80 RC 41 1,000 hp engines, Mar. 30, 1938.
National (U.S.) Record .... 157.319 mph.
Edwin Musick, Boris Sergievsky and Charles A. Lindbergh, Sikorsky S-42 seaplane, 4 Pratt and Whitney 670 hp Hornet engines, Aug. 1, 1934.

SPEED FOR 3,106.849 MI. .... No official record.

WITH PAYLOAD OF 11,023.11 LB.

ALTITUDE
International Record .... 24,310.973 ft
Mario Stoppani and Nicola di Mauro, pilots; Forlivesi, mechanic; Italy, Cant Z 506-B seaplane, 3 Alfa Romeo 700 hp engines, at Monfalcone, Nov. 7, 1947.
National (U.S.) Record .... 20,406.472 ft
Boris Sergievsky and Raymond B. Quick, Sikorsky S-42 seaplane, 4 Pratt and Whitney 670 hp Hornet engines, Bridgeport, Conn., May 17, 1934.

SPEED FOR 621.369 MI.
International Record .... 156.516 mph.
Mario Stoppani and Ing. Antonio Maiorana, pilots; A. Spinelli, S. Forlivesi and R. T. Suriano, crew; Italy, Cant Z, 508 seaplane, 3 Isotta-Fraschini Asso 11 R.C. 836 hp engines, Grado-Faro Ancona-Faro di Rimini temporary course, May 1, 1937.
National (U.S.) Record .... No official record.

SPEED FOR 1,242.739 MI.

International Record .... 154.356 mph
Mario Stoppani and Ing. Antonio Maiorana, pilots; A. Spinelli, S. Forlivesi and R. T. Suriano, crew; Italy, Cant Z, 508 seaplane, 3 Isotta-Fraschini Asso 11 RC 836 hp engines, Grado-Faro Ancona-Faro di Rimini temporary course, May 1, 1937.

National (U.S.) Record .... No official record.

SPEED FOR 3,106.849 MI. .... No official record.

WITH PAYLOAD OF 22,046.22 LB.

ALTITUDE

International Record .... 15,954.691 ft.
Mario Stoppani, pilot; G. Divari and A. Spinetti, passengers; Italy, Cant Z 508 seaplane, 3 Isotta Fraschini Asso 11 R.C. 836 hp engines, Monfalcone, Apr. 13, 1937.

National (U.S.) Record .... No official record.

SPEED FOR 621.369 MI.

International Record .... 131.110 mph.
Guillaumet, Leclaire, Comet, Le Duff, Le Morvan and Chapaton, France, Latecoere 521 seaplane, *Lt. de Vaisseau Paris*, 6 Hispano-Suiza 650 hp engines, Lucon-Aureilhan base, Dec. 27, 1937.

National (U.S.) Record .... No official record.

SPEED FOR 1,242.739 MI. .... No official record.

SPEED FOR 3,106.849 MI. .... No official record.

WITH PAYLOAD OF 33,069.33 LB.

ALTITUDE

International Record .... 13,509.162 ft.
Guillaumet, Leclaire, Comet, Le Duff, Le Morvan and Chapaton, France, Latecoere 521 seaplane, *Lt. de Vaisseau Paris*, 6 Hispano-Suiza 650 hp engines, at Biscarosse, Dec. 30, 1927.

National (U.S.) Record .... No official record.

SPEED FOR 621.369 MI.

International Record .... 117.899 mph.
Guillaumet, Leclaire, Comet, Le Duff, Le Morvan and Chapaton, France, Latecoere 521 seaplane, *Lt. de Vaisseau Paris*, 6 Hispano-Suiza 650 hp engines, Lucon-Aureilhan course, Dec. 29, 1937.

National (U.S.) Record .... No official record.

SPEED FOR 1,242.739 MI. .... No official record.

SPEED FOR 3,106.849 MI. .... No official record.

GREATEST PAYLOAD CARRIED TO AN ALTITUDE OF 6,561.660 FT.

International Record .... 39,771 lb.
Guillaumet, Leclaire, Comet, Le Duff, Le Morvan and Chapaton, France, Latecoere 521 seaplane, *Lt. de Vaisseau Paris*, 6 Hispano-Suiza 650 hp engines, at Biscarosse, Dec. 30, 1937.

National (U.S.) Record .... 16,608 lb.
Boris Sergievsky, Sikorsky S-42 seaplane, 4 Pratt and Whitney Hornet 650 hp engines, Bridgeport, Conn., Apr. 26, 1934.

LIGHT SEAPLANES—(Class C-2.a)

FIRST CATEGORY (LIGHT SEAPLANES WEIGHING LESS THAN 1,322.8 LBS.)

ALTITUDE

World Class Record .... 24,498 ft.
Charles L. Davis, United States, Piper Super Cub PA-18, Lycoming 125 hp engine, gross weight 1,295 lb., Detroit, Mich., June 18, 1952.

National (U.S.) Record .... Same as above.

DISTANCE IN A STRAIGHT LINE .... No official record.

SPEED FOR 62.137 MI. IN A CLOSED CIRCUIT

World Class Record .... 108.806 mph.
Charles L. Davis, United States, Piper Super Cub PA-18, Lycoming 125 hp engine, gross weight 1,321 lb., Grosse Point, Mich. Yacht Club, Aug. 29, 1952.

National (U.S.) Record .... Same as above.

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SPEED FOR 310.137 MI. IN A CLOSED CIRCUIT
World Class Record — 105.354 mph.
Charles L. Davis, United States, Piper Super Cub PA-18, Lycoming 125 hp engine, gross weight 1,321 lb., Grosse Point, Mich. Yacht Club, Aug. 29, 1952.
National (U.S.) Record — Same as above.

SPEED FOR 621.359 MI. IN A CLOSED CIRCUIT — No official record.
SPEED FOR 1,242.739 MI. IN A CLOSED CIRCUIT — No official record.

LIGHT SEAPLANES—(Class C-2.b)

SECOND CATEGORY (LIGHT SEAPLANES WITH A TOTAL WEIGHT, IN FLYING ORDER, BETWEEN 1,322.8 AND 2,645.6 LB.)

ALTITUDE
World Class Record — 20,169 ft.
Harold E. Mistele, United States, Aeronca, N 1454 H, Continental C-145 engine, gross weight 793 kilograms, Detroit, Seaplane Base, Mich., Sept. 3, 1951.
National (U.S.) Record — Same as above.

AIRLINE DISTANCE
World Class Record — 946.732 mi.
Harold E. Mistele, United States, Cessna 170, Continental 145 hp engine, gross weight 1,117 kilograms, from near Brownsville, Tex. to near Rosiclair, Ill., June 12, 1952.
National (U.S.) Record — Same as above.

SPEED FOR 62.137 MI. IN A CLOSED CIRCUIT
World Class Record — 109.081 mph.
Harold E. Mistele, United States, Cessna 170, Continental 145 hp engine, gross weight 1,986.5 lb., Grosse Pointe, Mich., Yacht Club, Aug. 25, 1952.
National (U.S.) Record — Same as above.

SPEED FOR 310.685 MI. IN A CLOSED CIRCUIT
World Class Record — 102.274 mph.
Harold E. Mistele, United States, Cessna 170, Continental 145 hp engine, gross weight 1,986.5 lb., Grosse Pointe, Mich., Yacht Club, Aug. 25, 1952.
National (U.S.) Record — Same as above.

SPEED FOR 621.369 MI. IN A CLOSED CIRCUIT — No official reocrd.
SPEED FOR 1,242.739 MI. IN A CLOSED CIRCUIT — No official record.

LIGHT SEAPLANES—(Class C-2.c)

THIRD CATEGORY (LIGHT SEAPLANES WITH A TOTAL WEIGHT, IN FLYING ORDER, BETWEEN 2,645.6 AND 4,629.7 LB.)

AIRLINE DISTANCE — No official record.
ALTITUDE — No official record.
SPEED FOR 62.137 MI. — No official record.
SPEED FOR 310.685 MI. IN A CLOSED CIRCUIT — No official record.
SPEED FOR 621.369 MI. — No official record.
SPEED FOR 1,242.739 MI. — No official record.

LIGHT SEAPLANES—(Class C-2.d)

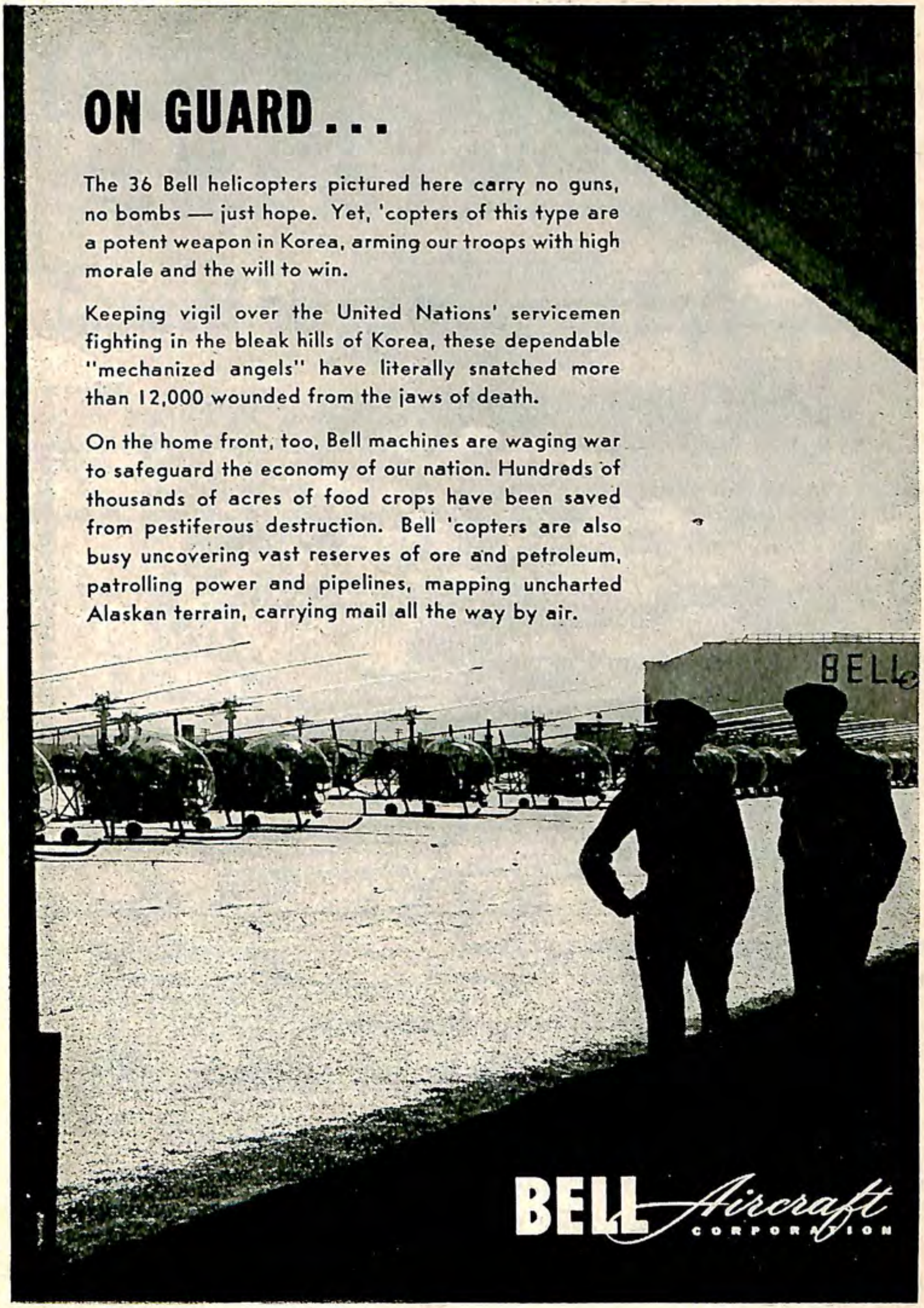
FOURTH CATEGORY (LIGHT SEAPLANES WITH A TOTAL WEIGHT, IN FLYING ORDER, BETWEEN 4,629.7 AND 7,495.7 LB.)

