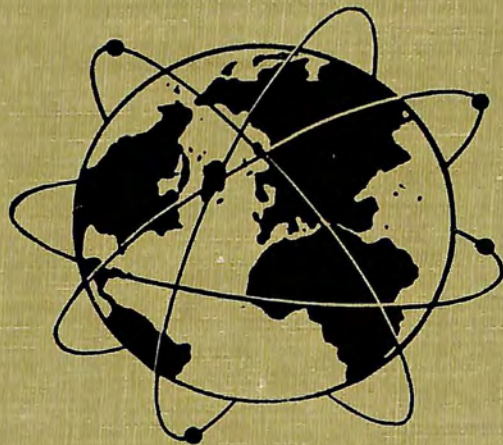


**1957-1958**

# **AIRCRAFT YEAR BOOK**

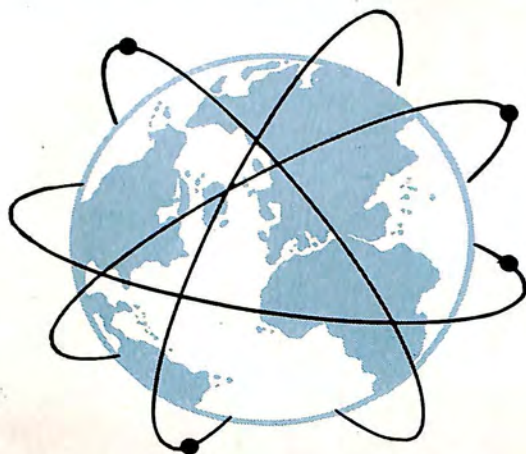


1957-1958

# AIRCRAFT YEAR BOOK

THIRTY-NINTH ANNUAL EDITION

OFFICIAL PUBLICATION  
OF THE  
AIRCRAFT INDUSTRIES ASSOCIATION, INC.



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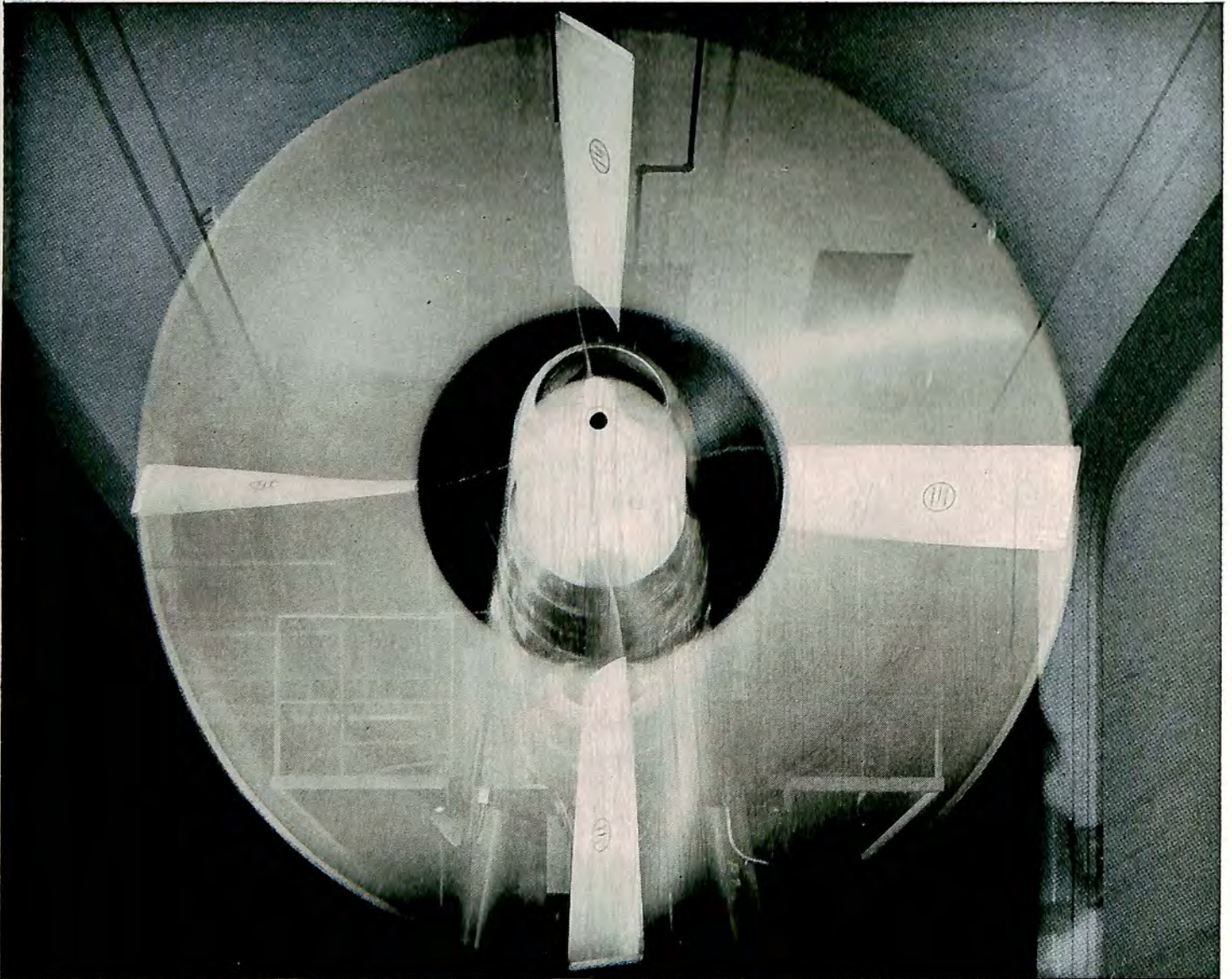
**AMERICAN AVIATION PUBLICATIONS, INC.**

1001 VERMONT AVE., N. W.

WASHINGTON 5, D. C.

STERLING 3-5400

# The Matched General Motors Power Team of Allison Prop-Jet Engines and AeroProducts Turbo-Propellers Marks Another Milestone by Receiving CAA Approval for Commercial Operation



**CAA AFFIRMS DEPENDABILITY OF ALLISON PROP-JET POWER.** Another major step toward commercial airline operation of Allison Prop-Jet power in the Lockheed Electra has been accomplished with the on-schedule approval of the Allison Model 501-D13 Prop-Jet engine and AeroProducts 606 Turbo-Propeller by the Civil Aeronautics Administration. Backing up the qualification test were 80,000 hours of development time on test stands, over 75,000 hours of experimental and service flight time and testing of engine components for an additional 50,000 hours. Approval of the CAA brings one step closer airline operation of this matched General Motors power team for the jet age in air transportation.



ALLISON DIVISION OF GENERAL MOTORS, Indianapolis, Indiana



## ALLISON PROP-JET POWER

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*Art Director*  
JAMES J. FISHER

*Printed by*  
THE MONUMENTAL PRINTING CO., Baltimore, Md.

## Foreword

This is the 39th annual edition of the Aircraft Year Book. In a bold new format, it describes graphically the status and achievements of the United States aircraft industry in 1957. It heralds the promise of aviation on the threshold of space in this International Geophysical Year, 1957-58.

Significance of this period to our industry, and to the United States and its friendly neighbors around the world, is simply expressed on the cover of this Year Book as man begins his exploration of our galaxy.

The year 1957 has been one of transition for the industry. It has marked a levelling out in production of aircraft and engines for military application. At the same time, the year has seen a record \$2.5-billion in orders placed by the world's airline network as it begins transition from piston engine aircraft to powerful turbojet and propjet aircraft. The year also has marked a major shift in emphasis from manned aircraft to missiles and rockets in our array of weapons for national defense.

The Aircraft Industries Association believes that this 1957-58 edition of the Aircraft Year Book will contribute to a more complete understanding of aviation and its vital relationship to the general welfare, prosperity and security of our nation.



ORVAL R. COOK

*President*

*Aircraft Industries Association*



## *Pattern for Air Progress:*

All Fairchild Divisions contribute to this goal. Fairchild combines in a single organization creative engineering, scientific capability and modern, flexible production facilities. On primary contracts or subcontracts, Fairchild accomplishments in design and production of airframes, missiles, propulsion systems, accessories and electronic systems, demonstrate a performance pattern high in economy and efficiency and broad in versatility.

**FAIRCHILD**

ENGINE AND AIRPLANE CORPORATION  
HAGERSTOWN 15, MARYLAND

...WHERE THE FUTURE IS MEASURED IN LIGHT-YEARS!

# pattern in performance:

# PROPJETLINERS

Fairchild will soon deliver the first of many F-27 transports — the new high-performance propjetliner for airlines and corporations. It is now being considered for utility cargo and training missions for the services.



It's being shouted from the treetops...

The good news is: there's an exciting new airline addit, a new business transport on the wing—the Fairchild F-27—the only airplane of its kind. Propjet-powered by twin airline-proven Rolls-Royce Dart engines the F-27 outflies, outperforms any airplane of its type. It offers short haul economy to regional air carriers, 2250-mile range as a business transport. Cruising at 280 mph, it is unmatched by competitive airliners or executive planes.

Address inquiries to: R. James Pfeiffer, Executive Director of Customer Relations, Fairchild Engine & Airplane Corporation, Hagerstown 15, Md.



THE FINEST AIRCRAFT FOR AIRLINES, CORPORATIONS AND MILITARY SERVICES.

## FAIRCHILD

# F-27



Announcing—The Fairchild F-27  
America's finest propjet transport



ROLLS-ROYCE DART PROPJET ENGINES • 280 MPH CRUISING • 2250 MILE RANGE • 40 PASSENGERS  
LOWEST OPERATING COSTS • SMALL FIELD PERFORMANCE • PRESSURIZED

The fastest short-to-medium haul airliner flying today, the new F-27 uses its performance, operating economy, and freedom from vibration to the hushed power of its airline-proven Rolls-Royce propjet engines. Its high-wing configuration provides panoramic visibility for each passenger. Built in

passenger stairway and carry on luggage racks are provided. Low fuselage exits passenger and cargo-handling time.

Tailored to the needs of the airline operator... requested for the comfort of the air traveler... the new F-27 Friendship is the most advanced air transport in its class. Priced at \$140,000.\*

FAIRCHILD  
F-27

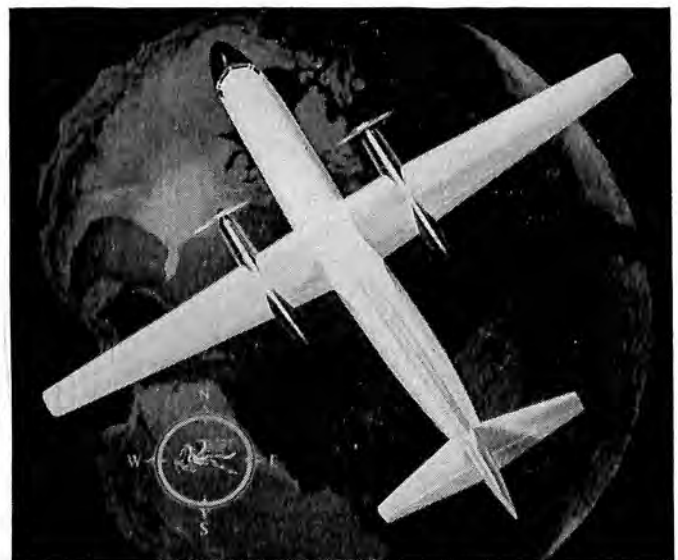


1964-65 F-27 PRICE LIST

THE FINEST AIRCRAFT

FOR AIRLINES AND CORPORATIONS.

Address inquiries to: R. James Pfeiffer, Executive Director of Customer Relations, Fairchild Engine & Airplane Corporation, Hagerstown, Md.



World-wide maintenance for the F-27

Corporations operating Fairchild F-27's as executive aircraft can be assured of maintenance the world over. With more and more customers purchasing F-27's throughout the Free World, overhaul and spares services will always be nearby. The F-27's Rolls-Royce Dart propjet engines are backed by a world-wide network of service facilities. Many corporations have decided that the F-27 is the aircraft to modernize their fleets. Cruising at better than 300 mph over a 2100-mile range, the F-27 surrounds airborne executives with pressurized and air conditioned comfort. And no other aircraft of its type has the F-27's short-field capability.

FAIRCHILD  
F-27

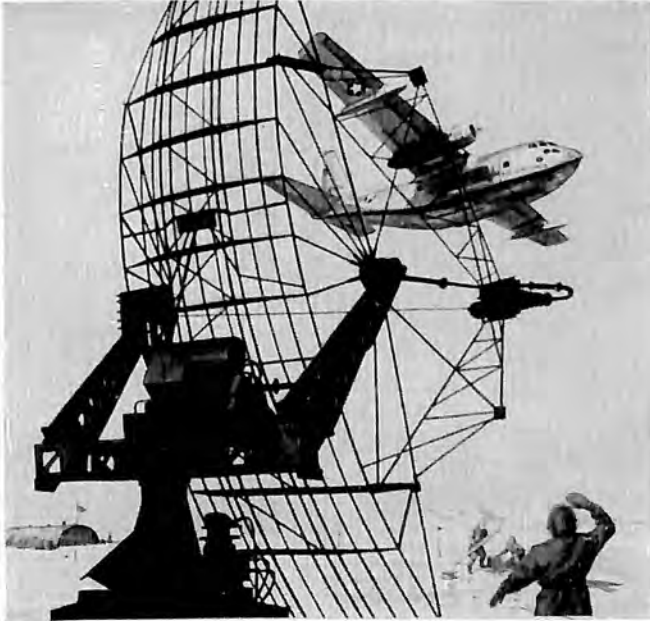


For full information write to: R. James Pfeiffer, Executive Director of Customer Relations, Fairchild Engine & Airplane Corporation, Hagerstown 15, Maryland.

THE FINEST AIRCRAFT FOR AIRLINES, CORPORATIONS AND MILITARY SERVICES

*pattern in performance:*

# PRODUCTION



**The high frontier**

Far to the north of settlements, roads and railways, DEW line outposts stand guard over America. They were built with the help of Fairchild C-123 transports, which flew in the men and the construction material—even the radar antennas which now scan the arctic skies.

The C-123 commutes service to the DEW line bases at the rate of up to eight tons of cargo per plane—

and at the end of the line the landing strips have proven too rough, too hazardous for any other heavy-duty transport now in service.

The members of this polar bear club have come to depend on the C-123—just as the U. S. Armed Forces everywhere. The C-123 shares these qualities with other Fairchild aircraft: ruggedness, reliability, and ever increasing utility.

**FAIRCHILD**  
AIRCRAFT DIVISION • HAGERSTOWN 10, MARYLAND  
A DIVISION OF FAIRCHILD ENGINE AND AIRPLANE CORPORATION

WHERE THE FUTURE IS MEASURED IN LIGHT-YEARS

The Fairchild Aircraft Division mass-produces the Fairchild C-123 assault transport and logistics carrier . . . builds major fuselage and wing sections for the B-52 intercontinental bomber.



**Strengthening the Sunday Punch of SAC**

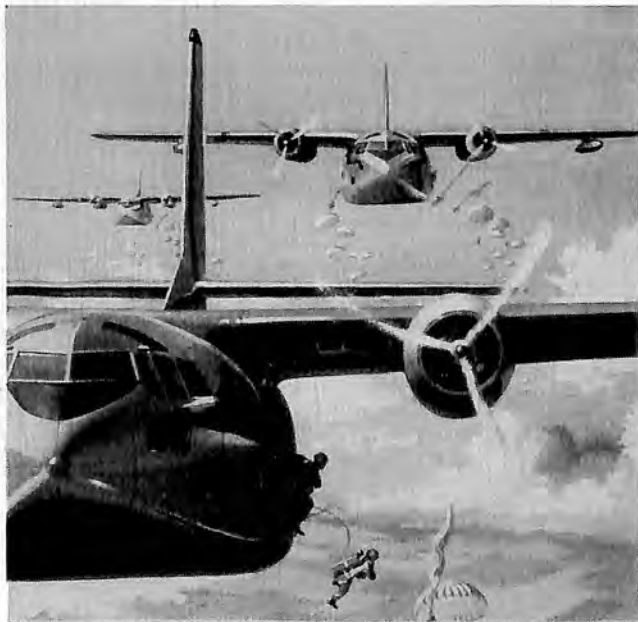
Every time one of the new B-52 global bombers is delivered, America is safer, stronger, more secure. In quality-producing huge wing and fuselage sections and vertical fins for the intercontinental bomber, Fairchild helps speed their delivery to the Strategic Air Command.

Always on schedule, these components stand up to exacting Air Force quality standards.

A major prime and sub-contractor, Fairchild specializes in low cost production, top quality control, consistent on-time deliveries—all adding up to security through air power.

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AIRCRAFT DIVISION • HAGERSTOWN 10, MARYLAND  
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**TRIPLE THREAT—Airborne... Assault... Logistics**

The Fairchild C-123, service-proven as assault and logistical transport, plays a third role to perfection—stays as a vehicle for airborne troops. Its slow-up speed, high tail configuration and twin jump doors mean quick and easy jumps for airborne troops. Numerous test drops have proved its effectiveness in the new mission.

The C-123 provides the military with a variety of services . . . airborne supply, air evacuation, assault missions, bulk cargo logistics and more paratrooper airdrops. Triple-threat quality too, in reliability, versatility and performance . . . these C-123 characteristics are typical of all Fairchild aircraft.

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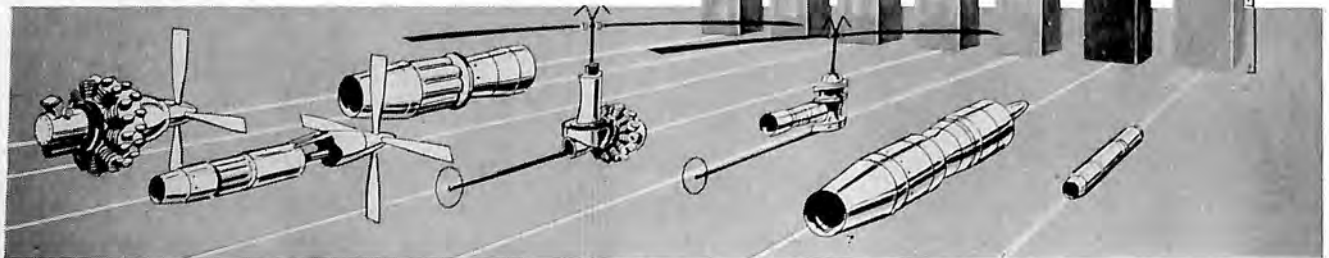
# pattern in performance: POWERPLANTS

## SMALL JET ENGINES... CHAMPION WEIGHT LIFTERS

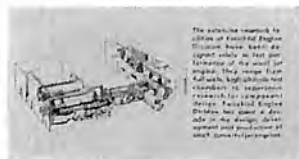
An entirely new family of aircraft will evolve from a new family of small lightweight jet engines now under development at the Fairchild Engine Division. These new powerplants will feature incredibly high thrusts and great lifting power... jet will be so light they can easily be carried by two men.

Highly compact, with low frontal areas, the small jet engines will deliver thrust/weight ratios starting at 8 to 1 with a long range potential of more than 10 to 1. They will be used in the high performance, lightweight trainers, interceptors, target drones, pilotless aircraft including missiles and intermediate class passenger and cargo jets of the nineteen sixties. They will also be used to power fighters and utility cargo craft, executive aircraft... and will make jet Short Take Off and Landing (STOL) and Vertical Take Off and Landing (VTOL) aircraft practical.

The small jet engine may be used singly, in pairs and in clusters. It provides multi-engine reliability in aircraft of a size now wholly dependent on a single engine. The small jet engine will produce greater versatility and utility in airplanes of tomorrow.

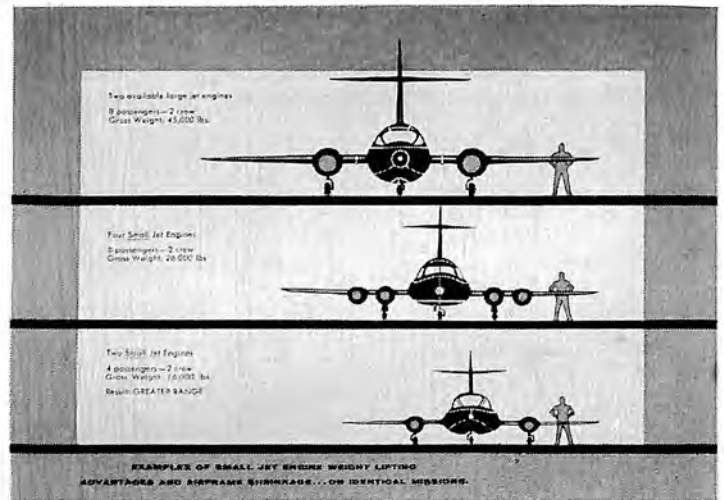


COMPARISON OF LIFTING CAPACITY OF POWER SYSTEMS  
How the new family of Fairchild Small Jet Engines compare with other mechanical lifting systems



**FAIRCHILD  
ENGINE DIVISION**  
DEER PARK, LONG ISLAND, N. Y.  
A DIVISION OF FAIRCHILD ENGINE AND AIRPLANE CORPORATION  
WHERE THE FUTURE IS MEASURED IN LIGHT-YEARS!

Fairchild Engine Division specializes in the design and production of small, light weight turbojet engines for commercial and military applications, including an entirely new family of powerplants in the 2000-pound thrust class and the CAA certified 1000-pound thrust J44 for pilotless planes and inhabited aircraft use.



## SMALL JET ENGINES... CHAMPION WEIGHT REDUCERS

The new breed of high-performance, lightweight, small jet engines coming to life will broaden the horizons of jet aircraft design, performance, versatility and utility.

Best of all, the new small jets will make possible lighter, less costly aircraft with performance to match the big planes of today. With power weight ratios as high as 8 to 1 and long range potentials of more than 10 to 1, the small jets may power lightweight fighters, basic and advanced jet trainers, transports of half the size with proportionate savings in weight and cost. As the new airplanes shrink, their performance and especially their versatility and utility expand.

Performance and potential in a smaller package... this is the promise held out by the new family of small jet engines of the J83 type now under development and test.

Fairchild Engine Division has long been a pioneer in aviation and a pioneer in power and is dedicated to the small jet engine concept.



Test cell for the powerplants of tomorrow... vital link in the chain of advanced research program of Fairchild Engine Division. Experience, expertise and design ingenuity... these are the elements in Fairchild's pioneering in small jet powerplants.

**FAIRCHILD  
ENGINE DIVISION**  
DEER PARK, LONG ISLAND, N. Y.  
A DIVISION OF FAIRCHILD ENGINE AND AIRPLANE CORPORATION  
WHERE THE FUTURE IS MEASURED IN LIGHT-YEARS!

**FAIRCHILD  
ENGINE DIVISION**

Cammack Road, Deer Park, L. I., N. Y.

A DIVISION OF FAIRCHILD ENGINE AND AIRPLANE CORPORATION

pattern in performance:

# PNEUMATICS



## IN AIR CONDITIONING

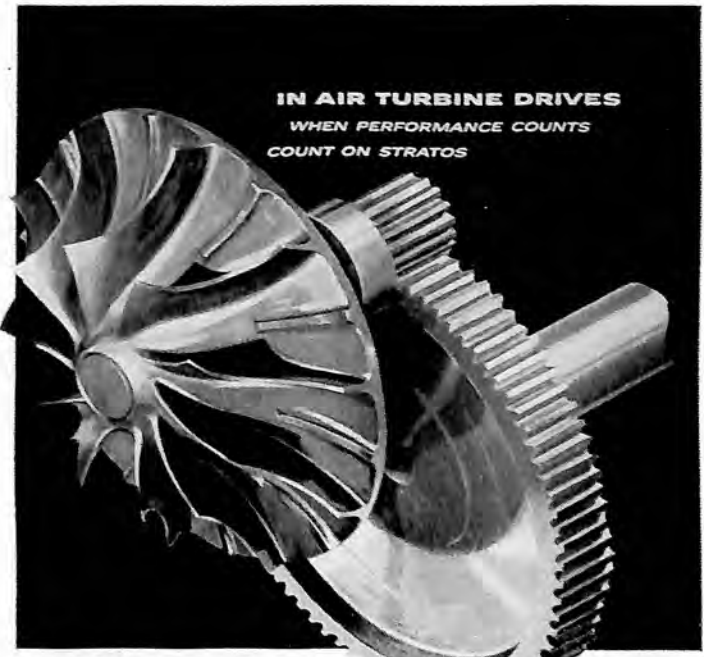
WHEN PERFORMANCE COUNTS COUNT ON STRATOS

Performance is the payoff in aircraft air conditioning. Weight, size, efficiency and reliability are prime criteria. Simple air cycle packages for trainers—complex systems for heavy bombers or Century fighters—Freon refrigeration systems—for any of these the aircraft engineer knows he can count on Stratos. One of the first to produce aircraft air conditioning, Stratos has designed, developed and delivered complete systems for transports as well as for combat aircraft. Introduced by Stratos were such advances as evaporative cooling, moisture separators, variable area nozzles, integral controls for temperature, flow and pressure regulation, pressurization rate limitation and many other features. Faced with a tough air conditioning problem? Look to Stratos for an original, effective solution. Others do

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## STRATOS

A DIVISION OF FAIRCHILD ENGINE & AIRPLANE CORPORATION  
Main Plant: Bay Shore, L. I., N. Y.  
Western Branch: 1800 Rosecrans Ave., Manhattan Beach, Calif.  
West Coast Office: 1355 Westwood Blvd., Los Angeles, Calif.



## IN AIR TURBINE DRIVES

WHEN PERFORMANCE COUNTS COUNT ON STRATOS

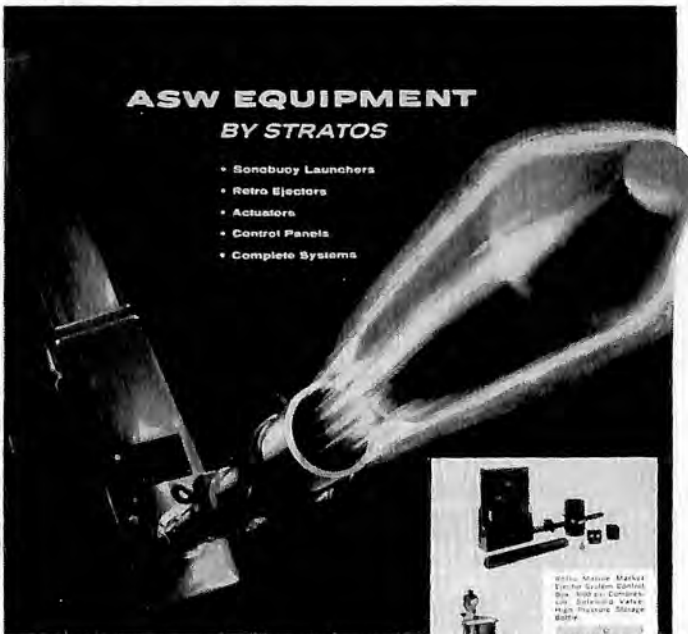
Constant speed air turbine drives are a Stratos specialty — an outstanding feature is their ability to hold speed within ± of 1% from no load to overload conditions. Particularly significant are the safety precautions designed into these rugged units. Besides an inherently sound design, each model incorporates an integral overspeed protection system — independent of the governing system — which shuts down the turbine mechanically. Overspeed trips are of several types — some resettable in flight — so that the best arrangement for each installation can be selected.

For additional information on Stratos' line of air turbine drives, write to:

**STRATOS**  
A DIVISION OF FAIRCHILD ENGINE & AIRPLANE CORPORATION  
Main Plant: Bay Shore, L. I., N. Y.  
West Coast Office: 1355 Westwood Blvd., Los Angeles, Calif.  
Western Branch: 1800 Rosecrans Ave., Manhattan Beach, Calif.



Model TP25-L, for driving a 15 kva alternator



## ASW EQUIPMENT BY STRATOS

- Sonobuoy Launchers
- Retro Ejectors
- Actuators
- Control Panels
- Complete Systems

Stratos builds a variety of equipment and complete pneumatic systems for sub-hunting patrol aircraft. Included are: Free Piston Pneumatic Store Ejectors—using the patented "Pogo Stick" principle to burst delicate sonobuoys clear of the aircraft without endangering delicate components. Complete ejection systems to plant flares and markers with pinpoint accuracy, using an air gun to "shoot" stores rearward at a speed which cancels out the aircraft's forward motion, and. Associated equipment such as skin door actuators, compressors, valves and integrated control systems.

**STRATOS** A DIVISION OF FAIRCHILD ENGINE & AIRPLANE CORPORATION  
Main Plant: Bay Shore, L. I., N. Y.  
Western Branch: 1800 Rosecrans Ave., Manhattan Beach, Calif.



Sonobuoy ejector using "Pogo Stick" Free Piston Air Actuator principle. Pneumatic Actuator for opening skin door.

# STRATOS

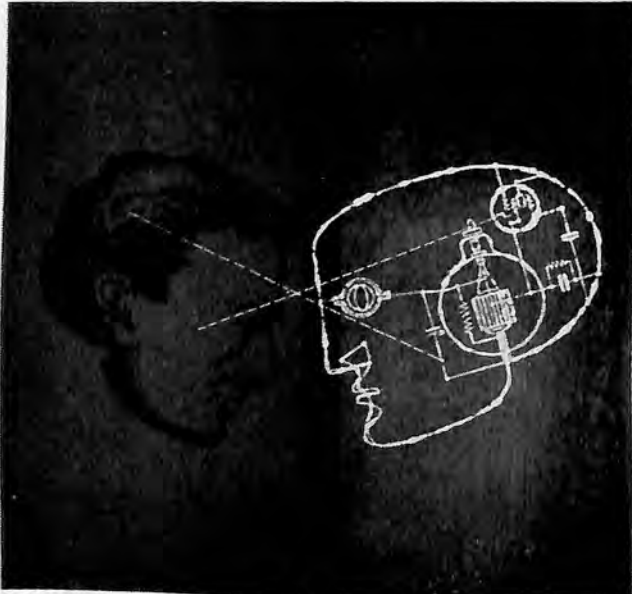
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West Coast Office: 1355 Westwood Blvd., Los Angeles, Calif.  
Western Branch: 1800 Rosecrans Ave., Manhattan Beach, Calif.

*pattern in performance:*

# PILOTLESS AIRCRAFT

The Fairchild Guided Missiles Division designed and produced the Navy's Petrel missile, a sophisticated air-to-underwater weapon. Other accomplishments include shipboard radar systems for missiles, guidance elements for the Goose weapons system, bombing radar simulators, and other electronics equipment.



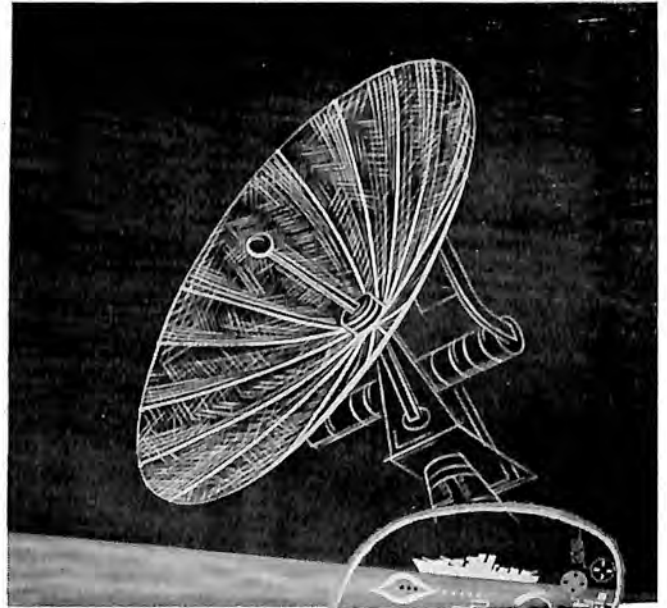
**HOW  
TO IMPROVE  
A MISSILE'S  
IQ**

*Today's guided missile is an amazingly sophisticated and intelligent instrument, capable of complex thought and precise action. Tomorrow's must have an even higher IQ.*

To improve a missile's intelligence, Fairchild Guided Missiles Division engineers and scientists have developed radical new concepts for guidance and control, transferring their intelligence into the missile's guidance center. Through sound research, inventiveness and imagination, FGMD engineers and scientists continue to make great strides in all fields of missile development...putting more brain-power into more missile power.

**FAIRCHILD**  
GUIDED MISSILES DIVISION • WYANDANCH, LONG ISLAND, N. Y.  
A Division of Fairchild Engine and Airplane Corporation

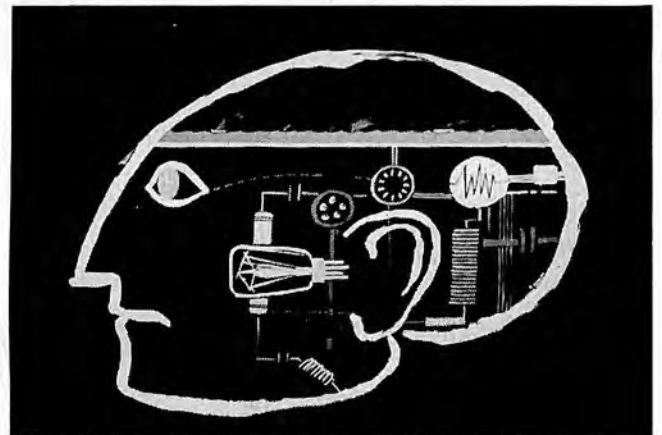
...WHEN THE FUTURE IS MEASURED IN LIGHT-YEARS



**FAIRCHILD SHIPBOARD RADAR**  
... Push Button Guidance  
FOR THE REGULUS

Shipboard radar, designed and produced by Fairchild Guided Missiles Division, makes possible the completely automatic guidance of the Regulus. Push-button operation contrasts the engineering complexity of this uniquely accurate guidance system. So versatile in its installation and adaptability, the Fairchild SPQ-2 radar system is now in operation with the fleet around the world.

**FAIRCHILD**  
GUIDED MISSILES DIVISION • WYANDANCH, LONG ISLAND, N. Y.  
A Division of Fairchild Engine and Airplane Corporation  
...WHEN THE FUTURE IS MEASURED IN LIGHT-YEARS



**A sophisticated weapon The Fairchild Petrel**

*Deadly accurate... exceptionally reliable*

Bombers armed with the new Fairchild Petrel missile can release the deadly "birds" well outside the protective wall of shipboard AA. Petrel thinks for itself... seeks out its victim and strikes with accuracy at sea.

Reliability exceptional for such a sophisticated "weapon", the Navy says. Petrel has been fully operational for some time. It is a masterpiece of advanced electronics and dating design... another major contribution to our national defense by Fairchild.

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GUIDED MISSILES DIVISION • WYANDANCH, LONG ISLAND, N. Y.  
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...WHEN THE FUTURE IS MEASURED IN LIGHT-YEARS



**FAIRCHILD**  
GUIDED MISSILES DIVISION • WYANDANCH, LONG ISLAND, N. Y.  
A DIVISION OF FAIRCHILD ENGINE AND AIRPLANE CORPORATION



## Introduction

A year is more than a number of days strung together. It is a separate entity in time, a unit of history. At times a year emerges as more noteworthy than its fellows because of a single event of startling impact — Pearl Harbor, the stock market crash, the great blizzard. Thenceforth the year and the event are inseparable in the minds of posterity.

In the annals of aviation, 1957 was such a year. It might be termed the Year of the Sputnik.

The launching of the first man-made object into space was a foreign achievement but its impact was world-wide and nowhere was it felt more than in the United States. It brought home to a somnolent populace the undeniable fact that no nation can rest on its laurels and that maintenance of a position of world leadership is something that must be continually nurtured.

It awakened the public to a new awareness of the need for a strong national defense, and it halted a retrogressive trend in defense thinking among those charged with our national security.

It heralded, too, the dawn of an era of space conquest, Man's dream for as long as he has had the intelligence to consider it.

Even without Sputnik, however, 1957 would have been a year to remember. It was a year marked by both progress and problems.

The commercial airlines found themselves beset by continually rising costs in every phase of operation, coupled with an unexplainable traffic decline in the latter part of the year. At the same time, the turbine age of transportation came a giant step closer as manufacturers entered the final phases of production on the new turbine airliners on order.

The major problem for the airlines was how to pay for some \$2-billion worth of new equipment in the face of declining revenues. In any other American industry the answer would have been obvious — raise the price of the product. Handcuffed by government regulations, the airlines could only request such an increase and hope that 1958 would bring a way out of a major dilemma.

General aviation found itself in a much more optimistic position during 1957. The amazing growth of this segment of aviation, constant since the end of World War II, continued its spiraling climb.

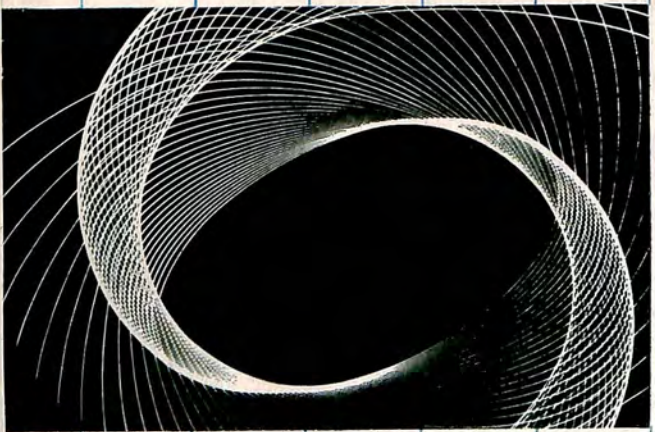
To the military, the year was one of perplexity. The guided missile blossomed into maturity in some phases of defense. From a budget item of \$21-million only six years earlier, it became a giant among security expenditures, a \$2-billion product in 1957. But although a number of missiles had reached operational status, the missile was still tomorrow's weapon. The problem for the military was to develop tomorrow's defense while maintaining today's force in being. It amounted to building two forces on a budget inadequate for one, a task which called for new breakthroughs in the art of fiscal accounting, and none were forthcoming.

To the military's partner in defense, the aircraft industry, the year was one of contradiction and confusion. At the start of the year, the industry held a fairly strong position. Employment was up, research and development was progressing at an excellent pace, and production was at a relatively high level. Then came the budget squeeze and with it cancellations, cutbacks, stretchouts, and reductions in progress payments which threw the machinery of the nation's air arsenal out of synchronization.

And yet, despite the problems, the industry can point with justifiable pride to a great many solid gains during 1957. This, the 39th annual edition of the Aircraft Year Book and the first under the aegis of American Aviation Publications, details those gains in a new format designed for easy assimilation. Even the most casual perusal of the pages to follow will bring home to the reader one strong impression: that an industry which can boast the accomplishments covered herein under the most difficult of circumstances need not accept second place in any technological race, provided it is given the support it needs from the public and its government. The theme of this issue of the Year Book is "Problems, but Progress."



# AVIATION EVENTS



1957  
1957  
1957  
1957  
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1957  
1957  
1957  
1957

A pictorial review  
of some of the  
outstanding events  
in aviation  
during 1957

# RECORDS

1957 was a record-breaking year in all categories as man flew faster, farther and higher than ever before.



## **NONSTOP ROUND-THE-WORLD**

Three of five Boeing B-52 jet bombers landed in California on January 18 culminating the first nonstop jet flight around the world. The 24,325-mile flight was accomplished in 45 hours 20 minutes, slashing by one-half the previous record of 94 hours set in 1949. Boeing KC-97's were used for aerial refueling. Flight Commander was Major General Archie Old, Jr., Commander, 15th Air Force at March AFB.



### WEST-EAST RECORD

On January 28, the Lockheed YC-121F Constellation set a west-east record for commercial-type aircraft of 4 hours 41 minutes, Long Beach, California, to Andrews AFB, Maryland. The aircraft averaged 490 miles per hour over the 2340-mile route.

### CONTINENT SPANNED

Prototype of Boeing 707, America's first jet airliner, arrives at Baltimore's Friendship Airport after completing nonstop flight from Seattle in 3 hours 48 minutes on March 11.



## CONTINUOUS BLIMP FLIGHT

The record-breaking Navy blimp, ZPG-2W, approaches Boca Chica field upon completion of its flight. The 343-foot Goodyear airship set a new world record for continuous flight—more than 300 hours—in mid-March.

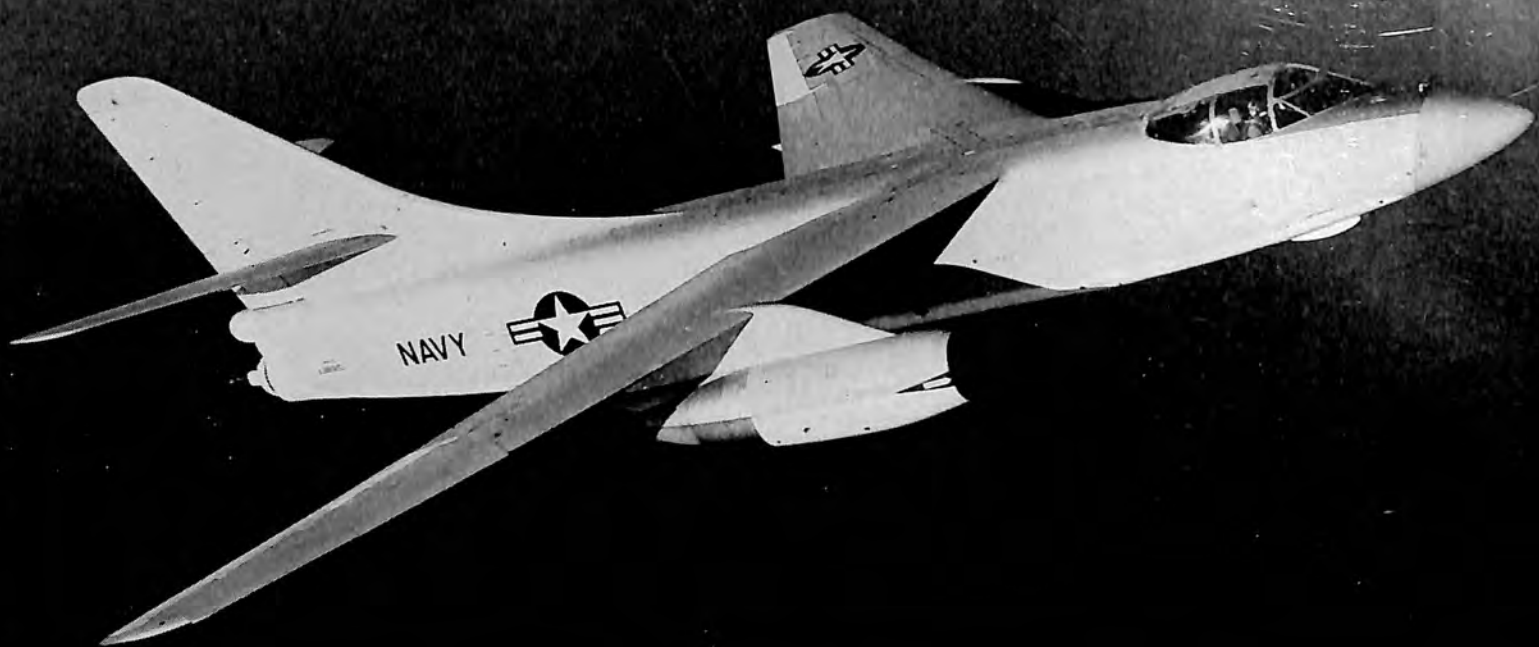


## BALLOON HEIGHT AND ENDURANCE

Air Force Captain J. W. Kittinger, Jr., in a balloon, soared to an 18-mile record on June 2. Two months later, Air Force Major David Simons topped this record by flying to 102,200 feet for a high altitude endurance record of 32 hours. Major Simons is pictured here at the peak of his climb.

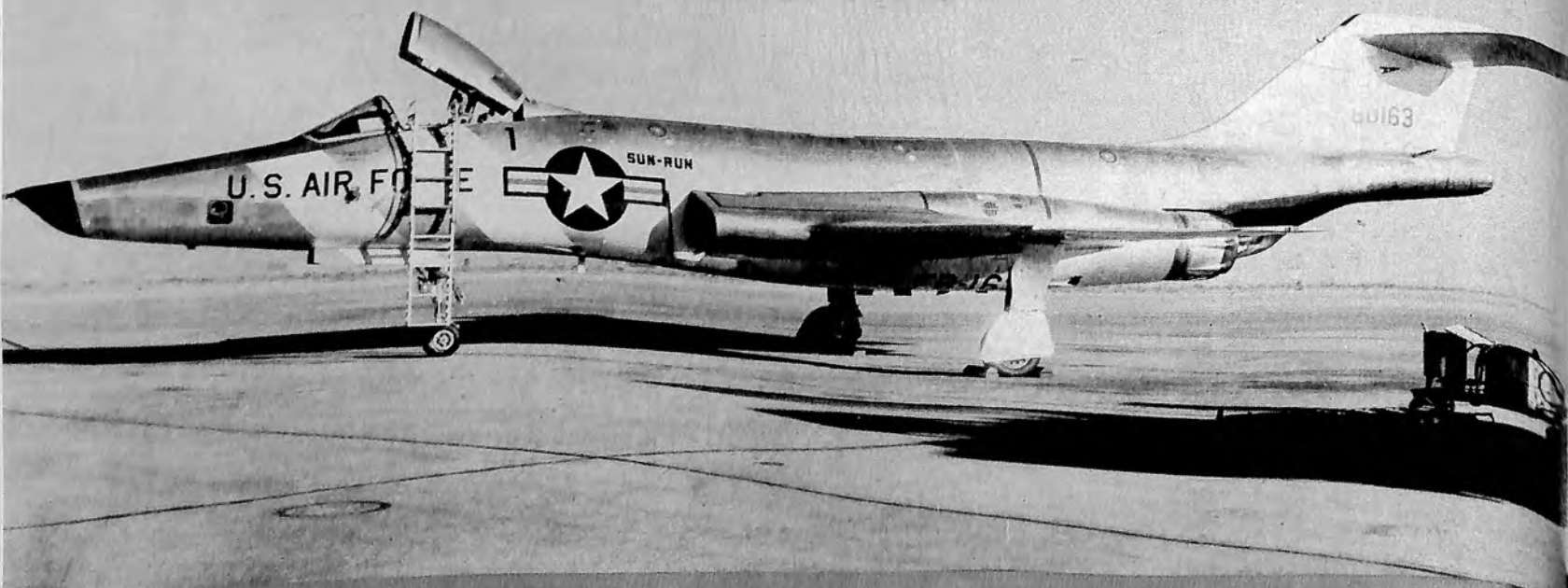






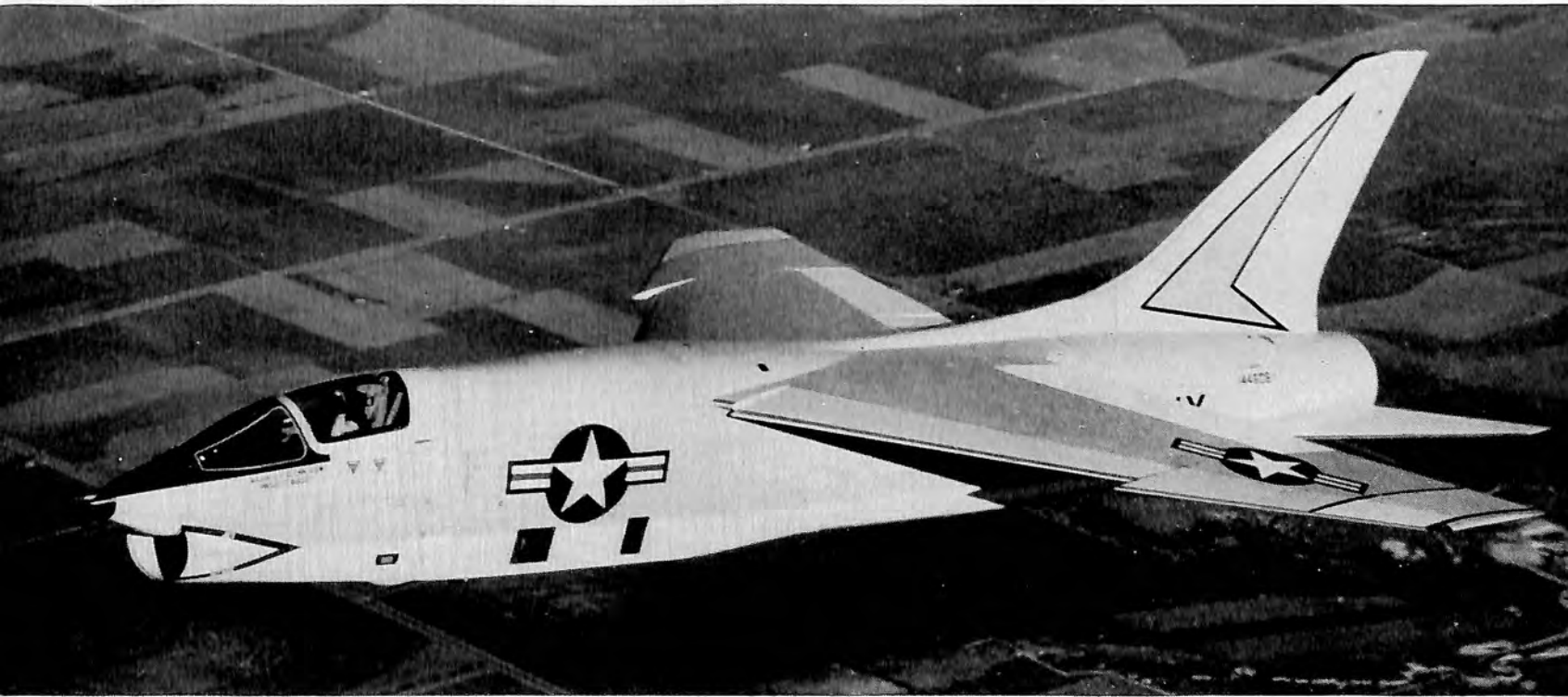
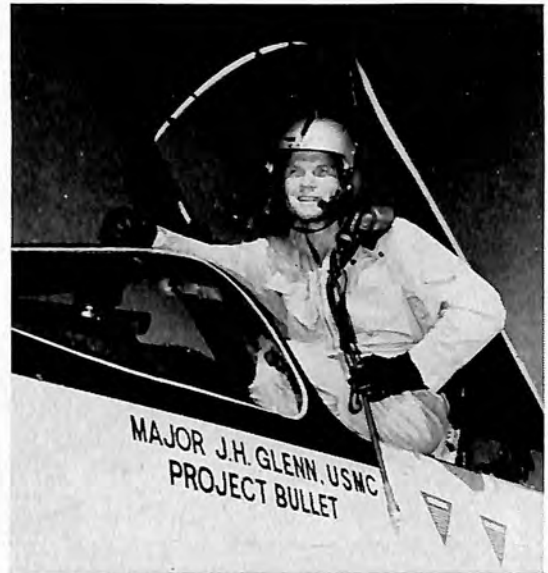
### VOODOO BREAKS THREE SPEED RECORDS

Air Force broke three speed records (previously held by Douglas A3D and Chance Vought F8U-1) on November 27 in McDonnell Voodoo RF-101 jets (below). A new round-trip speed record of 6 hours 42 minutes 6.9 seconds was set by Captain Robert Sweet, who also set a new east-west record of 3 hours 34 minutes 8.6 seconds. The new west-to-east record of 3 hours 5 minutes 39.2 seconds was set by Lieutenant Gustav B. Klatt.



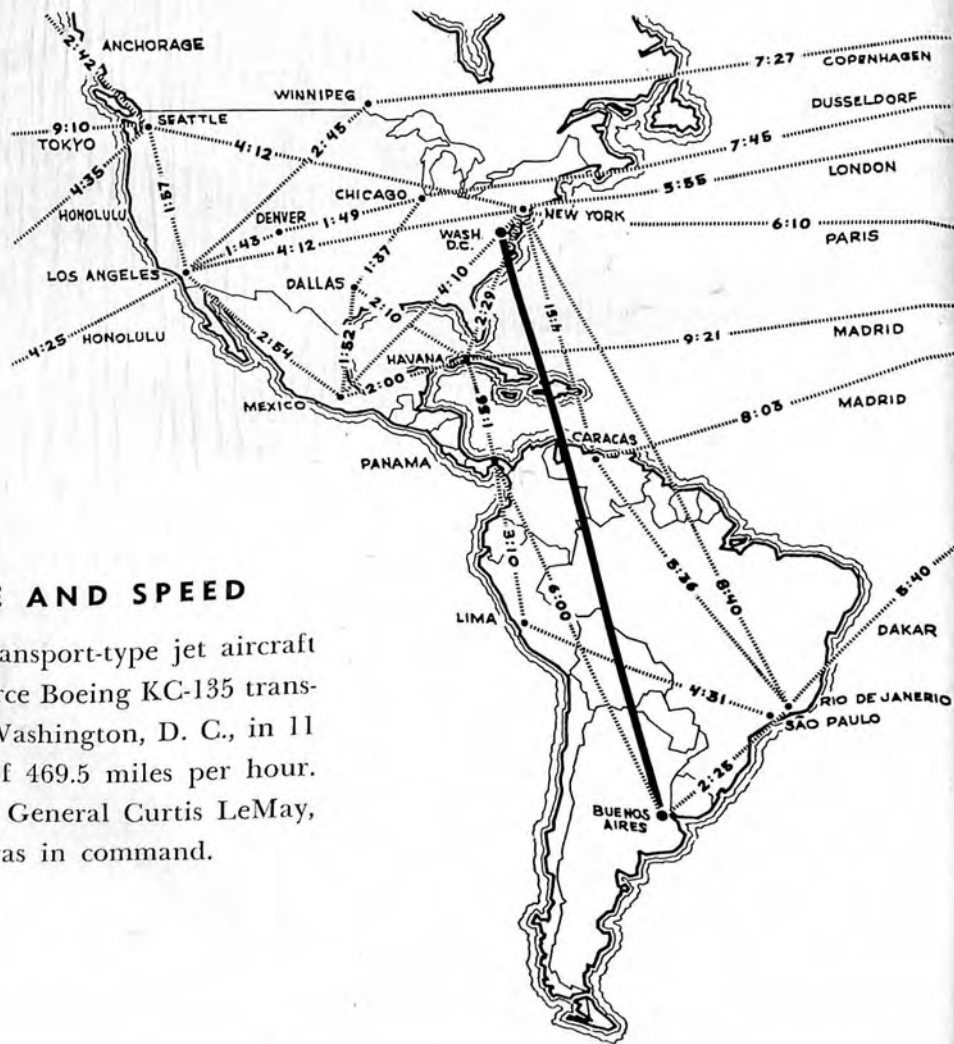
## DOUBLE RECORD

A Navy Douglas A3D twin jet attack bomber (left) cracked two speed records in late March, flying round-trip, Los Angeles—New York in 9 hours 31 minutes 35.4 seconds for one mark, and east-west in 5 hours 14 minutes 58 seconds.



## F8U-1 COAST-TO-COAST FLIGHT

On July 16 a Navy Chance Vought Crusader F8U-1 (above) sped across the continent to record the first of the year's two coast-to-coast records at an average speed of 725.55 miles an hour. Marine Major John Glenn, Jr., covered the 2456-mile route from Los Angeles to New York in 3 hours 23 minutes 8 and 4/10ths seconds.



### JET TRANSPORT DISTANCE AND SPEED

A new distance and speed record for transport-type jet aircraft was set on November 13 when an Air Force Boeing KC-135 transport-tanker flew from Buenos Aires to Washington, D. C., in 11 hours 5 minutes at an average speed of 469.5 miles per hour. The distance was just over 5200 miles. General Curtis LeMay, Vice Chief of Staff of the Air Force, was in command.



### **OPERATION FIRE WALL**

Air Force claimed a new world speed record on December 12 and captured the Thompson Trophy when a McDonnell F-101A, flown by Major Adrian Drew, chalked up an average speed of 1207.6 miles per hour along a measured 10.1-mile course at Edwards AFB, California. The Official international speed record, held previously by the British, was 1132.136 miles per hour.



# AWARDS

During the year, the industry honored the men responsible for the remarkable advancement of aviation. Some of the major award-winners are pictured on these pages.

## BENDIX TROPHY

Pictured at the right, the Bendix Trophy is being awarded to Captain Kenneth D. Chandler by M. P. Ferguson, President of Bendix Aviation Corp., while General Curtis E. LeMay (left), Vice Chief of Staff of the Air Force, looks on. The Bendix Trophy Race this year was flown from Chicago to Washington, D. C., in a Convair F-102 and the winning time was 54:45.5 minutes at a speed of 679.053 miles per hour.





#### **HARMON TROPHY**

Lieutenant Colonel Frank E. Everest, Air Force (bottom right), was designated the winner of the Harmon International Trophy as Outstanding Aviator for his pioneer work in rocket aircraft as Director of Experimental Flight at Edwards AFB, and as project director on the Bell X-2 research aircraft, which he flew at over 1900 miles per hour. Lieutenant Commander Malcolm D. Ross (bottom center) and Lieutenant Commander Morton L. Lewis, USN (bottom left), received the Outstanding Aeronaut (lighter-than-air pilot) Award for their piloting of a manned balloon to the unofficial record altitude of 76,000 feet in connection with a study of effects of the upper atmosphere on men and material.

#### **OCTAVE CHANUTE AWARD**

The 1957 Octave Chanute Award also went to Lieutenant Colonel Frank Everest for "outstanding contributions to the development of rocket powered flight test techniques."



#### **DR. ALEXANDER KLEMIN AWARD**

For contributions to helicopter development during his career as a test pilot, the late Captain Wayne W. Eggert, Air Force (left), was awarded the Dr. Alexander Klemin Award by the American Helicopter Society at its annual Honors Night Dinner in Washington, D. C.



#### **KOSSLER AWARD**

Robert Suggs (above), President of Petroleum Helicopters, received the Kossler Award for the "most outstanding practical application of the helicopter" for his extensive development work in the use of helicopters in off-shore drilling operations.



#### **DANIEL GUGGENHEIM MEDAL**

For "notable achievements in the advancement of aeronautics," Arthur E. Raymond (left), Vice President, Engineering, Douglas Aircraft Co., received the 1957 Daniel Guggenheim Medal.



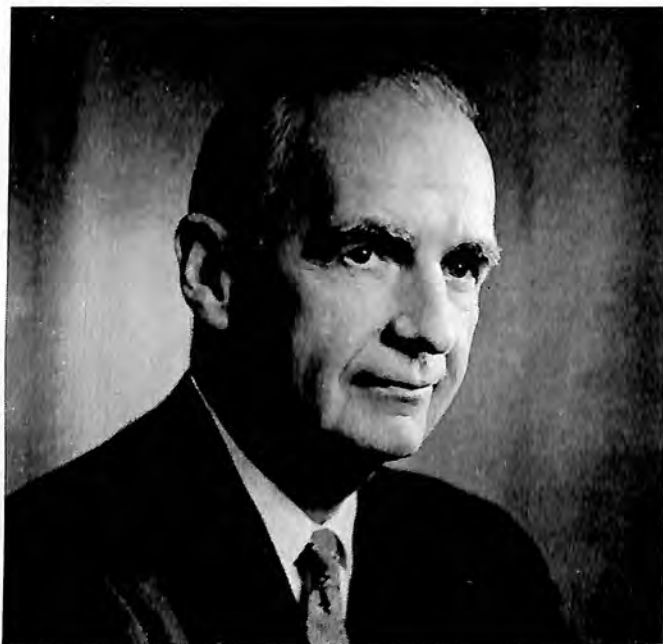
### **MACKAY TROPHY**

Captain Iven C. Kincheloe, Jr., was awarded the Air Force's Mackay Trophy for 1956 in May 1957 for "accomplishing the most meritorious flight" of 1956 by a member of the Air Force, as a result of his altitude-record-setting flight (126,200 feet) in the Bell X-2 research aircraft.



## HONORED AT WRIGHT BROTHERS DINNER

At the annual Wright Brothers Memorial Dinner in Washington on December 17, these men were honored: the *Collier Trophy* was presented to Vice Admiral James S. Russell (top left), Navy, and Charles J. McCarthy, (top right), Chairman of the Board, Chance Vought Aircraft, Inc., for development of the F8U Crusader; Edwin A. Link (bottom right), Chairman of the Board, Link Aviation, Inc., was recipient of the *Brewer Trophy* for development of simulators and other devices, and establishment of Link Foundation; and the *Wright Brothers Memorial Trophy* was awarded to Senator W. Stuart Symington (D., Mo.) (bottom left) for his many contributions to aviation over a number of years.





### H. H. ARNOLD AWARD

The Air Force Association's H. H. Arnold Award went to Edward P. Curtis for his outstanding contributions "through analysis and planning of a climate in which U. S. airpower can grow and flourish." Curtis was also named "Aviation Man of the Year" at the Association's golden anniversary convention in Washington in August.



### SPERRY AWARD

The Lawrence A. Sperry Award was presented to George F. Jude (right), Director of Flight Control Engineering at Sperry Gyroscope Co., by Dr. Edward R. Sharp, President of the Institute of Aeronautical Sciences, for his "significant contribution to advancement of precision automatic flight control and safe all-weather flight."

### SAE WRIGHT BROTHERS MEDAL

The 1956 SAE Wright Brothers Medal was presented in April, 1957, to C. H. Zimmerman, National Advisory Committee for Aeronautics, for his paper entitled "Some General Considerations Concerning VTOL Aircraft."

### THOMPSON TROPHY

Major Adrian E. Drew was winner of the Thompson Trophy by flying his McDonnell F-101A Voodoo to a new world speed record of 1207.6 miles per hour on December 12.



# NEW PLANES

## TURBINE PROGRESS

America's turbine-powered transports came a step closer to passenger service during the year.



## 707 STRATOLINER

First production model of the 600-mile-an-hour Boeing 707 Jet Stratoliners was rolled out from the Boeing plant in Renton, Washington, in late October. It will be delivered to Pan American after flight testing and is due to go into service in early 1959.

## DC-8

Final assembly operations on the Douglas DC-8 jetliner were taking place at year-end and the first flight was expected early in 1958. First deliveries of the 180-passenger, 5000 mile nonstop jetliner were scheduled for early 1959.





## ELECTRA

December saw the first flight of Lockheed's turbo-prop *Electra* (left) at Burbank, California—one month ahead of schedule. Slated for extensive testing, Lockheed aimed for CAA certification by September 30, 1958.



## 880

Convair's 880 (right) jet passenger transport was in production at the San Diego plant at year-end. This medium-range aircraft will cruise at 615 miles per hour at altitudes up to 40,000 feet.

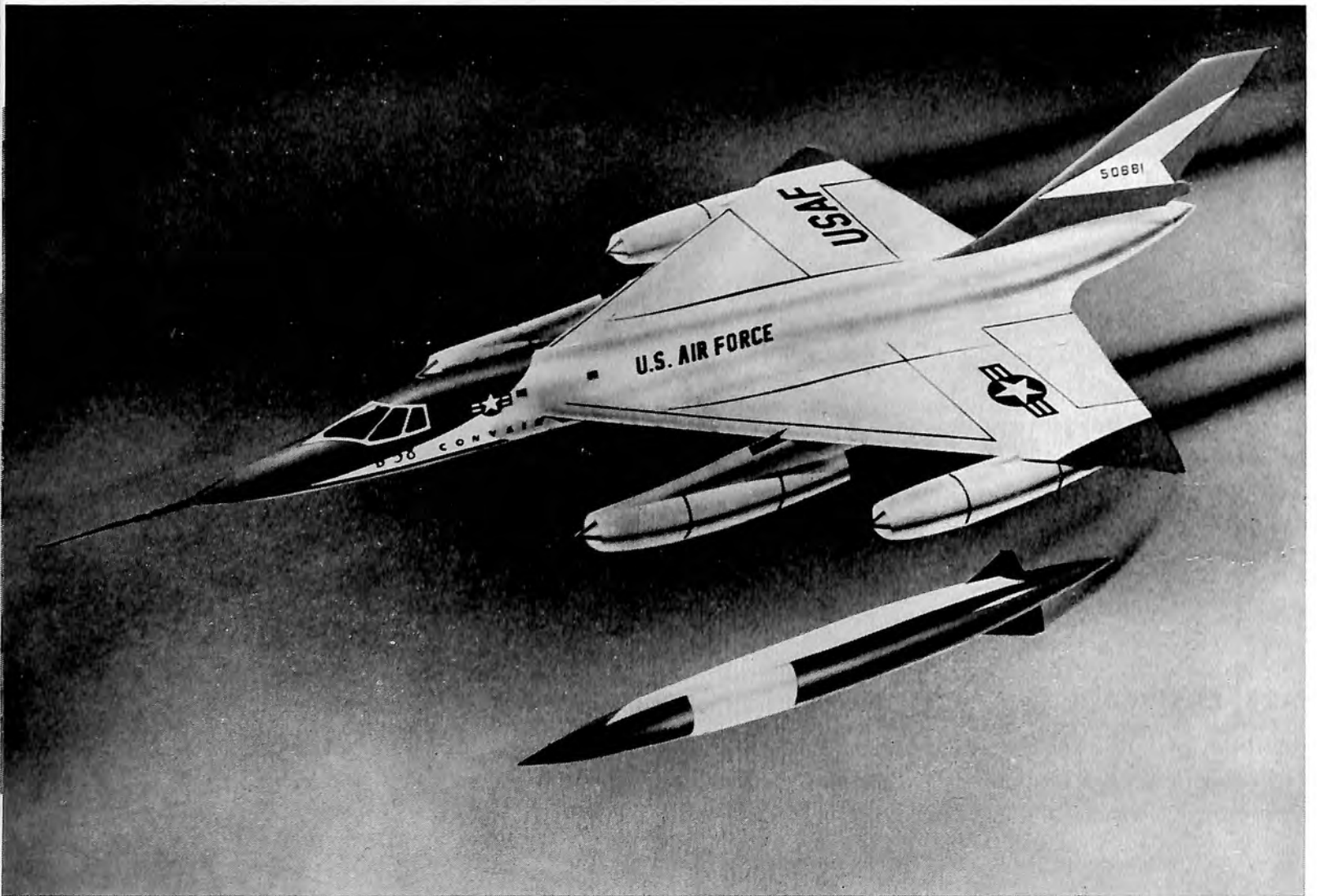
## F-27 FRIENDSHIP

Months of planning and preparation brought out the first F-27 propjet liner, Fairchild's bid to capture the fertile medium-range transport field. The aircraft was being put through ground tests at year-end in preparation for a February flight.



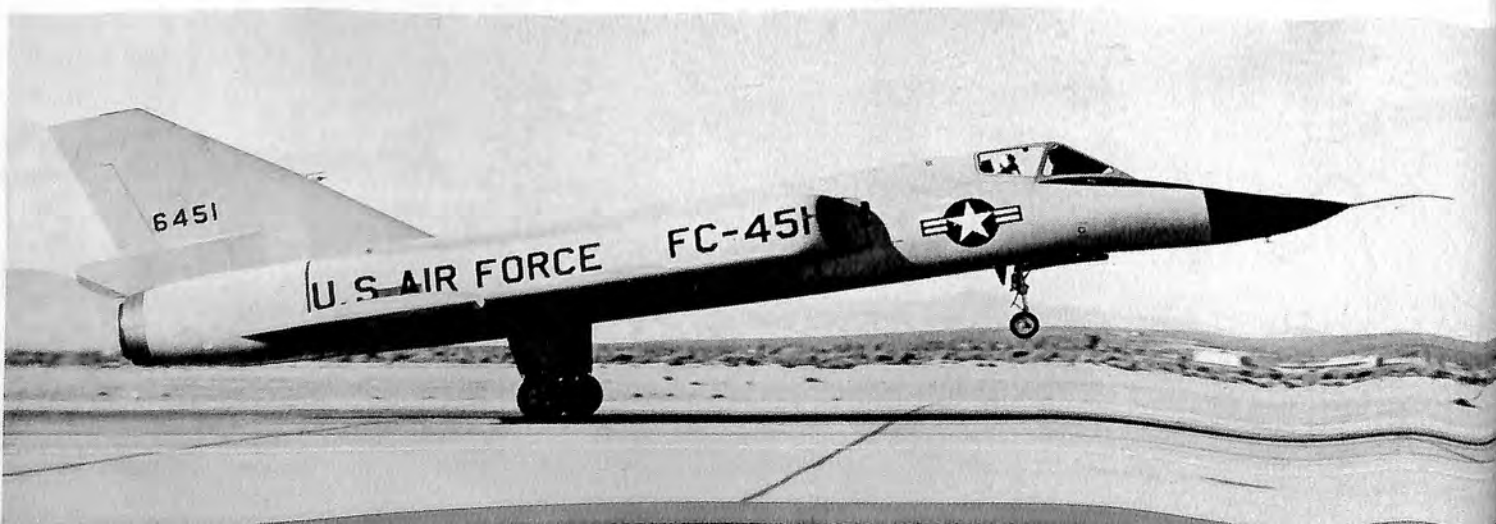
## SUPERSONIC BOMBER

During the year, Convair entered into production on the world's first Mach 2 bomber. The drawing here shows detachable "pod" seconds after its release from the B-58 Hustler.



## DELTA DART

The Convair F-106A all-weather interceptors were assigned for operational use with the Air Defense Command. Here the Delta Dart touches down after maiden test flight in September.





### THUNDERCHIEF

Republic's F-105 Thunderchief fighter-bomber (above) was slated for service with Air Force Tactical Air Command. Some of the design innovations, like the unique swept-forward air inlet ducts, are visible in this unusual photo of the Thunderchief going straight up. This plane made its first public appearance in March.

### JETSTAR

The Lockheed *JetStar* jet utility transport (below), powered by two Bristol Orpheus engines, was undergoing instrumented aerial tests at year-end. Second prototype will use four GE J85 or Fairchild J83 engines.



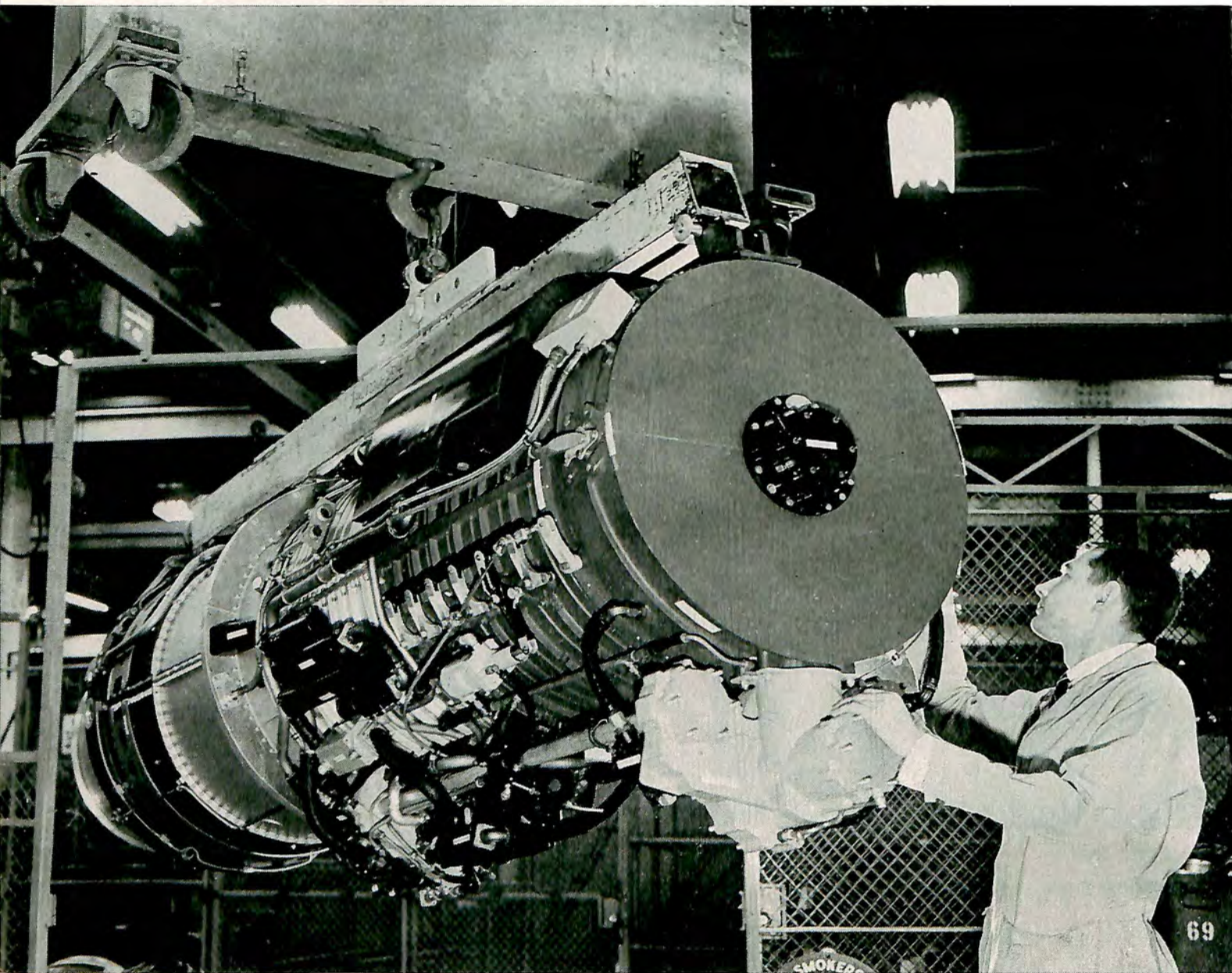
### TT-1 PINTO

The first production model of Temco's TT-1 primary jet trainer is shown (below) at Temco's Dallas plant being accepted by Navy's Lieutenant Commander P. W. Kerr. The Pinto was designed for a new training concept—all-jet flying for naval cadets.



# NEW ENGINES

Not only dramatic new planes, but the engines that powered them, made news during 1957.

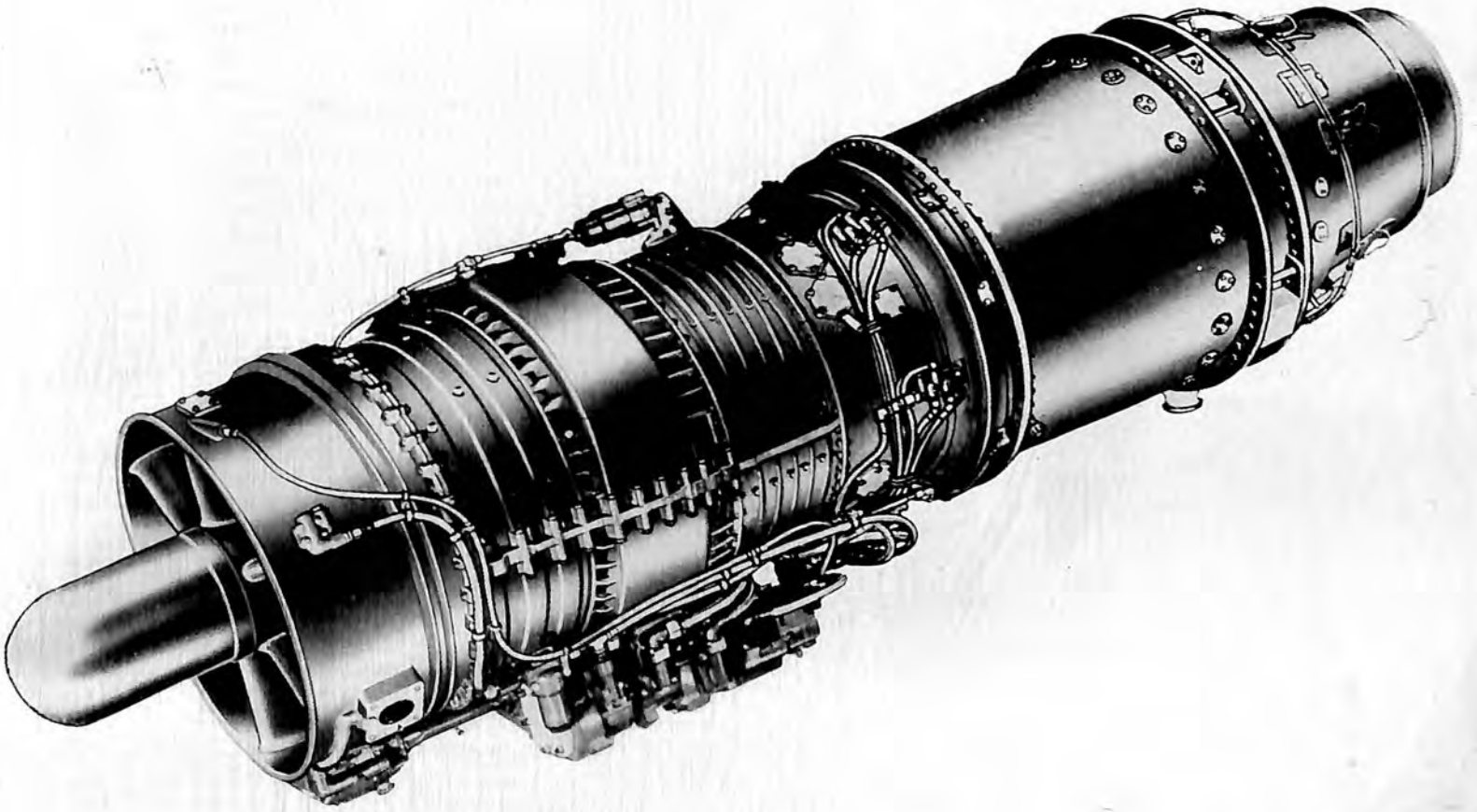


## GE TWINS

General Electric introduced its CJ-805, light-weight high-thrust turbojet, which will find its first application in the Convair 880 jetliner. The military version, the J79, which powers the Convair B-58, Lockheed F-104A and other military aircraft, is in the 10,000-pound thrust class.

## WESTINGHOUSE J54

Westinghouse took the wraps off its J54 turbojet engine, the result of a company sponsored development program.

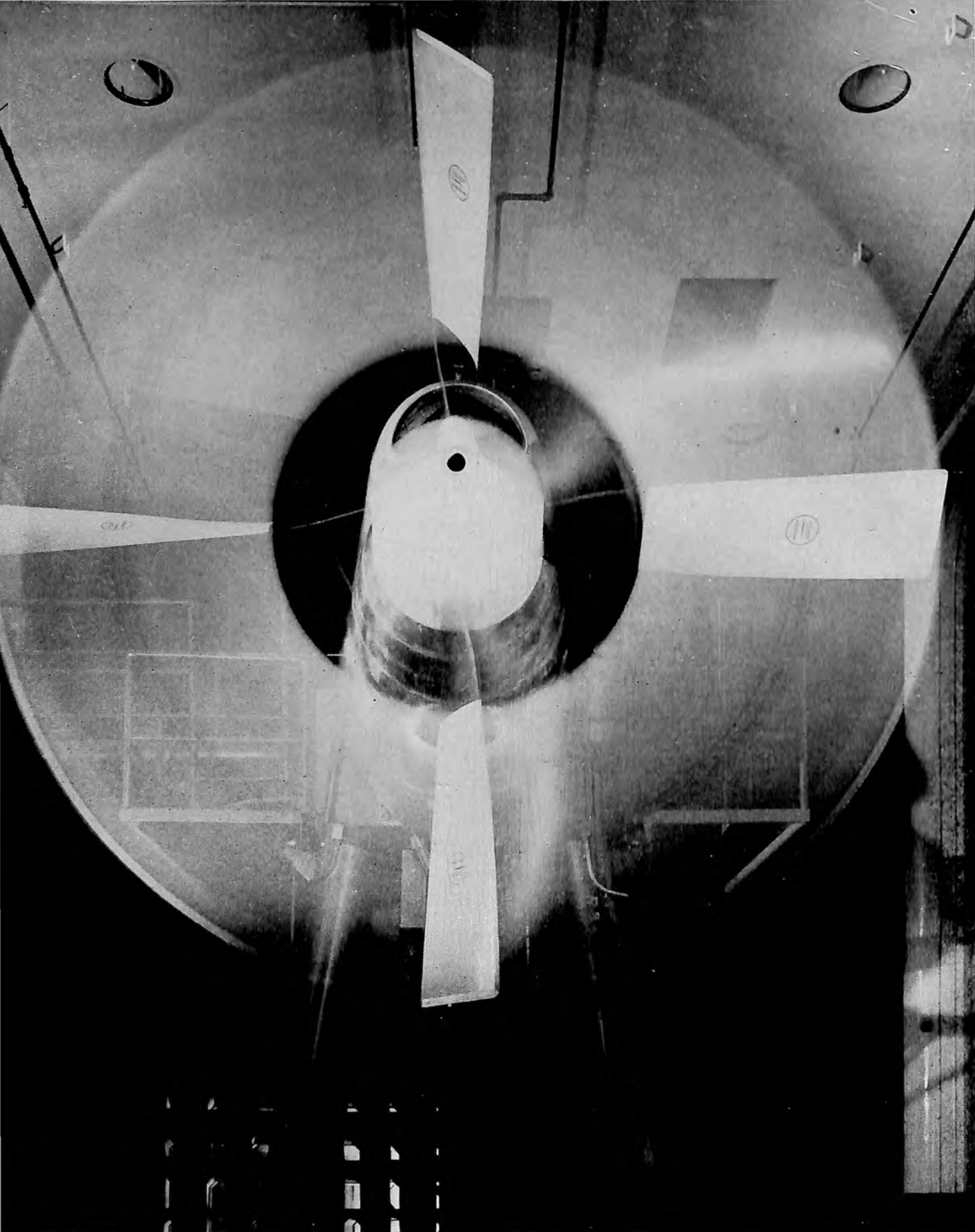


## CURTISS-WRIGHT ZEPHYR

The Curtiss-Wright TJ38 Zephyr was demonstrated publicly in May. It features a very low noise level.







### **ALLISON-AEROPRODUCTS TEAM**

Certification of the Allison 501-D13 Prop-jet engine and Aeroproducts 606 Turbo-propeller during 1957 launched Allison Division of General Motors into the "home stretch" phase of the first flight of the Allison-powered Lockheed Electra.



### **LIGHTWEIGHT ENGINE**

Pictured above is the Lycoming T55 engine in a test cell. This engine, in both turboprop and helicopter versions, is lightest American aircraft engine ever to achieve 1650-plus equivalent shaft horsepower.

### **NOW IN PRODUCTION**

Simultaneous commercial certification of the Pratt & Whitney J57 (right) and J75 (left) engines by CAA opened the way for delivery of these engines to Boeing for its 707 series and Douglas for the DC-8.



# VERTICAL FLIGHT

Intensified activity in the helicopter field and important strides in VTOL and STOL flight during 1957 were indications of the growing importance of vertical flight.