AIRLINE DISTANCE — No official record.
ALTITUDE — No official record.
SPEED FOR 62.137 MI. — No official record.
SPEED FOR 310.685 MI. IN A CLOSED CIRCUIT — No official record.
SPEED FOR 621.369 MI. — No official record.
SPEED FOR 1,242.739 MI. — No official record.

LIGHT SEAPLANES—(Class C-2.e)

FIFTH CATEGORY (LIGHT SEAPLANES WITH A TOTAL WEIGHT, IN FLYING ORDER, BETWEEN 7,495.7 AND 11,023 LB.)

AIRLINE DISTANCE — No official record.
ALTITUDE — No official record.
SPEED FOR 62.137 MI. — No official record.
SPEED FOR 310.685 MI. IN A CLOSED CIRCUIT — No official record.
SPEED FOR 621.369 MI. — No official record.
SPEED FOR 1,242.739 MI. — No official record.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AMPHIBIANS—(CLASS C3)

AIRLINE DISTANCE

International Record .... 1,429,685 mi.
Maj. Gen. F. M. Andrews, pilot; Maj. John Whiteley, co-pilot; .. 1 crew, United States, Douglas YOA-5 amphibian, 2 Wright Cyclone 800 hp engines, from San Juan, Puerto Rico, to Langley Field, Va., June 29, 1936.

National (U.S.) Record .... Same as above.

ALTITUDE

International Record .... 24,950.712 ft.
Boris Sergievsky, United States, Sikorsky S-43 amphibian, 2 Pratt and Whitney 750 hp Hornet engines, Stratford, Conn., Apr. 14, 1936.

National (U.S.) Record .... Same as above.

MAXIMUM SPEED

International Record .... 230.413 mph.
Maj. Alexander P. de Seversky, United States, Seversky Amphibian, Wright Cyclone 710 hp engine, Detroit, Mich., Sept. 15, 1935.

National (U.S.) Record .... Same as above.

SPEED FOR 62.137 MI. WITHOUT PAYLOAD

International Record .... 241.883 mph
R. R. Colquhoun, Great Britain, Vicker's Supermarine Seagull I, Rolls Royce Griffin Mark 29 1380 hp engine, Marston Moor, July 22, 1950.

National (U.S.) Record .... 209.451 mph.
Major A. P. deSeversky, United States, Seversky Amphibian, Wright "Cyclone" 1,000 hp engine, Miami, Fla., Dec. 19, 1936.

SPEED FOR 621.369 MI. WITHOUT PAYLOAD

International Record .... 186.076 mph.
Capt. W. P. Sloan and Capt. B. L. Boatner, USA AC, pilots; United States, Grumman YOA-9 amphibian, 2 Pratt and Whitney engines, 400 hp each, Dayton, O., July 31, 1939.

National (U.S.) Record .... Same as above.

SPEED FOR 1,242.739 MI. WITHOUT PAYLOAD

International Record .... 154.701 mph.
Giuseppe Burei and Enrico Rossaldi, pilots; Gino Velati, passenger; Italy, Macchi C-94 I.-NEP I amphibian, 2 Wright Cyclone 750 hp engines, Rovine Ansedonia-Faro Fiumicino Antignano temporary course, May 6, 1937.

National (U.S.) Record .... No official record.

SPEED FOR 3,106.849 MI. WITHOUT PAYLOAD .... No official record.

SPEED FOR 6,213.689 MI. WITHOUT PAYLOAD .... No official record.

WITH PAYLOAD OF 2,204.622 LB.

ALTITUDE

International Record .... 23,405.465 ft.
Ivan Soukhomline, USSR, Tsagui 44 D Amphibian, 4 M-87 840 hp engines, Katcha, near Sebastopol, June 17, 1940.

National (U.S.) Record .... 19,625.925 ft.
Boris Sergievsky, Sikorsky S-43, 2 Pratt and Whitney 750 hp Hornet engines, Stratford, Conn., Apr. 25, 1936.

SPEED FOR 621.369 MI.

International Record .... 172.409 mph.
Ivan Soukhomline, USSR, Tsagui 44 D Amphibian, 4 M-85, 750 hp engines, Katcha-Kersoness-Taganrog course, Sept. 28, 1940.

National (U.S.) Record .... No official record.

SPEED FOR 1,242.739 MI. .... No official record.

SPEED FOR 3,106.849 MI. .... No official record.

WITH PAYLOAD OF 4,409.244 LB.

ALTITUDE

International Record .... 20,616.756 ft.
Ivan Soukhomline, USSR, Tsagui 44 D Amphibian, 4 M-87 840 hp engines, Katcha, near Sebastopol, June 19, 1940.

National (U.S.) Record .... 19,625 ft.
Boris Sergievsky, United States, Sikorsky S-43 Amphibian, 2 Pratt and Whitney, 750 hp engines, Stratford, Conn., Apr 25, 1936.

SPEED FOR 621.369 MI.

International Record .... 149.694 mph.
Ivan Soukhomline, USSR, Tsagui 44 D Amphibian 4 M-85 750 hp engines, Katcha-Kersoness-Taganrog course, Oct. 7, 1940.

National (U.S.) Record .... No official record.

SPEED FOR 1,242.739 MI. .... No official record.
SPEED FOR 3,106.849 MI. .... No official record.

WITH PAYLOAD OF 11,023.11 LB.

ALTITUDE

International Record .... 17,122.669 ft.
Ivan Soukhomline, USSR, Tsagui 44 D Amphibian, 4 M-87 840 hp engines, Katcha, near Sebastopol, June 19, 1940.

National (U.S.) Record .... No official record.

SPEED FOR 621.369 MI. .... No official record.
SPEED FOR 1,242.739 MI. .... No official record.
SPEED FOR 3,106.849 MI. .... No official record.

WITH PAYLOAD OF 22,046.22 LB.

ALTITUDE .... No official record.
SPEED FOR 621.369 MI. .... No official record.
SPEED FOR 1,242.739 MI. .... No official record.
SPEED FOR 3,106.849 MI. .... No official record.

GREATEST PAYLOAD CARRIED TO AN ALTITUDE OF 6,561.660 FT.

International Record .... 11,023 lb.
Ivan Soukhomline, USSR, Tsagui 44 D Amphibian, 4 M-87 840 hp engines, at Katcha, near Sebastopol, June 19, 1940.

National (U.S.) Record .... No official record.

LIGHT AMPHIBIANS

FIRST CATEGORY, CLASS C-3.a (less than 1,322.7 lb.)
SECOND CATEGORY, CLASS C-3.b (1,322.8 to 2,645.4 lb.)
THIRD CATEGORY, CLASS C-3.c (2,645.6 to 4,629.7 lb.)
FOURTH CATEGORY, CLASS C-3.d (4,629.7 to 7,495.7 lb.)
FIFTH CATEGORY, CLASS C-3.e (7,495.7 to 11,023 lb.)

AIRLINE DISTANCE .... No official record.
ALTITUDE .... No official record.
SPEED FOR 62.137 MI. IN A CLOSED CIRCUIT .... No official record.
SPEED FOR 310.685 MI. IN A CLOSED CIRCUIT .... No official record.
SPEED FOR 621.369 MI. IN A CLOSED CIRCUIT .... No official record
SPEED FOR 1,242.739 MI. IN A CLOSED CIRCUIT .... No official record.

ROTORPLANES—(Class E)

DISTANCE IN A STRAIGHT LINE WITHOUT PAYLOAD

World Class Record .... 1,217.137 mi.
Elton J. Smith, United States, Bell 47D1 Helicopter, Franklin 200 hp engine, from Hurst, Ft. Worth, Tex., to Niagara Falls, N. Y. Sept. 17, 1952.

National (U.S.) Record .... Same as above.

DISTANCE CLOSED CIRCUIT WITHOUT PAYLOAD

International Record .... 621.369 mi.
Maj. D. H. Jenson and Maj. W. C. Dodds; USAAF; U.S.; Sikorsky R-5A Helicopter, Pratt and Whitney 450 hp engine, Dayton, O., Nov. 14, 1946.

National (U.S.) Record .... Same as above.

ALTITUDE, WITHOUT PAYLOAD
International Record .... 21,220 ft.
Capt. H. D. Gaddis. USA, United States, Sikorsky S-52-1 Helicopter, Franklin 0-425-1, 245 hp engine, Bridgeport, Conn., May 21, 1949.
National (U.S.) Record .... Same as above.

MAXIMUM SPEED WITHOUT PAYLOAD
International Record .... 129.552 mph.
Harold E. Thompson, United States, Sikorsky S-52-1 Helicopter, Franklin 0-425-1 245 hp engine, Cleveland, O., Apr. 27, 1949.
National (U.S.) Record .... Same as above.

SPEED FOR 62.137 MI. IN A CLOSED CIRCUIT, WITHOUT PAYLOAD
International Record .... 122.749 mph.
Harold E. Thompson, United States, Sikorsky S-52-1 Helicopter, Franklin 0-425-1 engine, 245 hp, Milford, Conn., May 6, 1949.
National (U.S.) Record .... Same as above.

SPEED FOR 310.685 MI. IN A CLOSED CIRCUIT WITHOUT PAYLOAD .... No official record.

SPEED FOR 621.369 MI. IN A CLOSED CIRCUIT, WITHOUT PAYLOAD
International Record .... 66.642 mph.
Maj. D. H. Jenson & Maj. W. C. Dodds, USAAF, Sikorsky R-5A Helicopter, Pratt and Whitney 450 hp engine, Dayton, O., Nov. 14, 1946.
National (U.S.) Record .... Same as above.

SPEED FOR 1,242.739 MI. IN A CLOSED CIRCUIT, WITHOUT PAYLOAD .... No official record.
SPEED FOR 3,106.849 MI. IN A CLOSED CIRCUIT, WITHOUT PAYLOAD—No official record.

AIRSHIPS—(CLASS B)

AIRLINE DISTANCE
International Record .... 3,967.137 mi.
Dr. Hugo Eckener, Germany, L. Z. 127, *Graf Zeppelin* 5 Maybach 450-550 hp engines, from Lakehurst, N. J., to Friedrichshafen, Germany, Oct. 29, 30, 31, and Nov. 1, 1928.
National (U.S.) Record .... No official record.

GLIDERS—(CLASS D)

(Single-Place)

DISTANCE IN A STRAIGHT LINE
International Record .... 535.169 mi.
Richard H. Johnson, U.S. Ross-Johnson sailplane, N-3722C, from Odessa, Tex. to Salina, Kan., Aug. 5, 1951.
National (U.S.) Record .... Same as above.

DISTANCE TO A PREDETERMINED POINT WITH RETURN TO POINT OF DEPARTURE
World Class Record .... 260.34 mi.
William H. Coverdale, Jr., United States, Schweizer 1-23 Sailplane, N 91875, from Grand Prairie, Tex. to Brownwood, Tex. and Return, Aug. 22, 1952.
National (U.S.) Record .... Same as above.

DISTANCE TO A PREDETERMINED DESTINATION
World Class Record .... 395.736 mi.
Viatcheslav I. Efimenko, U.S.S.R., A-9 Sailplane, from Grabtsevo (Kalouga) to Melovoe (Vorochilovograd), June 6, 1952.
National (U.S.) Record .... 332.903 mi.
Wallace R. Wiberg, Laister-Kaufmann 10A Sailplane, N 57826, from Odessa, Tex. to Guymon, Okla., Aug. 5, 1951.

DURATION WITH RETURN TO POINT OF DEPARTURE
World Class Record .... 56 hr., 15 min.
Charles Atger, France, Arsenal Air 100 glider, at Romanin les Alpilles (St. Remy de Provence), Apr. 2-4, 1952.
National (U.S.) Record .... 21 hr.,34 min.
Lt. William Cocke, Jr., Cocke "Nighthawk" glider, Honolulu, T. H., Dec. 17-18, 1931.