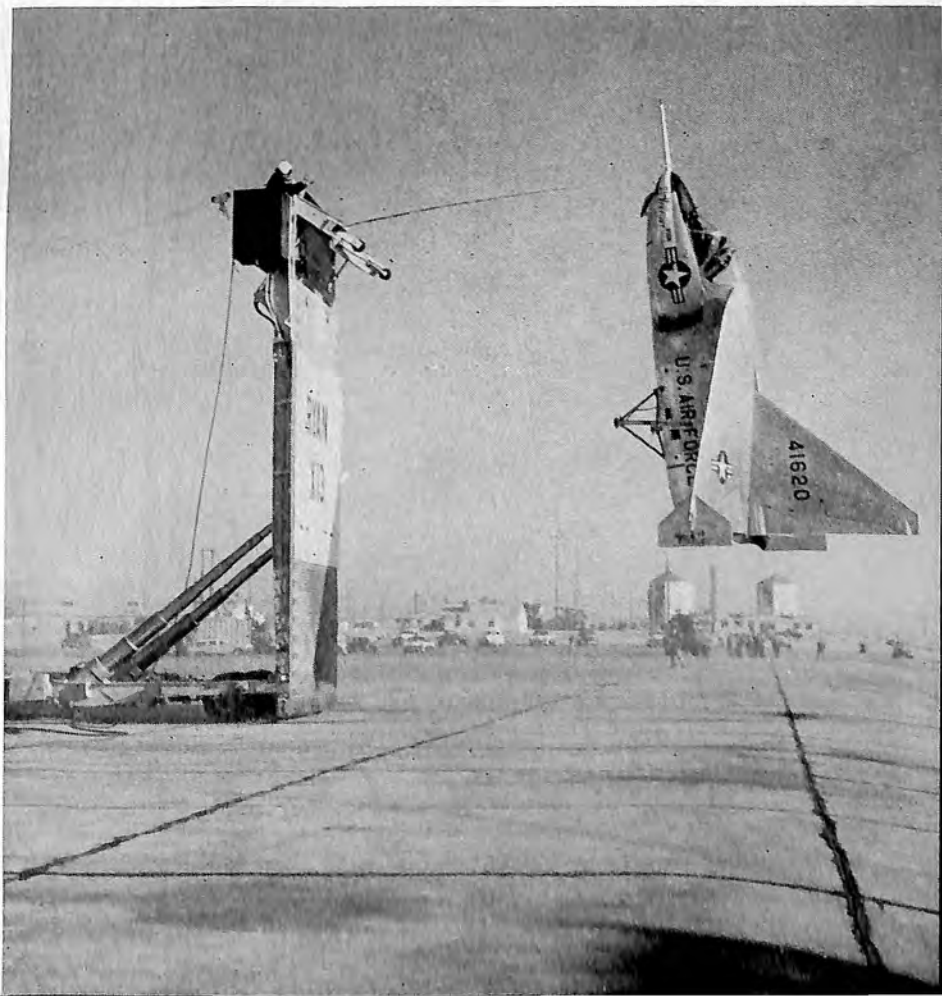


### **PRESIDENT EISENHOWER GETS HELICOPTER SERVICE**

Aviation history was made July 12, 1957, when President Eisenhower and staff members climbed into two Bell helicopters (H-47J's) on the White House lawn and were whisked away to a secret spot as part of civil defense exercises. The event marked the first time an American president ever had flown in a helicopter or a single-engine aircraft.

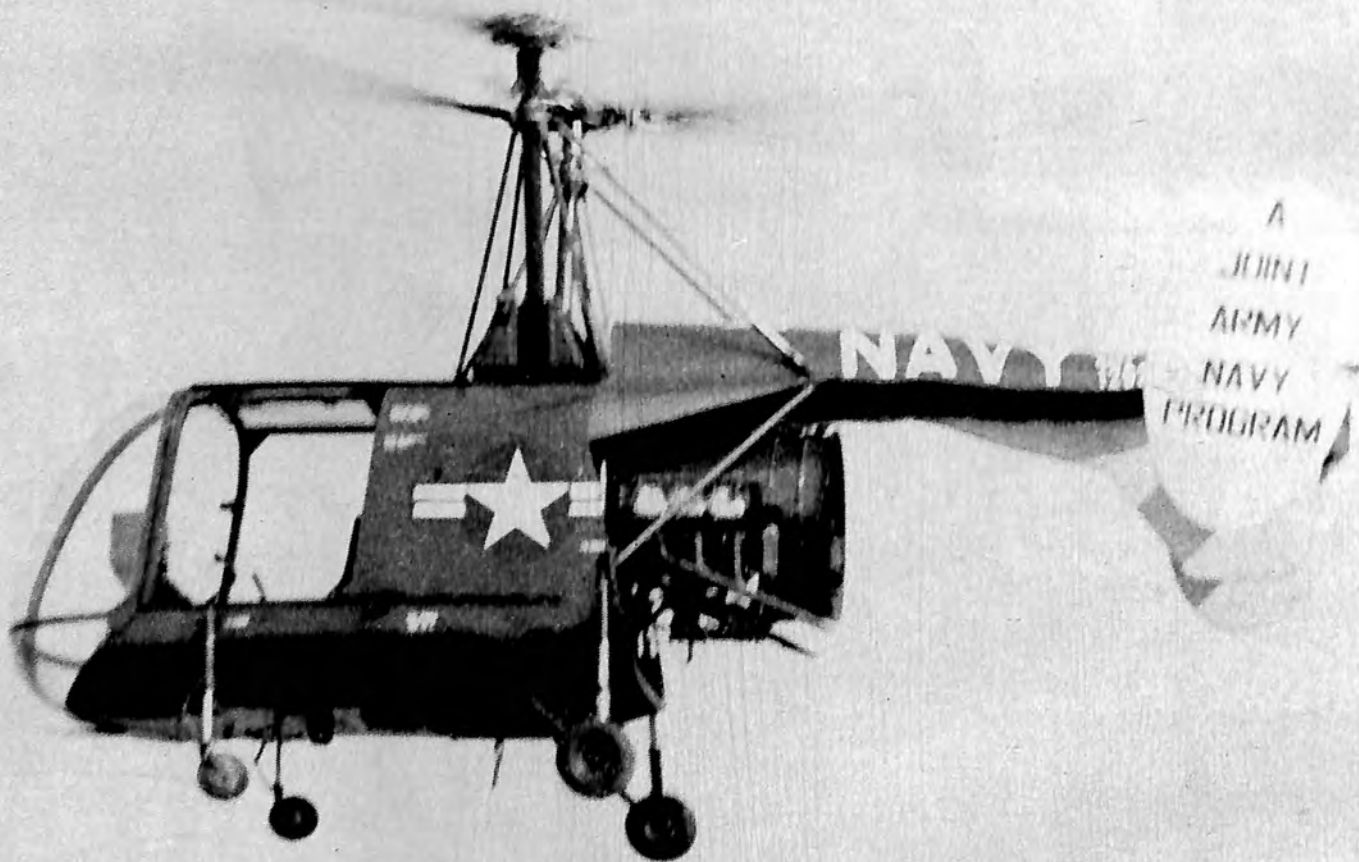
### **JET VERTICAL RISING AIRCRAFT**

The Air Force's pure jet VTOL research plane, the Ryan X-13 Vertijet (bottom), and Bell's X-14 (top) were both successfully flight-tested in mid-year. The X-13 took off vertically and made transitions to high speed horizontal flight. The X-14 hovered and flew conventionally.



## PILOTLESS HELICOPTER FLIGHT

Late in July, a pilotless helicopter flight was made at Kaman Aircraft, adding the 'copter's unique capabilities to the ranks of guided missiles and drone airplanes. Directed by radio signals from a control station on the ground, the robot helicopter took off vertically, hovered, flew forward, backward, sideward and landed.





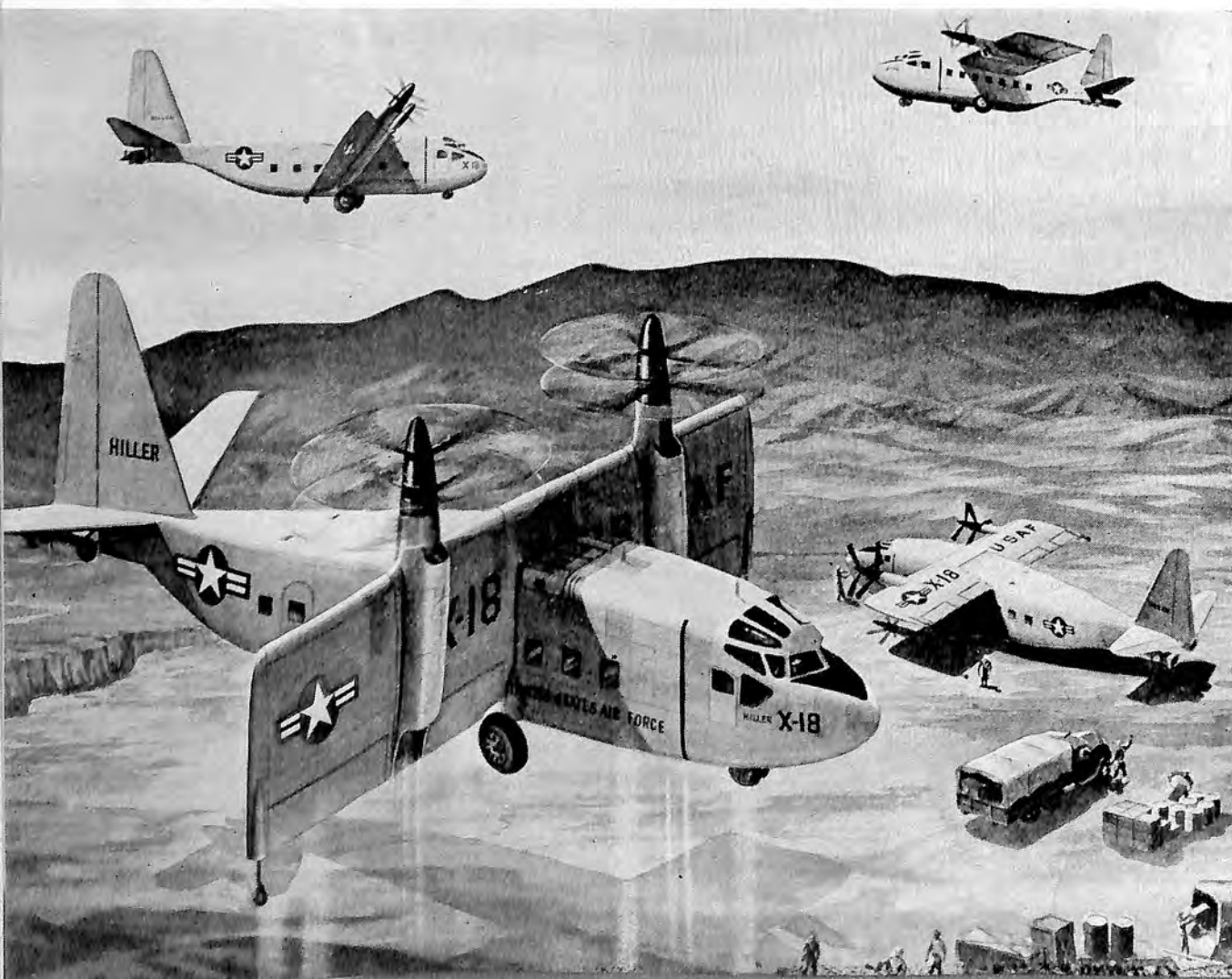
### **BELL'S NEW SUPERPOWERED H-40**

Culminating two years of development, Bell's H-40 utility helicopter was successfully tested in '57. The H-40 has a top speed of 150 miles per hour, can carry troops, litters or cargo, climbs vertically at a rate of 2000 feet per minute from sea level and has a range of more than 200 miles with full payload.



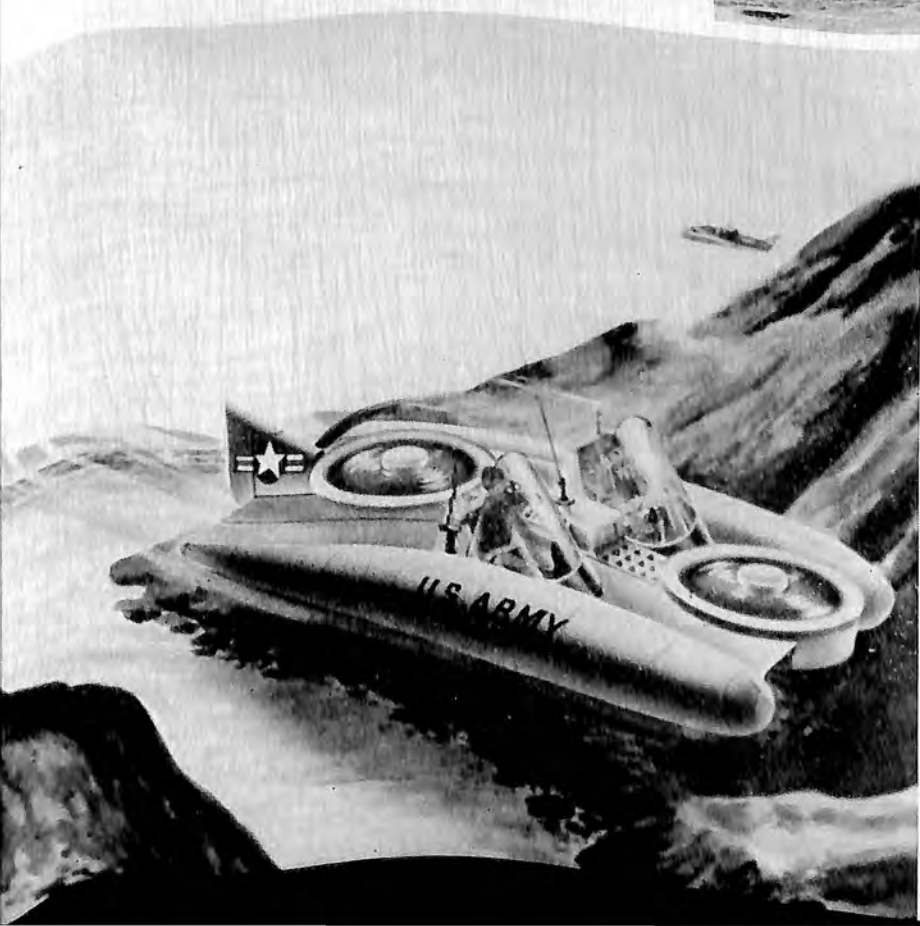
### TILT-WING AIRCRAFT DEVELOPED

Late in the year, Vertol Aircraft Corp. completed its Model 76 tilt-wing research aircraft, funded by the Army and developed in cooperation with the Office of Naval Research. Also, in Palo Alto, California, Hiller Helicopters continued development of its X-18 Propelloplane.



## ONE-MAN HELICOPTERS FLY

On January 11, Navy announced successful flight of Hiller's Rotorcycle (right), a collapsible and readily portable one-man helicopter. Also during 1957, the Gyrodyne Company completed a series of successful flights of the XRON-1 Rotorcycle powered by a Porsche 1600 cc automobile engine. This one-man helicopter was developed under a BuAer contract for use by the Marine Corps.



## ARMY AERIAL JEEPS

During the summer, Army awarded three contracts for ducted fan aerial jeeps, which will combine the versatility of conventional jeeps with the capabilities of hovering and flight. Three companies involved: Curtiss-Wright subsidiary, Aerophysics Development Corp.; Chrysler Corp.; and Piasecki Aircraft Corp.



## **VERTOL TWIN-TURBINE 105 FLIES**

First flight of the 105, using two Lycoming T53B's, took place at Morton, Pennsylvania, on November 20. The two engines can be used as a retrofit on the Vertol H-21 giving it a 50 percent increase in speed and a substantial increase in payload.



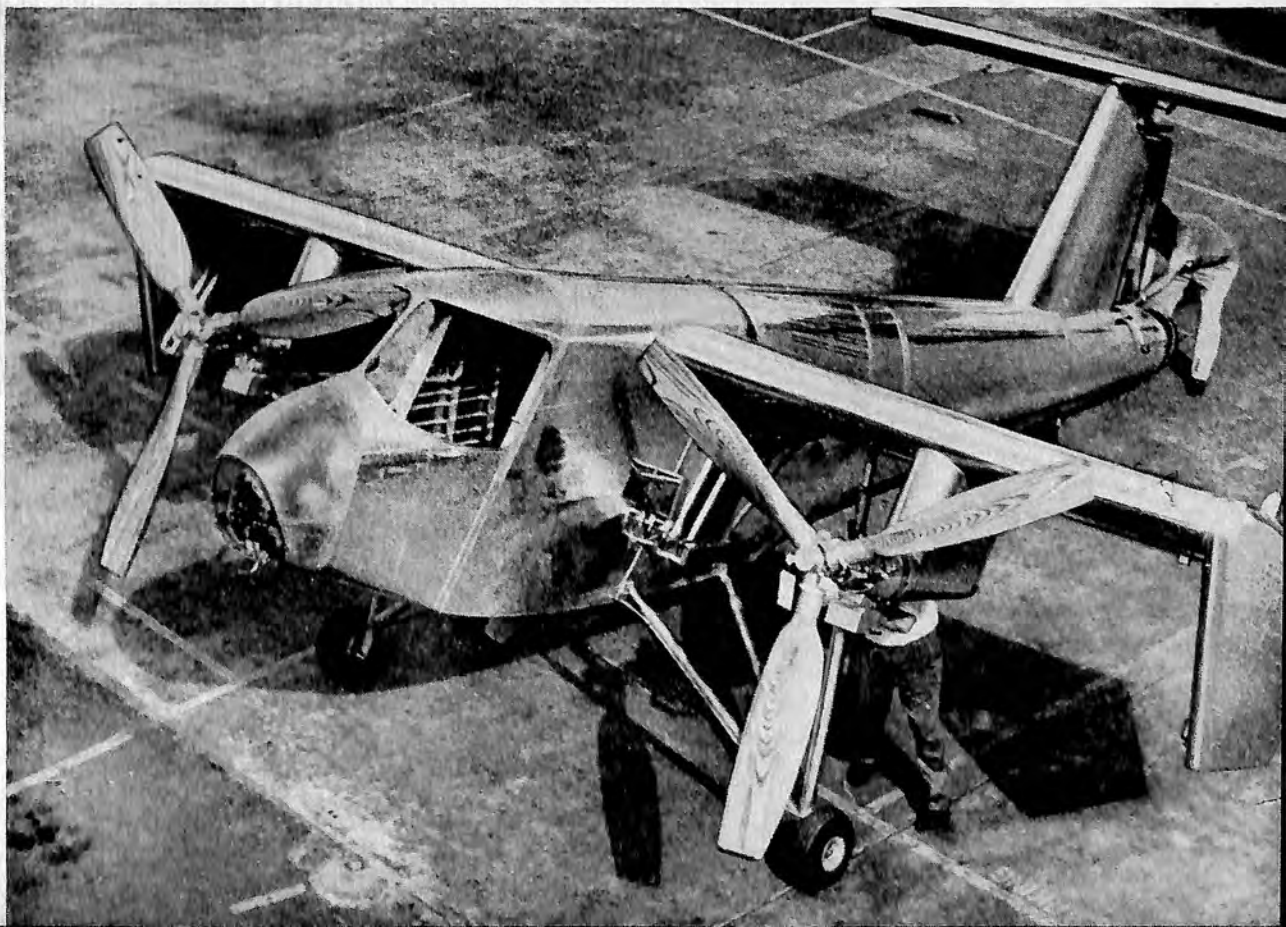


### **HUGHES PROTOTYPE MODEL 269**

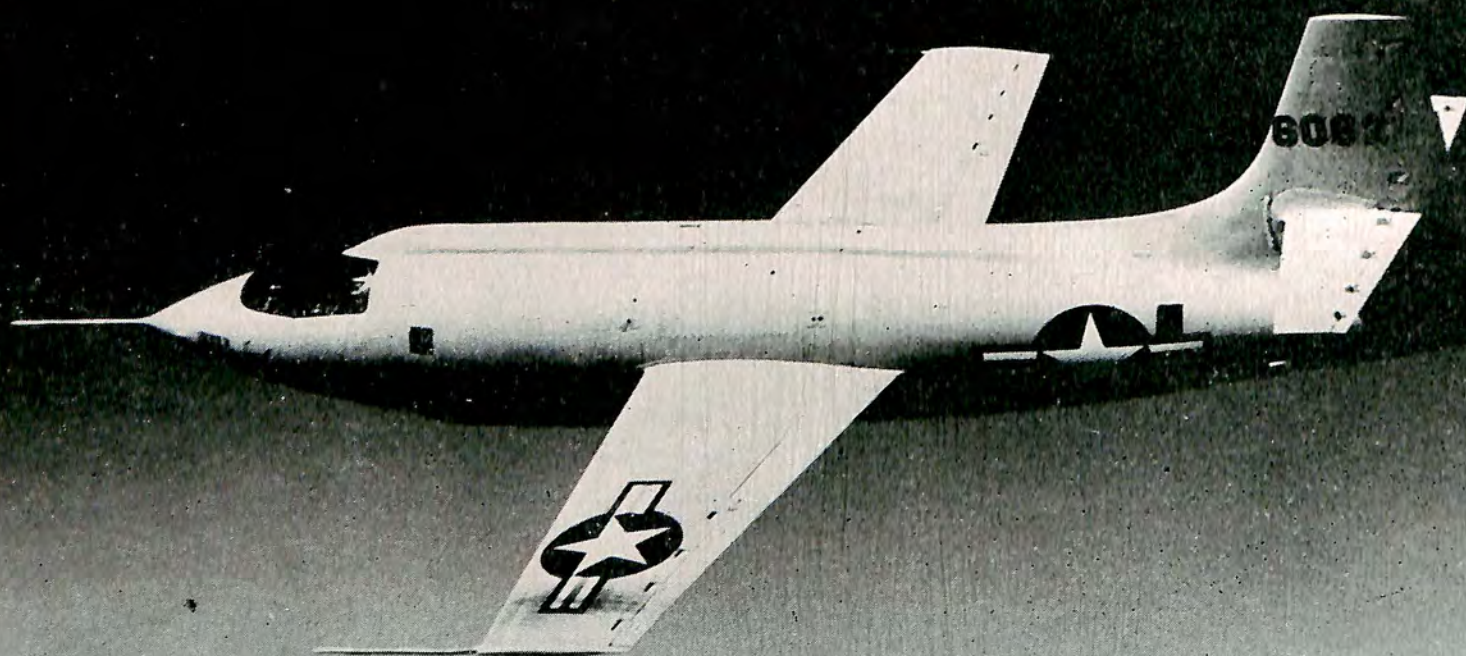
During the year, the Hughes Model 269 light two-place helicopter prototype made its first flight and the model was redesigned for production of an evaluation quantity.

### **NEW RESEARCH VERTIPLANE**

Early in December, first photographs of a unique research airplane, designed to take off and land vertically, hover and fly forward, were released by the Army, Navy, and Ryan Aeronautical Company. The Vertiplane is a level-lift design, conventional in appearance.

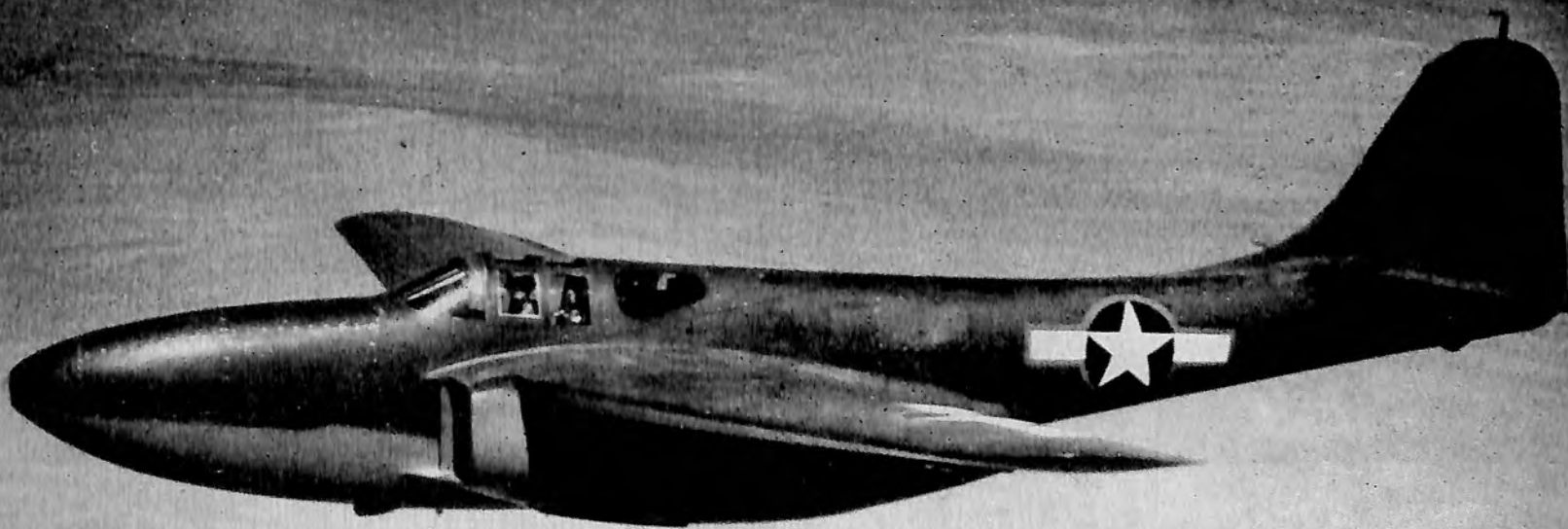


# ANNIVERSARIES



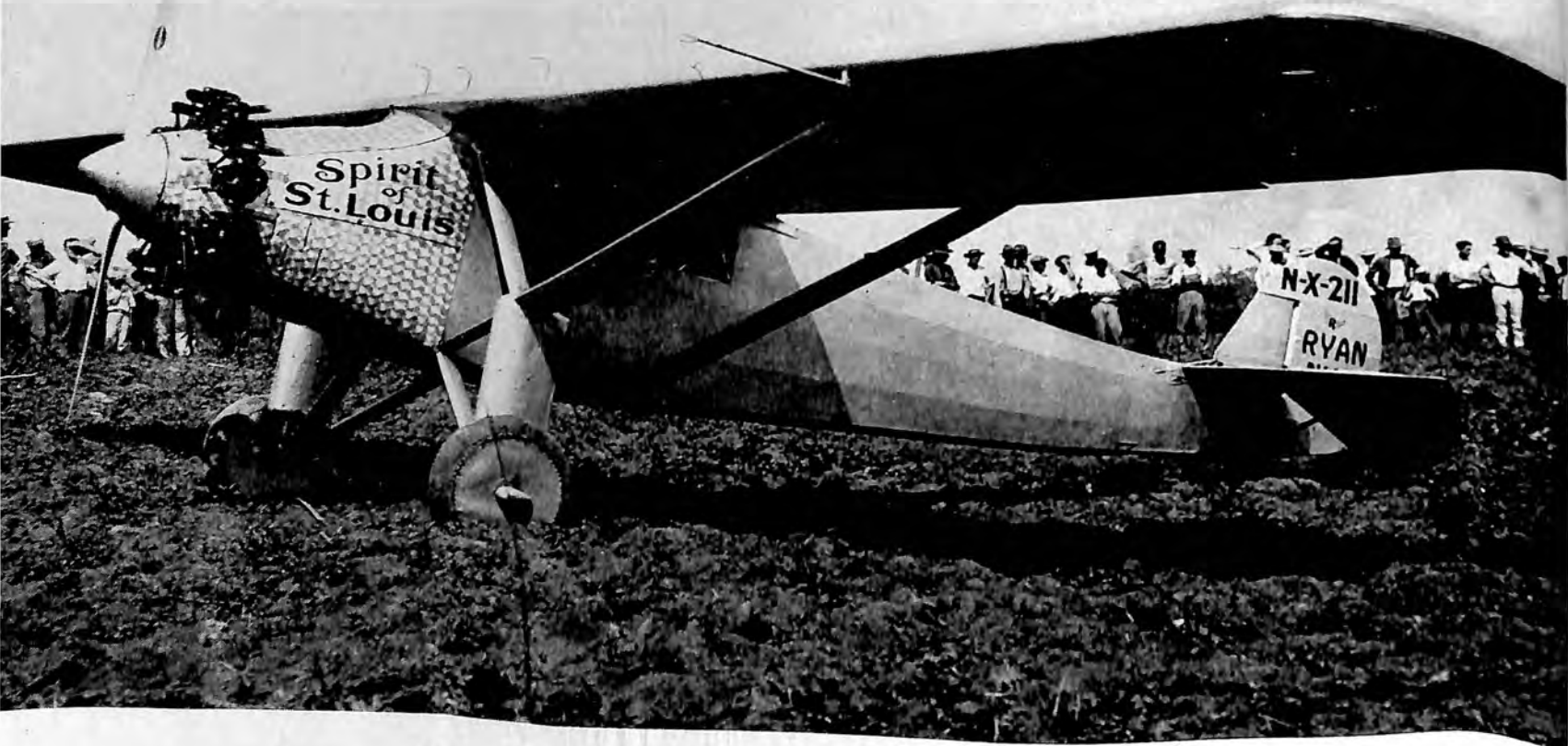
## TEN YEARS AGO . . . .

This is the rocket-powered Bell X-1 supersonic research airplane which introduced the "Rocket Age" ten years ago by flying faster than the speed of sound. The X-1 smashed the sonic barrier October 14, 1947, over Muroc Dry Lake, California. Speed on the first supersonic flight was 670 miles per hour.



### **FIFTEEN YEARS AGO . . . .**

The Bell XP-59 Airacomet, America's first jet-propelled airplane, made its initial flight at Muroc AFB, California, in October, 1942. It was powered by two General Electric jet engines.



### THIRTY YEARS AGO . . . .

In his single-engine Ryan Spirit of St. Louis, Charles Lindbergh flew solo from New York to Paris on May 21, 1927, making the trip in slightly less than 33 hours 30 minutes. Thirty years later to the day, Major Robinson Risner took off from McGuire AFB in New Jersey in his Air Force-North American Super Sabre and flew a slightly longer course in 6 hours 38 minutes.



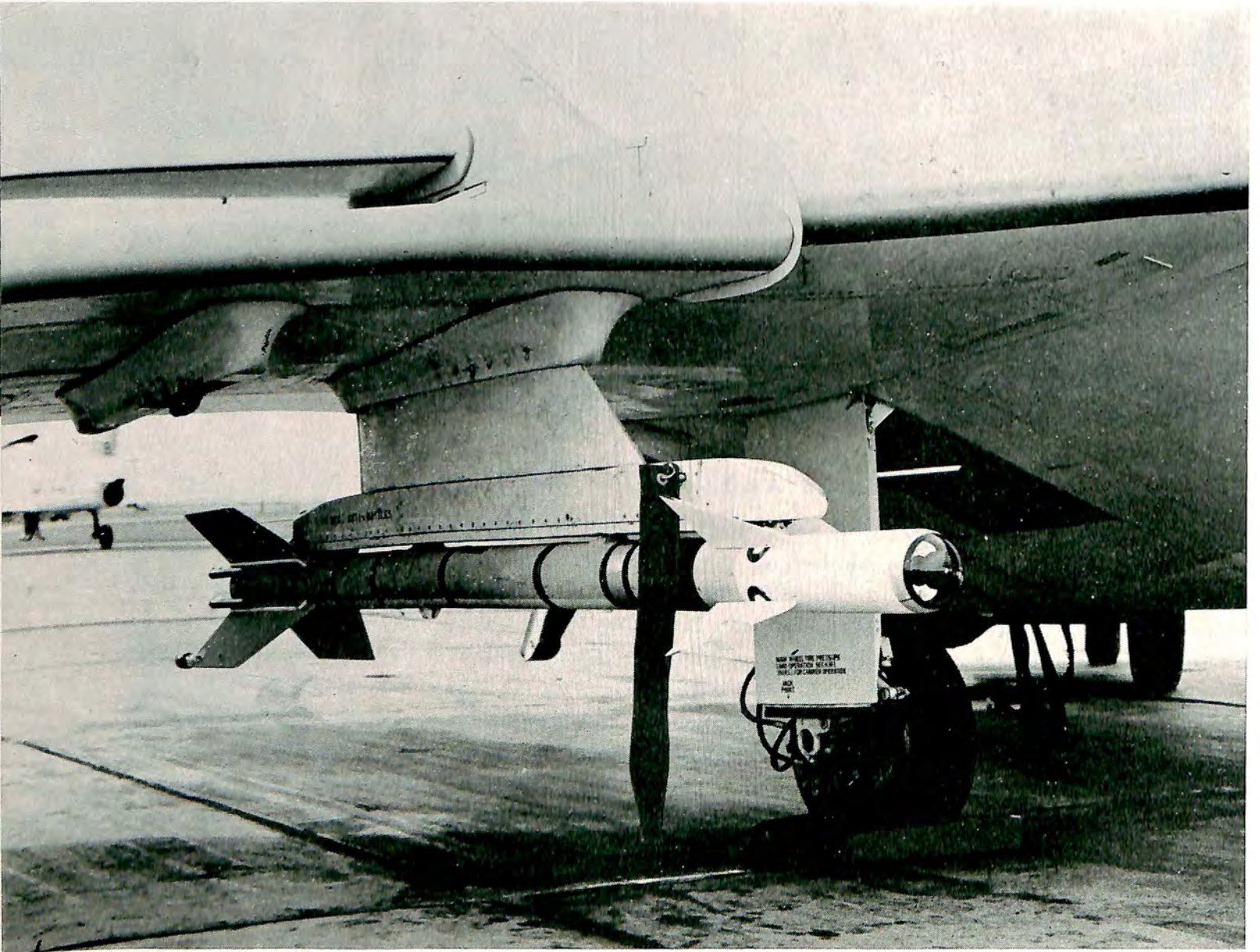


#### FIFTY YEARS AGO . . . .

The 1957 Air Force Association's National Convention climaxed the celebration of the Golden Anniversary of the Air Force. Shown is the Air Force family portrait, which was the highlight of the Anniversary Banquet at the Sheraton-Park Hotel, August 1, 1957, left to right: First Row: Dr. Theodore VonKarman, M/Sgt. Horst Tittel, Gen. Nathan F. Twining, Brig. Gen. Frank P. Lahm, 2nd Lt. Dennis R. LaFarlette, Mrs. Henry H. Arnold, Gen. Carl A. Spaatz and Maj. Charles E. Yeager. Second Row: Gen. Erik Nelson, Lt. Col. James Jabara, Gen. George C. Kenney, Jacqueline Cochran, Gen. Thomas D. White, Eddie Rickenbacker, Col. Oakley G. Kelly and Col. John Macready. Third Row: Col. Francis S. Gabreski, Edna Adkins, Senator W. Stuart Symington, Secretary of the Air Force James H. Douglas, Gen. Claire L. Chennault and Maj. James B. Gallagher. Fourth Row: Col. Paul Tibbets, Col. Bernt Balchen, Gen. William H. Tunner, Gen. Thomas D. Milling, James Kindelberger, Gen. Otto P. Weyland and Roscoe Turner.

# MISSILES

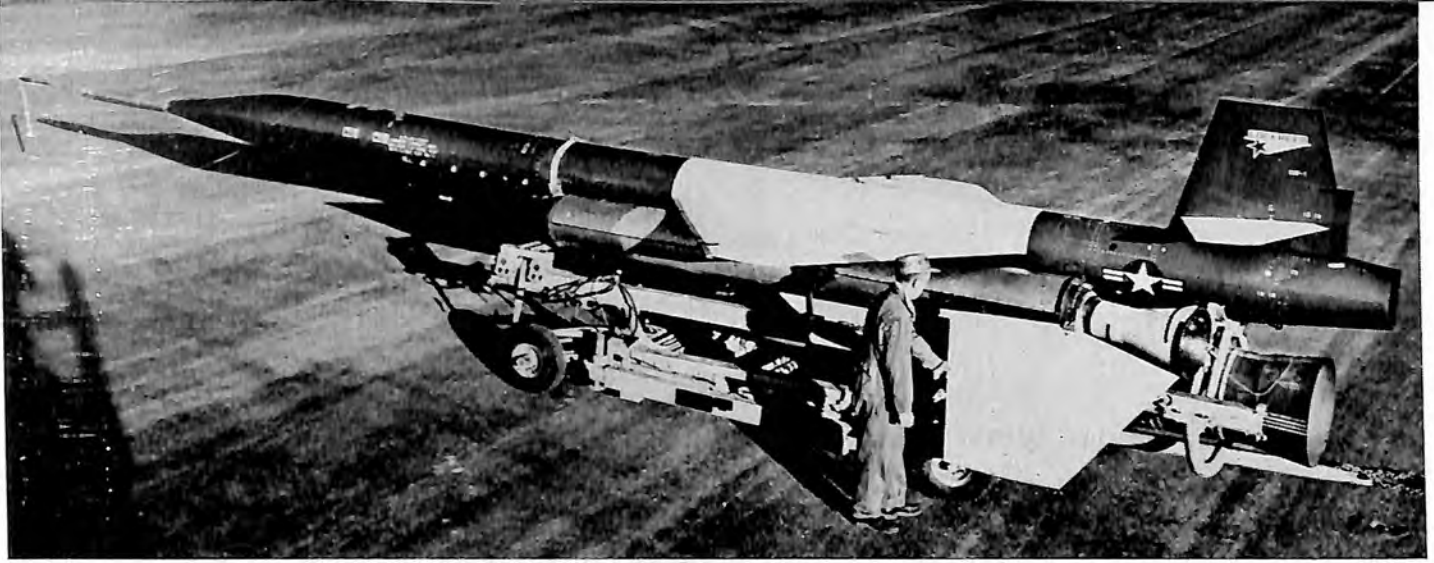
It was a year of greatly increased activity in guided weapons. Here are some of the highlights.



## INFRARED SIDEWINDER

Now in operational status with the fleet, the Navy's Sidewinder features a General Electric infrared guidance system which detects and homes on heat radiation from targets.



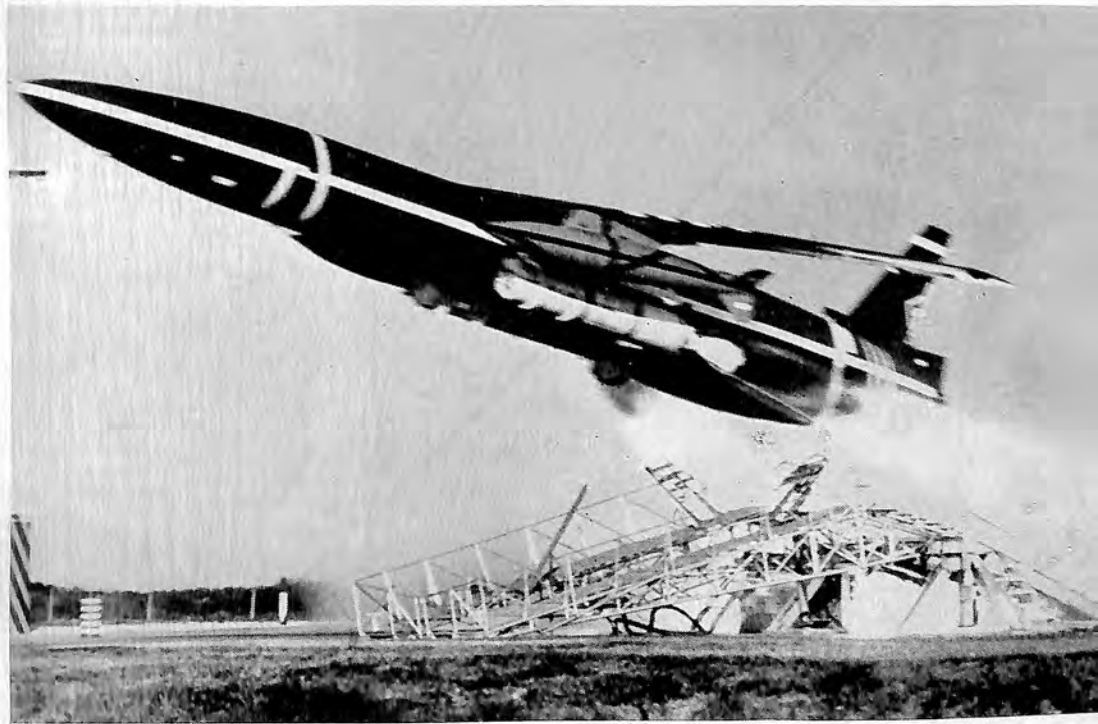


### SUPERSONIC MISSILE TARGET

For testing missile accuracy, Lockheed Aircraft Corporation developed the Q-5, a 39-foot Mach 2 target drone which can be recovered by parachute.