ALTITUDE GAINED
International Record .... 30,100 ft.
William S. Ivans, Jr., U.S., Schweizer SGS 1-23 sailplane, N-91876, Bishop, Cal., Dec. 30, 1950.
National (U.S.) Record .... Same as above.

ALTITUDE ABOVE SEA LEVEL
International Record .... 42,100 ft.
William S. Ivans, Jr., U.S., Schweizer SGS 1-23 sailplane, N-91876, Bishop, Cal., Dec. 30, 1950.
National (U.S.) Record .... 309.678 mi.

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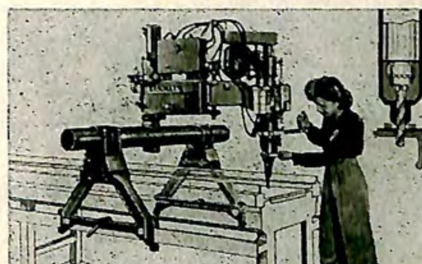
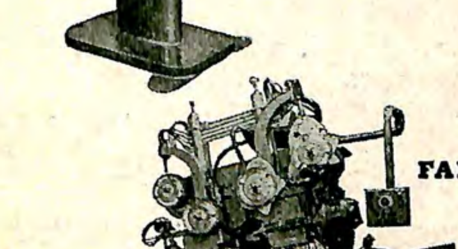


FARNHAM *Carriage Drills*
(Illustration shows work fixture in phantom)



FARNHAM *Spar Millers*

FARNHAM *Forming Rolls*

FARNHAM MANUFACTURING DIVISION
of the Wiesner-Rapp Co., Inc., Buffalo 10, N. Y.

SPEED FOR 62.137 MI. OVER A TRIANGULAR COURSE
World Class Record .... 47.935 mph.
A. I. Mednikov, U.S.S.R., A-9 Glider, Grabtsevo Airport, vicinity of Kalouga, June 24, 1951.
National (U.S.) Record .... No official record.

(Multi-Place)

DISTANCE IN A STRAIGHT LINE
International Record .... 358.093 mi.
J. Kartachev, pilot; P. Savtzov, passenger; USSR, Stakhanovetz glider, from Moscow-Izmailovo to Ochnia, July 17, 1938.
National (U.S.) Record .... 309.678 mi.
Richard H. Johnson, pilot; R. A. Sparling, passenger; Schweizer TG-2 glider, NC-479903, from Prescott, Ariz. municipal Airport to the Ackerman Ranch approximately 11 miles west of Governador, N. M., Sept. 8, 1946.

DISTANCE TO A PREDETERMINED POINT WITH RETURN TO POINT OF DEPARTURE
International Record .... 258.533 mi.
J. Kartachev and V. Petrotchenkova, USSR, Stakanovetz glider, from Toula to Kuklovo and return, Oct. 7, 1940.
National (U.S.) Record .... 153.930 mi.
Ted Nelson and Harry N. Perl, Hummingbird auxiliary powered sailplane, N 68959, from Grand Prairie, Tex. to Bowie, Tex. and return, Aug. 20, 1952.

DISTANCE TO A PREDETERMINED DESTINATION
World Class Record .... 317.552 mi.
A. Pawlikiewicz, pilot; Z. Pakielewicz, passenger; Poland, Ruraw/Kranich S.P. 524 glider, Lesnica to Warez, July 19, 1951.
National (U.S.) Record .... 223.138 mi.
David C. Johnson, pilot; Robert Fronius, passenger; Schweizer TG-2 from Adelanto, Cal. to Overton, Nev. July 3, 1950.

DURATION
World Class Record .... 53 hr., 4 min.
Albert Carraz and Jean Branswick, France, Castel-Mauboussin C.M. 7 glider, Glider site at Romanin les Alphilles, Province of St. Remy, Feb. 4-6, 1952.
National (U.S.) Record .... 12 hr., 3 min.
Leslie R. Arnold, pilot; Harry N. Perl, passenger, Schweizer TG3-A Glider, Warm Springs, Cal., Apr. 29, 1951.

ALTITUDE GAINED
World Class Record .... 34,426 ft.
Laurence E. Edgar, pilot; Harold E. Klieforth, passenger, United States, Pratt-Read PR-G1 Sailplane, Bishop, Cal., Mar. 19, 1952.
National (U.S.) Record .... Same as above.

ALTITUDE ABOVE SEA LEVEL
World Class Record .... 44,255 ft.
Laurence E. Edgar, pilot; Harold E. Klieforth, passenger, United States, Pratt-Read PR-G1 Sailplane, Bishop, Cal., Mar. 19, 1952.
National (U.S.) Record .... Same as above.

SPEED FOR 62.137 MI. OVER A TRIANGULAR COURSE
International Record .... 40.999 mph.
Capt. Rene Fonteilles, pilot; Rene Lemblin, passenger; France, Kranich sailplane, LeBourget du Lac, May 5, 1951.
National (U.S.) Record .... 27.873 mph.
William G. Briegleb, pilot; Jack LaMare, passenger; Briegleb BG-8 glider, N-33636, Adelanto, Cal., Aug. 12, 1949.

BALLOONS (CLASS A)

FIRST CATEGORY—(21,189 CU. FT. OR LESS)

DURATION
International Record .... 46 hr. 10 min.
Serge Sinoveev, USSR, VR 80 Balloon, 21,082.458 cu. ft., take-off near Dolgoproudnaia, Mar. 30, 1941.
National (U.S.) Record .... No official record.

DISTANCE
International Record .... 499.69 mi.
Georges Cormier, France, July 1, 1922.
National (U.S.) Record .... No official record.

ALTITUDE
International Record .... 23,285.712 ft.
Boris Nevernov, USSR, VR-80 Balloon, 13,984.344 cu. ft., at Dolgoproudnaia, Aug. 31, 1940.
National (U.S.) Record .... No official record.

SECOND CATEGORY—(21,224 - 31,783 CU. FT.)

DURATION
International Record .... 61 hr. 30 min.
F. Bourlouzki and A. Aliochine, USSR, from Moscow to Charaboulski, Apr. 3-6, 1939.
National (U.S.) Record .... 19 hr. 00 min.
W. C. Naylor and K. W. Warren, *Skylark*, Little Rock, Ark., to Crawford, Tenn., Apr. 29-30, 1926.

DISTANCE
International Record .... 1,056.950 mi.
F. Bourlouzki and A. Aliochine, USSR, from Moscow to Charaboulski, region of Koustanai, Apr. 3-6, 1939.
National (U.S.) Record .... 410.104 mi.
W. C. Naylor and K. W. Warren, *Skylark*, Little Rock, Ark., to Crawford, Tenn., Apr. 29-30, 1926.

ALTITUDE
International Record .... 27,718.117 ft.
Alexei Rostine, USSR, VR-70 Balloon of 29,451.876 cu. ft. at Dolgoproudnaia, Oct. 4, 1940.
National (U.S.) Record .... No official record.

THIRD CATEGORY—(31,818 - 42,376.8 CU. FT.)

DURATION
International Record .... 61 hr. 30 min.
F. Bourlouzki and A. Aliochine, USSR, from Moscow to Charaboulski, Apr. 3-6, 1939.
National (U.S.) Record .... 26 hr. 48 min.
E. J. Hill and A. G. Schlosser, Ford Airport to Montale, Va., July 4-5, 1927.

DISTANCE
International Record .... 1,056.950 mi.
F. Bourlouzki and A. Aliochine, USSR, from Moscow to Charaboulski, region of Koustanai, Apr. 3-6, 1939.
National (U.S.) Record .... 571.877 mi.
S. A. U. Rasmussen, Ford Airport to Hookerton, N. C., July 4-5, 1927.

ALTITUDE
International Record .... 27,718.117 ft
Alexei Rostine, USSR, VR-70 Balloon, 29,451.876 cu. ft., at Dolgoproudnaia, Oct. 4, 1940.
National (U.S.) Record .... No official record

FOURTH CATEGORY—(42,411.8 - 56,502.4 CU. FT.)

DURATION
International Record .... 69 hr. 20 min.
Boris Nevernov and Semion Gaiguerov, USSR, VR-73 Balloon, 50,357.764 cu. ft., from Dolgoproudnaia to Novosibirsk, Mar. 13-16, 1941.
National (U.S.) Record .... 26 hr. 46 min.
E. J. Hill and A. G. Schlosser, Ford Airport to Montvale, Va., July 4-5, 1927.

DISTANCE
International Record .... 1,719.215 mi.
Boris Nevernov and Semion Gaiguerov, USSR, VR-73 Balloon, 50,357.764 cu. ft., from Dolgoproudnaia to Novosibirsk, Mar. 13-16, 1941.
National (U.S.) Record .... 571.877 mi.
S. A. U. Rasmussen, Ford Airport to Hookerton, N. C., July 4-5, 1927.

ALTITUDE
International Record .... 27,718.117 ft.
Alexei Rostine, USSR, VR-70 Balloon, 29,451.876 cu. ft., at Dolgoproudnaia, Oct. 4, 1940.
National (U.S.) Record .... No official record

FIFTH CATEGORY—(56,537.7 - 77,690.8 CU. FT.)

DURATION

International Record .... 69 hr. 20 min.
Boris Nevernov and Semion Gaiguerov, USSR, VR-73 Balloon, 50,357.764 cu. ft., from Dolgoproudnaia to Novosibirsk, Mar. 13-16, 1941.
National (U.S.) Record .... 51 hr. 00 min.
T. G. W. Settle and C. H. Kendall, Gordon-Bennett Balloon Race, Chicago, Ill., Sept. 2-4, 1933.

DISTANCE

International Record .... 1,719.215 mi
Boris Nevernov and Semion Gaiguerov, USSR, VR-73 Balloon, 50,357.764 cu. ft., from Dolgoproudnaia to Novosibirsk, Mar. 13-16, 1941.
National (U.S.) Record .... 963.123 mi.
T. G. W. Settle and Wilfred Bushnell, from Basle, Switzerland to Daugieliski, Poland, Sept. 25-27, 1932.

ALTITUDE

International Record .... 30,754.529 ft.
Josef Emmer, Austria, *OE-Marek Emmer II* Balloon, Vienna-Lac de Nuesiedl, Sept. 25-27, 1937.
National (U.S.) Record .... No official record

SIXTH CATEGORY—(77,706 - 105,942 CU. FT.)

DURATION

International Record .... 69 hr. 20 min.
Boris Nevernov and Semion Gaiguerov, USSR, VR-73 Balloon, 50,357.764 cu. ft., from Dolgoproudnaia to Novosibirsk. Mar. 13-16, 1941.
National (U.S.) Record .... 51 hr. 00 min.
T. G. W. Settle and C. H. Kendall, Gordon-Bennett Balloon Race, Chicago, Ill., Sept. 2-4, 1933.

DISTANCE

International Record .... 1,719.215 mi
Boris Nevernov and Semion Gaiguerov, USSR, VR-73 Balloon, 50,357.764 cu. ft., from Dolgoproudnaia to Novosibirsk, Mar. 13-16, 1941.
National (U.S.) Record .... 963.123 mi.
T. G. W. Settle and Wilfred Bushnell, from Basle, Switzerland to Daugieliski, Poland, Sept. 25-27, 1932.

ALTITUDE

International Record .... 30,754.529 ft.
Josef Emmer, Austria, *OE-Marek Emmer II* Balloon, Vienna-Lac de Neusiedl, Sept. 25-27, 1937.
National (U.S.) Record .... 28,508.413 ft.
Capt. Hawthorne C. Gray, Scott Field, Belleville, Ill., Mar. 9, 1927.

SEVENTH CATEGORY—(105,977 - 141,256 CU. FT.)

DURATION

International Record .... 69 hr. 20 min.
Boris Nevernov and Semion Gaiguerov, USSR, VR-73 Balloon, 50,357.764 cu. ft., from Dolgoproudnaia to Novosibirsk, Mar. 13-16, 1941.
National (U.S.) Record .... 51 hr. 00 min.
T. G. W. Settle and C. H. Kendall, Gordon-Bennett Balloon Race, Chicago, Ill., Sept. 2-4, 1933.