### SNARK AND RASCAL TO SAC

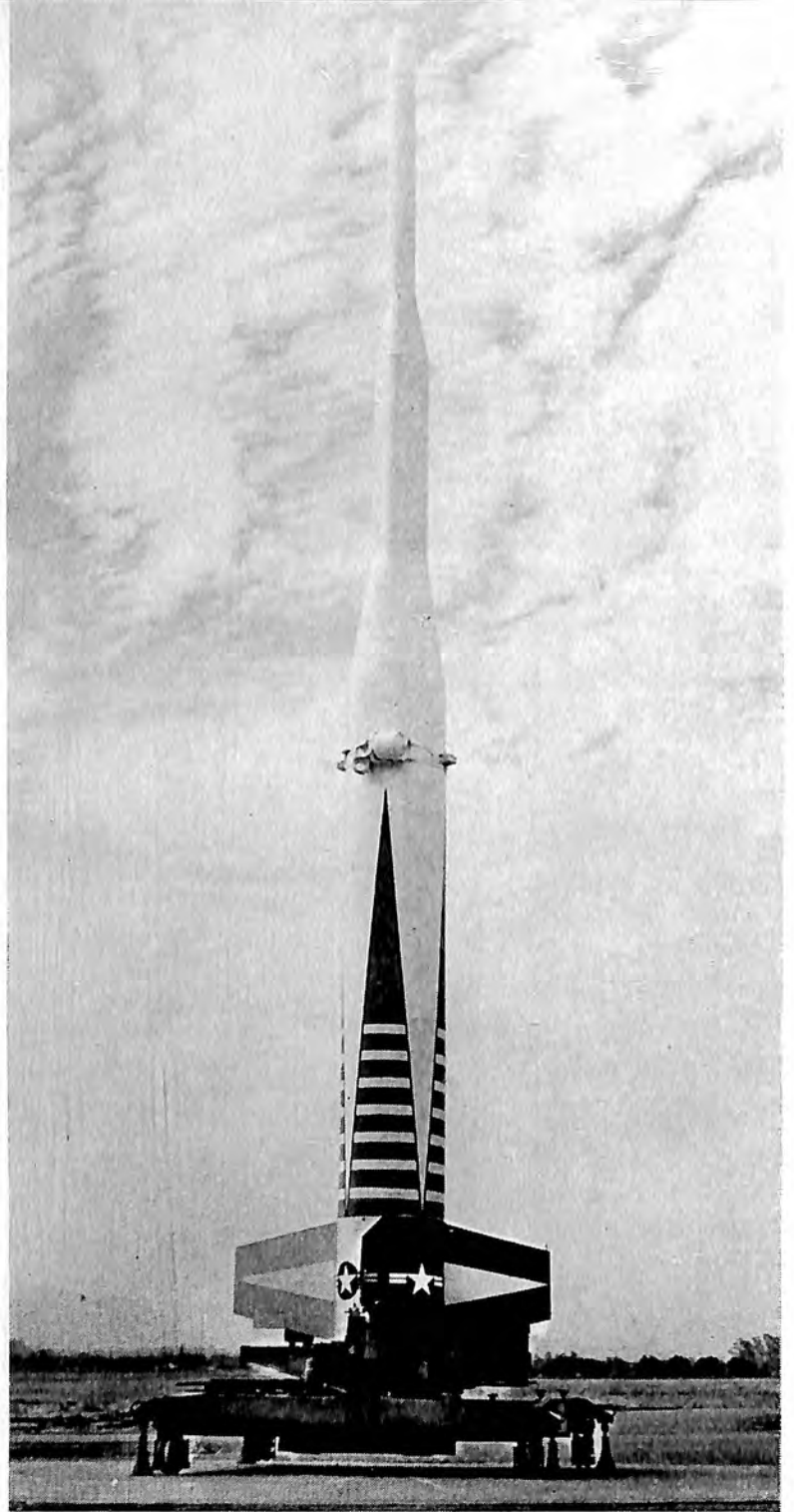
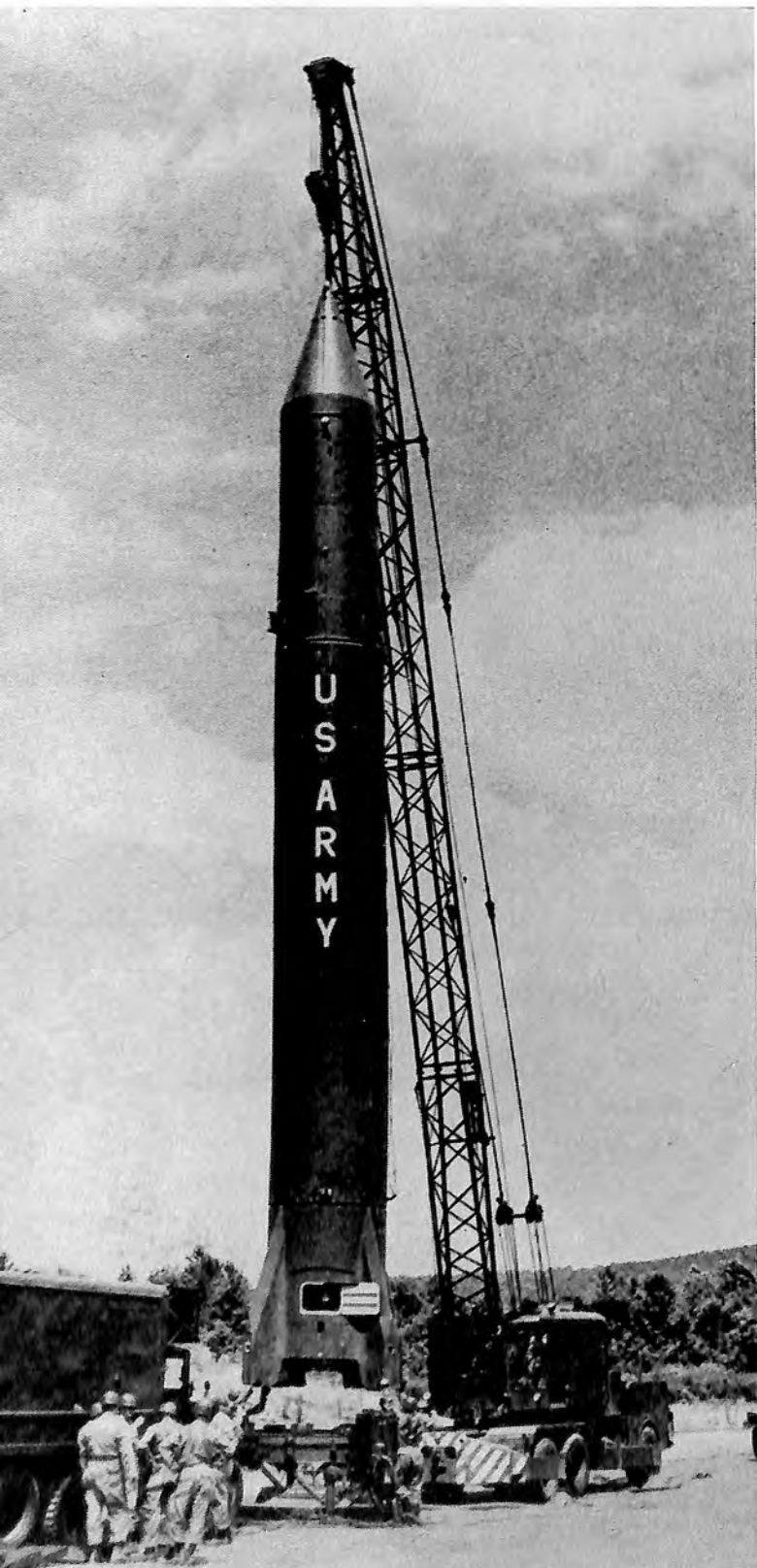
September saw the activation of the first missile squadron in the Strategic Air Command with introduction of Northrop's Snark missile (right). Bell Aircraft's Rascal (below) entered SAC service late in the year.





## REDSTONE ON DUTY

Army Redstone missile (below) went on active duty with activation of the 40th Field Artillery Missile Group. The 69-foot Redstone, a surface-to-surface weapon, has a range of 200 miles.

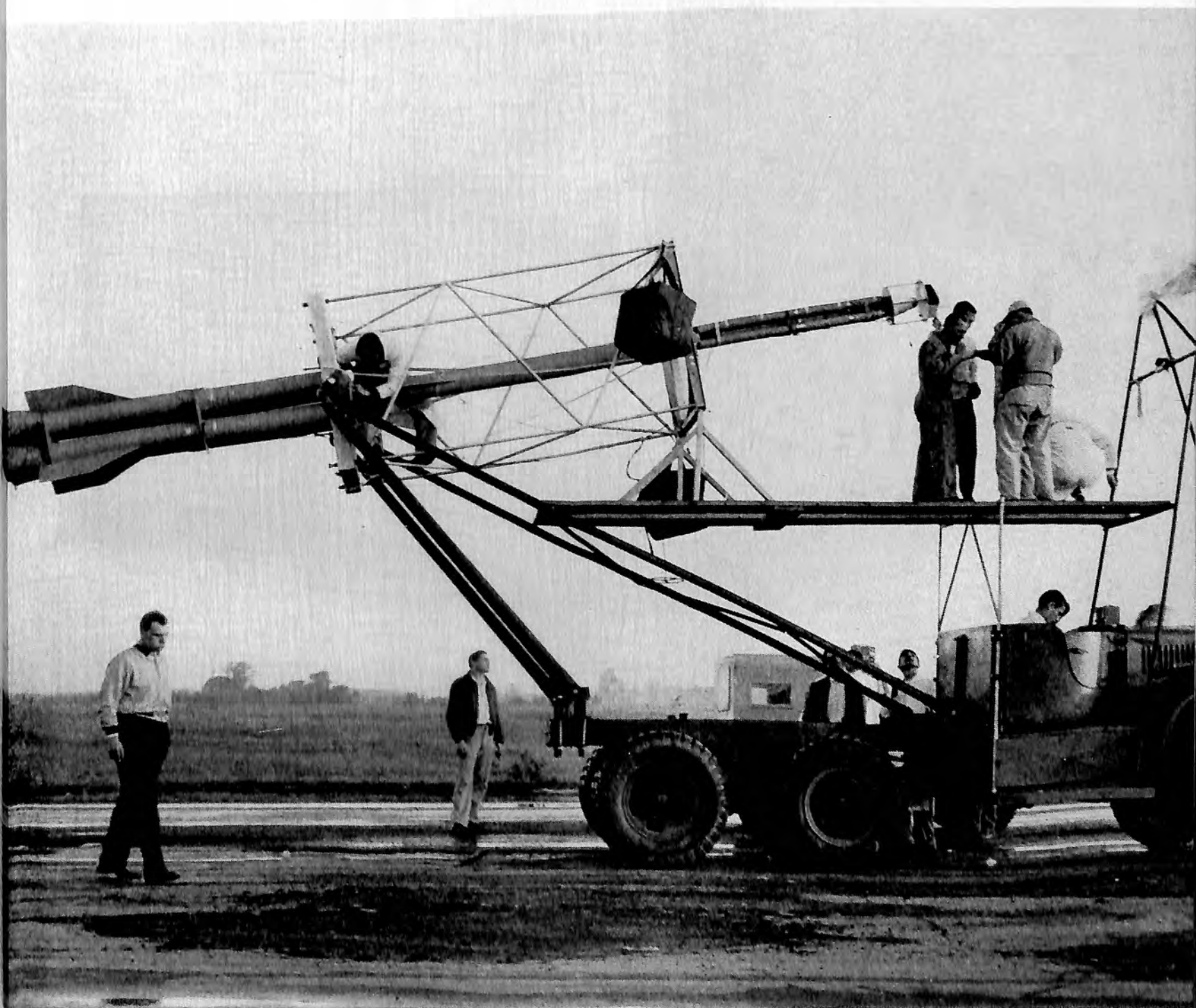


## RE-ENTRY TESTS

Successful re-entry tests were accomplished by Lockheed's X-17 test vehicle (above) which reached a speed of 9000 miles per hour.

## PROJECT FAR SIDE

A ten-pound instrument package capable of telemetering scientific information was blasted far beyond the atmosphere in October by a four-stage rocket vehicle. Air Force's Office of Scientific Research was unable to determine the precise distance of space penetration, but it was believed the vehicle reached an altitude between 2000 and 4000 miles.





### **BOMARC INTO PRODUCTION**

The Air Force ordered the Boeing Bomarc (left) into production for air defense. The long-range missile can be equipped with either a conventional or "special" (i.e., nuclear) warhead.



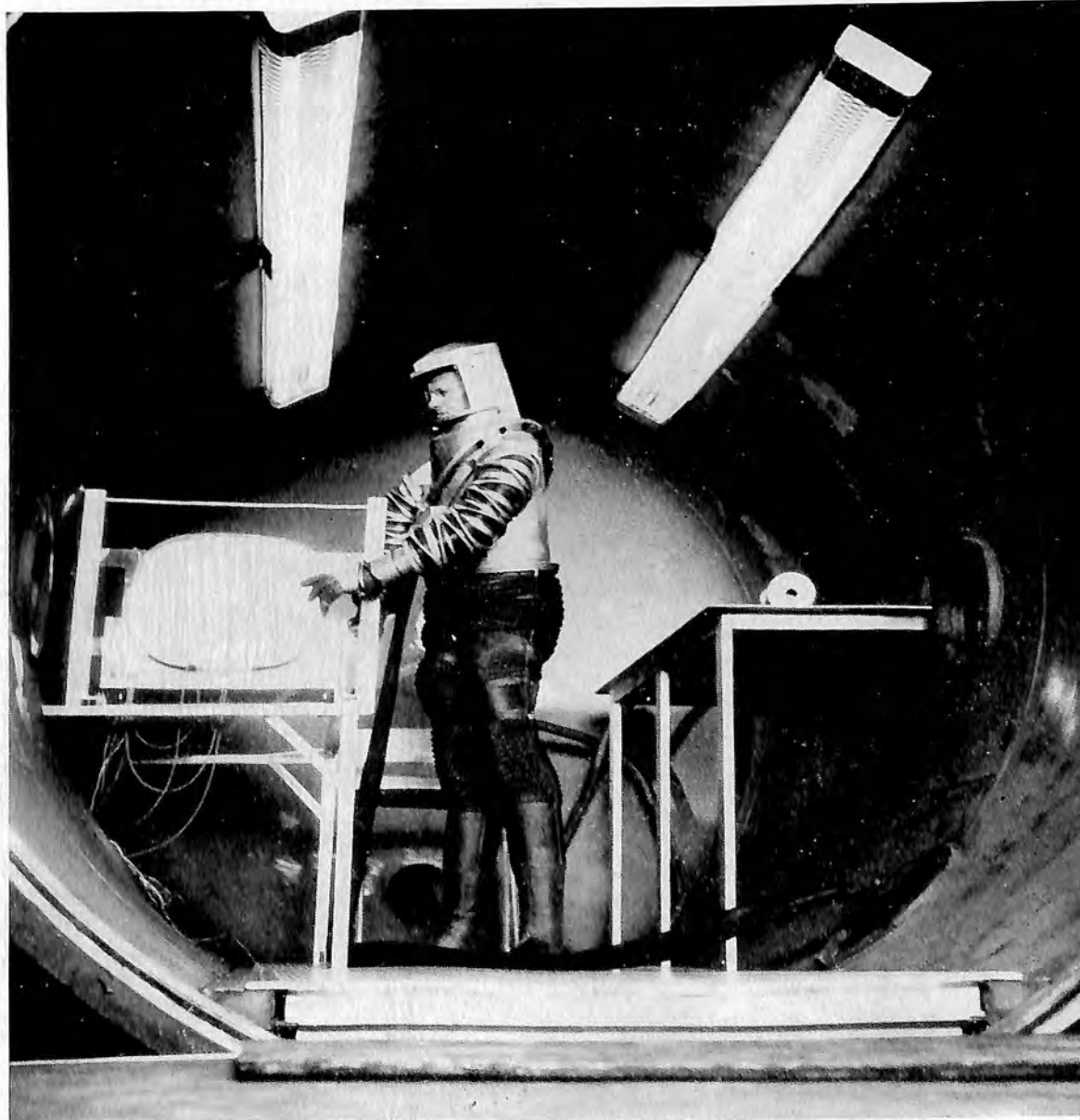
### **ANTI-TANK DART**

The Dart (above), a five-foot anti-tank missile which features a smokeless propellant, was successfully tested and production started by Utica-Bend Corporation.



### FIRST NUCLEAR AIR-TO-AIR MISSILE

Douglas Genie, an air-to-air missile with an atomic warhead, was fired in July from a Northrop F-89J fighter interceptor. Five Air Force officers stood directly beneath the blast to demonstrate lack of "fall out."

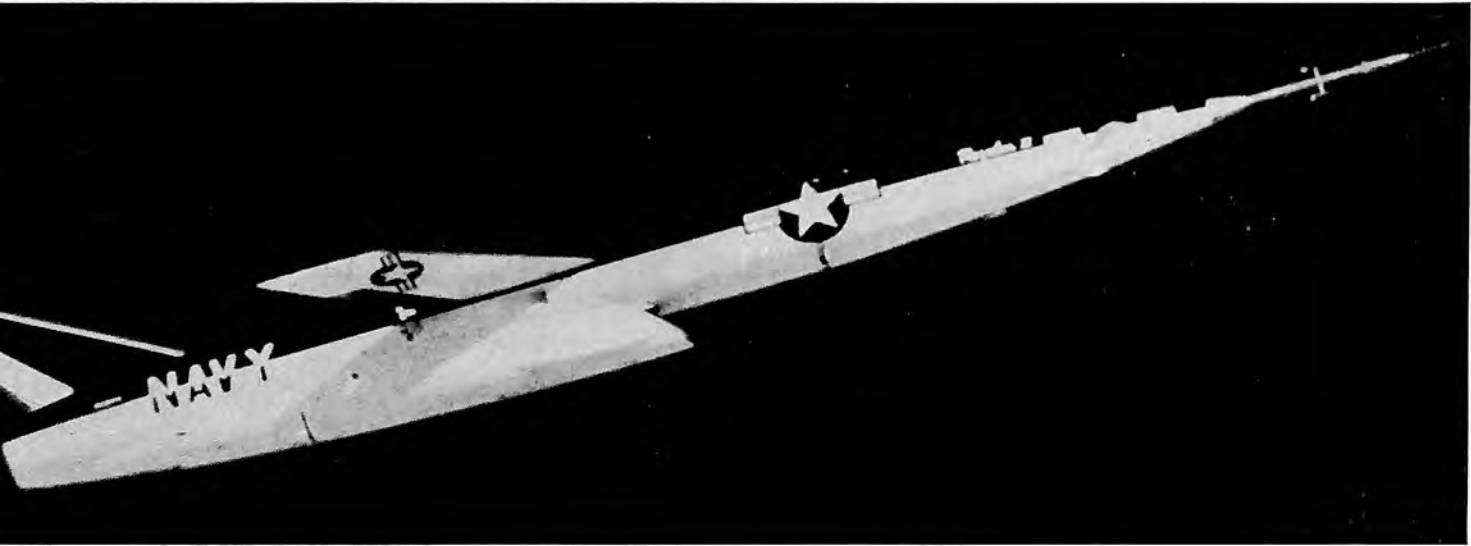


### VACUUM TEST CHAMBER

Space-suited engineer reached a simulated altitude of 95 miles in a vacuum chamber developed by Litton Industries, Inc., Beverly Hills, California. Chamber's primary use is to test missile components under near-vacuum conditions.

## REGULUS II

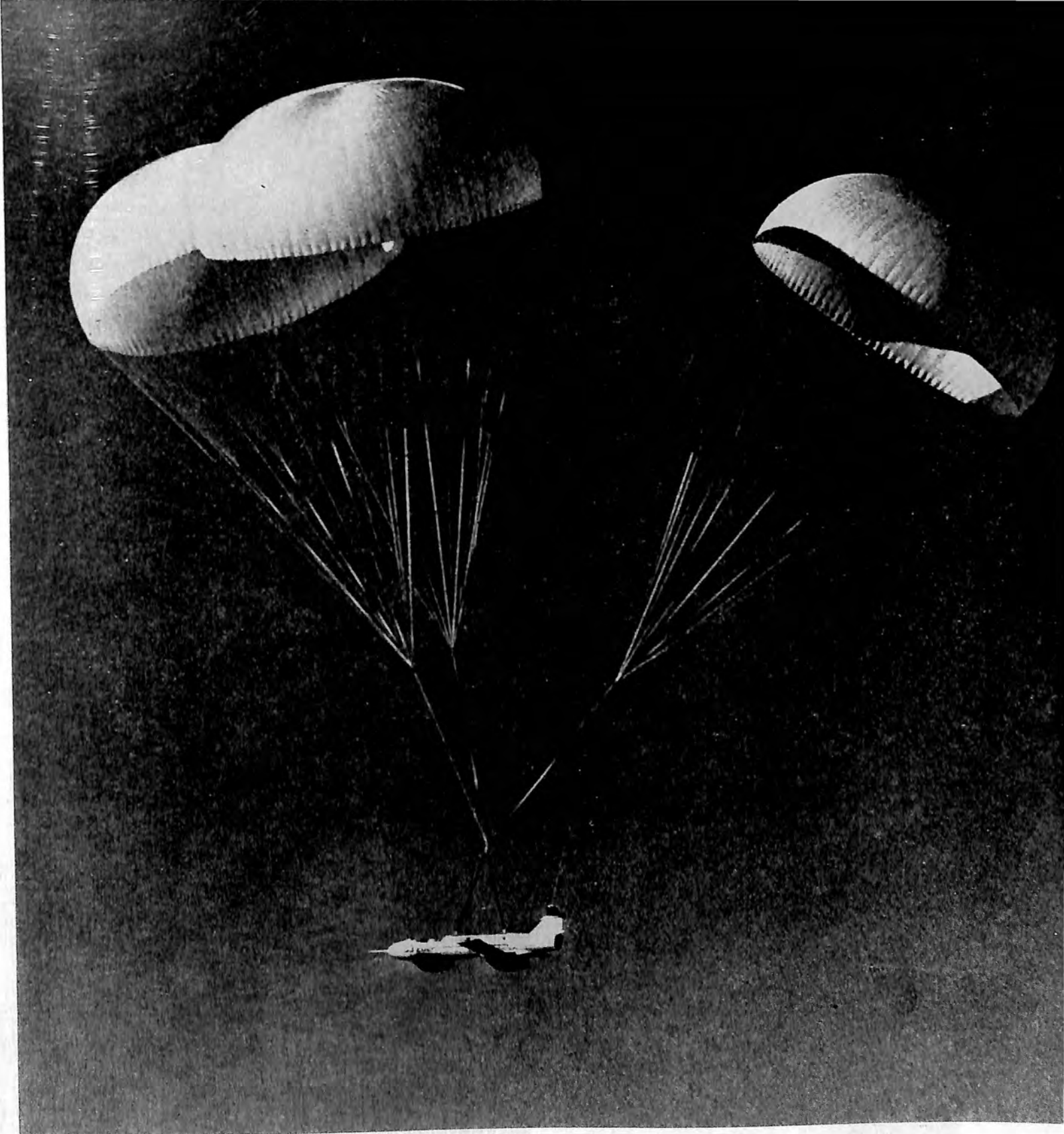
Initial tests were made of Chance Vought's Regulus II, a larger, faster and longer-ranging version of Regulus I already in fleet service.



## NIKE-HERCULES

The Army brought to operational status an improved air defense missile, the Nike-Hercules. Weapon was jointly developed by Douglas Aircraft Company and Western Electric. It incorporates a Thiokol solid propellant sustainer unit.





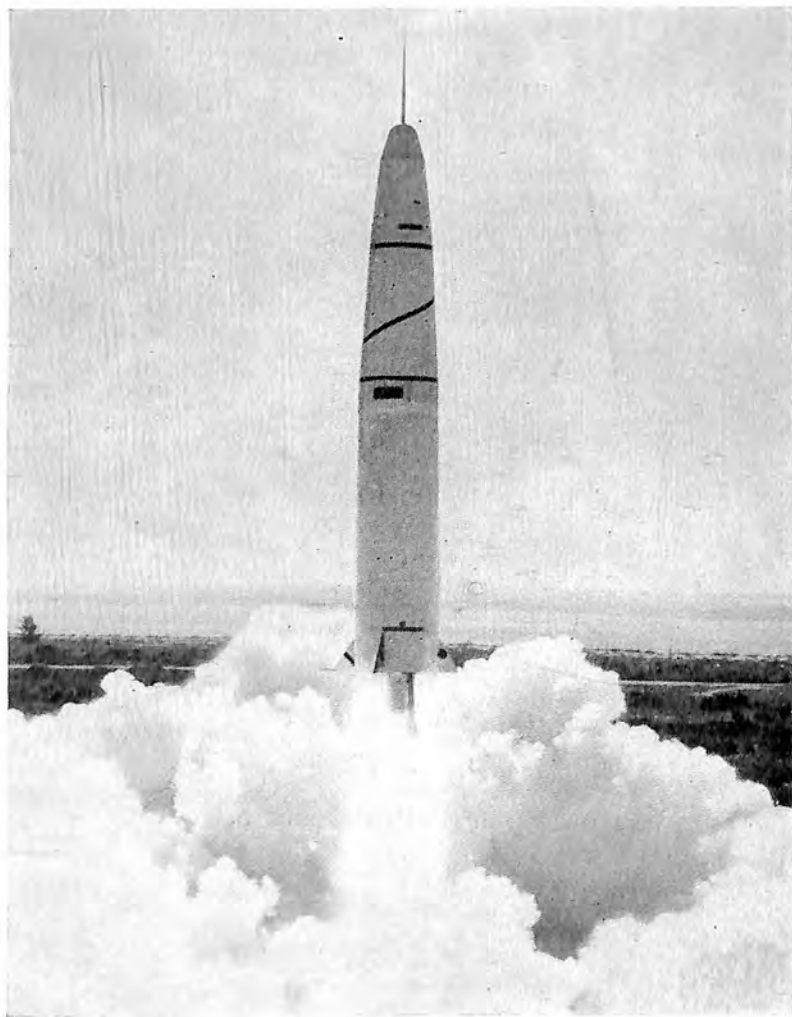
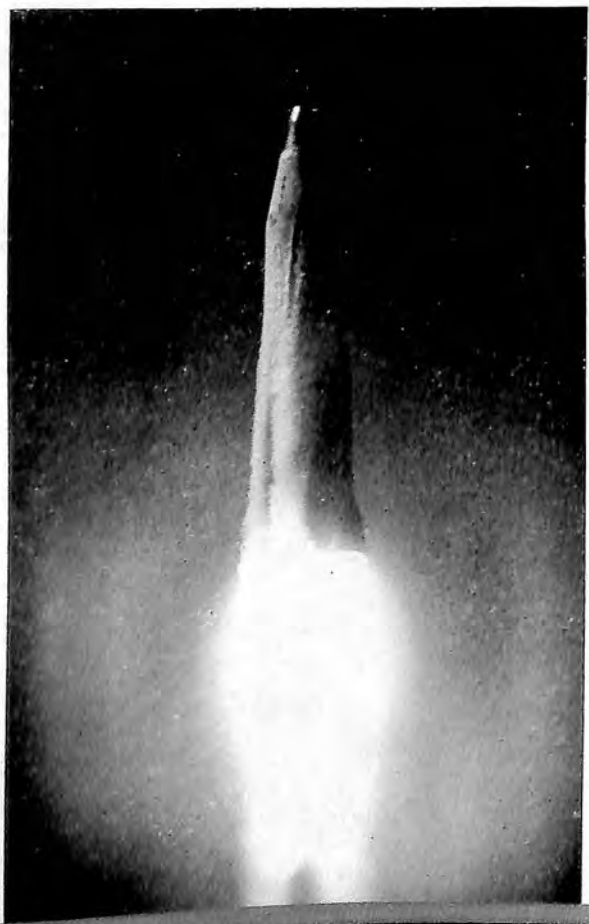
### **MATADOR COMES BACK**

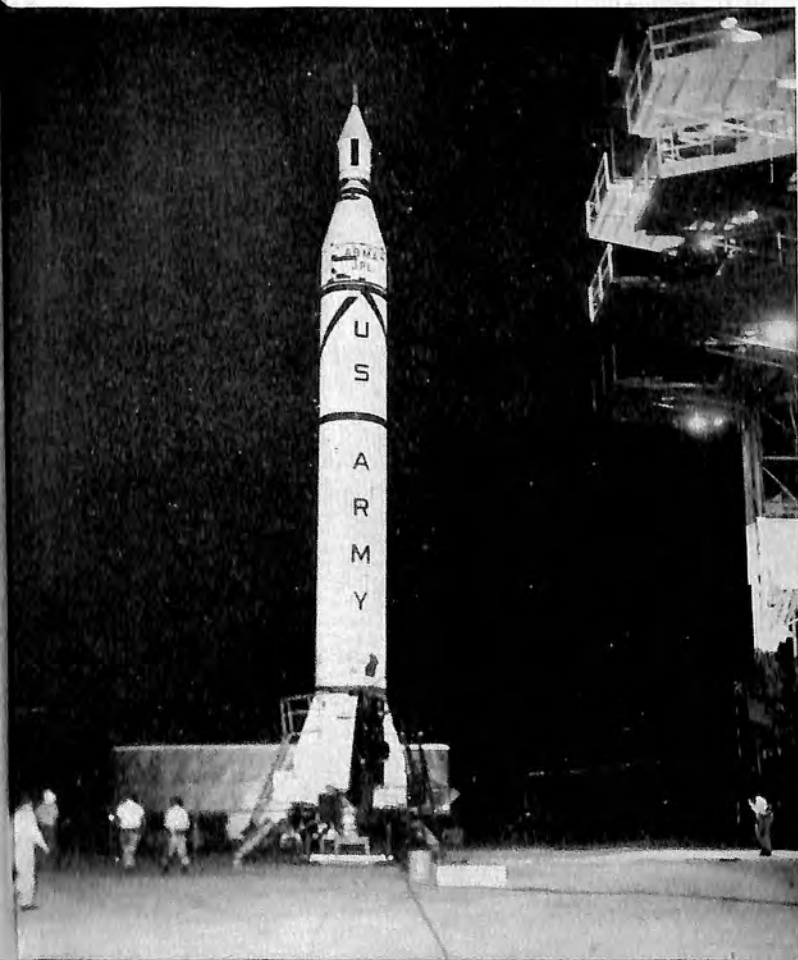
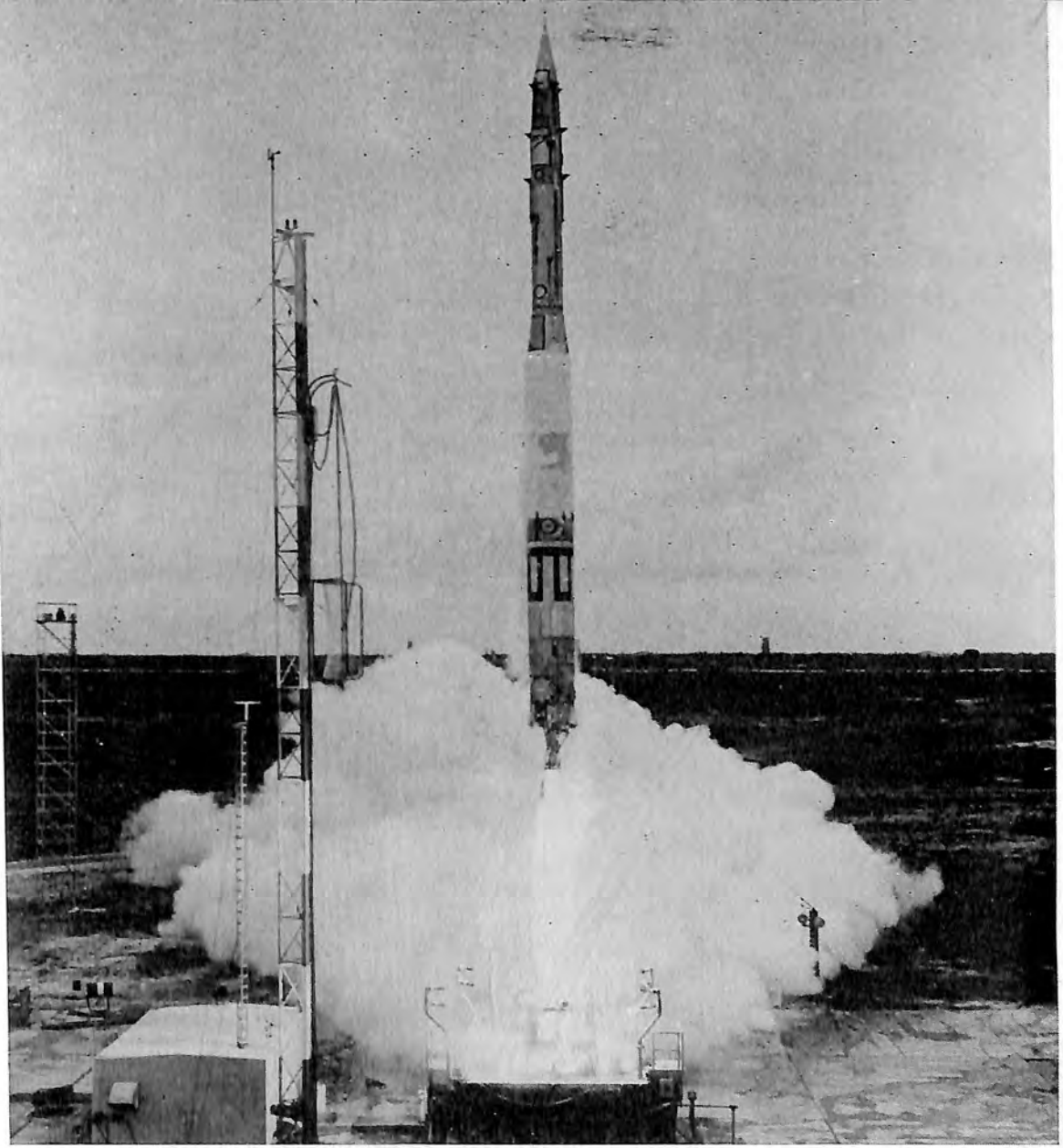
A Martin Matador floats gently to earth in a test of a controls-and-drag-chute kit developed to recover test missiles and target drones.



## BALLISTIC MISSILES

Major interest was focused on development of the all-important intermediate range and intercontinental ballistic missiles, the Army-Chrysler Jupiter (left), the Air Force-Douglas Thor (bottom right) and the Air Force-Convair Atlas (bottom left). Jupiter and Thor demonstrated exceptional accuracy in tests during the year after a few early failures. Atlas was fired three times, once successfully. All tests were conducted at the Air Force Missile Test Center, Patrick Air Force Base, Florida. Late in the year, Jupiter and Thor were ordered into production, with initial deliveries to both U. S. and NATO forces scheduled for late 1958. In earlier stages of development were the USAF-Martin Titan, second of the ICBM's, and the Navy-Lockheed Polaris, an "FBM" (Fleet Ballistic Missile) of intermediate range with submarine launching capability.





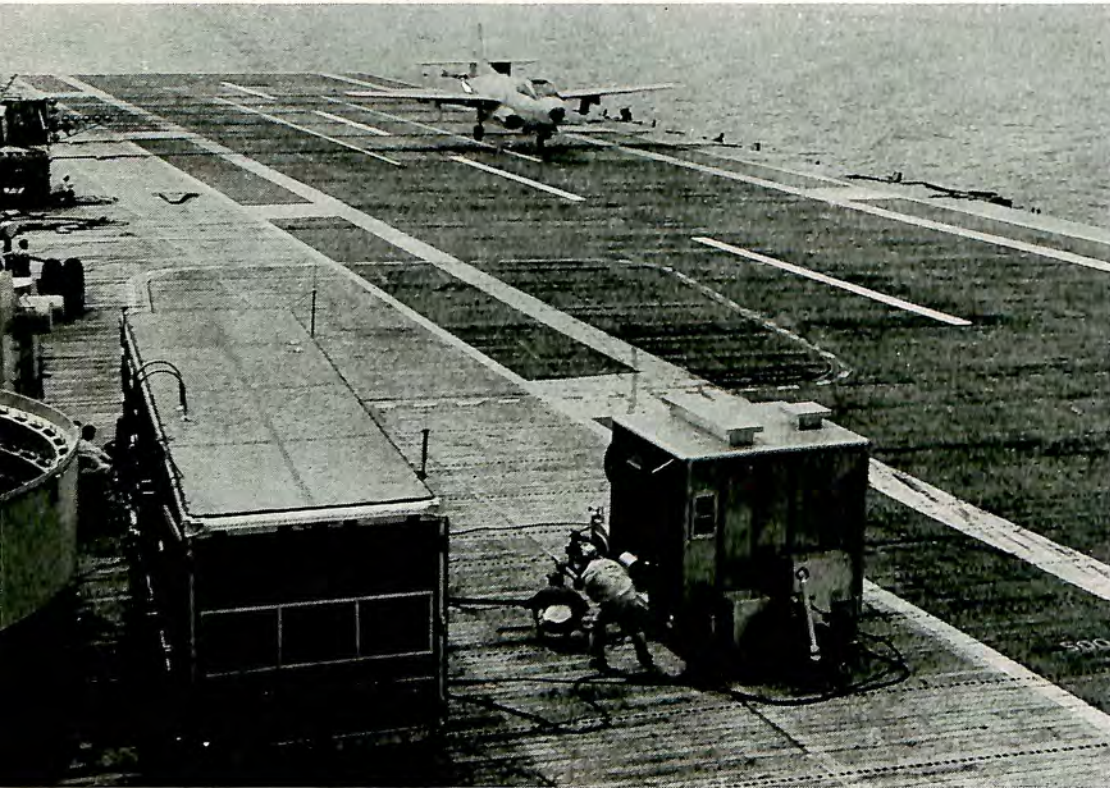
## SATELLITES

In the wake of successful Sputnik launchings by the U.S.S.R., American scientists were hard at work in efforts to match the Russian achievement. First attempt, with the Navy-Martin Vanguard vehicle, was unsuccessful as a malfunction of the first stage propulsion unit destroyed the vehicle on the launching pad. At year-end, a second Vanguard was being readied for launching of a small, transmitting test package. Plans called for firing of an instrumented satellite in March. Working on a parallel program, the Army's Redstone Arsenal was readying a Jupiter C satellite vehicle.



# NEW SYSTEMS

Space limitations prevent including all of the important developments in the field of systems and components. Those reviewed here are representative of the entire industry.



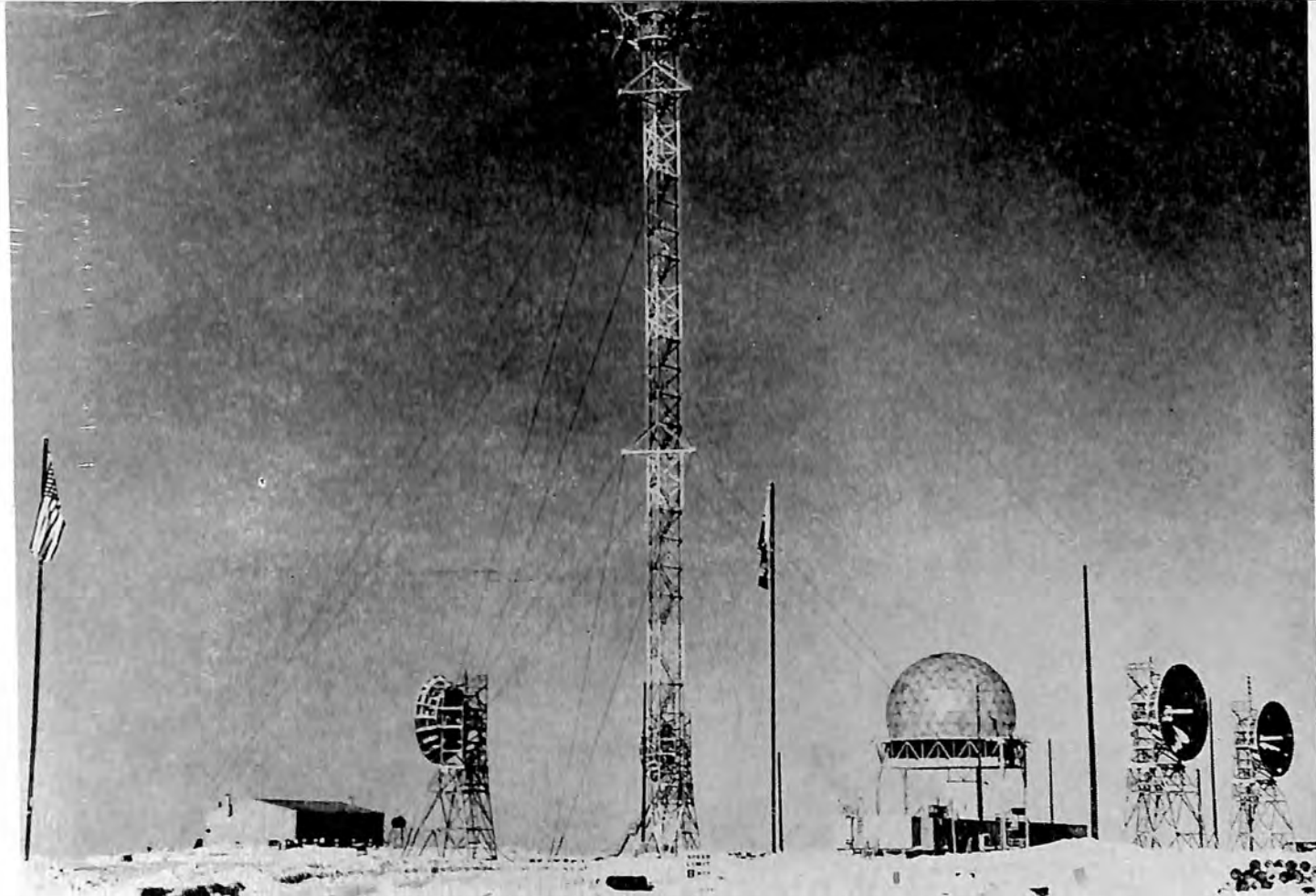
## AUTOMATIC LANDING SYSTEM

Bell Aircraft's highly mobile Automatic Carrier Landing System uses a combination of radio and radar to effect completely automatic landing under all weather conditions.