DISTANCE

International Record .... 1,719,215 mi.
Boris Nevernov and Semion Gaiguerov, USSR, VR-73 Balloon, 50,357.764 cu. ft., from Dolgoproudnaia to Novosibirsk, Mar. 13-16, 1941.
National (U.S.) Record .... 963.123 mi.
T. G. W. Settle and Wilfred Bushnell, from Basle, Switzerland to Daugieliski, Poland, Sept. 25-27, 1932.

ALTITUDE

International Record .... 32,811.132 ft.
Z. J. Burzynski, Poland, at Legjonowo, Mar. 29, 1936.
National (U.S.) Record .... 28,508.413 ft.
Capt. Hawthorne C. Gray, at Scott Field, Belleville, Ill., Sept. 2-4, 1933.

EIGHTH CATEGORY—(141,291.3 CU. FT. OR OVER)

DURATION

International Record .... 87 hr. 00 min.
H. Kaulen, Germany, Dec. 13-17, 1913.
National (U.S.) Record .... 51 hr. 00 min.
Lt. Comdr. T. G. W. Settle and Lt. Charles H. Kendall, Gordon-Bennett Balloon Race, Chicago, Ill., Sept. 2-4, 1933.

DISTANCE

International Record .... 1,896.856 mi
Berliner, Germany, Feb. 8-10, 1914.
National (U.S.) Record .... 1,172.898 mi.
A. R. Hawley, St. Louis, Mo. to Lake Tschotogama, Canada, Oct. 17-19, 1910.

ALTITUDE

International Record .... 72,394.795 ft.
Capt. Orvil Anderson and Capt. Albert Stevens, United States, *Explorer II*, take-off approximately 11 miles southwest of Rapid City, S. D., landing on school reserve land approximately 12 miles south of White Lake, S. D., Nov. 11, 1935.
National (U.S.) Record .... Same as above.

FEMININE RECORDS

AIRPLANES—(CLASS C) GROUP II

DISTANCE IN A CLOSED CIRCUIT .... No official record.

AIRLINE DISTANCE

International Record .... 3,671.432 mi.
V. Grisodoubova and P. Ossipenko, pilots: M. Raskova, Navigatrix; USSR; Soukhoi Rodina airplane, 2 M-96 800 hp engines, Sept. 24-25, 1938.
National (U.S.) Record .... 2,447.728 mi.
Amelia Earhart, Lockheed Vega monoplane, Pratt and Whitney Wasp 450 hp engine, from Los Angeles, Cal., to Newark, N. J., Aug. 24-25, 1932.

ALTITUDE

International Record .... 46,948.725 ft.
Mrs. Maryse Hilsz, France, Potez 506 biplane, Gnome and Rhone 900 hp engine, at Villacoublay, June 23, 1936.
National (U.S.) Record .... 30,052.430 ft.
Jacqueline Cochran, Beechcraft biplane, NX-18562, Pratt and Whitney 600 hp engine, Palm Springs, Cal., Mar. 24, 1939.

SPEED, MAXIMUM

International Record .... 412.002 mph.
Jacqueline Cochran, United States, North American P-51 monoplane, Packard built Rolls Royce Merlin 1,450 hp engine; Thermal, Cal., Dec. 17, 1947.
National (U.S.) Record .... Same as above.

SPEED FOR 62.137 MI. WITHOUT PAYLOAD

International Record .... 469.549 mph.
Jacqueline Cochran, United States, North American P-51 monoplane, Packard Rolls Royce Merlin Engine 1,450 hp, Coachella Valley, Col., Dec. 10, 1947.
National (U.S.) Record .... Same as above.

SPEED FOR 310.685 MI. WITHOUT PAYLOAD

International Record .... 436.995 mph.
Jacqueline Cochran, United States, North American F-51 monoplane, Rolls Royce Merlin 1,450 hp engine; Desert Center-Mt. Wilson Course, Dec. 29, 1949.
National (U.S.) Record .... Same as above.

SPEED FOR 621.369 MI. WITHOUT PAYLOAD

International Record .... 431.094 mph.
Jacqueline Cochran, United States, North American F-51 monoplane, Packard built Rolls Royce Merlin 1,450 hp engine; start and finish near Palm Springs, Cal., May 24, 1948.
National (U.S.) Record .... Same as above.


INSTRUMENT

SPEED FOR 1,242.739 MI. WITHOUT PAYLOAD
International Record .... 447.470 mph.
Jacqueline Cochran, United States, North American P-51 monoplane, Packard built Rolls Royce Merlin 1,450 hp engine; start and finish near Palm Springs, Cal., May 22, 1946.
National (U.S.) Record .... Same as above.

SPEED FOR 3,106.847 MI. WITHOUT PAYLOAD .... No official record.

SPEED FOR 6,213.695 MI. WITHOUT PAYLOAD .... No official record.

MAXIMUM SPEED AT HIGH ALTITUDE
International Record .... 464.374 mph.
Jacqueline Cochran, U.S., North American F-51 low wing monoplane, Packard built Rolls Royce Merlin 1,450 hp engine, near Indio, Cal., Apr. 9, 1951.
National (U.S.) Record .... Same as above.

AIRPLANES—(CLASS C)—GROUP I

JET POWERED AIRCRAFT

SPEED FOR 62.137 MI. IN A CLOSED CIRCUIT WITHOUT PAYLOAD
International Record .... 508.393 mph.
Mrs. Jacqueline Auriol, France, de Havilland "Vampire" aircraft, Goblin II DGN 301 jet engine, Istres-Avignon course, May 12, 1951.
National (U.S.) Record .... No official record.

SEAPLANES—(CLASS C2)

DISTANCE IN A CLOSED CIRCUIT
International Record .... 1,086.908 mi.
Lt. P. Ossipenko and Lt. V. Lomako, USSR, MP-1 monoplane seaplane, AM-34 750 hp engine, May 24, 1938.
National (U.S.) Record .... No official record.

DISTANCE, AIRLINE
International Record .... 1,392.801 mi.
Poline Ossipenko and Vera Lomako, pilots; Marina M. Raskova, navigatrix; USSR, MP-1 seaplane, AM-34 750 hp engine, from Sebastopol to Lake Kholmskoie, July 2, 1938.
National (U.S.) Record .... No official record.

ALTITUDE
International Record .... 29,081.304 ft.
Poline Ossopenko, USSR Canot Volant monoplane seaplane, AM-34 750 hp engine, at Sebastopol, May 25, 1937.
National (U.S.) Record .... 13,461.259 ft.
Mrs. Marion Eddy Conrad, Savoia-Marchetti seaplane, Kinner 125 hp engine, Port Washington, L. I., New York, Oct. 20, 1930.

MAXIMUM SPEED .... No official record.

SPEED FOR 62.137 MI. WITHOUT PAYLOAD
International Record .... 79.138 mph.
Miss Crystal Mowry and Miss Edith McCann, United States, Kitty Hawk seaplane, Kinner 125 hp engine, Miami, Fla., Dec. 9, 1936.
National (U.S.) Record .... Same as above.

SPEED FOR 310.685 MI. WITHOUT PAYLOAD .... No official record.

SPEED FOR 621.369 MI. WITHOUT PAYLOAD .... No official record.

SPEED FOR 1,242.739 MI. WITHOUT PAYLOAD .... No official record.

SPEED FOR 3,106.847 MI. WITHOUT PAYLOAD .... No official record

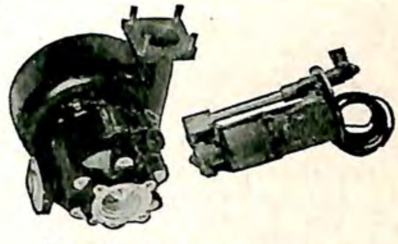
SPEED FOR 6,213.695 MI. WITHOUT PAYLOAD .... No official recora

GLIDERS—(CLASS D)

(Single-Place)

DURATION WITH RETURN TO POINT OF DEPARTURE
International Record .... 35 hr. 3 min.
Miss Marcelle Choisnet, France, Arsenal Air-100 glider, No. 5 Romanin les Alpilles, Nov. 17-19, 1948.
National (U.S.) Record .... 7 hr. 28 min.
Helen M. Montgomery, Stevens-Franklin glider, Crystal Downs Beach, 5 miles North of Frankfort, Mich., Sept. 4, 1938.

BUCKETS and BLADES



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DISTANCE IN A STRAIGHT LINE

International Record .... 465.532 mi.
O. Klepikova, USSR, Rot-Front 7 glider from Moscow to Otradnoie, region of Stalingrad, July 6, 1939.

National (U.S.) Record .... 201.450 mi.
Miss Betsy Woodward, Briegleb BG-7 Sailplane, from Grand Prairie, Tex. to Sweetwater, Tex., Aug. 22, 1952.

ALTITUDE GAINED

International Record .... 25,414 ft.
Mrs. Betty Loufek, Laister-Kaufmann 10-A, NC 44781 glider, at Bishop, Cal., Apr. 15, 1948.

National (U.S.) Record .... 14,496 ft.
Mrs. Yvonne Gaudry, France, N-2000 glider No. 12, St. Auban sur Durance, Jan. 20, 1951.

ALTITUDE ABOVE SEA LEVEL

International Record .... 27,342 ft.
Mrs. Yvonne Gaudry, France, N-2000 glider No. 12, St. Auban sur Durance, Jan. 20, 1951.

National (U.S.) Record .... No official record.

DISTANCE TO A PREDETERMINED DESTINATION

World Class Record .... 226.200 mi.
Mrs. Anna Samocadova, U.S.S.R., A-9 glider, from Serpoukov to Tambov, July 20, 1951.

National (U.S.) Record .... 76.752 mi.
Miss Betsy Woodward, Briegleb BG-7 Sailplane, from Grand Prairie, Tex. to Stephenville, Tex., Aug. 29, 1952.

DISTANCE TO A PREDETERMINED POINT WITH RETURN TO POINT OF DEPARTURE

World Class Record .... 154.128 mi.
Lucyna Wlazlo, Poland, Mucha SP-1098 glider, from Varsovie-Anin to Lodz-Dabrowska, July 1, 1951.

National (U.S.) Record .... 120.452 mi.
Miss Betsy Woodward, Briegleb BG-7 Sailplane, from Grand Prairie, Tex. to Mineral Wells, Tex. and return, Aug. 21, 1952.

SPEED FOR 62.137 MI. OVER A TRIANGULAR COURSE

International Record .... 31.069 mph.
Miss Irene Kempowna, Poland, "Sep" sailplane, number SP-552, Kiczera-Rownica-Pilsko-Kiczera Course, June 10, 1949.

National (U.S.) Record .... No official record.

GLIDERS—(CLASS D)

(Multi-Place)

DURATION

World Class Record .... 28 hr.,41 min.
Miss Choisnet-Gohard, pilot; Miss Yvette Mazellier, passenger, France, Castel Mauboussin C.M.7 glider, Romanin les Alphilles, Nov. 22, 1951.

National (U.S.) Record .... 4 hr., 15 min.
Miss Betsy Woodward, pilot; Anna Saudek, passenger, Pratt Read Sailplane, from Adelanto, Cal. to Las Vegas, Nev., July 11, 1952.

DISTANCE IN A STRAIGHT LINE

International Record .... 275.711 mi.
O. Klepikova and V. Bardina, USSR, Stakanovetz glider, from Toula to Konotop, June 19, 1940.

National (U.S.) Record .... 170.316 mi.
Miss Betsy Woodward, pilot; Anna Saudek, passenger, Pratt Read Sailplane, from Adelanto, Cal. to Las Vegas, Nev., July 11, 1952.

ALTITUDE ABOVE SEA LEVEL

International Record .... 23,104 ft.
Mrs. M. Choisnet-Gohard, pilot; Miss J. Queyrel, passenger; France, Castel Mauboussin CM glider No. 02, St. Auban sur Durance, Jan. 18, 1951.

National (U.S.) Record .... No official record.

ALTITUDE GAINED

International Record .... 19,921 ft.