## ELECTRONIC FLASH APPROACH SYSTEM

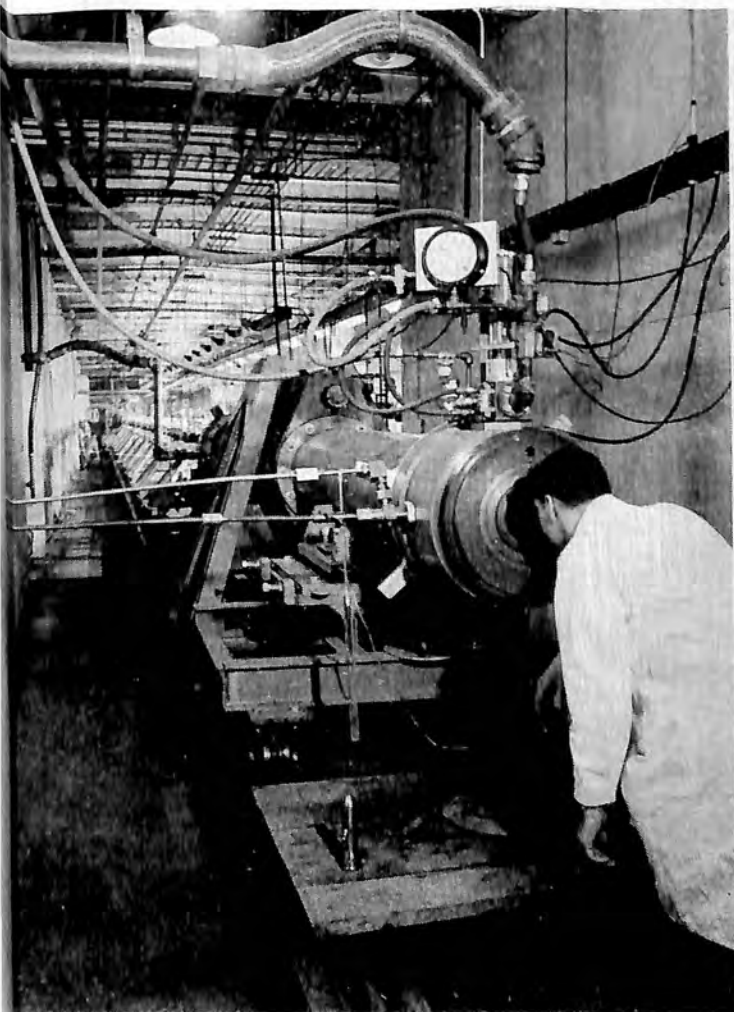
A line of flashing lights which guide a pilot to the center of the runway was developed by Sylvania Electric Products, Inc. of New York. The new system reconciles approach and lighting demand of the civil airlines and the Air Force.





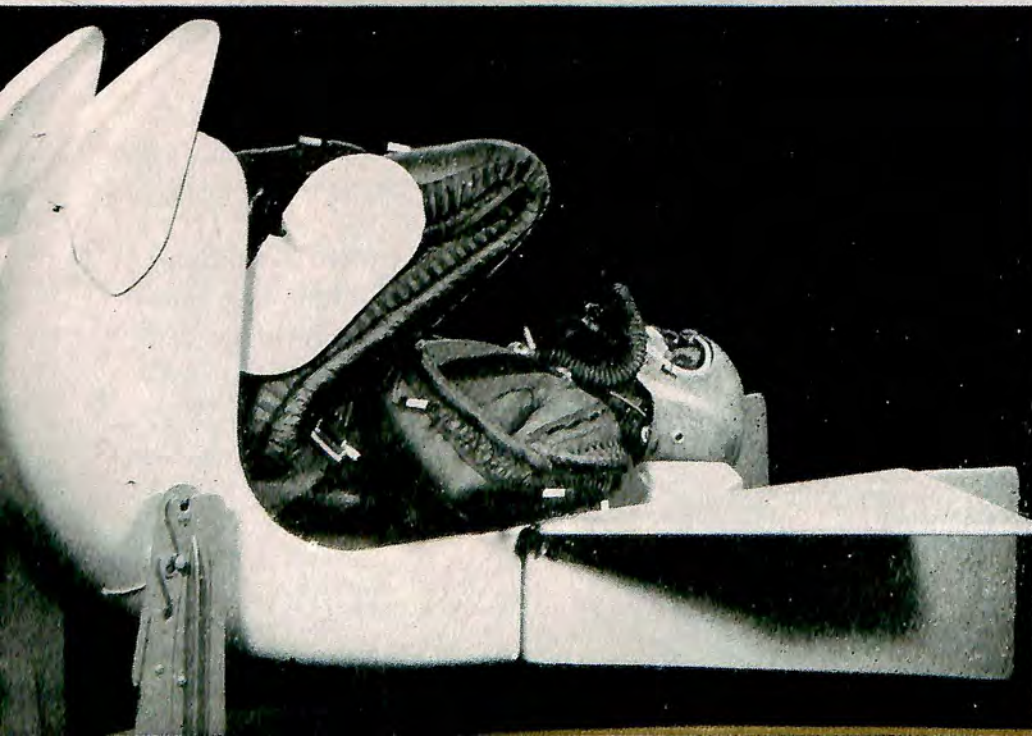
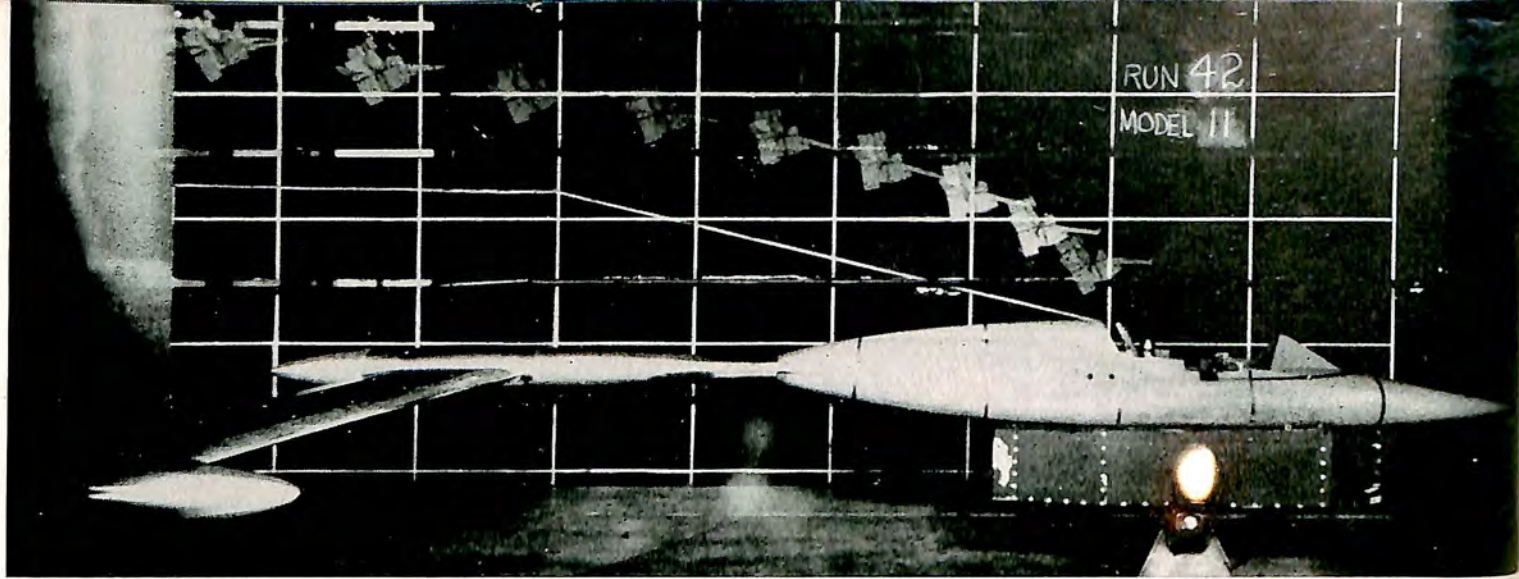
#### **ARCTIC DEW LINE**

Pictured here is a typical auxiliary station of the early-warning radar system, showing the modular construction of the building train, the plastic radome which houses the search radar antenna, and associated tower and dish-type communication antennae. Built for the Air Force by Western Electric Co., Inc., Arctic DEW Line was completed in 1957.



#### **AVCO SHOCK TUBE**

Creation of a shock tube by Avco Research Laboratory led to the theoretical shortcut that permitted nose cone design to go ahead rapidly before actual flight test information was available. Shock tube experiments coupled with Air Force flight tests with Lockheed's X-17 re-entry test vehicle have been the principal sources of such data.

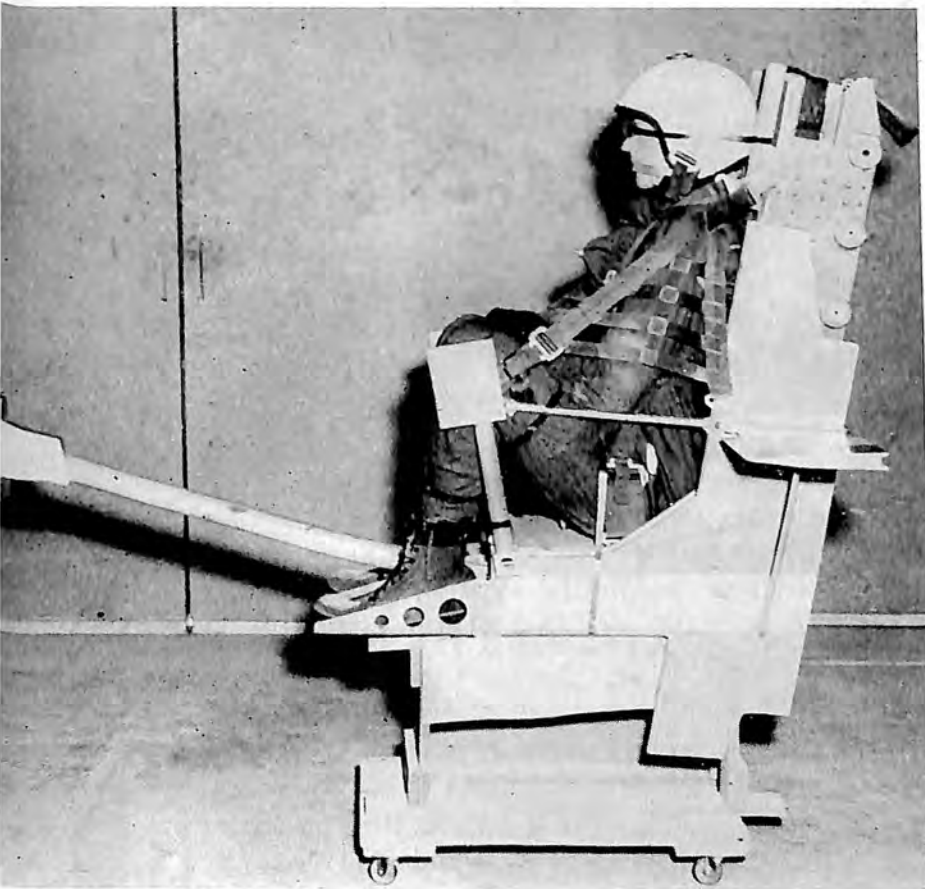


### **AERIAL BOBSLED**

A new aerial bobsled ejection seat for jet aircraft, which projects the pilot feet-first and on his back into the supersonic airstream, was developed by Convair.

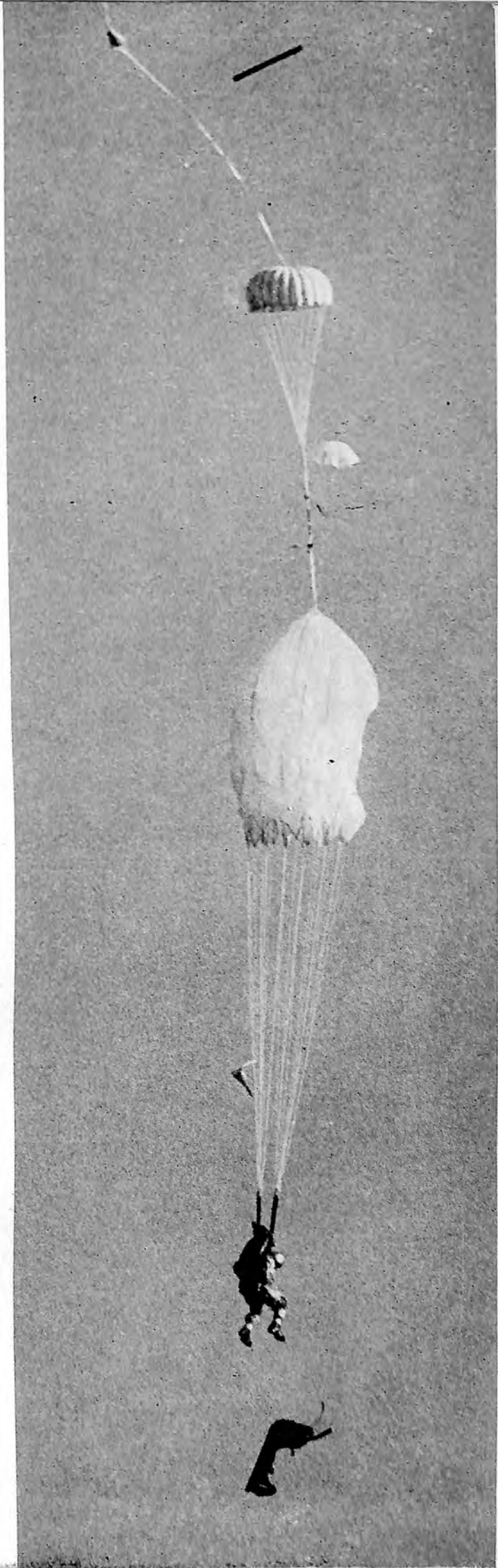
## SUPERSONIC ESCAPE

Safe escape from combat aircraft traveling more than 1500 miles per hour is the objective of this pilot ejection system (below) developed by Lockheed Aircraft Corp. The system is actually a parachute-equipped seat with wings and tail fins for aerodynamic stability.



## GROUND LEVEL EJECTION

A major step in gaining the ultimate in safety for pilots of high performance military aircraft was demonstrated with the ejection of a young British flyer from a Grumman Navy jet fighter that had just left the ground equipped with a new type ejection seat (right).





DUCTED-PROPELLER AIRCRAFT



JET-POWERED VTOL



XV-3 CONVERTIPLANE



XH-40 TURBINE-POWERED HELICOPTER

# VTOL

...new  
dimensions  
of FLIGHT

**BELL**  
*Aircraft Corp.*  
BUFFALO N.Y.

BELL AIRCRAFT has kept pace with the need for greater operational mobility and flexibility in both military and commercial aviation by developing four basic types of VTOL (vertical-take-off-and-landing) aircraft.

Studies and development work on a ducted propeller prototype have advanced to a point where this new design concept is fast approaching reality at Bell. The X-14 uses new principles of jet propulsion to take off and land vertically with the airframe in a normal horizontal position. The XV-3 convertiplane takes off like a helicopter, but as its rotors tip forward in flight, it becomes a normal, fixed wing aircraft. The XH-40 turbine-powered helicopter has substantially increased speed and payload and the ability to use a wide range of fuels.

The skillful and imaginative type of research which was the forerunner of these projects is being carried steadily forward at Bell Aircraft in the interest of still further scientific advancements in the commercial and military aircraft of tomorrow.

RESEARCH, DEVELOPMENT and PRODUCTION IN THE FIELDS OF: Guided Missiles • Research Aircraft • Servomechanisms • Electronics • Rocket Engines • Electronic Control Devices • Vertical Rising Aircraft

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AND COMPANY, INC.

ESTABLISHED 1883

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## ENGINEERING, RESEARCH AND DEVELOPMENT SERVICES

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ESCAPE CAPSULES  
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**AERCO**

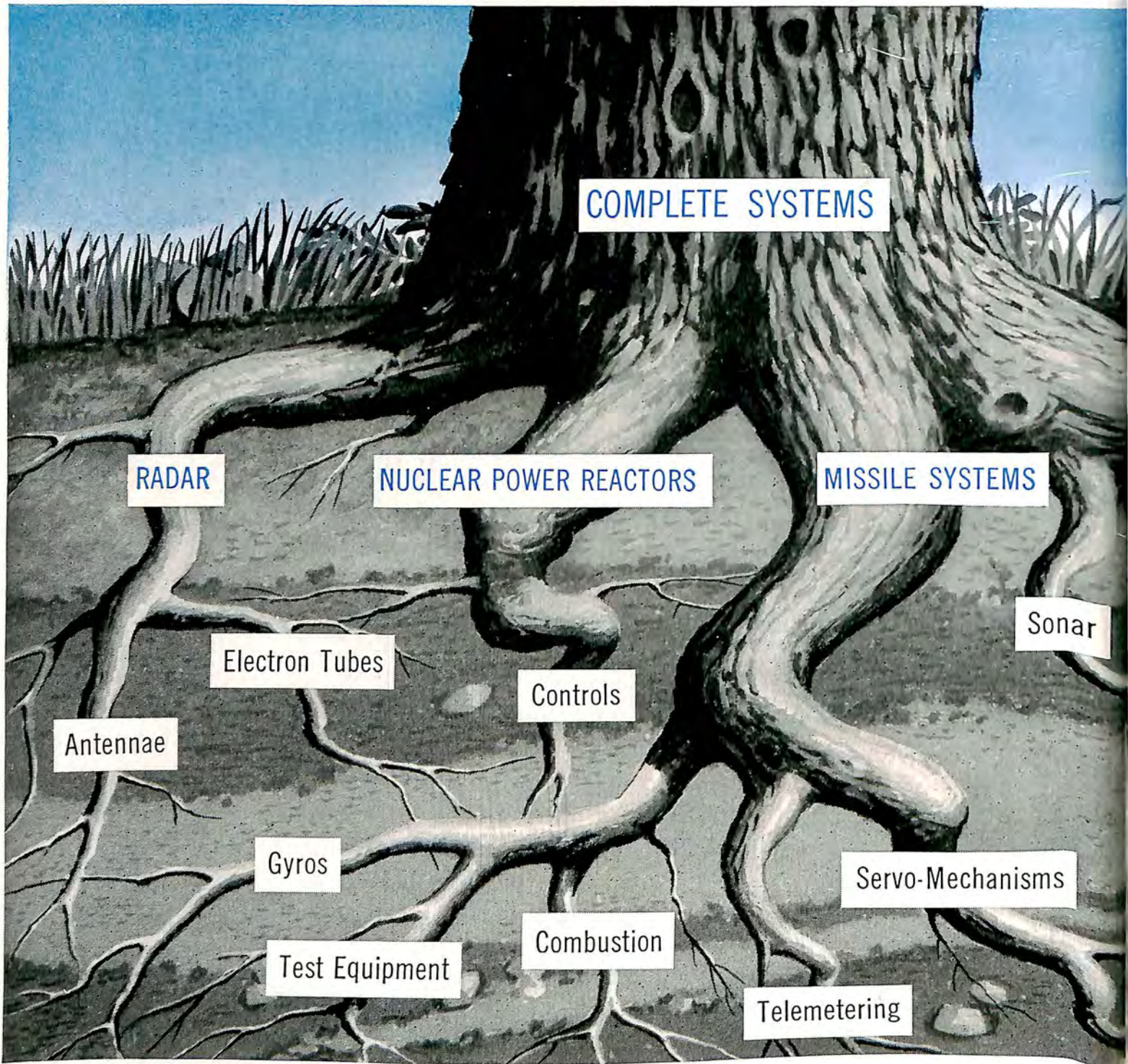
**AERONAUTICAL  
EQUIPMENT RESEARCH CORP.**

A DIVISION OF M. STEINTHAL & CO., INC.

**NEW YORK OFFICE**  
222 Fourth Avenue  
New York 3, N. Y.

**DAYTON OFFICE**  
271 Terminal Bldg.,  
Dayton Municipal Airport  
Vandalia, Ohio

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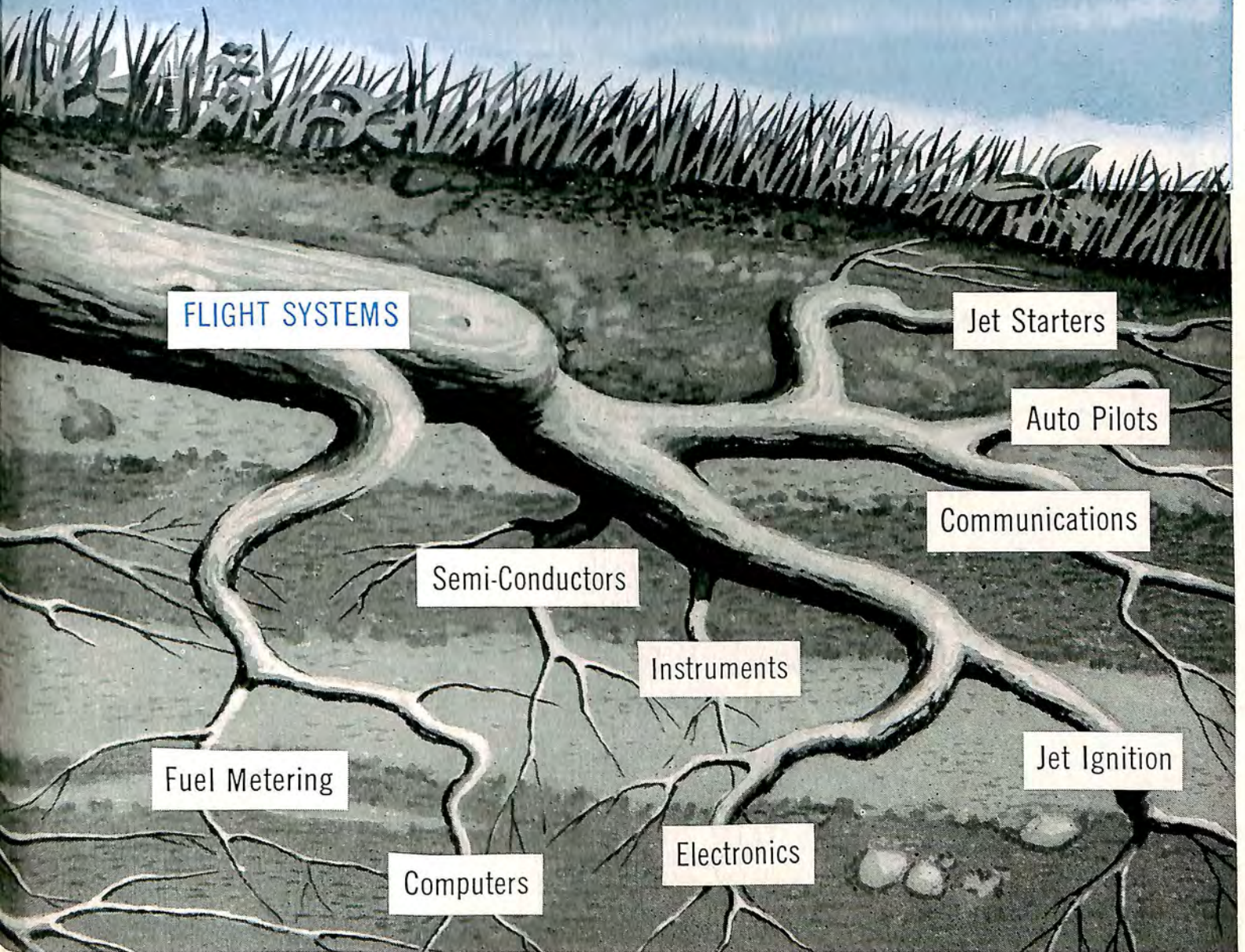
Complete ability to serve  
the Aviation,  
Missiles and Defense Industries

A THOUSAND PRODUCTS

**Bendix**

A MILLION IDEAS

AVIATION CORPORATION



We believe it is a matter of fact that no company anywhere is more completely equipped to serve the aviation, missiles and defense industries than Bendix Aviation. These are the assets at your disposal:

**EXPERIENCE**—We were born and raised with the aircraft industry. Our particular ability to anticipate its needs is a direct result of experience. It's something you can't buy on the open market.

**MANPOWER**—Over 9,000 engineers, scientists and technicians with as broad a range of abilities as any group in the country.

**ENGINEERING & RESEARCH**—Over \$100 million

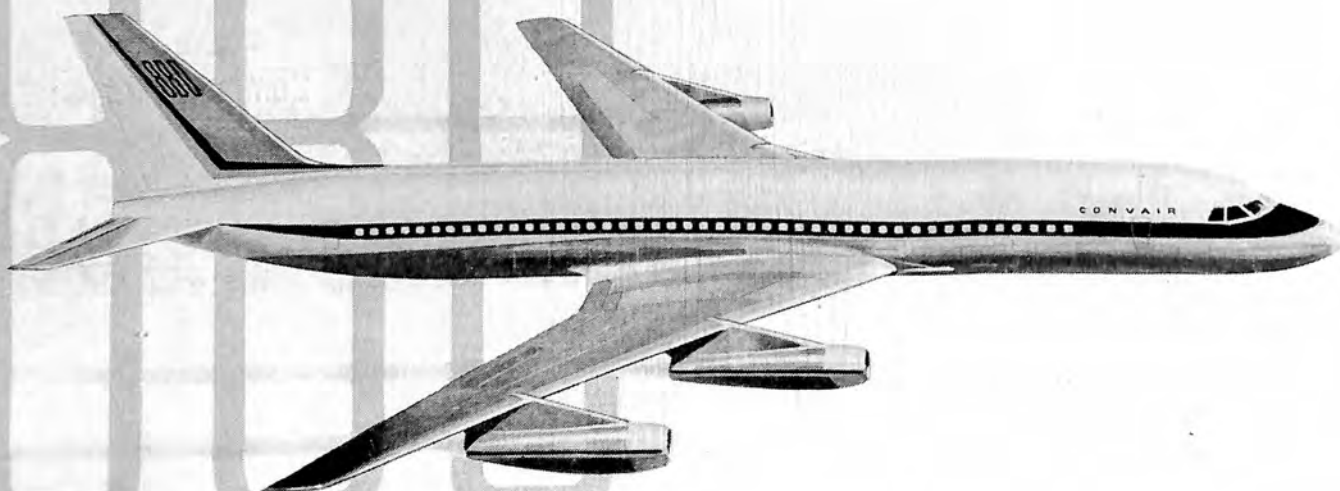
was expended on these functions in 1957.

**PRODUCTION FACILITIES**—Twenty-seven widely dispersed manufacturing facilities located coast to coast employing 50,000 people.

**SYSTEMS PLANNING**—The Bendix Systems Division, Ann Arbor, Michigan, functions to coordinate systems work and to give you a single, centrally located contact. These are the facilities. What are your problems?







## TWO OF A KIND

*...the world's fastest!*

The world's *fastest* and *most luxurious* passenger plane, Convair's Jet 880, is a companion achievement of the world's most spectacular bomber—Convair's supersonic B-58. Superior speed is only one indication of the over-all superior performance and passenger appeal of the Convair Jet 880—a significant jet age achievement for airline operators and travelers alike!

### CONVAIR

A DIVISION OF GENERAL DYNAMICS CORPORATION

Among airlines to first offer Convair 880 Jet-Liner service will be TWA, DELTA, TRANSCONTINENTAL, S.A. (Argentina), REAL-AEROVIAS (Brazil)

for **pp** precision  
**pp** performance  
**pp** progress

...choose **Simmonds products!**

**ELECTRONIC • HYDRAULIC • MECHANICAL**

**Lightweight Pacitron Fuel Gage Systems:** Fuel measurement and management systems incorporating latest technological improvements. Consistent reliability and dynamic progress are typified by the Load Limit Control, Center of Gravity Control and new True Mass Fuel Gaging System. Specification of Pacitron in latest military and commercial aircraft emphasizes Simmonds' continued leadership.

**Simmonds SU Fuel Injection Systems:** The only advanced type fuel injection system now in production for medium h.p. gasoline engines, the SU System has been proven in field tests to give economies up to 25%. Eliminates icing problems, gives improved cold starts.

**Precision Push-Pull Controls:** Simmonds Push-Pull Controls are positive, precise and rugged. Capable of heavy loads and accurate operation under vibration, continuous cycling,

temperature extremes, etc. Proved in millions of miles of service on aircraft engines, pressurized doors and specialized applications.

**Cowling and Access Latches:** Heavy duty flush fitting aircraft latches for installation on cowlings and access panels. Two-piece toggle type, available to fit a wide range of structural curvatures; for attachment of plastic radomes, etc.

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**AEROCESSORIES, INC.**

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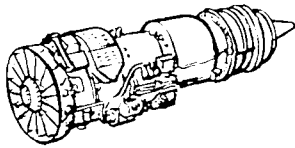
Branch Offices: Detroit, Michigan • Dayton, Ohio • Washington, D.C.  
 Dallas, Texas • Wichita, Kansas • Glendale, California • Seattle, Washington  
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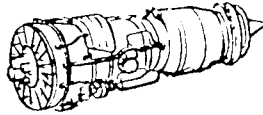
# What's Doing at United Aircraft?

## PRATT & WHITNEY AIRCRAFT

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J-75



J-57



T-34

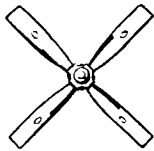


R-2800

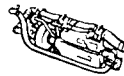
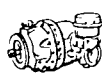
Jet engines for many types of modern U. S. military aircraft . . . Commercial jet engines (JT3 and JT4) for Boeing 707s, 720s and Douglas DC-8s ordered by U. S. and foreign airlines. Turboprop engines for large military transports. R-2800 piston engines for today's modern airliners.

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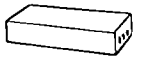
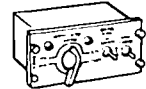
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JET AIRCRAFT EQUIPMENT



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Hydromatic propellers for current airline installations throughout the free world . . . Hydromatic and Controllable propellers for many types of military aircraft. Equipment (starters, fuel controls, air conditioning systems, pumps, valves) for more than 50 types of turbine-powered aircraft and missiles. Electronic products for missiles and manned aircraft.

## SIKORSKY AIRCRAFT

---



S-55



S-58



S-56

Helicopters for the armed forces of the U. S. and most of the free world, for industrial operators flying on all continents, and for scheduled passenger, cargo, and mail service in the U. S. and Europe.

In all divisions of United Aircraft, facilities are being expanded. The large corporate investment in the facilities and extensive research and development activities are representative of the emphasis being placed on planning for the future.

# United Aircraft Corporation

EAST HARTFORD, CONNECTICUT

NAA IS AT WORK IN THE FIELDS OF THE FUTURE



ARTWORK BASED ON OFFICIAL U. S. NAVY PHOTOGRAPH

## NEW HORIZONS ARE AHEAD FOR MANNED AIRCRAFT

No matter how far man's technical ability may soar, he himself has one faculty that no machine will ever duplicate—the ability to make a command decision . . . to meet an emergency or make the most of an opportunity.

This unique power—implemented by higher performance airplanes—may very well make the manned aircraft of the future our most versatile, flexible, accurate weapon.

Though the new strategic missiles will be mighty buttresses to our nation's defense, we also need *manned* weapon systems for *maximum* security.

These new aircraft will fly so fast, so high, so

far that they will be the forerunners of manned spacecraft. They will be able to bomb any target on earth with pinpoint precision—or to launch a missile from the edge of space.

Such aircraft are now being developed at North American. To this vital task North American brings the experience gained in building more supersonic aircraft than all other companies combined.

In manned and unmanned aircraft . . . in rocket engines . . . in automatic control systems . . . in nuclear reactors . . . North American Aviation and its divisions are constantly forging ahead into the fields of the future.

**NORTH AMERICAN AVIATION, INC.**

Los Angeles, Canoga Park, Downey, California; Columbus, Ohio; Neosho, Missouri

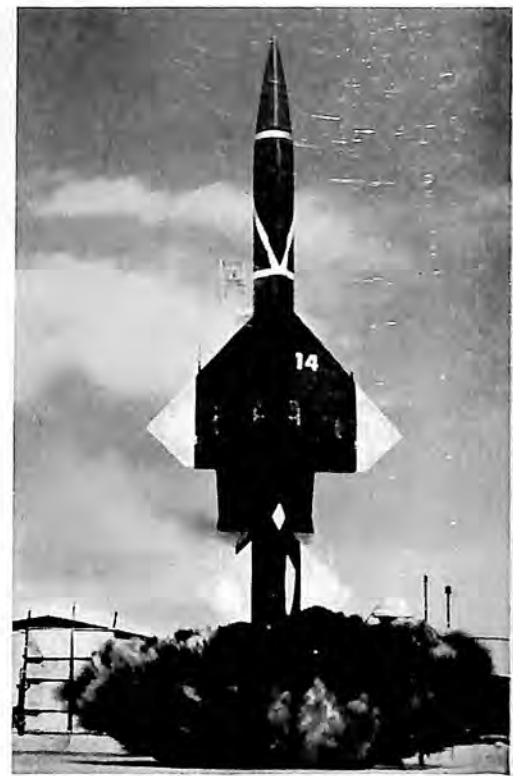


## BULLETIN FROM **BOEING**



**AMERICA'S "BIG STICK,"** the Boeing B-52 nuclear weapons carrier. It is the fastest, most advanced bomber now in service. B-52 jet bombers hold the round-the-world nonstop record, 45 hours, 19 minutes, and are the spearhead of the Strategic Air Command's long-range retaliatory defense force.

**BOEING BOMARC IM-99,** supersonic long-range defense missile. Part of a complete, Boeing-managed weapon system, it is launched automatically, and is capable of seeking out and destroying approaching enemy aircraft before they reach U. S. borders. Now in production for the Air Defense Command.



**AMERICA'S FIRST JETLINER,** the 707—and its shorter-range sister ship, the 720—by Boeing, world's most experienced builder of multi-engine jet aircraft. First deliveries of the 707 will be made in 1958. First 600-mile-an-hour Boeing 707 service will be offered by famous airlines in 1959.



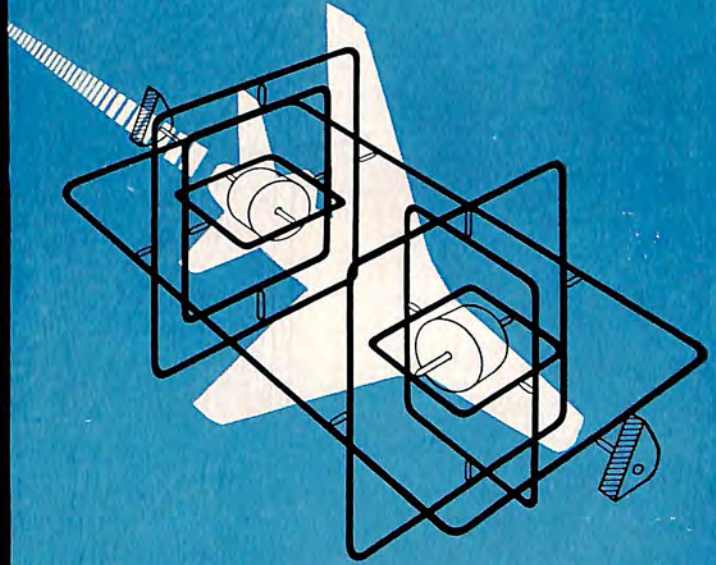
**BOEING KC-135** is both aerial tanker for jet bombers and fighters, and jet-age Air Force transport. The KC-135 holds jet transport nonstop-without-refueling record: 6,350 miles over indirect routes from Westover AFB, Mass., to Buenos Aires. Air Force made return 5,204-mile flight to Washington, D. C. in 11 hours, 5 minutes.

# **BOEING**



**SPERRY ANNOUNCES**

# NEW TWIN GYRO PLATFORM



## *Revolutionary design...and accuracy to 1/4° per hour*

In a fully maneuverable twin gyro platform utilizing completely new gyro design principles, Sperry has achieved unprecedented accuracies in heading information and all-attitude flight. The first of these new Sperry systems will soon be delivered to the Air Force's Wright Air Development Center.

This Sperry system provides azimuth drift rate as low as 1/4° per hour, and in the vertical axis, 1/10° per minute. The use of twin directional gyros and new design technique permits this extreme accuracy as it minimizes the disturbance torques inherent in conventional gyros. The low drift in the vertical axis minimizes turning error—permits freedom from erection control for longer periods of time.

Coupled with doppler radar navigators, the CEP (Circular Error Probable)

is materially reduced due to exceedingly low drift inertial heading feature. The inertial heading output permits either Great Circle or Rhumb Line flight paths.

The compactness of the twin gyro system makes it extremely reliable and easy to maintain. No warm-up period is required due to the balanced thermal construction and the absence of fluids.

The twin gyro platform has been designed to provide control information for complete and full maneuverability of high-performance aircraft without limit. Its full stabilization in all attitudes makes it especially adaptable for Low Altitude Bombing Systems, fighter maneuvers and missile applications.

*Write our Aeronautical Equipment Division for further information.*

### **FEATURES**

*Low Random Drift  
Inertial Heading  
Great Circle or Rhumb Line Output  
No Gimbal Error  
Low Turning Error  
Multiple Roll-Pitch-Heading Output  
Compact  
Rugged  
No Warm-up Time  
Light Weight*

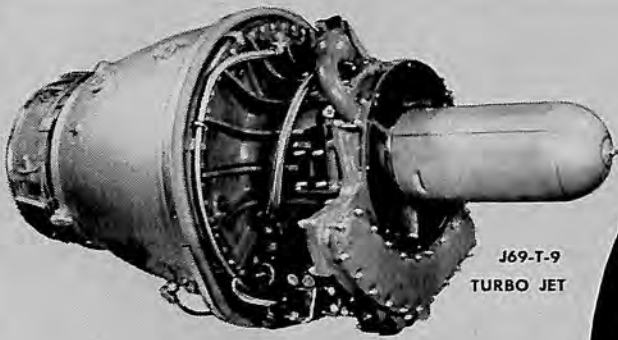
*Platform.....18 lbs.*

*Servo Amplifiers and  
Heading Computer }.....8 lbs.*

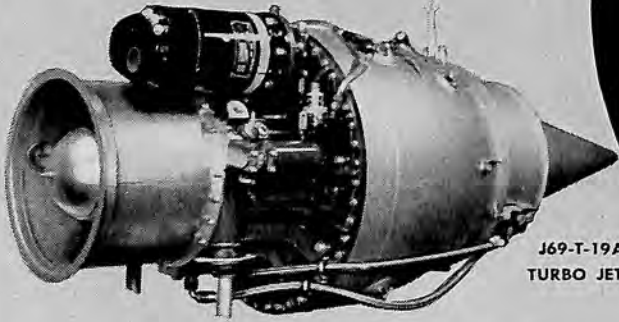
**AERONAUTICAL EQUIPMENT DIVISION**

**SPERRY** *GYROSCOPE COMPANY*  
Great Neck, New York

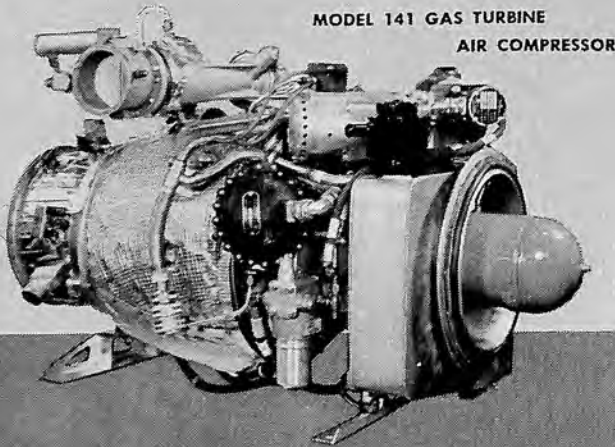
DIVISION OF SPERRY RAND CORPORATION



J69-T-9  
TURBO JET



J69-T-19A  
TURBO JET



MODEL 141 GAS TURBINE  
AIR COMPRESSOR



# IN THE AIR— ON THE GROUND C.A.E. Turbine Power

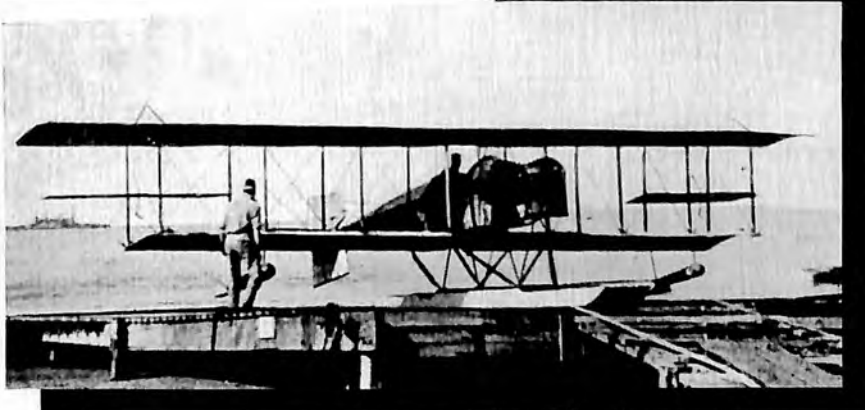
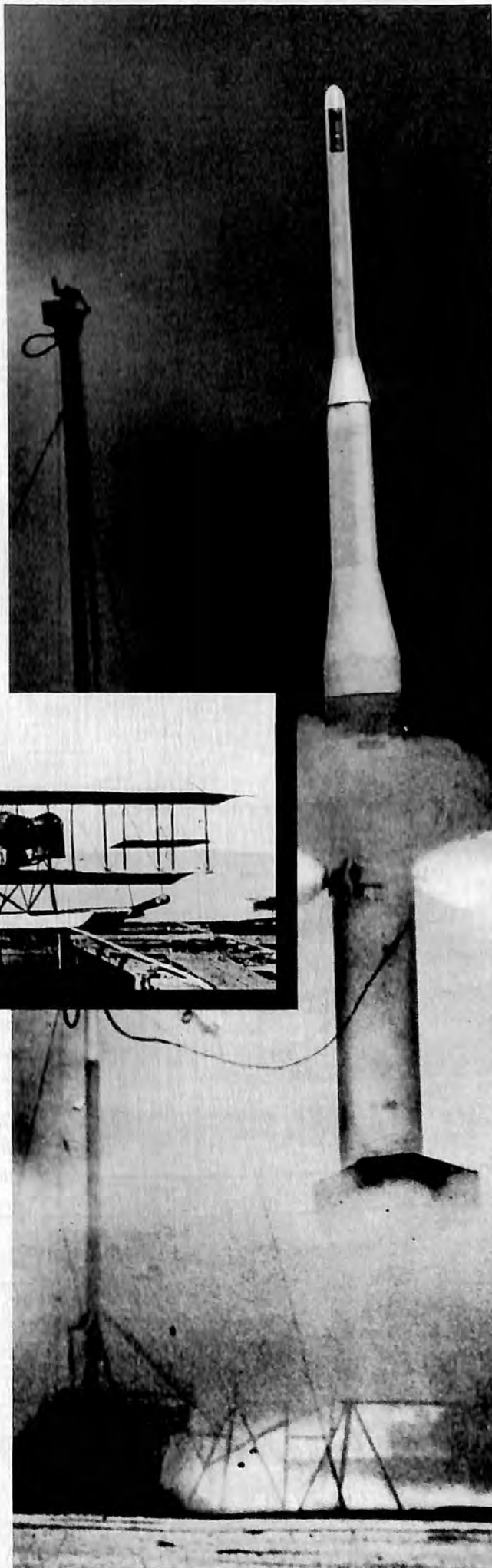
Continental, a great name in power, offers advanced development and modern manufacture to those requiring turbine power plants for helicopters, fixed wing aircraft, or ground applications. The models pictured are now in production.