Mrs. M. Choisnet-Gohard, pilot; Miss J. Queyrel, passenger; France, Castel Mauboussin CM glider No. 02, St. Auban sur Durance, Jan. 18, 1951.

National (U.S.) Record .... 10,797 ft.

Betsy Woodward, pilot; Vera Gere, passenger; Schweizer TG-3 glider, N-67871, El Mirage Field, Adelanto, Cal., Apr. 7, 1950.

DISTANCE TO A PREDETERMINED DESTINATION

World Class Record .... 170.316 mi.

Miss Betsy Woodward, pilot; Anna Saudek, passenger; United States, Pratt-Read Sailplane, from Adelanto, Cal. to Las Vegas, Nev., July 11, 1952.

National (U.S.) Record .... Same as above.

DISTANCE TO A PREDETERMINED POINT WITH RETURN TO POINT OF DEPARTURE

World Class Record .... 102.28 mi.

Wanda Szemplinska, pilot; Ryszarda Rozum, passenger; Poland, Zuraw S.P. 1276 glider, Varsovie-Tluszcz-Kolbiel, June 8, 1952.

National (U.S.) Record .... No official record.

SPEED FOR 62.137 MI. OVER A TRIANGULAR COURSE

World Class Record .... 35.967 mph.

Wanda Szemplinska, pilot; Ryszarda Rozum, passenger; Poland, Zuraw S.P. 1276 glider, Varsovie-Tluszcz-Kolbiel, June 17, 1952.

National (U.S.) Record .... No official record.

BALLOONS—(CLASS A)

FIRST CATEGORY (21,188.4 CU. FT. OR LESS)

DURATION

International Record .... 22 hr. 40 min.

A. Kondratyeva, USSR, SSSR BP-31 Balloon, Moscow to Loukino Polie, May 14-15, 1939.

National (U.S.) Record .... No official record.

DISTANCE

International Record .... 298.954 mi.

A. Kondratyeva, USSR, SSSR BP-31 balloon, from Moscow to Loukino Polie, May 14-15, 1939.

National (U.S.) Record .... No official record.

ALTITUDE .... No official record.

FOURTH CATEGORY (10,629.514 - 56,502.4 CU FT.)

DURATION

International Record .... 34 hr. 21 min. 36 sec.

Miss L. Ivanova and Miss S. Tonkova, USSR, take-off near the Central Aerology Observatory at Dolgoproudnaia, landing at ·Barachevo, Apr. 22-24, 1948.

National (U.S.) Record .... No official record.

DISTANCE .... No official record.

ALTITUDE .... No official record.

FIFTH CATEGORY (56,537.714 - 77,690.8 CU. FT.)

DURATION

International Record .... 34 hr. 21 min. 36 sec.

Miss L. Ivanova and Miss S. Tonkova, USSR, take-off near the Central Aerology Observatory at Dolgoproudnaia, landing at Barachevo, Apr. 22-24, 1948.

National (U.S.) Record .... No official record.

DISTANCE .... No official record.

ALTITUDE .... No official record.

SIXTH CATEGORY (77,726.114 - 105,942 CU. FT.)

DURATION

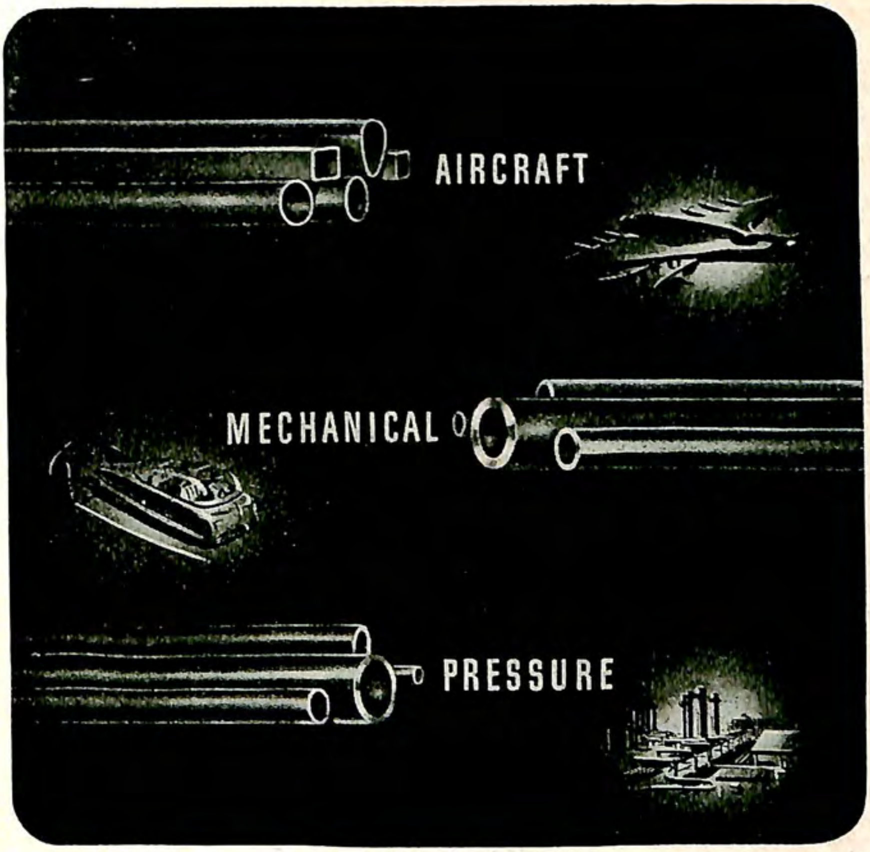
International Record .... 34 hr. 21 min. 36 sec.

Miss L. Ivanova and Miss S. Tonkova, USSR, take-off near the Central Aerology Observatory at Dolgoproudnaia, landing at Barachevo, Apr. 22-24, 1948.

National (U.S.) Record .... No official record.

DISTANCE .... No official record.

ALTITUDE .... No official record.


AIRCRAFT
MECHANICAL
PRESSURE

SEVENTH CATEGORY (105,977.314 - 141,256 CU. FT.)

DURATION
International Record .... 34 hr. 21 min. 36 sec.
Miss L. Ivanova and Miss S. Tonkova, USSR, take-off near the Central Aerology Observatory at Dolgoproudnaia, landing at Barachevo, Apr. 22-24, 1948.
National (U.S.) Record .... No official record.

DISTANCE .... No official record.

ALTITUDE .... No official record.

EIGHTH CATEGORY (141,291.314 CU. FT. OR OVER)

DURATION
International Record .... 34 hr. 21 min. 36 sec.
Miss L. Ivanova and Miss S. Tonkova, USSR, take-off near the Central Aerology Observatory at Dolgoproudnaia, landing at Barachevo, Apr. 22-24, 1948.
National (U.S.) Record .... No official record.

DISTANCE .... No official record.

ALTITUDE .... No official record.

ROTORPLANES—(Class E)

DISTANCE AIRLINE
International Record .... 67.713 mi.
Miss Hanna Reitsch, Germany, FW. 61. V2, D-EKRA helicopter, from Stendal airport to Tempelhof airport, Oct. 25, 1937.
National (U.S.) Record .... No official record.

DISTANCE, CLOSED CIRCUIT .... No official record.

ALTITUDE .... No official record.

SPEED FOR 12.43 MI. .... No official record.

F.A.I. COURSE RECORDS

LOS ANGELES TO NEW YORK
International Record .... 580.935 mph.
Col. W. H. Councill, USAAF, United States, Lockheed P-80 jet propelled monoplane, Allison J-33 engine, from Long Island Beach Municipal Airport to La Guardia Airport, Jan. 26, 1946. Distance: 2,453.807 mi. **Elapsed Time: 4 hr. 13 min. 26 sec.**
National (U.S.) Record .... Same as above.

WASHINGTON, D. C. TO HAVANA, CUBA
International Record .... 314.070 mph.
Woodrow W. Edmondson, United States, North American P-51 monoplane, Packard Rolls Royce 1,450 hp engine, from Washington National Airport to Rancho Boyeros Airport, Nov. 25, 1947. Elapsed Time; 3 hr. 37 min. 28.6 sec.
National (U.S.) Record .... Same as above

HAVANA, CUBA TO WASHINGTON, D. C.
International Record .... 350.328 mph
Woodrow W. Edmondson, United States, North American P-51 monoplane, Packard Rolls Royce 1,450 hp engine, from Rancho Boyeros Airport to Washington National Airport, Nov. 27, 1947. Elapsed Time: 3 hr. 15 min. 13 sec.
National (U.S.) Record .... Same as above

CAPETOWN, AFRICA TO LONDON, ENGLAND
International Record .... 151.456 mph
A. Henshaw, Great Britain, Percival Mew Gull airplane, D. H. Gipsy VI-2 motor, 205 hp. Feb. 7-9, 1939. Elapsed Time: 39 hr. 36 min.
National (U.S.) Record .... No official record

LONDON, ENGLAND TO ROME, ITALY
International Record .... 447.219 mph
John Cunningham and P. O. Bugge, Great Britain, de Havilland Comet DH-106 Mark I, 4 de Havilland Ghost Mark I jet engines, Mar. 16, 1950. Elapsed Time: 1 hr. 58 min. 37 sec.
National (U.S.) Record .... No official record

ROME, ITALY TO LONDON, ENGLAND
International Record .... 453.308 mph.
John Cunningham and P. O. Bugge, Great Britain, de Havilland Comet DH-106 Mark I, 4 de Havilland Ghost Mark I jet engines, Mar. 16, 1950. Elapsed Time: 1 hr. 58 min. 04 sec.
National (U.S.) Record .... No official record.

PARIS, FRANCE TO SAIGON, FRENCH INDO-CHINA
International Record .... 67.926 mph.
Miss Maryse Hilsz, France, Caudron Simoun C. 635 airplane, Renault engine, from Le Bourget Airport to Tan Son Nhut Airport, Dec. 19-23, 1937. Elapsed Time: 96 hr. 36 min. 15 sec.
National (U.S.) Record .... No official record.

PARIS, FRANCE TO HANOI, FRENCH INDO-CHINA
International Record .... 111.976 mph.
Andre Japy, France, Caudron Simoun airplane, Renault 6Q01, number 71 motor, from Le Bourget, Paris to Gia Lam Airport, Hanoi, Nov. 15-18, 1936. Elapsed Time: 50 hr. 59 min. 49 sec.
National (U.S.) Record .... No official record.

NEW YORK, N. Y. TO LOS ANGELES, CAL.
International Record .... 328.598 mph.
Capt. Boyd L. Grubaugh, pilot; Capt. J. L. England, co-pilot; M/Sgt. R. R. Pierron, M/Sgt. D. H. Atkins, M/Sgt. T. L. Wolfe, T/Sgt. D. B. Smith, crew; USAAF, United States, Boeing B-29 monoplane, 4 Wright R-3350-23A engines, from La Guardia Airport to Burbank, Cal., Aug. 1, 1946. Distance: 2,453.805 mi. Elapsed Time: 7 hr. 28 min. 03 sec.
National (U.S.) Record .... Same as above

NEW YORK CITY, U.S.A. TO LONDON, ENGLAND
International Record .... 169.227 mph.
Henry T. Merrill and John S. Lambe, pilots, United States, Lockheed Electra monoplane, Pratt and Whitney SHI engine, May 9-10, 1937. Elapsed Time: 20 hr. 29 min. 45 sec.
National (U.S.) Record .... Same as above

LONDON, ENGLAND TO MELBOURNE, AUSTRALIA
International Record .... 159.038 mph.
C. W. A. Scott and T. Campbell Black, Great Britain, de Havilland Comet monoplane, 2 D H. Gipsy VI engines, Oct. 20-23, 1934. Elapsed Time: 71 hr. 00 min. 18 sec.
National (U.S.) Record .... 121.267 mph.
Roscoe Turner and Clyde Pangborn, Boeing 247-D monoplane, 2 Pratt and Whitney supercharged 550 hp engines, Oct. 20-24, 1934.

LONDON, ENGLAND TO SYDNEY, AUSTRALIA
International Record .... 130.309 mph.
F/O A. E. Clouston and Victor Ricketts, Great Britain, de Havilland Comet monoplane, 2 D H Gipsy VI engines, Mar. 21-26, 1938. Elapsed Time: 80 hr. 56 min.
National (U.S.) Record .... No official record.

SYDNEY, AUSTRALIA TO LONDON, ENGLAND
International Record .... 81.261 mph.
F/O A. E. Clouston and Victor Ricketts, Great Britain, de Havilland *Comet* monoplane, 2 D. H. Gipsy VI engines, Mar. 21-26, 1938. Elapsed Time: 130 hr. 3 min.
National (U.S.) Record .... No official record.

LONDON, ENGLAND TO WELLINGTON, NEW ZEALAND
International Record .... 194.657 mph.
Air Commodore N. H. d'Aeth, Squadron Leader J. S. Aldridge, Flight Lt. D. D. Hurditch, and crew, Great Britain, Modified Avro Lancaster Aries, 4 Rolls Royce Merlin engines of 1,200 hp each, Aug. 21-24, 1946. Elapsed Time: 59 hr. 50 min.
National (U.S.) Record .... No official record.

WELLINGTON, NEW ZEALAND TO LONDON, ENGLAND
International Record .... 83.454 mph.
A. F. Clouston and Victor Ricketts, Great Britain; D. H. Comet airplane, 2 D. H. Gypsy VI engines, Mar. 20-26, 1938. Elapsed Time: 140 hr. 12 min.
National (U.S.) Record .... No official record.

LONDON, ENGLAND TO CAPETOWN, AFRICA
International Record .... 279.244 mph.
Sq. Ldr. H. E. Martin, pilot, Sq. Ldr. E. B. Simone, navigator, Great Britain, de Havilland Mosquito R. G. 238, type PR 34, 2 Rolls Royce Merlin 114 A engines, Apr. 30-May 1, 1947. Elapsed Time: 21 hr. 31 min. 30 sec.
National (U.S.) Record .... No official record.

LONDON, ENGLAND TO KARACHI, INDIA
World Class Record .... 256.110 mph.
S/Ldr. Neville Duke, Great Britain, Hawker Fury K.857, Bristol Centaurus XVIII 2,500 hp engine, May 12, 1949. Elapsed time: 15 hr., 18 min., 36 sec.
National (U.S.) Record .... No official record.

LONDON, ENGLAND TO DARWIN, AUSTRALIA
International Record .... 189 3 mph.
Air Commodore N. H. d'Aeth, Squadron Leader J. S. Aldridge, Flight Lt. D. D. Hurditch, and crew, Great Britain, Modified Avro Lancaster *Aries*, 4 Rolls Royce Merlin engines, 1,200 hp each, Aug. 21-22, 1946. Elapsed Time: 45 hr. 35 min.
National (U.S.) Record .... No official record.

PARIS, FRANCE TO TANANARIVO, MADAGASCAR
International Record .... 94.391 mph.
Genin and Robert, France, Caudron Simoun airplane, Renault 180 hp engine, from Le Bourget airport to Ivato airport, Dec. 18-21, 1935. Elapsed Time: 57 hr. 35 min. 21 sec.
National (U.S.) Record .... No official record.

TOKYO, JAPAN TO LONDON, ENGLAND
International Record .... 101.193 mph.
Masaaki Linuma and Kenji Tsukaloshi, Japan, Kamikase monoplane, type *Karigane*, Mitsubishi *Nakajima* 550 hp engine, Apr. 6-9, 1937. Elapsed Time: 94 hr. 17 min. 56 sec.
National (U.S.) Record .... No official record.

ROME, ITALY TO RIO DE JANEIRO, BRAZIL
International Record .... 137.923 mph.
Attileo Biseo, Magg. Amedeo Paradisi, S. Ten. Giovanni Vitalini Sacconi, pilots; Ubaldo Ardu, mechanic; Giovanni Cubeddu, radio operator; Italy, S.79 I-Bise airplane, 3 Alfa Romeo 126 RC.34 750 hp engines, Jan. 24-25, 1938. Elapsed Time: 41 hr. 32 min.
National (U.S.) Record .... No official record.

ROME, ITALY TO ADDIS ABABA, ETHIOPA
International Record .... 242.938 mph.
M. Lualdi, G. Mazzotti and E. Valente, pilots; S. Pinna, radio telegrapher and G. Guerrini, mechanic; Italy; Fiat BR. 20 L airplane, 2 Fiat Asso 80 1,000 hp motors, Mar. 6-7, 1939. Elapsed Time: 11 hr. 25 min.
National (U.S.) Record .... No official record.

BERLIN, GERMANY TO NEW YORK CITY, N. Y., U.S.A.
International Record .... 158.759 mph.
Alfred Henke and Rudolf Freiherr von Moreau, pilots; Paul Dierberg, radiomecanicien and Walter Kober, radiotelegraphiste; Germany, Focke-Wulf FW 200 Condor airplane, 4 BMW 132 L motors, 750 hp each, Aug. 10-11, 1938. Elapsed Time: 24 hr. 56 min. 12 sec.
National (U.S.) Record .... No official record.

NEW YORK, N. Y., U.S.A., TO BERLIN, GERMANY
International Record .... 199.409 mph.
Alfred Henke and Rudolf Freiherr von Moreau, pilots; Paul Dierberg, radiomecanicien, and Walter Kober, radiotelegraphiste; Germany; Focke-Wulf FW 200 Condor airplane, 4 BMW 132 L motors, 750 hp each, Aug. 13-14, 1938. Elapsed Time: 19 hr. 55 min. 1 sec.
National (U.S.) Record .... No official record.

BERLIN, GERMANY TO TOKYO, JAPAN
International Record .... 119.494 mph.
Alfred Henke and H. R. Freiherr von Moreau, pilots; P. Dierberg, radiomecanicien; W. Kober, radiotelegraphiste, and G. Kohne, mechanic; Germany, Focke-Wulf FW 200 Condor airplane; 4 BMW 132 L motors, 750 hp each, from Tempelhof to Tachikawa, Nov. 28-30, 1938. Elapsed Time: 46 hr. 18 min. 19 sec.
National (U.S.) Record .... No official record

BERLIN, GERMANY TO HANOI, FRENCH INDO-CHINA
International Record .... 151 mph.
Alfred Henke and H. R. Freiherr von Moreau, pilots; P. Dierberg, radiomecanicien; W. Kober, radiotelegraphiste, and G. Kohne, mechanic; Germany, Focke-Wulf FW 200 Condor airplane; 4 BMW 132 L motors, 750 hp each, from Tempelhof to Gia Lam, Nov. 28-30, 1938. Elapsed Time: 34 hr. 17 min. 27 sec.
National (U.S.) Record .... No official record.

LONDON, ENGLAND TO PARIS, FRANCE
International Record .... 617.702 mph
Squadron Leader Trevor S. Wade, DFC, Great Britain, Hawker P-1052, Rolls Royce Nene jet engine, May 13, 1949.
National (U.S.) Record .... No official record

LONDON, ENGLAND TO CAIRO, EGYPT
International Record .... 426.607 mph
John Cunningham, D.S.O., D.F.C., Great Britain, de Havilland DH-106 Mark I Comet, 4 Ghost D. Gt. 3 jet engines, Apr. 24, 1950. Elapsed Time: 5 hr. 6 min. 58.3 sec.
National (U.S.) Record .... No official record.

CAIRO, EGYPT TO LONDON, ENGLAND
International Record .... 385.887 mph.
John Cunningham, D.S.O., D.F.C., Great Britain, de Havilland DH 106 Mark I Comet, 4 Ghost D. Gt. 3 jet engines, May 11, 1950. Elapsed Time: 5 hr. 39 min. 21.7 sec.
National (U.S.) Record .... No official record.

LONDON, ENGLAND TO COPENHAGEN, DENMARK
International Record .... 541.417 mph.
Janusz Zurakowski, Great Britain, Gloster Meteor Mk. F8 V2468, 2 Rolls Royce Derwent V jet engines, Apr. 4, 1950. Elapsed Time: 1 hr. 5 min. 5 sec.
National (U.S.) Record .... No official record.

COPENHAGEN, DENMARK TO LONDON, ENGLAND
International Record .... 500.670 mph.
Janusz Zurakowski, Great Britain, Gloster Meteor Mk. F8, 2 Rolls Royce Derwent V jet engines, Apr. 4, 1950. Elapsed Time; 1 hr. 11 min. 17 sec.
National (U.S.) Record .... No official record.

GIBRALTAR TO LONDON, ENGLAND
International Record .... 435.886 mph.
Group Capt. A. C. P. Carner, Great Britain, de Havilland Hornet F Mark III, 2 Rolls Royce Merlin 130, 2,030 hp engines, Sept. 19, 1949. Elapsed Time: 2 hr. 30 min. 21 sec.
National (U.S.) Record .... No official record.

LONDON, ENGLAND TO LA VALETTE, FRANCE
International Record .... 387.896 mph.
Lt. Commander W. R. MacWhirter, Lt. P. C. S. Chilton, Lt. D. A. Hook and Lt. D. W. Morgan, Great Britain, Hawker XI Sear Fury, Bristol Centaurus XVIII 2,560 hp engine, July 19, 1949. Elapsed time: 3 hr. 20 min. 49 sec.
National (U.S.) Record .... No official record.

LONDON, ENGLAND TO KHARTOUM, EGYPT
World Class Record .... 212.994 mph.
Squadron Leader J. C. T. Downey, chief pilot; Squadron Leader A. D. Frank, Squadron Leader, J. McKay, and Lt. Comdr. D. B. Law, pilots; and crew of 7; Avro Lincoln II "Aries", 4 Rolls Royce Merlin 68 A engines, 1,760 hp each; Oct. 20-21, 1950. Elapsed time: 14 hr., 23 min., 10 sec.
National (U.S.) Record .... No official record.

BELFAST, IRELAND TO GANDER, NEWFOUNDLAND
World "Class" Record .... 481.099 mph.
Roland P. Beamont, pilot; D. A. Watson, navigator; R. Rylands, radio operator, Great Britain, English Electric Canberra B. Mark 2, WD 940 aircraft, two Rolls Royce Avon RA 3 jet engines, Aug. 31, 1951. Distance: 2,071.7 mi.; Duration: 4 hr. 18 min. 24.4 sec.
National (U.S.) Record .... No official record.

LONDON, ENGLAND TO STOCKHOLM, SWEDEN
World Class Record .... 109.190 mph.
Capt. Jan H. Christie, Norway, Klemm airplane, Hirth 105 hp engine, Sept. 23, 1951. Elapsed time: 8 hr., 9 min., 48.5 sec. (Class C.1.b)
National (U.S.) Record .... No official record.

LONDON, ENGLAND TO BRUSSELS, BELGIUM
World Class Record .... 665.890 mph.
David W. Morgan, Great Britain, Vickers Armstrong Supermarine Swift, Rolls Royce Avon R.A.7 jet engine, July 10, 1952. Elapsed time: 18 min., 3.3 sec.
National (U.S.) Record .... No official record.

OFFICIAL NATIONAL TRANSCONTINENTAL AND INTER-CITY RECORDS

WEST TO EAST TRANSCONTINENTAL (JET PROPELLED)
Col. W. H. Councill, USAAF, Lockheed P-80 jet-propelled monoplane, Allison J-33 engine, from Municipal Airport, Long Beach, Cal. to La Guardia Airport, L. I., N. Y., Jan. 26, 1946. Distance: 2,453.807 mi. Elapsed Time: 4 hr. 13 min. 26 sec. Average Speed: 580.935 mi.