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SUBSIDIARY OF CONTINENTAL MOTORS CORPORATION



**From  
San Francisco Bay  
to the dark edge  
of outer space**

On June 15, 1913, with its designer-builder, Allan Lockheed, at the pilot's controls, the first plane to bear the Lockheed name made a 20-minute flight over San Francisco Bay—at a speed of 60 mph.

Today's Lockheed X-17—the U.S. Air Force's fastest missile—can rocket its way from sea level high into the ionosphere, to the dark edge of outer space, in less than one minute.

Lockheed, now deeply engaged in electronics, nuclear research, ultrasonic aerodynamics, missile technology, rocketry, and outer space investigation, will continue in the years ahead to make important contributions to every phase of flight. Other projects to which Lockheed scientists are also dedicated will broaden man's knowledge of the unknown and enrich the peoples of the world.

LOCKHEED AIRCRAFT  
CORPORATION\*

*\*The present Lockheed Aircraft Corporation, which bought the previous Lockheed company in 1932, is one of America's 100 largest industrial companies.*

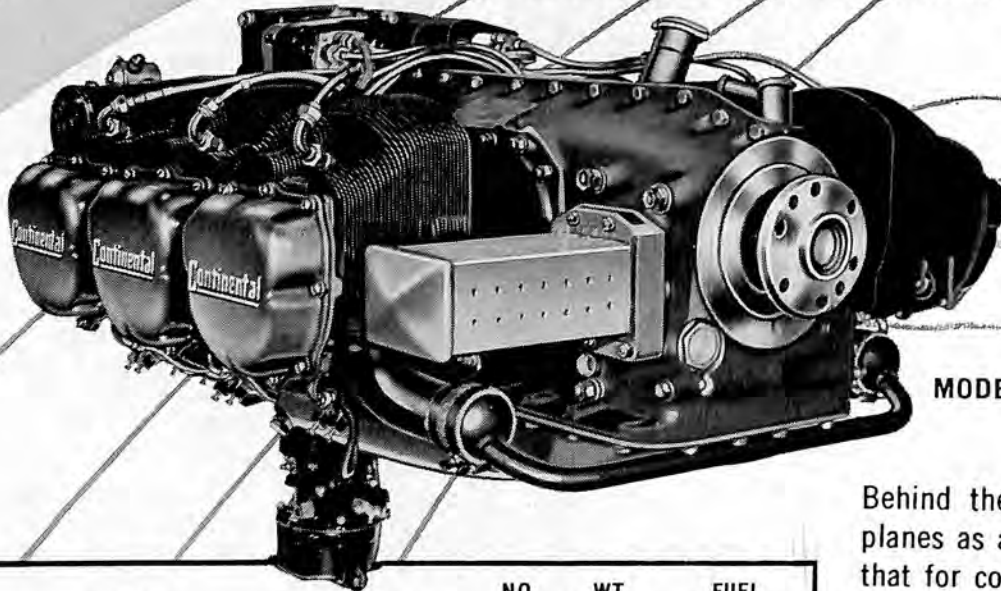
**LOCKHEED**  
*means leadership*



TODAY'S FINEST  
EXECUTIVE AIRCRAFT  
FLY WITH



# DEPENDABLE CONTINENTAL POWER



MODEL O-470-K

MODEL	HP	RPM	NO. CYL.	WT. COMPLETE	FUEL OCTANE
A65 .....	65	2300	4	168	80/87
C90 .....	90	2475	4	184	80/87
O-300-A&B .....	145	2700	6	287	80/87
*O-470-15 .....	213	2600	6	405	80/87
GO-300 .....	175	3200	6	312	80/87
O-526 .....	225	2300	6	428	80/87
*O-470-13A .....	225	2600	6	415	80/87
*O-470-2 .....	250	2600	6	474	100/130
O-470-K&L .....	230	2600	6	404	80/87
O-470-M .....	240	2600	6	409	91/96
IO-470-C .....	250	2600	6	432	91/96
FSO-526-A. (Helicopter)	270	3200	6	568	91/96
GO-526 .....	290	3200	6	408	80/87
GSO-526-A .....	320	3000	6	523	91/96

\*For military use.

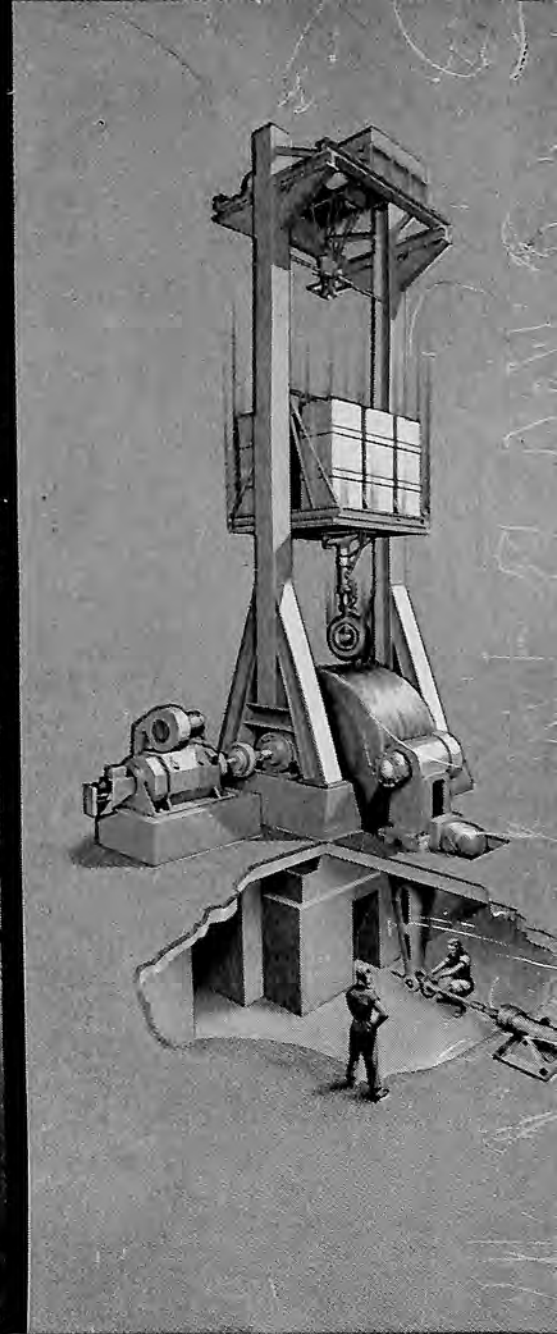
Behind the growing dependence on airplanes as adjuncts to business is the fact that for company after company they are more than paying their way. As pioneer and leader in utility aircraft power, Continental Motors finds solid satisfaction in its role as engine source for the outstanding planes of this type. It has every reason to believe that the performance of these engines—their power, economy and dependability as proven in thousands of hours of flying—has been not only a major factor in the leadership of those aircraft, but one destined to assure their ever-wider use.

Continental's Factory Re-manufacture plan, successor to the periodic overhaul, backs you with the specialized skills of the men who know your engine best. With your factory re-manufactured Continental, you get new engine warranty—new log book with zero hours—at a modest, pre-determined price. Most important of all, you're back in the air with an absolute minimum of costly down time.

***Continental Motors Corporation***

AIRCRAFT ENGINE DIVISION

MUSKEGON • MICHIGAN



Giant landing gear test facility is 60 feet high. It simulates conditions that heavy, high-speed planes actually meet.

## BENDIX SHOOTS LANDINGS INDOORS TO HELP PRODUCE BETTER LANDING GEAR SYSTEMS

When designing and producing complete landing gear systems it is vitally important to know in advance just how every component part will respond to the stresses and strains of flight conditions.

That's why the giant landing gear testing equipment pictured above plays such an important part in the development and production of Bendix\* complete landing gear systems.

All major components that make up the system such as control valves, nose wheel steering, retractor actuators, power braking as well as wheels, brakes, shock absorbing struts and even tires are subjected to repeated tests of braking, dropping, twisting and vibration before final approval.

For Bendix has proven over many years that landing gear components

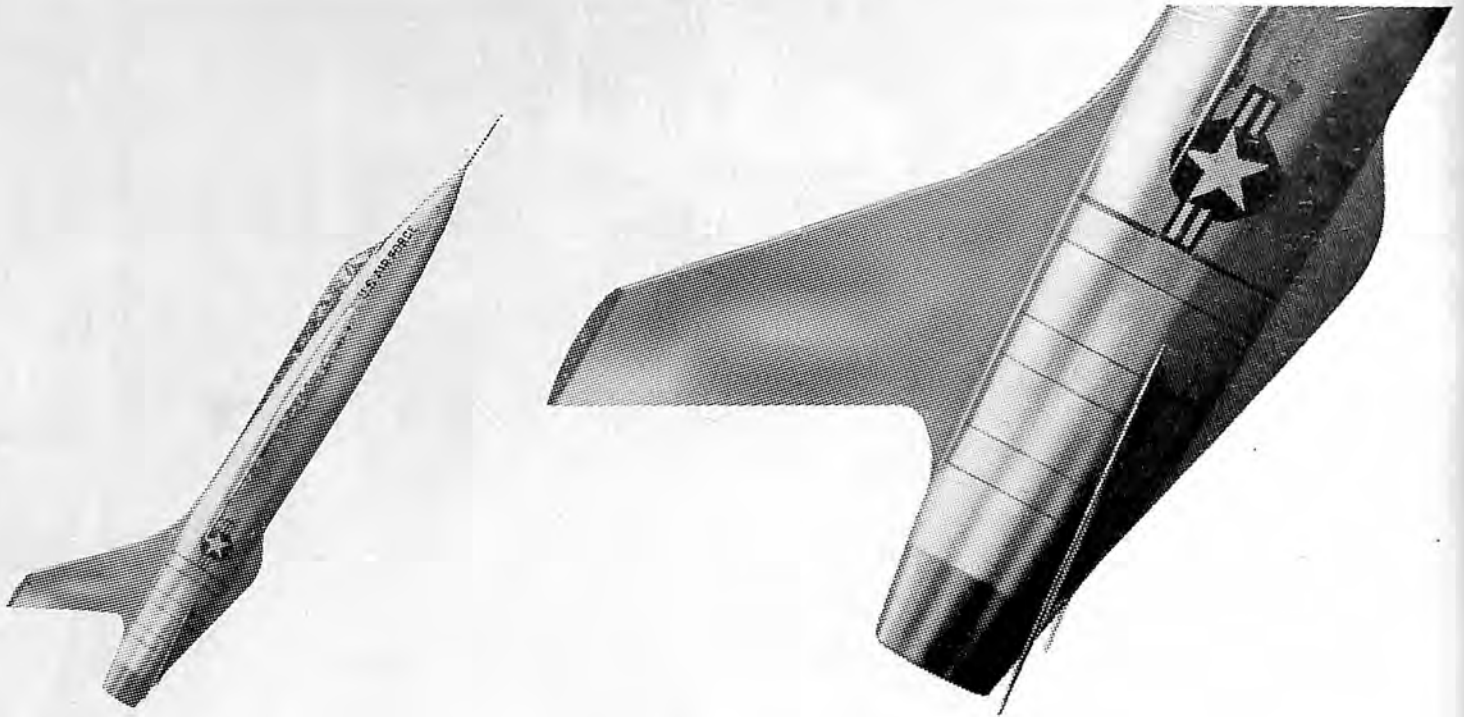
that have been designed, engineered and tested to work together give better and more dependable performance than any arbitrary assembly system.

So, when it comes to gear for landing, think and plan in terms of a complete landing gear system. Then, we suggest you think of Bendix and Bendix Products Division at South Bend, Indiana.

\*REG. U. S. PAT. OFF.

Bendix PRODUCTS DIVISION South Bend, IND.





***NOW YOU SEE IT . . . NOW YOU DON'T***



## ***THE F-105***

Furious speed . . . smashing primal power . . . overwhelming persuader for peace, this new Thundercraft\*, more than any other . . . is designed to deliver Tactical Air Command's composite air strikeforce knockout punch at any target, any time!

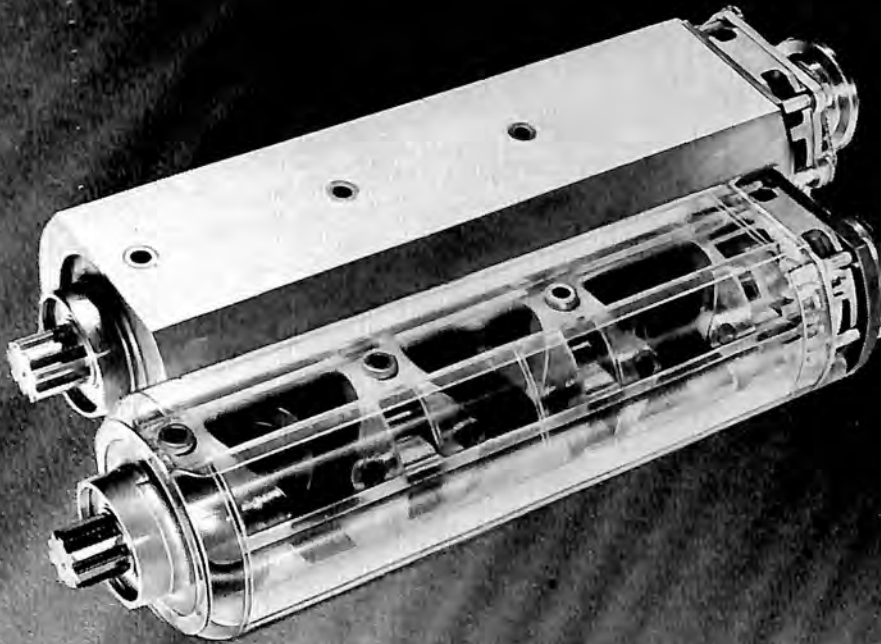
\*Latest in the line . . . The THUNDERCHIEF

**REPUBLIC AVIATION**

FARMINGDALE, LONG ISLAND, N. Y.

*Designers and Builders of the Incomparable THUNDER-CRAFT*

# Power Actuation at +1000°F



**AiResearch Cam-Piston Air Motors** function with complete reliability at extreme temperatures—require no conventional lubrication or cooling

SPECIFICATIONS			
Model Numbers	CM-710 *(illustrated)	CM-350	CM-160
Total Length (in.)	13.3	11.8	9.7
Min. Height (in.)	3.1	2.9	2.5
Max. Dia. Envelope (in.)	4.0	3.2	2.5
Weight (lb.)	22	15.5	7.5
Output at 200 psig supply pressure and 1200 rpm (hp)	18.5	9.1	4.2
Starting Torque at 200 psig supply pressure (inch-pounds)	1800	890	400

Here are air motors that operate dependably far beyond the temperature limits of electronic and hydraulic units.

Using bleed air as a source of energy, the output of the air motor is almost linear with inlet pressure, allowing maximum efficiency through a wide range of operating conditions. High horsepower and torque to weight ratios are obtained by displacement volume per revolution exceed-

ing the overall volume of the motor.

Motor acceleration is extremely fast—less than .05 second in most applications. Low rotating speeds— from 100 rpm to 2500 rpm— make gear reduction unnecessary and minimize problems of over-speed control, rotational stresses and wear.

Flexibility of the basic design allows for a wide range of motor sizes— from less than 1 hp up to 300 hp— depending on the available pressure

supply. Length vs. diameter shape can be changed by varying the number of pistons and/or the piston diameter and stroke.

When coupled with a ball screw which may retract within the full length of the motor shaft, the cam-piston air motor has wide application as a compact, high-performance linear actuator in high temperature pneumatic power control systems.

Your inquiries are invited.

*• Outstanding opportunities for qualified engineers*



**AiResearch Manufacturing Divisions**

*Los Angeles 45, California . . . Phoenix, Arizona*

*Designers and manufacturers of aircraft and missile systems and components:* REFRIGERATION SYSTEMS • PNEUMATIC VALVES AND CONTROLS • TEMPERATURE CONTROLS  
CABIN AIR COMPRESSORS • TURBINE MOTORS • GAS TURBINE ENGINES • CABIN PRESSURE CONTROLS • HEAT TRANSFER EQUIPMENT • ELECTRO-MECHANICAL EQUIPMENT • ELECTRONIC COMPUTERS AND CONTROLS

# FLIGHT TRAINING CHART NO

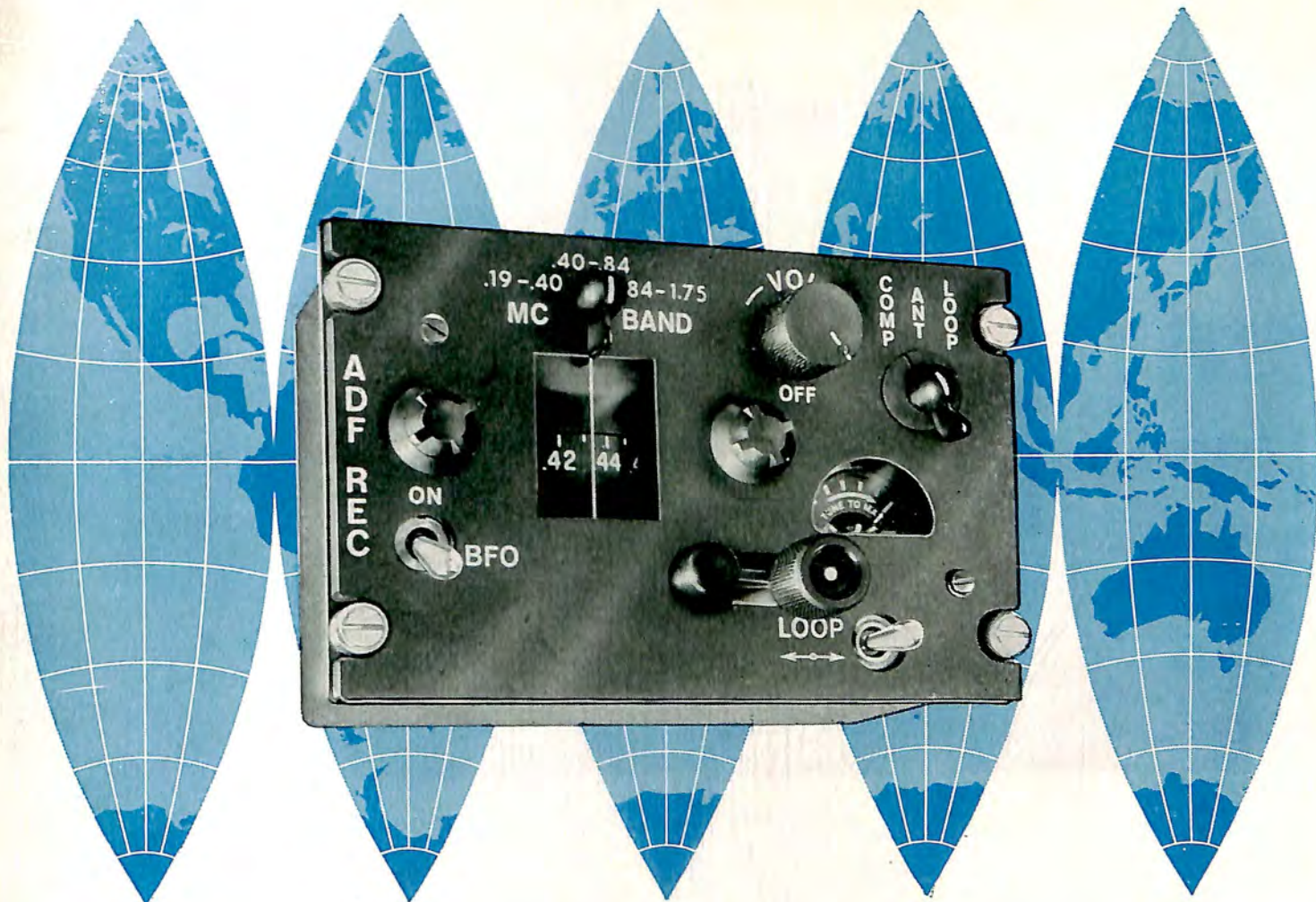


**SIMPLE ARITHMETIC**—It costs approximately ten thousand dollars to send a student through college today, but more than ten times that amount to give a young man the superlative training that he must receive to become an Air Force pilot. A saving in either expense would be welcome to most Americans. Northrop Aircraft is *doing something* about reduction of national defense costs by applying “dollar engineering” to planning and production of new weapon systems. Latest Northrop achievement is its supersonic T-38 jet trainer, a simple, lightweight airplane capable of using any improved airport. Costing less to produce, fuel and maintain than other airplanes with comparable performance, the T-38 can save American taxpayers hundreds of millions of dollars in pilot training. This T-38 jet trainer...and the Snark SM-62, world's first intercontinental guided missile...are noteworthy developments of the budget-minded research, engineering and production teams at Northrop.



**NORTHROP**  
NORTHROP AIRCRAFT, INC. • BEVERLY HILLS, CALIFORNIA

*Builders of the First Intercontinental Guided Missile*



**TYPE 21A ADF WEIGHS ONLY 19.7 POUNDS**

*Component Unit Weights:*

Receiver, 6.8 lbs.; Loop, 4.3 lbs.; Loop Housing, 0.5 lbs.;  
 Indicator, 1.3 lbs.; Control Unit, 1.6 lbs.; Power Unit, 5.2 lbs.;  
 CAA Certificate No. 1R4-9 U.S. Military: AN/ARN-59  
 British Certificate of Approval VC-78

# World-Wide navigation aid

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B-47 F-84 F-86

Canberra Bomarc

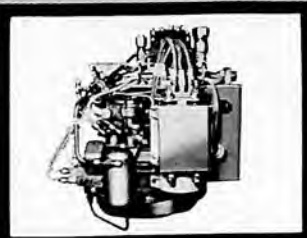
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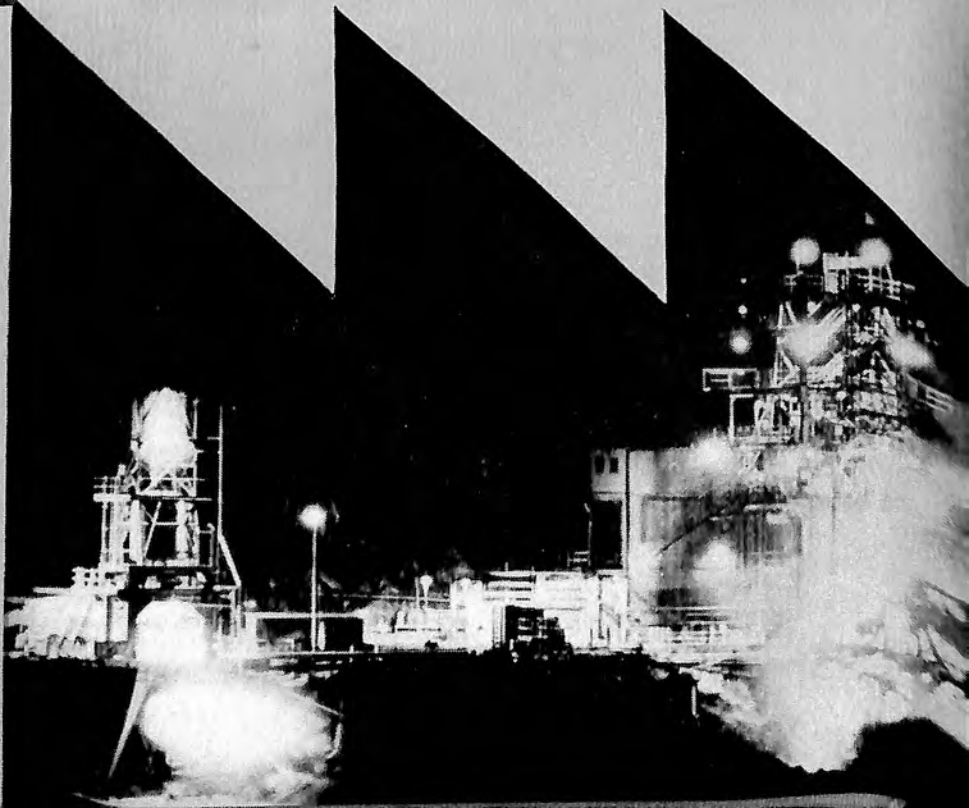
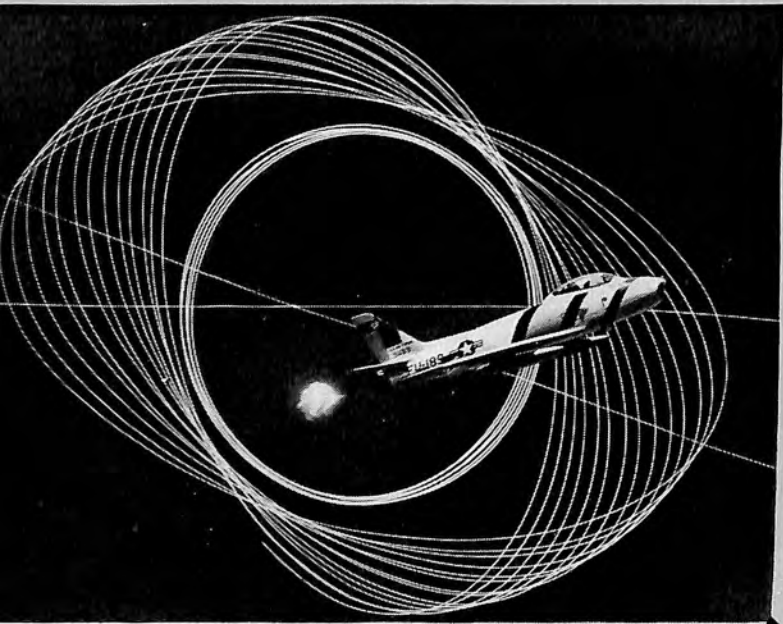
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AIRCRAFT CORPORATION • Dallas, Texas

# THE INDUSTRY



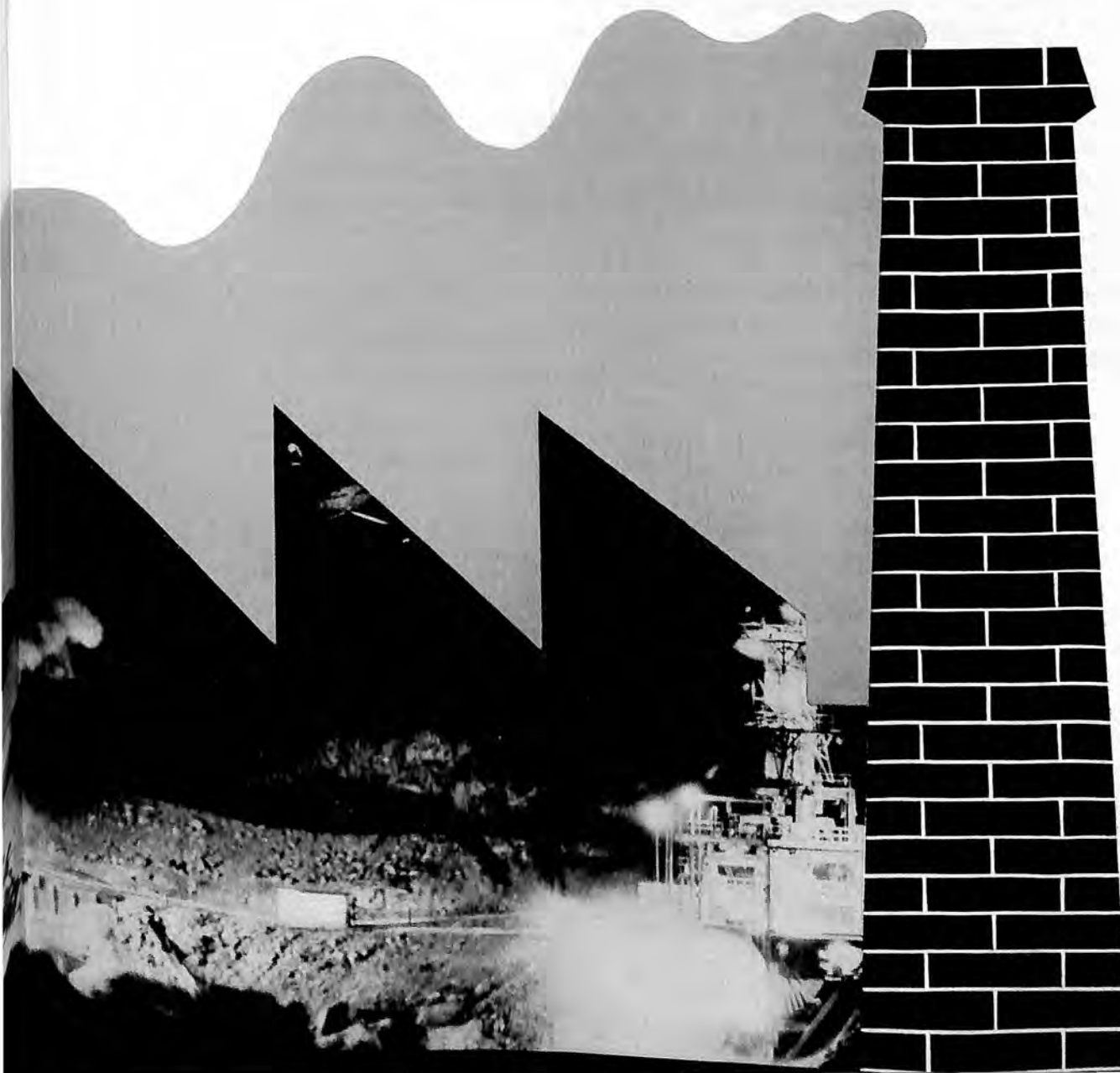
TO AN industry which has never known normalcy, 1957 must be classed as an exceptionally abnormal year. It was a year characterized by confusion and contradiction on the part of the major customer, the armed forces, and a year which brought about radical changes in contracting procedures which at times threw the industry out of tempo. It was, on the one hand, a frustrating year, yet despite the handicaps of official uncertainty, some very solid gains were realized.

At the start of the year, the situation might have been termed relatively routine. Production of military equipment was proceeding at a reasonably high level. Commercial and other civil aircraft production was also on the upswing. Progress was being made in several important areas of research and development. Employment was on a rising scale, reaching about 910,000 by early summer.

Then came a sequence of events which tossed out the window the hopes for an orderly production program.

The trouble started in May, when the Department of Defense realized that its rate of expenditures would put spending well above the imposed \$38-billion spending level. Industry was informed that there would necessarily be major changes in military contracts. Shortly afterward, progress payments were sharply curtailed and defense contractors were instructed to reduce overtime to a bare minimum. At the same time, it was decided that there would be increased emphasis on missiles, but only at the expense of manned aircraft programs, a decision which further complicated the production program.

In June, contractors summoned to Washington were forewarned that some drastic



economies were in the offing. In the next two months there followed a series of cutbacks, stretchouts and cancellations in both aircraft and missiles, affecting practically every category of the industry effort except ballistic missiles. This forced contractors to reduce personnel in large numbers, retire certain facilities, cancel or stretch out subcontracts and lower costs in whatever other manner they could.

In September, it was found that even these drastic measures were not enough, since expenditures had not been sufficiently decreased. In another move of major impact, the Air Force stated it would be forced to limit payments to contractors for work done to the extent necessary to stay within the expenditure rate. The contractors were expected to finance the difference themselves, which would require heavy borrowings, but the interest on the loans would not be an allowable item of cost. The Navy planned similar measures, and the industry estimated that the total amount of financing required would run to a billion dollars. It appeared that still further stretchouts and cancellations would become necessary.

In late October the situation was alleviated to some extent by the new Secretary of Defense, Neil H. McElroy, who stated that the government would pay its bills on time, but that contractors would be asked to finance a great portion on their inventories and work in progress. The industry learned that progress payments would be at a rate of 70 percent and that companies would be encouraged to finance up to 20 percent of cost-plus-fixed-fee contracts. The new policy, while it imposed hardship in some cases, was generally felt to be acceptable and one which would at least permit more orderly planning.

The impact of the stretchouts, cutbacks, cancellations and economic restrictions was felt in earnings for the year, although sales were not significantly affected. For the first nine months of the year, the 12 major airframe companies reported a sales increase of more than a billion dollars, from a 1956 figure of \$3.8-billion to \$4.9-billion. Earnings increased less than \$8-million during the same period, from \$112.6-million to \$120.1-million. Earnings for the 1957 nine months were only 2.4 percent compared with 2.9 percent for the comparable 1956 period.

Aircraft Industries Association estimated that sales in 1957 totaled \$11.5-billion, compared with \$9.5-billion in 1956. At the same time, production of military aircraft declined from 6800 units in 1956 to slightly more than 5000. The increased sales were due in part to increased output of guided missiles and greater deliveries of commercial aircraft. Commercial sales topped the \$2-billion mark for the first time in history and were up more than \$500-million over 1956.

A major factor in the sales increase was inflation. The price index for aircraft materials averaged 152.0, compared with 109.2 in 1950. Average hourly earnings were \$2.36, compared with \$2.27 in 1956.

Although the military was still by far the industry's best customer, the proportion declined slightly due to increased commercial activity. Where 1956 deliveries to the military represented 85 percent of the industry's total sales, the proportion dropped to 82 percent in 1957. Commercial aircraft deliveries declined in numbers from 7205 units in 1956 to 6850 in 1957, but there was a sharp increase in dollar value. AIA estimated commercial sales of \$725-million in 1957, compared with \$454-million in 1956.

The backlog of unfilled orders at the end of the third quarter, latest date for which figures were available, was \$14.4-billion, compared with \$18.4-billion for the same period in 1956. About \$3.8-billion, or 36 percent, was in commercial orders.

After the peak of 910,000 in early summer, employment started a steady decline to a year-end estimate of about 800,000. Average for the year was 880,000, substantially higher than 1956's 814,000.

Despite a year of uncertainty and fluctuating fiscal policies, the industry could point to a great many substantial achievements, some of which are detailed in the following pages. A company-by-company summary follows.

# AIRFRAME AND MISSILE MANUFACTURERS

## AERO DESIGN AND ENGINEERING COMPANY

In February the company added the Model 560E to its Commander family and shortly thereafter the E was added to the Aero's approved type certificate. The E model was a more powerful version of the normal Commander. It was powered by two 295-horsepower high compression engines and carried a gross load of 6500 pounds. For increased performance, the E featured a longer wing than predecessor models.

The company secured additional space through lease of a hangar at Mustang Field, El Reno, Oklahoma. It was put to use for storage and modification work in early 1957.

In May, Aero received an Army order for two Aero Commanders equipped with "side-looking" radar. The plane type was designated RL-26D.

The company also developed a photographic and survey modification of the Commander.

## BEECH AIRCRAFT CORPORATION

Beechcraft's 25th Anniversary year saw new sales records, military production gains, licensing of a new business plane, several outstanding aeronautical engineering achievements and a general expansion of all aviation research, development and manufacturing activity.

Total commercial and military sales for fiscal 1957, ending September 30, were nearly \$104-million—up some 39 percent over 1956.

Commercial sales during the year reached a new high of approximately \$35.7-million, compared with its previous record totals of \$32.091-million for fiscal 1956 and \$27.246-million for fiscal 1955.

Sales of military aviation products soared from \$42.447-million in fiscal 1956 to more than \$68-million in fiscal 1957.

Unit sales during the year curved upward for the company's business aircraft models—the eight-place Beechcraft Super 18 executive transport, the six-place Beechcraft Twin-Bonanza twin-engine airplane, and the four-place Beechcraft Bonanza single-engine plane.

The year 1957 also marked introduction of the company's first supercharged business plane in the Twin-Bonanza series, the Model E50 powered by two 340-hp supercharged Lycoming engines.

In March the company delivered its 5000th Beechcraft Bonanza for business and industry and later in the year announced that a substantial fleet of new Bonanzas had been acquired for use in contract instrument training of Army aviators. Delivery of the 300th Beechcraft Super 18 in August brought to more than 6600 the total number of units in the Model 18 series delivered to military and commercial customers since the prototype flew

in 1937.

On June 18, the CAA issued Type and Production certificates for the new Beechcraft (Model 95) Travel Air, the company's first entry into the four-place, twin-engine business aircraft field. Initial deliveries of the 200-mile-per-hour Travel Air were made in November.

For Beech Aircraft, the Model 95 added a fourth business plane to its commercial line and enlarged market selection of aircraft in the \$40,000 to \$60,000 price range. Beechcraft on August 3 announced that the new Travel Air, with standard equipment, would list for \$49,500—a price non-competitive with the company's three other models.

Beechcraft's "pay-as-you-fly" sales and lease programs combined had resulted in \$6.206-million worth of retail business by the end of fiscal 1957. In addition, Beechcraft's special "floor plan" for distributors and dealers had produced a total of more than \$12.762-million in new airplane sales.

On March 18 the company started its ninth annual nationwide "Beechcraft Safety and Efficiency Clinic," an aircraft inspection service for Beechcraft owners. During 1957 alone more than 1500 Beechcrafts received free maintenance checks at various distributor locations.

Foreign interest in the Beechcraft (Model 73) Jet Mentor continued to mount. The company awarded rights to manufacture the jet trainer in Canada to Canadian Car Company, Limited, which previously built the propeller-driven Beechcraft T-34 under license. Other foreign powers holding Beech licensing agreements included Japan and Argentina, both for Beechcraft T-34 production.

In May, Beechcraft's Boulder, Colorado, facility

was elevated to full division status. Boulder work in 1957 included production of 1200-gallon and 6000-gallon mobile (Dewar) containers for the Atomic Energy Commission, among the first of several classified projects undertaken by the new division in the fields of cryogenics, high energy fuels, thermodynamics and missiles.

Also in May the company unveiled its proposed Beechcraft Model 1013 reconnaissance drone designed for photo and television battle area surveillance and enemy position observation. The Model 1013 was adapted from the XKDB-1 target aircraft which Beech is building for the Navy.

Flight evaluations of the 320-mile-per-hour Beech-designed Navy XKDB-1 started in the spring of 1957 at the Naval Air Missile Test Center, Point Mugu, California.

The XKDB-1 in summer trials demonstrated its ability to meet or exceed Navy specifications for stability, controllability, launching and recovery, and on one flight reached an altitude of 38,500 feet from ground launch.

The Army during the year ordered additional quantities of the L-23D command transport, military version of the supercharged Model E50 Twin-Bonanza business plane, extending L-23 production into 1959. In October, Beechcraft also began deliveries of rebuilt L-23's under a separate contract calling for the remanufacture of early A and B models to the new Army L-23D configuration.

The year's activities were also highlighted by continued production of Beechcraft T-34B Mentor trainers for the Navy, large numbers of Beech-designed ground power support units for starting and servicing jet aircraft, and thousands of jettisonable fuel tanks with capacities ranging from 200-gallon pylon tanks for the USAF F-104 to 1700-gallon external stores for the USAF B-47.

A pioneer in the field of aircraft range extension, Beechcraft on January 8 reported successful flight tests of its new jet fighter in-flight refueling "buddy" system which the company is developing for McDonnell Aircraft Corporation. The Beech-designed system enables one jet fighter to refuel a sister craft at high speeds and altitudes.

Besides prime contracts with the Air Force, Army and Navy, Beechcraft in 1957 received additional subcontract orders for production of complete wings for jet trainers and for parts, assemblies and components for jet fighter-interceptors.

As the company entered its 25th anniversary year, officials computed that total commercial and military sales since its founding in 1932 had already topped the \$1-billion mark.

At year-end, Beech Aircraft had nearly 2,000,000 square feet of plant area in use at six major production facilities—three in Wichita, Kansas, and one each at its fully-integrated divisions in Herington and Liberal, Kansas, and in Boulder, Colorado.

Also in operation were the parent company's two wholly-owned subsidiaries, The Beech Acceptance Corporation, Inc., organized in 1956 to finance sales of business aircraft on deferred time payment plans, and Beechcraft Research & Development, Inc., also formed in 1956 to explore the new fields of powered flight. In addition to 775 acres of land which the company owns near Wichita, Beechcraft early in 1957 increased its Colorado property holdings to 1460 acres at the site of its preliminary test facility near Boulder.

During the year, Beechcraft's total employment climbed from 6500 at the end of 1956 to 8000 by the end of fiscal 1957.

At year-end, Beechcraft's diversified aviation activity embraced more than 60 different aeronautical projects—ranging in scope all the way from the manufacture of commercial aircraft to engineering research on emergency escape systems.

*Beech has produced 423 T-34B Mentor trainers for the Navy.*





*Bell Aircraft Corporation's new Data Processing Center.*

## **BELL AIRCRAFT CORPORATION**

Bell continued development and production of its GAM-63 Rascal and one of the highlights of the company year came in October when the air-to-surface missile was accepted for operational service by the Strategic Air Command.

Another highlight was the successful demonstration of Bell's Automatic Landing System. In a series of tests aboard the aircraft carrier *Antietam*, a Douglas F3D was landed over 100 times without the pilot touching the controls. The system combines radio and radar for automatic approach and touch-down control. Bell also completed almost 1500 ground landings prior to the sea trials.

The company also continued extensive research and development programs in aircraft, missiles, rocket engines, avionics and servo mechanisms.

The Avionics Division was developing an inertial navigation system for fighter aircraft embodying radically new techniques and greater accuracy. It is built around an accelerometer and a gyro designed by Bell engineers. The accelerometer was also being built in quantity for installation in various guided missiles.

Avionics was also supplying a proportional radio control system for the Chance Vought Regulus guided missile and radio command receivers for the Navaho, Atlas and Thor missiles.

With much advanced work under way, Bell's Rockets Division continued delivery during the year of liquid-propellant ceramic rocket thrust chambers for the Army's Nike surface-to-air guided missile, as well as engines for Bell's Rascal.

Research in the area of advanced aerodynamics required for high speed and high altitude flight was carried on by the Research Division. Hypersonic tests were conducted in the helium wind tun-

nel at Princeton University and studies conducted to evaluate low cost insulation for aircraft structures operating at high speeds.

The Research Division also conducted studies in the company's environmental laboratories in support of avionics, propulsion, aircraft and missile projects.

Flight studies continued on Bell's rocket-powered special research planes, the X-1B, X-1E and jet X-5, under the supervision of the National Advisory Committee for Aeronautics.

Investigation of revolutionary new aircraft types is under way in the Aircraft Division which pioneered in the jet VTOL field with such aircraft as the original test VTOL and the X-14.

The Bell X-14 built for the Air Force, completed early stages of its test program successfully during the year. Powered by two jet engines, the X-14 was designed to take off vertically from a conventional position, shift to forward flight and land vertically, eliminating the need for runways.

Bell expanded its manufacturing facilities with the addition of large-scale production equipment to be used for its own work as well as subcontracts. Numerically tape-controlled contour and profile mills were scheduled for installation early in 1958.

During the year, delivery of B-47 and B-52 engine nacelles and spare parts continued, with planning for other sub-contracts of a similar nature under way.

Other manufacturing included internal wing members for the McDonnell F-101 and tail cones and electronic equipment platforms for the B-66.

Bell moved to consolidate its Niagara Frontier operations during the 1957 year with completion of a Data Processing Center, plans for a new Re-





*Bell XV-3 Convertiplane.*

search Center and a \$2.5-million addition to its main plant.

The new data unit occupies 30,000 square feet of floor space and cost \$750,000. It will handle all the data processing in support of the company's technical and administrative programs, including those of the Niagara Frontier operation and the Bell Helicopter Corporation in Fort Worth, Texas, and some of its subsidiaries.

The company also acquired 350 acres 30 miles east of Buffalo as a site for the projected Lawrence D. Bell Research Center which will include, among other services, a hypersonic wind tunnel capable of handling the highest speed ranges and a laboratory for heat studies.

Continuing its policy of diversifying into commercial fields which have growth potential in new technological areas, Bell acquired two new subsidiaries, the Lake Erie Engineering Corp., of Buffalo, New York, and Birma Manufacturing Corp., of Buffalo and Greenfield, Indiana. Lake Erie is one of the leading companies in the hydraulic press field. Birma Manufacturing is a producer of molded fibre glass products. This brings to seven the number of wholly-owned subsidiaries.

For the nine-month period ended September, Bell Aircraft Corporation reported consolidated sales of \$151,366,136 and net income after taxes of \$3,089,271.

Employment totalled 16,901 persons, including 12,369 in the parent company.

## BOEING AIRPLANE COMPANY

Maiden flight of the first production model commercial jet transport built in the United States, first sale of the 720 short-to-medium range jet transport and unveiling of the IM-99 Bomarc interceptor missile were major Boeing highlights in 1957.

Deliveries of KC-135 jet tanker-transport to the Strategic Air Command began in June, and B-52's continued to roll from the Seattle and Wichita plants.

Boeing announced its Seven-Twenty jet liner November 20 and United Air Lines disclosed its purchase of 11 of the transports the following Monday. United announced in December that it would purchase an additional 40 Seven-Twenties by 1965.

The first 707 Jet Stratoliner moved out of the Boeing Transport Division factory October 28 and made its first flight December 20. This plane, with several others now in the final stages of production, will undergo Civil Aeronautics Administration certification tests before delivery. First

delivery was to go to Pan American World Airways in 1958 for service in early 1959.

Successful test firings and drone intercepts by the Bomarc missile, which can carry either a conventional or nuclear warhead, led to a \$140-million initial production order from the United States Air Force in August. The Bomarc has a leading role in the new joint Canadian-U. S. (NORAD) defense system.

First photographs of the Bomarc were released in May and revealed the 47 foot long missile to be powered by a single Aerojet rocket for launching and two Marquardt ramjets for cruising at "extreme" altitudes. Bomarc is an air defense missile capable of destroying enemy aircraft or missiles long before they reach potential target areas.

A decision was made to build advanced models of the B-52 only at the Wichita Division, a plan initiated by the company to save the Air Force many millions of dollars in tooling costs. This step was part of an extensive cost reduction program conducted by Boeing.

The Boeing XB-52 arrived at the Wichita Division in March to receive installation of J75 engines in each of the outboard pods, thus making the original Stratofortress a six-jet airplane instead of the normal eight-jet configuration. Structural changes were made to the wing to accommodate the new engines, ground testing was completed and the airplane made its maiden flight in October. It was subsequently delivered to the Air Force for an accelerated J75 service test program.

In May, the B-47 once more made national headlines when the Air Force declared the six jet medium bomber capable of the spectacular "toss-bombing" technique, which calls for aerial maneuvering normally confined to fighter aircraft. The maneuver was proved feasible by the Wichita Division experimental flight test section and further developed by the Air Force.

The Strategic Air Command received its first KC-135 in June after the first ten had been delivered to the Air Research and Development Command for functional tests.

The 720 jet transport became the latest addition to Boeing's family of jet transports, now composed of three different models exclusive of engine differences. The 720's are designed to carry 88-130 passengers on flights of 200 to 1700 miles; the 707-120 models will carry up to 146 passengers on medium to long range flights and the 707 "Intercontinentals" will accommodate as many as 160 passengers on flights as many as 5000 miles.

The commercial jet transports, as well as the KC-135, were developed from the 707 prototype, a \$16-million company-financed project, which has accumulated nearly 800 flight test hours since its maiden flight July 15, 1954. In March, the prototype flew non-stop from Seattle to Baltimore in 3 hours 48 minutes for an average speed of 612 miles per hour.

The 707 has assisted CAA and air line authorities in determining schedules and airport facilities needed for jets through actual demonstrations.

Sale of three 707's to Empresa de Viacao Aerea Rio Grandese (VARIG) air line of Brazil and two to Compania Cubana de Aviacion during 1957 brought the total sales to 151 planes. At the end of the year, thirteen air lines had ordered 707's.

The Industrial Products Division, employing approximately 800 people, was developing and manufacturing small gas turbine engines in the 100 to 500 horsepower class. In early 1957 delivery of 240-horsepower 502-10C engines was made to the Navy for use as boat power plants and to drive minesweeping generators. A small quantity of 502-

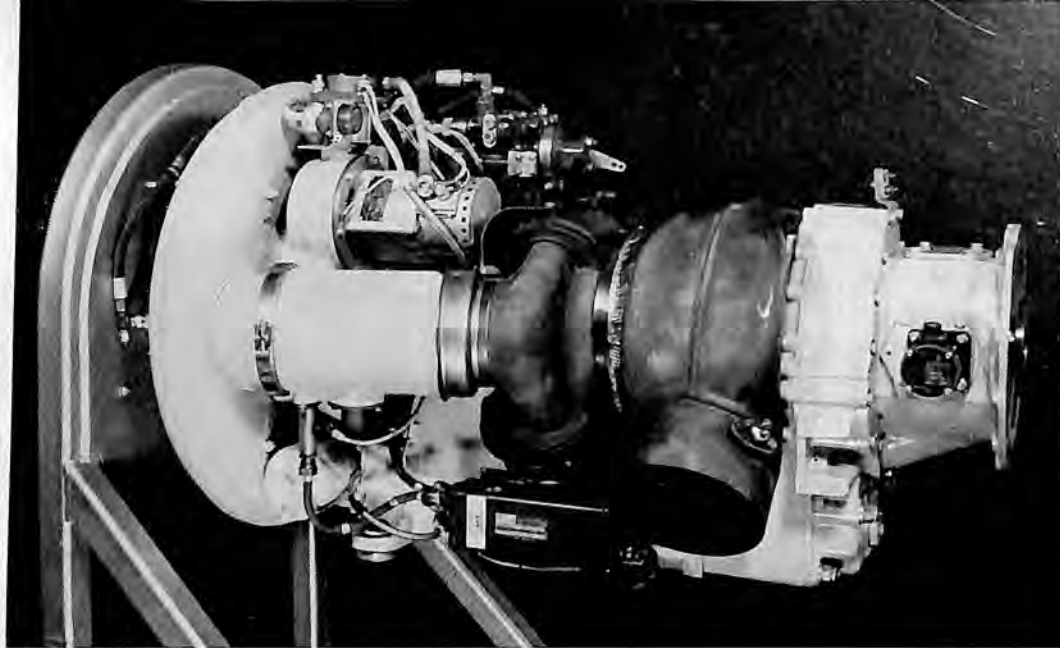


*Boeing sound suppressors.*

10C engines was sold to commercial organizations for experimental and service test purposes in boat, truck, and earth moving applications. Late 1957 saw start of deliveries of the 300-horsepower 502-10F for installation in the Radioplane RP-77D medium altitude target drone.

The compressor version of the 502-10C, the 210-air horsepower 502-11B, was being used by the Air Force and the Navy to provide ground air for start of large jet aircraft and operation of pneumatic systems.

Boeing research contributed two advances in manufacturing processes to the industry during 1957. A "breakthrough" in titanium fabrication was accomplished by the company and films of Boeing processes were loaned to companies and scientific groups throughout the nation. Airframe parts cutting and forming through the use of numerically controlled machines was another major achievement. Punched cards are fed through an electronic computer which sends impulses to a cutting or forming machine, directing all its actions.



*Boeing's 502-10C gas turbine engine.*

This method insures exact duplication of components requiring extremely small tolerances and eliminates the sizable rejection rate of manually cut or formed parts.

In September, new giant, 105-foot spar mills were placed in operation at Wichita for the B-52 program and that installation was underway on eight numerically controlled machines.

With the largest construction program in the history of the company underway, Boeing opened several new facilities designed to implement its extensive research programs and production schedules. Employees moved into the \$21-million Developmental Center during the summer and fall at the Seattle Division while the Transport Divi-

sion at Renton, Washington, opened its new commercial jet transport factory and a new office building for 4000 non-manufacturing employees.

In October aerodynamicists began tests in Boeing's new \$2-million supersonic wind tunnel, capable of duplicating speeds to Mach 4. Work also progressed on the company's flight test terminal for commercial jets.

As an example of community responsibility, Boeing at Wichita started operation in July of a new industrial waste treatment plant. One of the largest of its type in the nation, the plant receives alkaline and chrome wastes and converts them into water pure enough to drink.

### **BRANTLY HELICOPTER CORPORATION**

During 1957, Brantly was in process of setting up production facilities at the municipal airport in Frederick, Oklahoma. Preliminary design and

experimental work was being carried on at the main office in Philadelphia, Pennsylvania. The company is building the Brantly B-2 helicopter.

### **CESSNA AIRCRAFT COMPANY**

An increase in military volume during 1957 provided a boost in Cessna's sales. During the company's 1957 fiscal year, sales topped \$70-million, up from \$66-million in the preceding year.

Military business got off to a good start in early 1957 with the Air Force announcement of Cessna's winning the Air Materiel Command's light-twin competition for an administrative and light cargo airplane. The USAF placed a \$5-million plus order for 80 of the twin-engine commercial Model 310's.

In January, Cessna delivered the first five T-37

twin-jet trainers to the USAF. Later, the entire T-37 project was moved to Bainbridge Air Base, Georgia, a Southern Airways civilian contract primary flight school, where 20 students started using the T-37 after 30 hours in a prop-driven trainer. The class will finish training in March, 1958.

During early February, Cessna received an additional contract to provide horizontal stabilizers for the intercontinental Boeing B-52 bomber. The contract amounted to more than \$4.5-million.

Cessna's commercial airplane business made an

excellent showing during 1957 both in the U. S. and abroad. Commercial sales during the year were much better than expected. During the year, the company was producing the single-engine Model 172, 180 and 182's as well as the twin Model 310B. A fifth production model, the 175, was scheduled to join the Cessna family early in 1958.

During the first half of 1957, Cessna exported 250 airplanes to 28 different foreign countries. Central and South America received 201 of the total.

The company's commercial aircraft division launched a concentrated push during the year. New finance and lease plans as well as a drive to expand the firm's distributor-dealer organization were part of the over-all program.

In March Cessna delivered its 500th Model 310, and during May, the company produced its 30,000th airplane, a single-engine Model 172. This achievement came when Cessna was celebrating its thirtieth year as an airframe manufacturer. In November, 1957, Cessna topped off its year by building the 3000th L-19, a single-engine two-place observation and liaison airplane for the Army. Also, in November, under a licensing agreement, the Japanese rolled the first L-19's off the assembly line in a plant near Tokyo.

At mid-year, Cessna and the Hertz Corporation joined together in an agreement to provide the nation's travelers with a new rent-a-plane service which will be available through the nationwide network of Hertz offices. The new service will be handled by Cessna dealers that Hertz will license

to participate in the rent-a-plane plan. Service is expected to be available by early 1958.

In May the Army announced it would evaluate the T-37 trainer as a high-speed observation aircraft possibility. Later, three of the Cessna jets were delivered to the Army and evaluations are currently underway. By late May, the Air Force had accepted its first L-27.

On July 2nd, Cessna unveiled its new commercial Model 310B for 1958 with many new improvements for the flying businessman. More than 650 of the light twins are in service throughout the world today.

A few days later, the 310 made news when it became the first post-war designed light twin executive airplane to make the 2442 mile trip between Oakland, California, and Honolulu. Total time required for the crossing was 13 hours 51 minutes.

On August 30 Cessna delivered the first of an evaluation quantity of YH-41 helicopters to the Army. Two of the Army's new high performance helicopters were sent to Edwards Air Force Base for testing. Others were delivered to the Army Aviation Center in Fort Rucker, Alabama.

The first two phases of construction on Cessna's proposed new \$10-million Wallace Plant were completed in early September.

In early November Cessna started previewing its 1958 commercial line at a series of dealer meetings throughout the U. S. The new 172 for 1958 was shown to the public at a series of announcement showings on November 23-24. Models 175, 180, 182 and Skylane were to be shown early in 1958.

*Cessna built its 3000th L-19 in 1957.*



## CHANCE VOUGHT AIRCRAFT, INC.

The company's 40th anniversary year was marked by start of production of the Regulus II supersonic guided missile, first deliveries of the F8U Crusader to operational units of the fleet and development of a new super-speed all-weather interceptor.

Existence of the latter project was disclosed in June. The interceptor is designed for Mach 2 performance and will carry air-to-air missiles.

Initial flight testing was scheduled for the summer of 1958 and first fleet deliveries were programmed for 1960. Chance Vought received an initial contract for \$35-million for the new fighter, which will be powered by a Pratt & Whitney J75 engine and will incorporate a number of advanced electronic devices in its radar and fire control systems. An additional \$100-million contract was announced in December.

Test work continued on the Regulus II guided missile, which has a speed of more than twice the speed of sound, a range of more than 1000 miles and a ceiling of more than 50,000 feet.

Designed for launching from submarines, surface vessels and shore bases, the Regulus II is the follow-on to the shorter range Regulus I, which has been serving with the fleet since 1955 and has been proved out in more than 650 launchings.

During the year one Regulus I made its 18th flight and recovery. It passed the record of another Regulus I which was flown and recovered on its tricycle landing gear 15 times before it was intentionally expended on the 16th flight.

Regulus II will be carried aboard the USS Halibut, first nuclear-powered submarine designed to launch such missiles. The Regulus missiles can be launched off an enemy shore and streak hundreds of miles inland to deliver a nuclear warhead.

Conversion of the Navy's air striking power to 1000-miles-an-hour-plus fighters began in March when Fighter Squadron 32 at Cecil Field, Florida, became first fleet operational squadron to receive the Crusader. The delivery was made on March 25,

exactly two years from the day the first XF8U-1 experimental model made its first flight. At year's end, Crusaders were serving with fleet squadrons on both coasts. In September the XF8U-1 prototype, still very active in test work, marked up its 400th flight.

Production and deliveries of both Crusaders and guided missiles were reflected in the company's backlog of \$414-million for the period ending September 30. For the first nine months of 1957, Chance Vought had a net income of \$3,672,054, or \$3.37 a share. This represented an increase from the \$1,994,838, or \$1.84 a share, reported for a similar period in 1956. Sales of aircraft, guided missiles, parts and services for the nine-month period in 1957 totaled \$145,474,079, as compared with \$77,147,535 for the same period in 1956.

In December, the Navy awarded Chance Vought a contract totaling approximately \$200-million for production of a new version of Crusader aircraft, designated the F8U-2, and for continued production of the F8U-1 version.

Approximately 17,000 employees, including those in California in connection with Regulus and Crusader programs, were on the payroll as of September 30. The weekly payroll was approximately \$1.75-million.

In October the first group of Navy personnel who will operate the supersonic Regulus II guided missile began an intensive indoctrination course at the Chance Vought plant in Dallas.

Chance Vought continued construction of a \$3.8-million high speed wind tunnel which will test models of aircraft and guided missiles at speeds up to 3800 miles an hour, or five times the speed of sound. Initial shakedown of the tunnel, which will complement the company's low-speed tunnel, is expected in the spring of 1958.

On November 9 and 10 Chance Vought was host to more than 100,000 who visited the plant as the company observed its 40th anniversary as an aircraft manufacturer.

## CONVAIR

### A DIVISION OF GENERAL DYNAMICS CORPORATION

Highlighting Convair's 1957 production progress and facilities expansion at its five plants were the following major achievements:

Continued volume production of the Air Force F-102A Delta Dagger supersonic interceptor;

Start of extensive flight testing and production of two new Air Force supersonic aircraft: the B-58 Hustler bomber and the F-106A Delta Dart interceptor;

Beginning of exhaustive tests and pilot produc-



*Convair F-106A Delta Dart (left) and F-102 Delta Dagger.*

tion of the Air Force Atlas intercontinental ballistic missile, the first successful launching and test flight of Atlas, and establishment of Convair-Astronautics as an operating division;

Start of production on the Convair 880 jet transport;

Continued quantity production of the Navy Terrier guided missile and extensive testing of improved models;

Initiation of some and completion of other projects in a San Diego \$21-million capital improvement and expansion program.

As volume production continued at San Diego on the F-102A jet interceptor and TF-102A proficiency trainer, these aircraft were in active operation with more than 20 Air Defense Command fighter-interceptor squadrons by year's end. Simultaneously, F-106A production got under way at San Diego following first flight of the Delta Dart. First flight of the initial F-106A production aircraft took place August 31, 1957, and production flight tests began in October at Convair's Palmdale, Cali-

fornia, facility, adjoining the Air Force Acceptance Center.

Orders for the F-106A and its sister-ship, the twin tandem-seat F-106B, totaled \$263-million. The F-106B, under development at the San Diego plant, will carry the same armament and fire control system and be capable of performing the same missions as the F-106A. The latter has a more powerful engine—the Pratt & Whitney J75 turbojet—than the F-102A and is designed to fight at even greater speeds and altitudes. The F-106A's guided missile armament—carried in a bay under the fuselage—and sophisticated electronic fire control give this newest delta-wing interceptor an increased "kill probability." On command from the ground controller or pilot, its Hughes MA-1 integrated electronic guidance system directs the F-106A to its target through any kind of weather, day or night.

The B-58 Hustler went into limited production at Fort Worth. Its flight test program gained impetus with additional aircraft participating in various

parts of Phase I and II tests. At a July 10 national press showing, it was announced the Hustler had met or exceeded all performance specifications. Later, a high Air Force officer credited the 150,000-pound B-58 with speeds faster than twice that of a .45-caliber bullet—1130 miles per hour.

The Hustler was designed and built under the Air Force weapons system management concept under which Convair was given the responsibility for management development of all B-58 systems except the engines.

Pilot production began on the Air Force Atlas ICBM at San Diego, home of the Astronautics Division. In March, the division was elevated to full status as a Convair operating facility. J. R. Dempsey, former Air Force officer with broad experience in missile field, was named division manager.

The successful flight of Atlas occurred December 17, 1957, at the Air Force Missile Test Center, Cape Canaveral, Florida. It followed two launchings of limited success, on June 11 and September 25.

Convair-Palmdale, which functions as a San Diego operation, moved into its new \$12-million installation and San Diego's Plant II initiated a three-year \$2.5-million rehabilitation program. At Plant I, four sound suppressor buildings costing \$1-million were constructed for F-102A/F-106A engine run-ups, a \$3.5-million Mach 5 wind tunnel neared completion, a \$2.5-million engineering building modernization program began, and a \$450,000 steam plant modernization program was completed.

New orders were announced for the Convair 880 and more than \$4.5-million was allocated for new machine tools and special equipment as production began on the 615-mph luxury jet transport. Transcontinental, the new Argentine airline, and REAL Aerovias of Brazil, each ordered four Model 880s. The 48 on order include 30 previously ordered by Trans World Airlines and ten by Delta Air Lines.

New Convair 880 production equipment was installed, including a 105-foot Onsrud spar mill and a 75-ton Cyril Bath radial draw stretch forming machine, each worth more than \$500,000; a large drying oven for curing Scotchweld metal-to-metal bonding of wing panels; a 9-by-30-foot precision template camera worth \$50,000; and various milling machines and other heavy duty equipment. Construction of six wing bucks, each 90 feet long and 22 feet high, neared completion. First flight of the prototype 880 was scheduled for January, 1959. Deliveries start in 1960.

As negotiations for additional Convair 880 sales continued at home and abroad, the company estab-

lished separate managerships for export and domestic sales of this transport and other commercial aircraft and a European sales office was opened in Geneva, Switzerland.

Metropolitan 440 twin-engine transport production was scheduled to phase out in April 1958, by which time 199 Model 440's will have been built. During the year, 82 of the transports were scheduled for delivery. In June, Eastern Air Lines took delivery of one of its 20 Model 440's, this one the 1000th twin-engine prop-driven transport produced by Convair for military, commercial and private customers since the initial Convair-Liner 240 was delivered in 1948.

During the year, the division moved into a new 500,000-square-foot leased warehouse erected to centralize receiving, shipping and materials operations formerly scattered through the city.

At Fort Worth, Convair's specialized aircraft maintenance program, SAM-SAC, was completed in April. Since 1953, the plant inspected, modernized and repaired the Air Force's fleet of 383 B-36 intercontinental bombers. In September, a new Air Force modernization contract started a "substantial" number of F-102A's and TF-102A's through a modification program.

In addition to its B-58 production, the Fort Worth Division was building F-102A components; nose sections for its trainer counterpart, the TF-102A; and complete nose sections for the F-106B, tandem version of the F-106A. All these aircraft are assembled at Convair-San Diego. Fort Worth also is producing a number of tail fins and out-board wing assemblies for the Boeing B-52 jet bomber. These are shipped to Wichita, Kansas, for assembly.

Extensive testing of Atlas was initiated at static test facilities located at Sycamore Canyon, near San Diego, and at Edwards Rocket Base, California. On Point Loma, San Diego, missile components are tested.

Major part of the work was completed in 1957 on Convair-Astronautics' new \$40-million plant on the northern outskirts of San Diego. Personnel expect to begin occupying the facility in February 1958. It will comprise more than 1,250,000 square feet of floor space and consist of five major buildings and several smaller ones.

Krafft Ehrlicke, assistant to the technical director, received the American Rocket Society's 1957 Astronautics Award for outstanding contributions to the advancement of space flight.

At Daingerfield, Texas, Convair continued its operation for the Navy Bureau of Ordnance of the

Ordnance Aerophysics Laboratory. Research and development progressed for the armed services in the full-scale testing of jet engines and supersonic wind tunnel models for classified projects.

The Convair-Navy research, development and volume production program of Terrier supersonic, anti-aircraft, surface-to-air guided missiles at the Naval Industrial Reserve Ordnance Plant in Pomona included weapons, systems analysis, and the preliminary design of new and improved guided missiles components. Convair-Pomona also pro-

duced Terriers for the Marine Corps and continued production of components for the F-102A interceptor.

Convair Division employment, which totaled 64,205 in late October 1956, stood at 66,333 on October 1, 1957. Year's peak was 73,716, attained in June.

B. F. Coggan and C. F. Horne, managers of the San Diego and Pomona divisions, respectively, were elected Convair vice presidents during the year.

### DOMAN HELICOPTERS, INC.

Doman completed plans in 1957 to put its LZ-5-2 helicopter into production during 1958.

An engineering contract to design a two-place helicopter for the Army was also completed in 1957.

Doman also acquired West Fabrication Laboratories, Annandale, New Jersey, a producer of helicopter rotor blades, molded laminated doors and windows, laminated wooden boats, small aircraft parts and molded gutters for bowling alleys.

A General Products Division for the development, manufacture and sale of a varied line of services and products other than helicopters was also established.

Services offered by the new division include machining; sheet metal work and assembly; gas, arc and heliarc welding; jig and fixture fabrication; aircraft engineering and design prototype development and related services.

### DOUGLAS AIRCRAFT COMPANY

Record deliveries of commercial airplanes, substantial progress in the manufacture of the DC-8 jet transport, and notable achievements in the development and manufacture of missiles marked the activities of the Douglas Aircraft Company during the past year.

Delivery of DC-6 and 7 type aircraft reached

a peak of 16 per month in June and was continuing at that rate at the end of the year. Moving from the same assembly line were DC-6A, DC-6B, DC-7, DC-7B and DC-7C airplanes. The intercontinental DC-7C started into service on additional airlines throughout the world.

A KLM-Royal Dutch Airlines DC-7C set a non-

*Delivery of Douglas DC-7 aircraft reached peak in June.*





stop record of 6,148 miles in 21 hours 52 minutes from Long Beach to Paris. The flight was made in May on the anniversary of Charles A. Lindbergh's New York to Paris hop 30 years earlier.

Wing-joining of the DC-8 took place on schedule in October at the new \$20-million jet transport facility in Long Beach. The new DC-8 buildings were dedicated at a ceremony in May. The jetliner is scheduled to fly in the spring of 1958.

In the military field, the Military Air Transport Service took delivery on the first of the giant C-133 transports in August at Dover Air Force Base.

A new version of the Navy A3D Skywarrior, the A3D-2, went into service early in the year. Production for the Navy continued on the A4D Skyhawk attack bomber and the F4D Skyray interceptor. A new version of the A4D, the A4D-2, also went into production at the El Segundo plant.

Last of 3180 AD Skyraiders, one of the Navy's most famous and versatile planes, came off the production line at El Segundo in February.

Production on various versions of the B-66 Air Force bomber continued at the Long Beach and Tulsa Divisions. A new weather reconnaissance version known as the WB-66D, built at the Tulsa plant, was placed in service by the Tactical Air Command.

The Douglas-built Thor, the Air Force intermediate range ballistic missile, was successfully fired from Cape Canaveral, Florida, during a year that saw stepped-up activity in all phases of the nation's ballistic missile program.

Another notable event was the successful firing in Nevada of the Douglas-built Genie, first air-to-air rocket with an atomic warhead. This new Air Force missile is operational and is in the hands of Air Defense Command units.

Existence of Nike Hercules, an improved version of the Nike surface-to-air missile with many times the destructive power of the original, was revealed by the Army. Douglas has been associated with the Western Electric Company, prime contractor, in development and manufacture of the Nike missile system. Nike Ajax was the initial version of the missile.

Production continued on the Army's Honest John surface-to-surface missile. Several other missile projects were under development.

Curtailment of defense spending resulted in cancellation of the huge Air Force C-132 transport, which would have been the world's largest airplane, the Navy F5D Skylander interceptor and the Navy A1D-3 Skyhawk attack plane.

In addition to the DC-8 buildings at Long Beach, new company facilities included a missile test site near Sacramento on which \$3-million in company funds were spent. The Air Force bore the rest of the cost. One of the most important activities scheduled for the base was captive firing of the Thor missile.

Chief among personnel changes during the year was the elevation of Donald W. Douglas, Jr. to the presidency of the company from the position of vice president-military relations. Donald W. Douglas, Sr. relinquished the presidency but continues as chairman of the board and chief executive officer of the company. Frederic W. Conant was advanced to the position of vice-chairman and will function as chief executive officer in the absence of Douglas, Sr. General Ira C. Eaker joined the company in October and was elected vice-president in charge of the eastern offices.

Honors to company personnel included the selection of Arthur E. Raymond, vice president in charge of engineering, to receive the 1957 Daniel Guggenheim Medal for the "development of a long line of successful civil and military aircraft."

The company reached the final quarter of the year with an increase in sales and earnings over the previous year. Net earnings of \$26,030,472 resulting from record sales of \$828,417,000 were reported for the first three quarters of the 1957 fiscal year. These figures compare with a net of \$20,596,000, or \$5.56 per share, on \$711,286,000 in sales for the comparable period of 1956.

Current earnings, equivalent to \$7.03 per share of capital stock outstanding, were reduced to \$24,710,406 or \$6.67 per share by a renegotiation refund for the 1953 fiscal year of \$1.320-million, paid during the first quarter. This refund is under appeal by the company.

Employment reached a peak of 83,000 in June, a new peacetime high, at the company's five divisions, Santa Monica, Long Beach and El Segundo, California; Tulsa, Oklahoma, and Charlotte, North Carolina.

It was expected to drop to about 76,000 at the end of the year.

Progress on aviation's cockpit instrument panel of the future, designed and developed under a prime contract to the El Segundo Division as an Army-Navy program, was revealed. The device consists of a revolutionary, transparent, flat plate television tube which produces an artificial picture of outside flying conditions through use of a new, miniature computer.



*Fairchild re-enters commercial aircraft field with F-27.*

## **FAIRCHILD ENGINE AND AIRPLANE CORPORATION**

### **AIRCRAFT DIVISION**

Production of the Fairchild F-27 propjet transport marked the re-entry of Fairchild into the commercial aircraft field and climaxed a six-year program of development and testing of the new aircraft which was sponsored jointly by Fairchild and Fokker Aircraft Company, Amsterdam, Holland.

When delivery of the first F-27 is made early in 1958 to West Coast Airlines it will be the first American manufactured turbine-powered aircraft to go into commercial airline service. In addition to West Coast, the 40-passenger successor to the DC-3 will be delivered in 1958 to Piedmont Airlines, Bonanza Air Lines, Southwest Airways, Mackey Airlines, Northern Consolidated Airlines, Quebecair, Wien Alaska Airlines, Wheeler Air Lines, AVENSA (Venezuela), AREA (Ecuador), and Linea Aeropostal Venezolana (LAV).

Fourteen corporations also have purchased the 300-mile-per-hour-plus executive version of the high-wing aircraft, bringing the 1957 year-end total of orders and options to 84.

Development and production of the F-27 is one of the major parts of a "diversification for stabilization" program emphasizing research, production, modification and sub-contract efforts.

The division received an Air Force contract calling for production of 18 additional C-123 assault and logistics transports, bringing to nearly 300 the total number of these aircraft Fairchild has manufactured or has on order. A number of C-123's

were equipped with a new wheel-ski gear and are scheduled for assignment to the Northeast Air Command and will be used for cold weather operations in the Far North. The division also developed a new wide-tread main landing gear for the C-123 to further improve its rough terrain performance.

C-123 assault-logistics transports in service with the USAF have established an impressive flight safety record. These aircraft have been involved in less than 10 accidents, three of which occurred during extremely hazardous DEWline logistics operations, and none of the accidents involved fatalities or were charged to mechanical failure or faulty design.

The division during 1957 received a new \$47-million sub-contract for the production of three major components for Boeing B-52 intercontinental jet bombers. Fairchild is the sole source sub-contractor for vertical fins, outer wing panels and major fuselage sections of the B-52. The division also received a "follow on" contract for modification and repair of B-26 bombers, and a \$12-million contract from the Army Signal Corps to manufacture a quantity of high-speed surveillance drones.

Developmental work on the Goose weapons system, a highly classified project, reached advanced stages during 1957 and has great potential as a major production activity.

New projects announced during the year include design and development of a four-engine turboprop

transport to be known as the Turboboxcar, a research program on "jet wing" aircraft, a research and development contract from the Army for the M-224-1 "Fledgling" incorporating the principle of the vectored slip stream, and a research program to develop a radically new type of landing gear based on use of a folding tire.

The Turboboxcar, designed as the successor to the Fairchild C-119's and C-123's now in use by the military services, will have boundary layer control, enabling it to operate from short fields and from the decks of aircraft carriers. It will have a takeoff gross weight of 75,000 pounds and will be able to carry more than 32,000 pounds of cargo over short ranges and in excess of 21,000 pounds at a range of 1500 miles.

The "jet wing" concept, as now contemplated, incorporates the distribution of engine exhaust over the trailing edges of the wing flaps. The "Fledgling" is designed to prove the principle of the vectored slip stream, considered to be one of the most practical approaches to production of a plane capable of taking off and landing vertically. It is expected that the "Fledgling" will combine the most desirable features of the VTOL (Vertical Takeoff Or Landing) and the high cruise speed of fixed wing aircraft.

Fairchild's new folding tire and landing gear system, now in the prototype stage, will provide a high pressure tire for use on paved landing surfaces, a low pressure unit for use on unprepared fields, and for the complete deflation of the tire in

flight. Design characteristics of the new tire permit it to be deflated after takeoff and folded somewhat like a bellows, thus reducing the storage size to about one-eighth that of the inflated tire.

#### ARMALITE DIVISION

The Air Force in 1957 adopted as standard the MA-1 survival rifle (Fairchild designation AR-5), and the government of Nicaragua became the first purchaser in quantity of the Armalite AR-10 lightweight automatic rifle. Negotiations were in progress with several European countries for additional purchases of the AR-10.

Under license by Fairchild, the AR-10 rifles will be manufactured in Holland by Artillerie-Inrichtingen, which is tooling to produce 10,000 of the rifles per month beginning January 1, 1958. Both the MA-1 and the AR-10 are part of a series of lightweight weapons developed by Fairchild, and are manufactured of light metals and plastics. The AR-10 weighs less than seven pounds, and fires the 7.62 mm. NATO cartridge at a rate of more than 600 per minute. The MA-1 survival rifle weighs approximately two and a half pounds. Barrel and action can be disassembled without tools, to be stowed in the plastic stock and made a part of the USAF survival kit. The rifle floats in water, whether assembled or disassembled.

The Armalite Division was also developing several other versions of both the AR-10 and the MA-1, as well as a line of lightweight shotguns with anodized aluminum barrels in a variety of colors.

*Air Force ordered 18 additional Fairchild C-123 transports.*





*Fairchild's high-speed surveillance drone.*

#### **ELECTROTECHNICS DIVISION**

The Fairchild Electrotechnics Division, under an Air Force contract, continued development of manufacturing methods and production-type machinery for resistance welding of stainless steel "sandwich" material. The material is designed for use in both structural and semi-structural parts of aircraft and missiles exposed to extremely high temperatures produced by supersonic flight or by power plant heating. In this connection, the division has developed a superior type of temperature-resistant honeycomb material called Ribboncore.

#### **GUIDED MISSILES DIVISION**

The Fairchild Guided Missiles Division, which developed and produced the Petrel air-to-surface missile now in operation with fleet air units of the Navy, in 1957 embarked on an expanded program of research and development in the missile and allied fields.

Security restrictions prevented the disclosure of many of these projects. 1957 activities of the Division included initial deliveries to the Navy of a bombing system trainer, receipt of a contract to develop a bombing and navigation simulator for the Navy P6M, development of a missile guidance system for the Army Signal Engineering Laboratories, and initial delivery of a guidance system for a new missile.

The Division also modified and serviced SPQ-2 radar for use with the Chance Vought Regulus missile, and initiated flight testing of a new concept in electronic measurement for the USAF.

The Plastics Department of the Division, at Copiague, Long Island, N.Y., designed and manufactured numerous types of plastic products, including structural and functional parts for the aircraft industry such as wings, fairings, wing tips, radomes and control surfaces. Other plastic products include various types of containers, including a shipping container for J57 engines; a 14½-foot aluminum honeycomb polyester skin radar reflector; and sextant carrying cases, plastic Bazookas, drogues and JATO bottles.

#### **STRATOS DIVISION**

During 1957, Stratos continued the production of accessories and systems for military and commercial turbojet, turboprop and piston-powered aircraft in its plant at Bay Shore, Long Island, and at Manhattan Beach, California.

Among other items in production were air cycle refrigeration systems of varying capacities, constant speed air turbine drives, high pressure compressors, anti-submarine warfare equipment, fuel flow proportioners and pneumatic actuators. Going into production in 1957 was a new ground air cooler package to be included in all-purpose ground service vehicles for military and commercial aircraft.

The plant at Bay Shore neared completion in 1957 of an expansion of the manufacturing area and the erection of a two-story test laboratory.

The division introduced for the first time in operating aircraft in the United States the unique compressor known as the Heli-Rotor, featuring positive displacement and built-in compression ratio. The Heli-Rotor is the vital element in a vapor cycle cooling system which is part of the cabin pressurization and cooling system devised by Stratos for the new F-27 propjet transport being produced by Fairchild.

Driven by a turbine, electric or hydraulic motor, or directly from an accessory shaft on a prime mover, the Heli-Rotor compressor consists of a pair of intermeshing rotors which mesh with a rolling rather than a sliding motion. Power is applied to the "male" rotor. The "female" rotor acts as a moving seal, and is driven by timing gears. Compression is achieved by reducing the volume of the trapped charge of gas as it passes through the chamber and is "squeezed" by the intermeshing rotors before it leaves the discharge port.

The Western Branch of Stratos completed an extensive test installation for the development of large valves for guided missiles, and now holds contracts for the development of a number of valves for ballistic and other types of missiles.

The test installation can handle valves up to 12" in diameter, which are needed to handle the fluid flows demanded by the larger missiles.

Included in the new cryogenics facility are a 100 psi, 1100 cfm air compressor and arrangements which permit the simultaneous testing of water, fuel and liquefied gas. With them, it is possible to test missile and aircraft components designed to control liquefied nitrogen and oxygen, anhydrous ammonia and other fluids to measure pressure drops, surge pressures and effect of thermal shock.

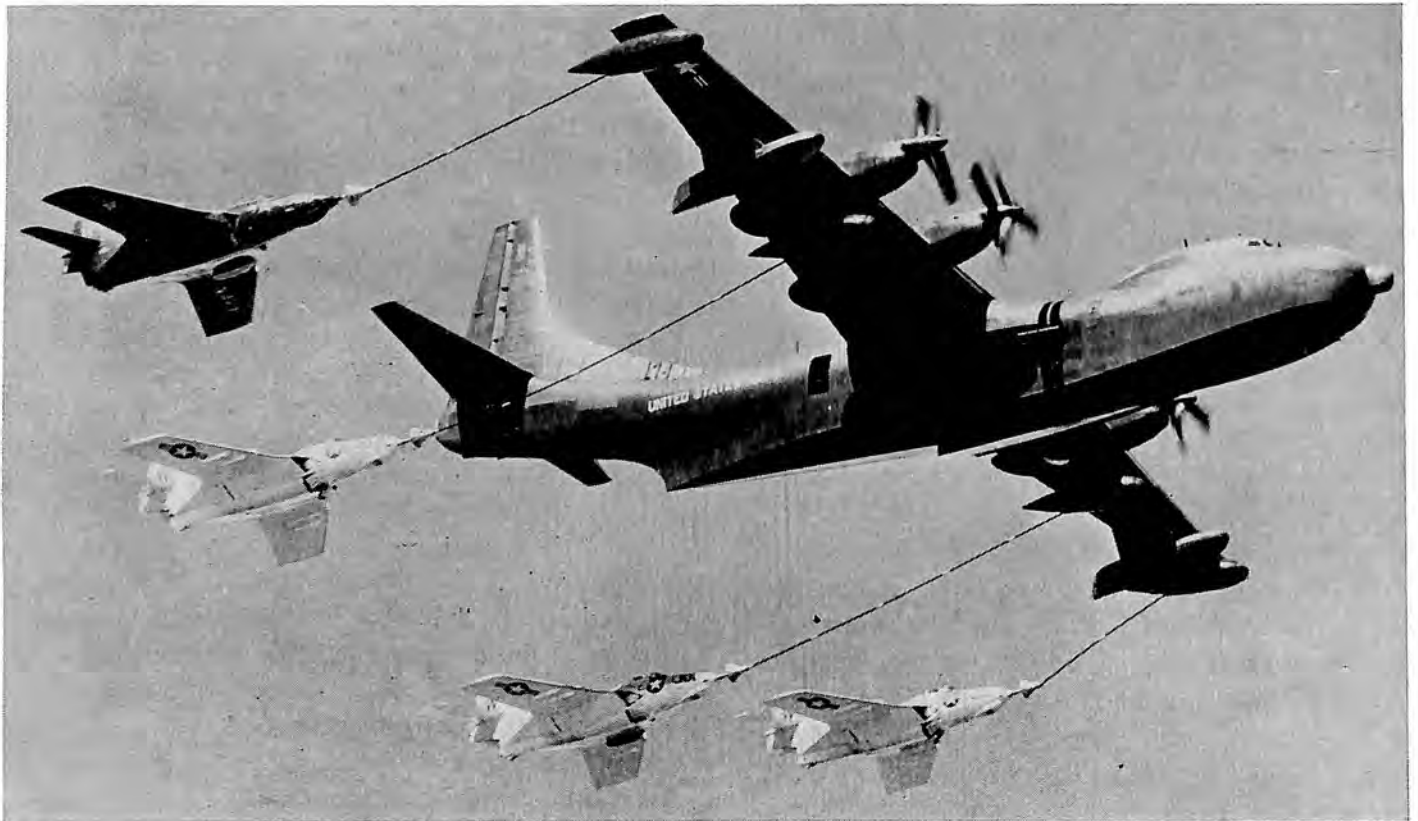
## FLETCHER AVIATION CORPORATION

Fletcher's primary business during the year was the design, testing and production of external fuel tanks. Among the company's products were a 1700 gallon tank for the Boeing B-47, a 150 gallon tank for the Grumman F9F and a 230 gallon tank for the Lockheed T2V.