WEST TO EAST TRANSCONTINENTAL (MULTI-ENGINE MILITARY AIRCRAFT)
Col. C. S. Irvine, pilot; Lt. Col. G. R. Stanley, co-pilot; Lt. Col. F. J. Shannon Maj. K. L. Royer, Capt. W. J. Bennett, Capt. R. A. Saltzman, M/Sgt. D. E. West, Sgt. J. F. Broughton, crew; USAAF; Boeing B-29 monoplane, 4 Wright R-3350-23A engines; from Burbank, Cal. to Floyd Bennett Field, Brooklyn, Dec. 11, 1945. Distance: 2,457 mi. Elapsed Time: 5 hr. 27 min. 19.2 sec. Average Speed: 450.385 mph.

LOS ANGELES, CAL. TO MEXICO CITY, D. F.
A. Paul Mantz, North American F-51 monoplane, NX-1204, Packard built Rolls Royce Merlin 1,450 hp engine, from Lockheed Air Terminal, Burbank to Mexico City Airport, Mar. 8, 1950. Distance: 1,560.767 mi. Elapsed Time: 3 hr. 34 min. 45 sec. Average Speed: 436.070 mph.

WEST TO EAST TRANSCONTINENTAL (SINGLE RECIPROCATING ENGINE-SOLO)
A. Paul Mantz, North American F-51 monoplane NX-1204, Packard Merlin 1,650 hp engine, from Lockheed Air Terminal to La Guardia Airport, L. I., N. Y., Jan. 22, 1950. Distance: 2,453.805 mi. Elapsed Time: 4 hr. 52 min. 58 sec. Average Speed: 502.543 mph.

WEST TO EAST TRANSCONTINENTAL (COMMERCIAL TRANSPORT AIRCRAFT)
Capt. Fred E. Davis, pilot; Capt. H. Lloyd Jordan, co-pilot; and Flight Engineer, E. L. Graham; Eastern Air Lines' Lockheed Constellation, 4 Wright R-3350 2,500 hp engines, from Lockheed Air Terminal, Burbank, Cal. to La Guardia Airport, Jackson Heights, L. I., N. Y., Feb. 5, 1949. Elapsed Time: 6 hr. 17 min. 39.4 sec. Distance: 2,453.805 statute mi. Average Speed: 389.847 mph.

EAST TO WEST TRANSCONTINENTAL (SINGLE RECIPROCATING ENGINE-SOLO)
A. Paul Mantz, North American P-51 monoplane, NX-1202, Packard Merlin 1,650 engine, 1,450 hp, from La Guardia Airport, Jackson Heights, L. I., N. Y., to Lockheed Air Terminal, Burbank, Cal., Sept. 3, 1947. Distance: 2,453.805 mi. Elapsed Time: 7 hr. 00 min. 4 sec. Average Speed: 350.488 mph.

EAST TO WEST TRANSCONTINENTAL (MULTI-ENGINE MILITARY AIRCRAFT)
Capt. Boyd L. Grubaugh, pilot; Capt. J. L. England, co-pilot; and M/Sgt. R. R. Pierron, M/Sgt. D. H. Atkins, M/Sgt. T. L. Wolfe, T/Sgt. D. B. Smith, crew; USAAF, Boeing B-29 monoplane, 4 Wright R-3350-23A engines, from La Guardia Airport, L. I., N. Y., to Lockheed Air Terminal, Burbank, Cal., Aug. 1, 1946. Distance: 2,453.805 mi. Elapsed Time: 7 hr. 28 min. 3 sec. Average Speed: 328.598 mph.

LOS ANGELES, CAL. TO WASHINGTON, D. C.
Lt. Col. H. F. Warden, pilot; Capt. G. W. Edwards, co-pilot; Douglas XB-42 monoplane, 2 Allison V-1710-129 engines, 1,820 hp each, from Long Beach Municipal Airport to Bolling Field, Anacostia, D. C., Dec. 8, 1945. Elapsed Time: 5 hr. 17 min. 34 sec. Distance: 2,295 mi. Average Speed: 433.610 mph.

LOS ANGELES, CAL. TO MIAMI, FLA. (TRANSPORT AIRCRAFT)
Frank J. Bennett, pilot; John D. Scott, co-pilot; J. Jerram, flight engineer; and six passengers; Eastern Airlines' Lockheed Constellation, NC-104A, 4 Wright 2,100 hp engines, from Lockheed Air Terminal, Burbank, Cal. to 36th Street Airport, May 28-29, 1947. Elapsed Time; 6 hr. 24 min. 8 sec. Distance: 2,337.590 statute mi. Average Speed: 365.236 mph.

LOS ANGELES, CAL. TO JACKSONVILLE, FLA. (TRANSPORT AIRCRAFT)
Charles H. Dolson and Frank O. Boyer, pilots, thirty-seven passengers, including two stewardesses, Delta Airlines' Douglas DC-6, 4 Pratt and Whitney R-2800-CA-15 1,800 hp engines, from Clover Field, Santa Monica to Thomas Cole Imeson Airport, Oct. 4, 1948. Elapsed Time: 6 hr. 43 min. 10 sec. Distance: 2,154.448 statute mi. Average Speed: 320.600 mph

LOS ANGELES, CAL. TO TAMPA, FLA. (TRANSPORT AIRCRAFT)
G. T. Baker, pilot; J. Bailey, co-pilot; and 17 passengers; Northwest Airlines' Douglas DC-6, NC-90891, 4 Pratt and Whitney 2,100 hp engines, from Clover Field, Santa Monica to Drew Field, June 3, 1947. Elapsed Time: 6 hr. 5 min. 10 sec. Distance: 2,157 mi. Average Speed: 354.413 mph.

LOS ANGELES, CAL. TO ATLANTA, GA.
Capt. Charles Dolson and William H. Davis, Jr., Delta Airlines Douglas DC-6, 4 Pratt and Whitney R-2800-CA-15 1,800 hp engines, from Clover Field, Santa Monica to Atlanta Municipal Airport. Oct. 23, 1948. Elapsed Time: 6 hr. 11 min. 42 sec. Distance: 1,944.01 mi. Average Speed; 313.803 mph.

LOS ANGELES, CAL. TO CHARLESTON, S. C. (TRANSPORT AIRCRAFT)
Capt. T. P. Ball and Capt. John Van Buren, pilots, six passengers; Delta Airlines' Douglas DC-6, 4 Pratt and Whitney R-2800-CA-15 1,800 hp engines, from Clover Field, Santa Monica to Charleston Municipal Airport, Nov. 6, 1948. Elapsed Time: 6 hr. 24 min. 32 sec. Distance: 2,203 mi. Average Speed: 344.192 mph.

LOS ANGELES, CAL. TO MEXICO CITY, D. F. (TRANSPORT AIRCRAFT)

Capt. Roberto Pini, pilot; Guillermo S. Prieto, co-pilot; Cia. Mexicono de Aviacion Douglas DC-6 low wing monoplane, 4 Pratt and Whitney R-2800 engines, from Los Angeles International Airport to Mexico City Airport, Dec. 3, 1950. Elapsed time: 4 hr., 11 min., 50 sec. Distance: 1,551.941 statute miles. Average speed: 369.754 mph.

MEXICO CITY, D. F. TO LOS ANGELES, CAL.

A. L. Rodriques, North American P-51 monoplane, NX-33699, Rolls Royce Merl[illegible] 68 engine, from Mexico City (Balbuena) Airport to Clover Field, Santa Monica, Dec. 17, [illegible]6. Elapsed Time: 4 hr. 24 min. 30 sec. Distance: 1,557.5 mi. Average Speed; 353.308 mph.

LOS ANGELES, CAL. TO DENVER, COLO.

Miss Dianna C. Cyrus, Douglas A-26, 2 Pratt and Whitney R-2800 engines of 2,000 hp each, from Lockheed Air Terminal, Burbank to Stapleton Airport, June 20, 1947. Elapsed Time: 2 hr. 18 min. 58 sec. Distance: 836 mi. Average Speed: 360.949 mph.

SAN FRANCISCO, CAL. TO LOS ANGELES, CAL.

Capt. R. D. Creighton, USAF, North American F-86A monoplane, General Electric J-47-A jet engine from San Francisco International Airport to Los Angeles International Airport, May 20, 1950. Elapsed Time: 32 min. 56 sec. Distance: 339.121 mi. Average Speed: 617.932 mph.

SAN FRANCISCO, CAL. TO SALT LAKE CITY, UTAH

Frank W. Fuller, Jr., Seversky monoplane, NX-70Y, Pratt and Whitney Twin Row Wasp 1,200 hp engine, from San Francisco Airport to Salt Lake Municipal Airport, Apr. 20, 1939. Elapsed Time: 2 hr. 9 min. 44 sec. Distance: 598.5 mi. Average Speed: 276.799 mph.

SAN FRANCISCO, CAL. TO SEATTLE, WASH.

Frank W. Fuller, Jr., Seversky monoplane, NR-70Y, Pratt and Whitney Twin Row Wasp 1,100 hp engine, from San Francisco Airport to Boeing Field, May 25, 1938. Elapsed Time: 2 hr. 31 min. 41 sec. Distance: 684.5 mi. Average Speed: 270.261 mph.

SAN FRANCISCO, CAL. TO SAN DIEGO, CAL.

Earl Ortman, Marcoux-Bramberg Special, Pratt and Whitney Wasp Jr., 1,195 hp engine, from Oakland Airport to Lindbergh Field, June 1, 1938. Elapsed Time: 1 hr. 48 min. 1 sec. Distance: 447 mi. Average Speed 248.295 mph.

SAN FRANCISCO, CAL. TO PORTLAND, ORE.

Frank W. Fuller, Jr., Seversky monoplane, NX-70Y, Pratt and Whitney Twin Row Wasp engine, from San Francisco Airport to Pearson Field, Jan. 16, 1938. Elapsed Time: 2 hr. 13 min. 53 sec. Distance: 553 mi. Average Speed: 247.828 mph.

SAN FRANCISCO, CAL. TO PHOENIX, ARIZ.

Frank W. Fuller, Jr., Seversky monoplane, NR-70Y, Pratt and Whitney Twin Row Wasp engine, from San Francisco Airport to Sky Harbor Airport, Jan. 16, 1939. Elapsed Time: 2 hr. 11 min. 58 sec. Distance; 650.5 mi. Average Speed: 295.757 mph.

SAN FRANCISCO, CAL. TO BOISE, IDAHO

Frank W. Fuller, Jr., Seversky monoplane, NR-70Y, Pratt and Whitney Twin Row Wasp 1,200 hp engine, from San Francisco Airport to Boise Municipal Airport, May 4, 1939. Elapsed Time: 1 hr. 47 min. 26 sec. Distance: 525.5 mi. Average Speed: 293.484 mph.

SAN FRANCISCO, CAL. TO DENVER, COLO.

Frank W. Fuller, Jr., Seversky monoplane, NX-70Y, Pratt and Whitney Twin Row Wasp 1,200 hp engine, from San Francisco Airport to Denver Municipal Airport, June 7, 1939 Elapsed Time: 3 hr. 22 min. 26.8 sec. Distance: 954 mi. Average Speed: 282.741 mph.

SAN FRANCISCO, CAL. TO WASHINGTON, D. C. (TRANSPORT AIRCRAFT)

Capt. Scott Flower, pilot; 1st officer R. E. McDonald, co-pilot; crew of seven and nine passengers; Pan American Airways Boeing B-377 Stratocruiser, 4 Pratt and Whitney Wasp Major 4,360 engines, from San Francisco Airport to Washington National Airport, Mar. 3, 1949. Elapsed Time: 6 hr. 22 min. 25.4 sec. Distance: 2,436.917 statute mi. Average Speed: 382.338 mph.

NEW YORK, N. Y. TO ATLANTA, GA. (TRANSPORT AIRCRAFT)

H. T. Merrill and Clifford Zieger, pilots; Eastern Airlines' Lockheed Constellation, NC-108A, 4 Wright 3,350 engines, 2,500 hp each, from La Guardia Airport to Atlanta Municipal Airport, Aug. 5, 1947. Elapsed Time: 2 hr. 36 min. 20 sec. Distance: 759.707 mi. Average Speed: 330.068 mph.

ATLANTA, GA., TO NEW YORK, N. Y. (TRANSPORT AIRCRAFT)
H. T. Merrill and Clifford Zieger, pilots; Eastern Airlines' Lockheed Constellation, NC-108A, 4 Wright 3350 engines, 2,500 hp each, from Atlanta Municipal Airport to La Guardia Airport, Aug. 5, 1947. Elapsed Time: 2 hr. 36 min. 20 sec. Distance: 759.707 mi. Average Speed: 291.572 mph.

NEW YORK, N. Y. TO HAVANA, CUBA
Col. A. P. de Seversky, Modified Seversky P-35 monoplane, powered with a Pratt and Whitney 1830-9 850 hp engine, from Floyd Bennett Field to Camp Columbia, Havana, Dec. 3, 1937 Elapsed Time: 5 hr. 3 min. 5.4 sec. Distance: 1,307 mi. Average Speed: 258.735 mph.

NEW YORK, N. Y., TO HOUSTON, TEX.
Henry T. Merrill, pilot, J. D. Scott, co-pilot; Eastern Airlines' Lockheed Constellation, NC-102A, 4 Wright 2,100 hp engines from La Guardia Airport, Jackson Heights, L. I. to Houston Municipal, June 6, 1947. Elapsed Time: 4 hr. 39 min. 3 sec. Distance: 1,425.5 mi. Average Speed: 306.504 mph.

HOUSTON, TEX. TO NEW YORK, N. Y. (TRANSPORT AIRCRAFT)
Henry T. Merrill, pilot, J. D. Scott, co-pilot; Eastern Airlines' Lockheed Constellation, NC-102A, 4 Wright 2,100 hp engines, from Houston Municipal to La Guardia Airport, June 6, 1947. Elapsed Time: 4 hr. 41 min. 35 sec. Distance: 1,425.5 mi. Average Speed: 303.746 mph.

NEW YORK, N. Y. TO MIAMI, FLA. (TRANSPORT AIRCRAFT)
E. R. Brown, pilot; E. H. Parker, co-pilot; Eastern Airlines' Lockheed Constellation, 4 Wright engines, 2,100 hp each, from La Guardia Airport to 36th Street Airport, May 28, 1947. Elapsed Time: 3 hr. 58 min. 41.2 sec. Distance: 1,096.427 mi. Average Speed: 275.615 mph.

MIAMI, FLA. TO NEW YORK, N Y. (TRANSPORT AIRCRAFT)
E. R. Brown, pilot; E. H. Parker, co-pilot; Eastern Airlines' Lockheed Constellation, NC-102A, 4 Wright engines, 1,200 hp each, from 36th Street Airport to La Guardia Airport, May 28, 1947. Elapsed Time: 3 hr. 29 min. 11.4 sec. Distance: 1,096.427 mil. Average Speed: 314.477 mph.

NEW YORK, N. Y. TO NEW ORLEANS, LA. (TRANSPORT AIRCRAFT)
H. T. Merrill and E. R. Brown, pilots; Eastern Airlines' Lockheed Constellation, NC-108A, 4 Wright 3350 engines, 2,500 hp each, from La Guardia Airport, L. I., to Moisant International Airport, July 23, 1947. Elapsed Time: 3 hr. 52 min. 29.8 sec. Distance: 1,182.466 mi. Average Speed: 305.157 mph.

NEW ORLEANS, LA. TO NEW YORK, N. Y. (TRANSPORT AIRCRAFT)
H. T. Merrill and E. R. Brown, pilots; Eastern Airlines' Lockheed Constellation, NC-108A, 4 Wright 3350 engines, 2,500 hp each, from Moisant International Airport to La Guardia Airport, L. I., July 23, 1947. Elapsed Time: 3 hr. 35 min. 10.8 sec. Distance: 1,182.466 mi. Average Speed: 329.714 mph.

NEW YORK, N. Y. TO WASHINGTON, D. C.
Capt. Martin L. Smith, USAF, Lockheed P-80 jet-propelled monoplane, Allison J-33-11 engine, from La Guardia Airport, Jackson Heights, L. I. to Washington National Airport, Apr. 21, 1946. Elapsed Time: 29 min. 15 sec. Distance: 214 mi. Average Speed: 438.974 mph.

MEXICO CITY, D. F. TO NEW YORK, N. Y.
Francisco Sarabia, Gee Bee monoplane, X-BAKE, Pratt and Whitney Hornet 980 hp engine, from the Military Airport, Mexico City to Floyd Bennett Field, May 24, 1939. Elapsed Time: 10 hr. 47 min. 46.8 sec. Distance: 2,087.5 mi. Average Speed: 193.353 mph.

HONOLULU, HAWAII TO NEW YORK, N. Y.
Lt. Col. Robert E. Thacker, pilot; 1st Lt. John M. Ard, co-pilot; North American P-82 monoplane, 2 Rolls Royce V-1650 engines, 2,250 hp each, from Hickam Field, Honolulu to La Guardia Airport, Jackson Heights, L. I., Feb. 28, 1947. Elapsed Time: 14 hr. 31 min. 50 sec. Distance: 4,968.852 mi. Average Speed; 341.959 mph.

CHICAGO, ILL. TO ATLANTA, GA. (TRANSPORT AIRCRAFT)
H. T. Merrill and S. A. Bell, pilots; Eastern Airlines' Lockheed Constellation, NC-108A, 4 Wright 3350 engines, 2,500 hp each, from Chicago Municipal Airport, to Atlanta Municipal Airport, Aug. 5, 1947. Elapsed Time: 1 hr. 48 min. 20 sec. Distance: 590.281 mi. Average Speed: 326.925 mph.

ATLANTA, GA. TO CHICAGO, ILL. (TRANSPORT AIRCRAFT)
H. T. Merrill and S. A. Bell, pilots; Eastern Airlines' Lockheed Constellation, NC-108A, 4 Wright 3350 engines, 2,500 hp each, from Atlanta Municipal Airport to Chicago Municipal Airport, Aug. 5, 1947. Elapsed Time: 2 hr. 1 min. 55 sec. Distance: 590.281 mi. Average Speed: 290.501 mph.

CHICAGO, ILL. TO LOS ANGELES, CAL.
Howard R. Hughes, Northrop Gamma monoplane, NR-13761, Wright Cyclone engine, from Chicago Municipal Airport to Grand Central Air Terminal, Glendale, Cal., May 14, 1936. Elapsed Time: 8 hr. 10 min. 29.8 sec. Distance: 1,734.5 mi. Average Speed; 212.172 mph.

CHICAGO, ILL. TO MIAMI, FLA. (COMMERCIAL TRANSPORT)
Capt. Jack Roth, pilot; First Officer, A. C. Bonner, co-pilot, 2 stewardesses and 37 passengers, Delta Air Lines, Douglas DC-6, N-1905M, 4 Pratt and Whitney R-2800 engines, from Midway Airport to Miami International Airport, Mar. 2, 1950. Elapsed time: 3 hr. 8 min. 48 sec. Distance; 1,183.422 mi. Average Speed: 376.087 mph.

CHICAGO, ILL. TO WASHINGTON, D. C. (TRANSPORT AIRCRAFT)
Jack Frye, TWA, Northrop Gamma 2-D monoplane, NR-13758, Wright Cyclone 710 hp engine, from Chicago Municipal Airport to Washington-Hoover Airport, S. Washington, Feb 18, 1936. Elapsed Time: 2 hr. 22 min. Distance: 599 mi. Average Speed: 253.098 mph.

VANCOUVER, B. C., CANADA TO AGUA CALIENTE, MEXICO
Frank W. Fuller, Jr., Seversky monoplane, NX-70Y, Pratt and Whitney Twin Row Wasp 1,100 hp engine, from Vancouver Airport to Agua Caliente Airport, Nov. 4, 1937. Elapsed Time: 4 hr. 54 min.

MIAMI, FLA. TO CHICAGO, ILL. (TRANSPORT AIRCRAFT)
Henry T. Merrill and P. L. Foster, pilots; Eastern Airlines' Lockheed Constellation, NC-105A, 4 Wright 3350 engines, 2,500 hp each, from 36th Street Airport to Chicago Municipal Airport, July 16, 1947. Elapsed Time: 3 hr. 56 min. 22 sec. Distance: 1,183.368 mi. Average Speed: 300.390 mph.

VANCOUVER, B. C., CANADA TO OAKLAND, CAL.
Frank W. Fuller, Jr., Seversky monoplane, NX-70Y, Pratt and Whitney Twin Row Wasp 1,100 engine, from Vancouver Airport to Oakland Airport, May 28, 1938. Elapsed Time: 3 hr. 8 min. 43 sec. Distance: 792.5 mi. Average Speed: 251.965 mph.

MARCH FIELD, CAL. TO MITCHEL FIELD, N. Y.
Lt. Ben S. Kelsey, USAF, Lockheed XP-38 airplane, 2 Allison liquid cooled 1,000 hp engines, Feb. 11, 1939. Elapsed Time: 7 hr. 45 min. 36 sec. Distance: 2,425 mi. Average Speed: 312.5 mph.

WICHITA, KAN. TO LOS ANGELES, CAL.
Paul Mantz, Lockheed Orion NR-12222, from Wichita Airport to Union Air Terminal, July 4, 1938. Elapsed Time: 7 hr. 11 min. 5 sec. Distance: 1,201 mi. Average Speed: 167.160 mph.

DETROIT, MICH. TO AKRON, O.
Louise Thaden, Beechcraft biplane, NC-15835, from Detroit City Airport to Akron Municipal Airport, Jan. 21, 1937. Elapsed Time: 40 min. 43 sec. Distance: 123.5 mi. Average Speed: 181.989 mph.

DETROIT, MICH. TO MIAMI, FLA. (TRANSPORT AIRCRAFT)
H. T. Merrill and F. Bennett, pilots; Eastern Airlines' Lockheed Constellation, NC-113A, 4 Wright 3350 engines, 2,500 hp each, from Willow Run Airport to 36th Street Airport, Aug. 7, 1947. Elapsed Time: 3 hr. 36 min. 29 sec. Distance: 1,150.455 mi. Average Speed: 318.857 mph.

TAMPA, FLA. TO MIAMI, FLA. (TRANSPORT AIRCRAFT)
G. T. Baker, pilot; J. Bailey, co-pilot; and passengers; National Airlines' Douglas DC-6, NC-90891, 4 Pratt and Whitney 2,100 hp engines, from Drew Field to 36th Street Airport, June 3, 1947. Elapsed Time: 39 min. 13 sec. Distance: 204.429 mi. Average Speed: 312.769 mph.

OFFICIAL FEMININE NATIONAL TRANSCONTINENTAL AND INTER-CITY RECORDS

WEST TO EAST TRANSCONTINENTAL RECORD
Jacqueline Cochran, modified Seversky pursuit monoplane, Pratt and Whitney Twin Row Wasp engine, from Burbank, Cal. to Brooklyn, N. Y., Sept. 3, 1938. Elapsed Time: 10 hr. 27 min. 55 sec. Average Speed: 234.776 mph.

EAST TO WEST TRANSCONTINENTAL RECORD
Louise Thaden and Blanche Noyes, Beechcraft, Wright 420 hp engine, from Floyd Bennett Field, Brooklyn, N. Y. to Los Angeles Municipal Airport, Cal., Apr. 19-20, 1935. Elapsed Time: 13 hr. 33 min.

MEXICO CITY TO WASHINGTON, D. C.
Amelia Earhart, Lockheed Vega monoplane, Pratt and Whitney Wasp 550 hp engine from Central Airport, Mexico City to Washington-Hoover Airport, S. Washington, Virginia, May 8, 1935. Elapsed Time: 13 hr. 1 min. 51 sec.

MEXICO CITY TO NEW YORK, N. Y.
Amelia Earhart, Lockheed Vega monoplane, Pratt and Whitney Wasp 550 hp engine from Central Airport, Mexico City to Newark Airport, Newark, N. J., May 8, 1935. Elapsed Time: 14 hr. 19 min.

INDEX

A

INDEX

B

C

D

F

G

H

M

N

O

P

Q

R

Z

INDEX TO ADVERTISERS