Fletcher also continued development work on in-flight refueling equipment. A production quantity of 250 gallon per minute in-flight reels were

made for Convair's R3Y flying boat. Design work was completed on 300, 600 and 900 gallon per minute reels, each of which is equipped with automatic controls that can be operated by the pilot, eliminating the need for a separate operator.

Production of the FU-24 utility airplane was continued and further development work was accomplished on the Flair 115 airborne vehicle.



*Fletcher refueling reels installed on Convair R3Y.*

## GOODYEAR AIRCRAFT CORPORATION

Goodyear Aircraft continued production in the lighter-than-air field in both ASW and AEW Airships. The largest non-rigid airship ever built entered the final stages of construction. Goodyear also launched a ZPG-2W Airship, carrying the largest antenna ever constructed for the Navy in AEW missions.

An evaluation quantity of the Inflatoplane was being constructed for both the Navy and Army.

Development work was progressing rapidly in

the field of high temperature resisting plastics for planes and missiles. Production of electronic analog computers maintained a high level and production of rocket booster cases continued at near capacity. Aircraft and missile guidance systems were being produced in quantity. Radar antenna structures were being built in several different designs for many different phases of the defense of United States.

## GRUMMAN AIRCRAFT ENGINEERING CORP.

Grumman continued a move toward increased diversification, chalking up three major developments in 1957. Foremost was the Long Island firm's re-entry into a commercial market it abandoned at the outset of the Korean conflict. The new product, a turbo-prop executive transport named "Gulfstream," was expected to roll off production lines late in the year.

The second major item on 1957's calendar of developments was the company's joining Army ranks for the first time. The product: a new higher performance observation airplane (the Mohawk) that was selected in design competition by both the Army and Marine Corps.

The observation airplane, when in production, will make Grumman a supplier of various types of aircraft to all military services.

Third, Grumman closed the year with the December 31st announcement that it was the winner in design competition for an attack airplane for the Navy. Designed for high and low altitude operation, the carrier-based aircraft will be turbojet powered and will be manned by a crew of two.

Beyond these developments, Grumman completed production of its F9F-8 Cougar, continuing a full scale schedule on the production of the F9F-8T two-seat fighter/trainer version of the Cougar.

Other production aircraft included the F11F-1 Tiger jet fighter, the S2F Tracker anti-sub aircraft, the TF-1 Trader cargo and passenger airplane and the WF-2 Tracer, an early warning aircraft.



*Grumman's new turbo-prop executive transport.*

The rugged SA-16A Albatross amphibian was in production for Indonesia under the Mutual Defense Assistance Program, with Air Force and Coast Guard "A's" undergoing a modification program at the Long Island plant. Modified aircraft (SA-16B's) have a greater wingspan, offering increased range and altitude capabilities.

## HILLER HELICOPTERS

Hiller's role as a producer of vertical lift devices continued to grow in 1957 with the introduction to service of the Army H-23D helicopter. Initial deliveries of the aircraft, which has a drive system designed for 1000 hours between overhauls, were made late in the year.

The Flying Platform program continued under Army sponsorship. The new three-engine ducted fan platforms were completed and started into their test programs designed to bring closer to practical utilization the radical new concept for lift and simplified control.

Hiller's one-man helicopter, the XROE-1 collapsible Rotorcycle, was successfully demonstrated

during the year. The Rotorcycle was designed and developed for Marine Corps use.

The transport-size X-18 tilt-wing VTOL, being built for the Air Force, was largely completed during the year and scheduled for early roll-out and flight test. Earlier, a series of X-18 wind tunnel tests at Langley Aeronautical Laboratory of the National Advisory Committee for Aeronautics had proved successful.

In the commercial field, Hiller continued sales missions of its 12-C, with emphasis focused on South America and Australia. The company also embarked on a program to help communities establish practical standards for heliports.

## HUGHES AIRCRAFT COMPANY HUGHES TOOL COMPANY

Early in 1957 the Air Force and Hughes revealed the existence of a new air-to-air guided missile. The missile, a new version of the Hughes Falcon designated GAR 1-D, was developed in the Culver City Laboratories and was being manufactured at Tucson, Arizona. The GAR 1-D is a radar-guided supersonic missile designed to be carried by all-weather jet interceptors like the Northrop F-89H and the Convair F-102A.

Hughes Tool Company was also active in the aircraft business in 1957. In mid-January the company unveiled the Hughes Model 269 ultra-light two-man helicopter. Only eight and one-half feet high, its empty weight of 850 pounds is about half that of the smallest operational helicopters accommodating more than one man. Its length is 19 feet 5 inches, and diameter of the 3-blade main rotor is 25 feet. Skid-type landing gear is used. Its lifting capacity, 900 pounds, is more than its weight.

Hughes Aircraft Company continued to expand during the year and a new electronics plant and engineering facility were planned for Fullerton, California.

Continuing to expand in the student-aid field, the company started a work-study plan for undergraduates, with full payment of college tuition and related expenses for students while they work part-time in their chosen fields. The new program was expected to raise to nearly 950 the number of part-time or full-time employees studying for degrees at company expense in its extensive engineering scholarship plan. The program was extended to undergraduates outside the company for the first time.

In March Hughes was awarded two Air Force contracts totaling \$15,486,692 for work on airborne electronic armament control systems. The following month the company created a new department

of nuclear electronics, for studying the effects of nuclear radiation on electronic equipment, at the Culver City plant.

HAC established a unique scholarship program for high school students majoring in science or mathematics. The program combines paid research experience with a cash grant for college. Twelve juniors and seniors selected from public schools in the Greater Los Angeles area worked for pay at the Hughes Culver City Laboratory in the summer on a ten-week research project. Each received an additional \$400 grant to attend the college of his or her choice upon graduation.

In mid-summer Hughes Aircraft Company unveiled a new guided missile based on detection of infra-red radiation.

Designated GAR-2A it was the latest in the Falcon GAR series of air-to-air missiles produced for all-weather interceptors of the Air Defense Command. Secret of the weapon's operation is its revolutionary guidance unit which senses, at a distance of miles, the infra-red radiation thrown out by invading aircraft. Chief difference between the GAR-2A and the GAR-1 and ID missiles lies in the IR guidance nature of the 2A; the others are guided by radar.

Probably one of the biggest advances of the year by the HAC was the development of an airborne miniaturized digital computer that can fly an Air Force jet interceptor airplane, through all phases of supersonic combat, from takeoff to touchdown, leaving the pilot free to make tactical decisions. Called Digitair, it is small enough to fit into the cabinet of a 21-inch table model television set, yet, it can make 9600 basic arithmetical computations in one second and render 6250 decisions in one minute. Its extremely light weight, 120 pounds, was made possible through new advances in miniaturization techniques.

## KAMAN AIRCRAFT CORPORATION

Highlight of 1957 for Kaman was the receipt of a prototype quantity contract for the HU2K-1 helicopter, winner of a Navy Bureau of Aeronautics competition. Of two entries submitted by Kaman, the company won a single-rotor design powered by General Electric's T58 engine.

Kaman also won an Air Force competition for a local crash rescue helicopter using its Navy HOK-1 to demonstrate the technique of airlifting fire fighting equipment and a rescue team to the scene of a crash. The company received an Air Force contract for the production of two types of

crash rescue helicopters: the H-43A powered by a Pratt & Whitney Wasp R-1340 engine and the H-43B powered by Lycoming's T53 gas turbine.

During 1957 Kaman produced HOK-1 helicopters for the Navy and Marines. The company also received a contract to produce HUK-1 helicopters (modified HOKs) for the Navy.

In October, Kaman leased 300,000 square feet of additional production space and aircraft manufacturing equipment in Moosup, Connecticut, to supplement the main plant in Bloomfield, Connecticut. The Moosup plant is now turning out subassemblies for the main plant and will add Kaman's subcontract operations to its activities in the near future.

Early in the year Kaman formed its Nuclear Division in Albuquerque, New Mexico. The Nuclear Division is engaged in systems analysis and research in the fields of nuclear ordnance and the application of certain aeronautical devices to the special weapons field.

In the fields of research and development, Kaman Aircraft has contracts with the Army, Navy and Air Force and in addition is carrying out certain Research and Development programs with its own



*Mockup of Kaman's new HU2K-1.*

funds. Included are robot helicopters, Rotochutes, STOL aircraft and other projects which are classified.

Kaman reached its highest employment level with 1400 employees. Sales for the first six months of 1957 totaled \$7,139,800 compared to \$6,497,000 for the first six months of 1956. Backlog as of December 1957 was approximately \$33-million.

## LOCKHEED AIRCRAFT CORPORATION

The new, turboprop Lockheed Electra rolled out of the plant in November of 1957, a month ahead of schedule. First flight took place December 6, 56 days ahead of schedule. Electra orders increased

during the year to 144 planes for 11 airlines.

Flight testing of the Air Force F-104A Starfighter neared completion and the ultrasonic day-and-night fighter was being prepared for early entry into serv-

*Lockheed's Georgia division builds the C-130 Hercules transport.*





ice with Air Defense Command.

The JetStar jet utility transport started its flight test program after a prototype construction period of only 241 days. A sales program for the 10-passenger plane, designed for military requirements, was launched.

The company also completed deliveries of 25 1649A Starliners for TWA's "Jetstream" service, under one of the largest single commercial contracts ever undertaken by Lockheed.

Production of T-33 jet trainers for the Air Force and P2V-7 Neptune anti-submarine warfare planes for the Navy was continued.

Lockheed also received a marked increase in its orders for the Polaris, solid-propellant intermediate range ballistic missile being developed for the Navy. During the year, the Missile Systems Division's backlog rose to about \$100-million—more than four times higher than last year's figure.

For the first nine months of 1957, sales totaled \$645,727,000, a company record. Total commercial sales for the period—for 68 Super Constellations and 1649A's—were \$175,356,000, also a record.



*Cargo is loaded into Hercules propjet air freighter.*

## THE MARTIN COMPANY

In keeping with the current industrial trend toward shorter names, company stockholders approved in April a change of the firm's official name from "The Glenn L. Martin Company" to "The Martin Company."

The year was also marked by an expansion of facilities at the new Denver and Orlando Divisions and a revision of the organizational corporate structure to handle the added management responsibilities. A corporate staff was created to determine policies and goals and to evaluate and control the business as a whole. A vice president and general manager was appointed for each of these new

divisions and for the Baltimore division.

On November 18, the Company created a new division under one of its most experienced vice presidents to expedite on-the-spot arrangements for launching both the Navy Vanguard satellite rocket and the Air Force Titan intercontinental ballistic missile. This division will be responsible for all Martin activities at Patrick Air Force Base and Cape Canaveral, Florida.

At Denver, where Martin is developing the Titan intercontinental ballistic missile under a \$358-million contract from the Air Force, work shifted from interim facilities to the permanent plant about 20 miles southwest of the city. Besides 306,700 square feet of factory space, an engineering and administration building of 155,400 square feet, and the necessary power and maintenance facilities, the building complex includes a cold flow laboratory and four captive firing stands for static tests of the mammoth missile. Manufacturing, assembly and testing operations can all be carried out at this division.

In Orlando, Florida, Martin began production of two missiles—Lacrosse and Bullpup—and the Missile Master, an electronic system for coordinating Nike and Hawk anti-aircraft batteries. The Navy Bullpup is an air-to-surface missile designed

*Navy LSD takes aboard a Martin P5M patrol seaplane to illustrate new concept of mobile seaplane striking forces.*



to provide light attack aircraft with an accurate, relatively inexpensive weapon against tanks, pill-boxes, truck convoys, and other small but important targets.

During most of 1957, Martin-Orlando carried on production in temporary facilities. The \$18.6-million plant, which includes half a million square feet of floor space, was scheduled to operation in January, 1958.

In Baltimore, Martin continued production of two new versions of the USAF TM-61 Matador. In April, the Air Force revealed that the Matador tactical missiles already in operation around the globe were being replaced by the TM-61C, which boasts greater accuracy than the TM-61A, a vastly improved guidance system, and high resistance to electronic countermeasures. The TM-61B, which the Air Force recently redesignated as the TM-76, is longer and has a shorter wing span. It has greater range, a folded-wing design which facilitates speedy assembly at its launch site, and the ability to carry out either high or low-level attacks. Martin also developed "drag" chutes and other devices which permit the Air Force to recover intact the Matadors used as target or test drones. In June, the company delivered its 1000th Matador (including all types) to the Air Force.

In July, a 41,000 square foot structural test building was completed at the Baltimore Division. It can be used to test complete assemblies of the giant P6M SeaMaster.

Flight tests of the SeaMaster were scheduled for resumption near the end of the year. In February, a P5M Marlin was used to demonstrate the Navy's ability to service seaplanes in an LSD (Landing Ship Dock). Later in the year, Martin proposed a new series of 8 to 10-jet seaplanes, each capable of

transporting more than 400 passengers or three light tanks or a fully-equipped infantry company with vehicles and three days of supplies. Operating from natural "indestructible runways," the seaplanes would provide logistical support anywhere in the world.

In April, the Navy let a contract of more than \$24-million for Martin to modernize the power plant, electrical and electronic systems of eighty early P5M Marlins and to add magnetic airborne detection units to increase their efficiency on anti-submarine patrol duty and air-sea rescue operations. The program was expected to last through most of 1959.

Major components of the Vanguard satellite launching rocket were flight-tested successfully in May and October. The first and third-stage engines were flown. The October test also proved the aerodynamic soundness of the full Vanguard configuration, since "dummies" of the second and third stages were mounted atop the "live" first-stage engine. On December 6, 1957, the first complete test vehicle was launched unsuccessfully.

During the year, production was completed on the B-57E, a twin-jet tow-target airplane which can be converted for use as a tactical bomber. Field tests continued on the use of the latest types of frangible aerial targets with the B-57E.

Atomic research continued in Martin's Nuclear Division, where a contract was signed in August to supply four tubular fuel element assemblies to the Phillips Petroleum Company for use in its Material Test Reactor. Among the atomic projects under development at Martin are a 12,500-kilowatt Water Reactor Power Station and a 1000 to 2000-kilowatt "packaged" power plant which can be transported by air to remote locations. In late

*Flight tests of the Martin SeaMaster resumed at year-end.*





*Martin's electronically controlled milling machine.*

1956, The Martin Company formed "Martin International," a wholly-owned subsidiary to explore and develop world markets for such nuclear-powered electrical generating systems.

RIAS, Inc., transferred its activities from Baltimore to a four-and-a-half acre estate in nearby Ruxton, Maryland, chosen to provide "the ideal atmosphere for its research program." The Research Institute for Advanced Study was formed in 1955 to carry on basic studies in science without any tie to product development or production problems at Martin itself. The stately English-style mansion gives the RIAS staff of about 40 three times as much room as they had in their city quarters. In July, RIAS was awarded a contract by the National Science Foundation to develop instrumentation to be used in an artificial earth satellite to carry

out fundamental measurements of the heavy cosmic ray flux outside the densest part of the atmosphere.

In 1957, Martin put into operation an electronically controlled milling machine. Built to Martin specifications by the Research Laboratories Division of the Bendix Aviation Corporation, the 50-ton device uses a punched tape control system to turn out structural parts for the SeaMaster.

A number of new production methods, testing devices and components were developed during the year. To drill and countersink thousands of rivet holes in the skins of its new SeaMasters, Martin produced a vacuum assembly which holds the drill at the proper angle, then slides it automatically along a track to the next position. Savings in time and tooling costs amount to about 85 percent, and the operation is carried out with great accuracy. A high-speed precision tube tester was developed to meet the growing demand for large quantities of electron tubes in the highly complex guidance and control systems of today's missiles and aircraft. A new airborne cooling system was designed and produced to keep electronic equipment within operating temperature ranges even during flights at speeds up to Mach 5. A low-cost, portable jet engine muffler was developed during 1957 to reduce the noise of aircraft during ground preparations.

Martin's corporate sales for the first nine months of 1957 were \$308,186,621, as compared to \$228,766,424 for the same period in 1956.

## McDONNELL AIRCRAFT CORPORATION

The year 1957 was a record-making one for the F-101 Voodoo.

On December 12, Major Adrian E. Drew piloted an F-101A Voodoo to a new official world speed record of 1207.6 miles per hour.

Just 15 days earlier, RF-101 Voodoos had set three transcontinental records as part of "Operation Sun Run." One RF-101, piloted by Lieutenant Gus Klatt, had flown from Los Angeles to New York in 3 hours 7 minutes.

Another Voodoo, flown by Captain Robert Sweet, flew non-stop from Los Angeles to New York and return, setting a West to East record of 3 hours 36 minutes and a round trip mark of 6 hours 46 minutes.

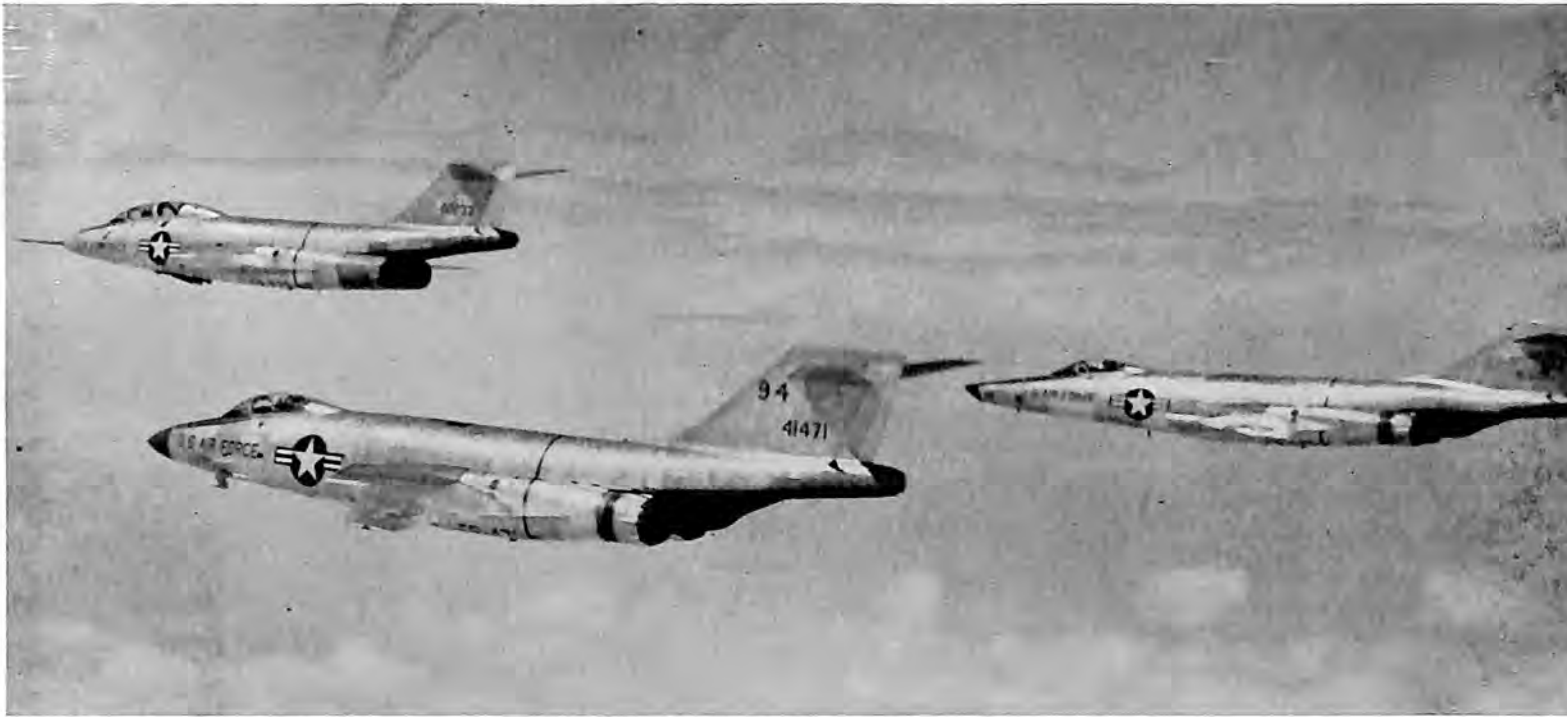
A total of six RF-101's had taken off in the grey dawn from Ontario International Airport in Cali-

fornia to participate in Sun Run. The two spares dropped out quickly as planned, when it was apparent that the four airplanes were performing flawlessly.

All four completed the 2445-mile trips without mechanical difficulty of any kind. Total distance, flown mostly with afterburner at supersonic speeds, amounted to over 15,000 miles.

On December 2, four RF-101 Voodoos streaked across the Pacific from Tokyo to Honolulu in 6 hours and 35 minutes as part of Operation Mobile Zebra, for the first non-stop jet flight over the route.

On December 20, another RF-101 set a new speed record for the Japan to Hawaii flight. The Air Force announced the time as 6 hours 3 minutes for the nearly 4000-mile flight.



*McDonnell's F-101B (left), F-101A (foreground) and RF-101 fly in formation.*

The first flight of the new two-seat interceptor, the F-101B, was successfully completed at Lambert-St. Louis Municipal Airport on March 27, 1957.

This latest version of the Voodoo carries a pilot and radar operator and is equipped with J57 engines of a more advanced design than its sister ships, the F-101A and RF-101. The F-101B will provide the Air Defense Command with round-the-clock all-weather capabilities and tremendous fire power.

First deliveries of the two other versions of the Voodoo were made during the year to operational squadrons of the Air Force.

On May 2, 1957, the first F-101A was delivered to the 27th Strategic Fighter Wing at Bergstrom AFB, and four days later, the RF-101 went on

active duty with the 363rd Tactical Reconnaissance Wing at Shaw AFB.

During the past year work was intensified on the long-range F4H-1, a twin-jet, two-man, all-weather Navy attack fighter. With improved radar and firepower, and a crew of two, the F4H should provide the fleet with a weapons system of outstanding effectiveness and reliability.

Airframe and ram jet propulsion units were delivered for Talos, the Army and Navy surface-to-air missile scheduled for fleet use next year.

Sales of \$335,287,764 for fiscal 1957 represented an 80 percent increase over 1956.

The backlog on September 30, 1957 was \$636,545,719.

#### **NORTH AMERICAN AVIATION, INC.**

With a wide diversification of products, North American's work during the year ranged from production of operational plane types to very advanced research and development projects.

In the latter field, the company was working on designs for the YF-108 long range interceptor and the X-15 research plane. It also won an Air Force contract for the WS-110 strategic bomber with a radical departure in aircraft design. This Air Force bomber will be capable of speeds in excess of 2000

miles per hour for long distances without refueling at ceilings of over 70,000 feet. These three projects were being handled by the Los Angeles division, while other research work was in process at the Rocketdyne, Autonetics and Atomics International Divisions.

Parallel with these projects were two others at the Columbus, Ohio, Division, an integrated engineering and manufacturing plant specializing in Navy projects. Columbus went into production on



*North American's new jet utility airplane was scheduled for first flight in 1958.*

the T2J jet trainer and was developing the A3J attack weapon system, while also completing Fleet Indoctrination for the FJ-4B Fury Jet.

Production of F-100D's and F-100F's at Los Angeles and FJ-4B's at Columbus continued. The year saw, after ten years, the final phasing out of the F-86 Sabre Jet, America's conqueror of the Russian MIG-15 in Korea. The F-86D interceptor version was continued through a modification program producing the F-86L as part of the vital SAGE defense system. Phased out at Columbus was the T-28 trainer for the Navy after four years of on-schedule production.

Air Force cancellation of the SM-64 Navaho guided missile program for budgetary reasons halted production of the supersonic weapon. But out of Navaho had come pioneering work in inertial navigation and control systems by Autonetics and rocket propulsion at Rocketdyne's Canoga Park and Neosho, Missouri, plants where engines were being produced for such major missiles as the Convair Atlas, Douglas Thor, Army Jupiter and Chrysler Redstone.

Retaining the nucleus of the Navaho technical team, the Missile Development Division won a design competition and contract to develop an air-to-surface missile for use on the Air Force Boe-

ing B-52. At the same time, MDD revealed existence of a special section devoted to the study of space travel.

Space also drew attention in research and development at Rocketdyne where scientists studied the problems of ion propulsion, and in the Los Angeles Division where fabrication started on the X-15 research airplane for the Air Force, Navy and National Advisory Committee for Aeronautics. The rocket-powered X-15 was designed to fly higher and faster than man has ever flown before.

The F-107 completed its preliminary testing in the Mach 2 area and was turned over to the NACA flight section for continued exploration of flight phenomena in this range.

Design and production of supersonic aircraft and missiles brought forth new research equipment and production techniques in the handling of titanium, stainless steel and other high temperature materials essential for the demands of higher performance.

At Los Angeles the company put in operation a privately-owned wind tunnel capable of supersonic speeds up to 2500 miles an hour. Capable of testing models in the sub, trans and supersonic ranges, the Tri-Sonic tunnel cost approximately \$5-million. Work was started at Columbus on a low speed

wind tunnel with control room space for the addition of a high speed tunnel, and an alternating current electrical laboratory.

Specialists of the Missile Development Division designed, built and started operating a vacuum wind tunnel for Rocketdyne to furnish data on rocket engine performances at extreme altitudes. One of the first of this type, it stimulates flight conditions on the fringe of the earth's atmosphere.

Armament control engineers in the Autonetics Division completed a specially designed microwave test tower for research and development of advanced systems for the Air Force and Navy. Equipment on the 60-foot tower simulates target information for use in development of new radar systems. The controls can make the targets appear in varied sizes and distances.

Through another device, Autonetics is subjecting its guidance and control systems' components to functional and environmental tests at near 90,000 feet in a metal-framed gondola carried aloft by a huge helium-filled balloon.

Better production accuracy and savings in time and cost of aircraft work was demonstrated at Los Angeles through use of Autonetics' NUMILL, a complete numerical control system, in controlling operations of a standard milling machine.

For profile mill fixtures (patterns used to guide the stylus of a profiler in production of a wide variety of parts) NUMILL eliminated handwork, saved time and cost of normal 20 percent scrap and rework and increased the accuracy of the completed tool.

Autonetics also designed and produced RECOMP,

a portable, general purpose digital computer for the Air Force. The 200-pound instrument was designed to meet special needs of field units dependent upon immediate and accurate information for research, planning and defense operations. Another entry in the computing field was Rocketdyne's Instrumentation Digital On-Line Transcriber (IDIOT) for high speed translation of test data. The equipment is being manufactured under license by Minneapolis-Honeywell.

Other Autonetics developments included a unique monopulse radar for the Republic F-105, a transistorized antenna selector for airborne communications and navigation, and advanced NADAR magnetic tape recorder-reproducer systems now used in various Air Force and Navy aircraft.

An outgrowth of the Navaho program is Autonetics' fully automatic, self-contained landing system tested in more than 400 successful landings of unmanned test missiles and piloted airplanes. Originally designed for the North American X-10, the ALS automatically levels off an aircraft through a pre-determined path to touchdown. The system is adaptable to instrument landings and ground controlled approach systems.

Starting the year with postwar record employment of 72,537 in all divisions, North American dropped approximately 30 percent by year end because of the Navaho cancellation and reduced labor requirements under aircraft contracts. Financially, the 1957 fiscal year which ended September 30 set record sales and earnings.

Sales totaled \$1,243,767,483 and net income was \$33,864,462.

## **NORTHROP AIRCRAFT, INC.**

A major refinement in the corporate structure of Northrop Aircraft took place early in 1957. Principal steps in the realignment were the creation of an overall corporate organization with headquarters in Beverly Hills, California, and establishment of company operations under a line division structure. The Northrop facility in Hawthorne where aircraft and missiles are in production was designated the Northrop Division. A new division named Northrop International was established as the overseas marketing arm of the company. Radioplane Company, formerly a wholly-owned subsidiary, was merged in the corporation as a division. A fourth division called Nortronics was created to handle the company's growing activity in the design, development and manufacture of electronic,

electro-mechanical and opto-mechanical products and components.

A multi-million dollar engineering and science center was completed at the Northrop Division. The new facility houses approximately 3000 Northrop engineers in an air-conditioned environment of shadowless lighting and modular partitioned work areas.

Other new Northrop Division facilities constructed simultaneously with the scientific research center included a 46,000 square foot engineering test laboratory, a high performance wind tunnel, a new air-conditioned cafeteria, a modern "sales showcase" building to house product displays, a new tooling structure, tank sealant building and improved underground utilities.



*Northrop T-38 supersonic jet trainer.*

Additional facilities built during the same period for the Air Force include a super-quiet muffler for testing guided missile engines, an environmental laboratory for simulation of various flights and launch conditions in aircraft and missile testing programs and a guided missile pre-flight installation.

The Air Force placed a \$73-million production order with Northrop for Snark SM-62 intercontinental guided missiles for delivery to operational units of the Strategic Air Command. This was the

first production contract although production prototype versions of the missile have been manufactured by Northrop for testing purposes. In one spectacular test flight, the Snark flew 5000 miles from Cape Canaveral, Florida, to a target near Ascension Island in the South Atlantic Ocean under simulated operational conditions. The Snark delivered a dummy hydrogen warhead accurately on its target after the long flight.

Further progress in the development of the Northrop T-38 supersonic jet trainer was recorded in 1957. Extensive pre-production testing marked the T-38 program. The T-38 is designed to give the Air Force a "pure" jet trainer with a performance capability to match the characteristics of supersonic combat aircraft.

From the Army Ordnance Corps, Northrop received contracts amounting to approximately \$20-million for the Hawk ground-to-air missile system. This amount covered research, development and manufacture of Hawk airframe components and weapon system support equipment. As major subcontractor to Raytheon Manufacturing Company, Northrop has responsibility for structural integrity and aerodynamic performance of the missile, design and fabrication of major portion of the airframe, the mobile launcher, missile loader, pallet and reusable container. Manufacture of the Northrop portions of the Hawk missile is underway at the company's Anaheim, California, facility.

## PIASECKI AIRCRAFT CORPORATION

A contract for \$650,000 for construction and test of an "aerial jeep" was awarded the company by the Army's Transportation Research and Engineering Command. A new concept in military aircraft, the jeep will have a low silhouette and the ability to "hug the ground," as well as all-weather capability. Since its rotor blades are protected by shrouds, it will be able to operate in streets, between buildings and among trees and its agility and small size permit easy concealment or camouflage.

The company also received a Navy Bureau of Aeronautics Contract for the second "Sea Bat." The original design of the "Bat" was undergoing ground tests.

Ground tests and wind tunnel tests were being concluded on a "ring-wing" VTOL and further development work was planned.

The company was appointed U. S. representative

of Fairey Aviation Company, Limited, of England, for their new "Ultra Light" helicopter. Two additional contractual agreements were being negotiated with other European aircraft manufacturers.

*Fairey ultra-light helicopter.*



## PIPER AIRCRAFT CORPORATION

With sales of \$26.6-million, Piper celebrated the biggest year in its history. The volume represented an increase of six percent over 1956, the previous record year.

Production amounted to 2395 aircraft, and once again the pace in dollar volume was set by the twin-engine Apache, which accounted for about 40 percent of the company's gross.

A Piper milestone was celebrated in August when the company turned out its 45,000th plane. More than 650 aircraft carrying 2300 persons flew into Lock Haven, Pennsylvania, to join in the celebration.

Late in the year, the company introduced a newcomer to the Piper line—the Comanche, a low-wing, all-metal high performance business plane. It was placed in quantity production.

For its 1958 line, Piper increased the horsepower of its executive twin, the Apache, and the Tri-Pacer. Power in the Apache's Lycoming engines

was stepped up from 150 to 160 horsepower and a similar boost was made in the Tri-Pacer's single Lycoming. The new power was achieved at a weight increase of only six pounds by increasing the compression ratio.

Also in production were the PA-18 Super Cub, general utility plane in wide use throughout the world, and the PA-18-A agricultural plane that is offered as sprayer, duster, or combination unit.

With Fred E. Weick as director, the new Piper Aircraft Development Center was established early in 1957 at Vero Beach, Florida. The center is devoted to the design, construction and test flight of certain future aircraft to be marketed by Piper. This new establishment is in addition to the existing development group at the main plant in Lock Haven.

On February 11, 1957, Piper Aircraft Corporation was admitted to trading on the New York Stock Exchange.

## REPUBLIC AVIATION CORPORATION

In early 1957, Republic's F-105 Thunderchief supersonic fighter-bomber was unveiled to the public as the company received an Air Force order for volume production of the aircraft, which will be used by units of the Tactical Air Command. The company also started regular flights of the F-105B from the plant airport at Farmingdale, Long Island.

Another new aircraft, the French designed and built Alouette helicopter, was introduced to the United States by Republic in 1957. The Alouette, a five-place, medium range roto-jet with a cruising speed of 110 miles an hour, is being marketed by Republic's Helicopter Division in the U. S., Canada, Alaska, Hawaii, Puerto Rico and Central America. Republic also has manufacturing rights for the Alouette and it is planned to enter production by gradually phasing in Republic-built components with French-built components. Made by Sud Aviation, largest aircraft manufacturer in Western Europe, the Alouette set a world's helicopter altitude record of 26,931 feet in 1955.

In the missile field, Republic began production of one of two combat surveillance drone systems under contract from the Army's Signal Corps. The first of the two types of drones is propeller-driven and designed for immediate operational use. The other is an advanced, future type. Both drone sys-



*Republic introduces Alouette II to U. S.*

tems were conceived for battle area operations by Army field units to provide quick intelligence data on the enemy. Both systems use advanced techniques of surveillance such as photography, radar and infrared.

The company's Missiles Division also produced nose cone structural units for an intercontinental



ballistic missile under subcontract from General Electric Company and continued to supply Terrapin high altitude research and weather reconnaissance rockets to the University of Maryland for its upper atmosphere research program. Other missile activities include air-to-air, air-to-surface and surface-to-air projects.

During the year Republic delivered the last F-84F Thunderstreak fighter-bomber, culminating 10 years of F-84 production. A total of 7883 F-84 Thunderjets, RF-84F Thunderflashes and F-84F Thunderstreaks were delivered. Flying under the flags of 16 different nations F-84 Thundercraft have compiled more than 4,000,000 hours of flight time, won 10 major aviation trophies and set speed and distance records.

In 1957 Republic formed a Commercial Contracts Division to provide engineering, development and manufacturing services to other aviation companies and allied industries and to market Republic-developed commercial products.

Among the items being marketed by the commercial division is an automatic circuit analyzer which reduces the time for electrical circuit checks from hours to less than five seconds for every 100 circuits. Five different models of the circuit analyzer, ranging from 100 to 1200 circuit capacity, have been developed. All of the models except the 100 circuit portable field unit are available.

In 1957 Republic continued to expand its base for increased research and development. In March the company announced it had completed its international "talent" hunt for scientists and had formed a Scientific Research Staff. The Staff, divided into nuclear physics, applied mechanics, electronics and aerophysics sections, is working on a series of basic



*Ground-breaking ceremonies for Republic's new \$1.2-million wind tunnel facility.*

problems connected with high speed flight of manned aircraft and missiles.

Construction of the company's 3000-mile-an-hour wind tunnel facility was started in September. Actually two tunnels—a transonic and a supersonic—are housed in one laboratory. The facility was expected to be in operation in April, 1958.

Republic received a contract from the Air Force for development of a 1000-degree Fahrenheit hydraulic temperature system for high Mach number aircraft. It is also doing research into high temperature surface coatings to resist friction heat at very supersonic and hypersonic speeds; high-strength, high-temperature super alloys; new antenna design concepts and servomechanism systems.

The company continued, in 1957, its research in titanium extrusions and sheet stock.

Net income for the first nine months of the year was \$4,890,418 on sales totaling \$220,744,918.

## RYAN AERONAUTICAL COMPANY

Highlight of the year was the initial test program on Ryan turbojet VTOL aircraft, the Air Force X-13 Vertijet. Climaxing 10 years of research and development in this new area, Ryan successfully demonstrated a complete VTOL mission in April with the X-13. The plane made a vertical takeoff, hovered on its exhaust, transitioned to horizontal flight for high speed runs and returned to vertical hover and landing on its service trailer. Chief engineering test pilot Peter F. Girard handled the plane on this flight at Edwards Air Force Base, California. Later, a similar demonstration was

made before 100,000 persons at Andrews Air Force Base, Washington, D. C.

At year's end, Ryan unveiled another revolutionary type aircraft in its VTOL series, the Vertiplane, a vertical-rising plane with conventional configuration, except for extremely large wing flaps. This plane, being developed for the Army under technical supervision of the Office of Naval Research, achieves vertical takeoff and landing by employing the deflected slipstream principle.

Quantity production of Firebee remote-controlled jet target drones was stepped up for both the Air

Force and the Navy. During 1957, the first Firebees joined operational squadrons of the Fleet at Brown Field, Otay Mesa, on the West Coast, and at the Chincoteague, Virginia, Naval Air Station on the East Coast. A third squadron, at the Naval Ordnance Test Station, Inyokern, California, was being equipped with Firebees for missile target practice. Meanwhile, testing of constantly improved versions continued at the Pt. Mugu, California, Naval Air Missile Test Center, and at the Air Force Missile Development Test Center, New Mexico. To date, over 800 flights have been made by Firebees at various installations throughout the country.

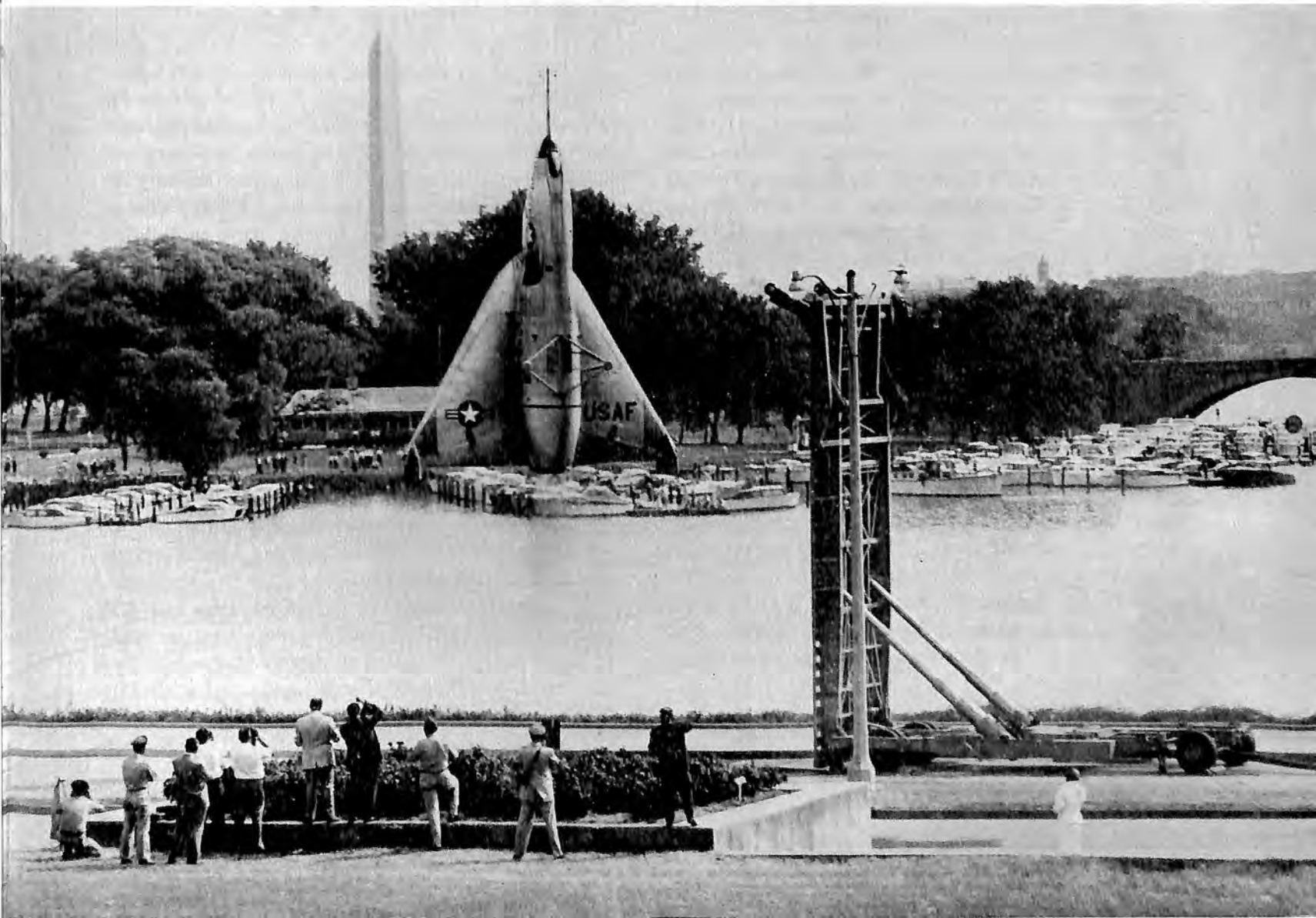
Firebees are now being assembled at Ryan's new 137,000-square-foot plant at Torrance, California, where planned expansion will virtually double the floor space within the next year and permit the transfer of Douglas DC-8 "power package" and pylon assembly work from the San Diego plant, which during 1957 began delivery of the production units for this jetliner project.

First details of Ryan's unique system of automatic aerial navigation for high-speed jet planes (AN/APN-67) were revealed by the Navy as quantity output of the "electronics intelligence" device continued production under a \$5-million program. The small, lightweight system, which gathers data instantaneously, with "pin-point" accuracy, and with no dependence on ground facilities or aerological data, has been extensively flight tested, and has passed the Navy's most stringent Operational Development Force tests. It has been used by Navy planes on "Expedition Deepfreeze" in the Antarctic, "Project Magnet," which measures direction and intensity of the earth's magnetic field over oceans and trackless polar wastes, and "Project AROWA," exploration of the jet stream.

Outgrowths of the AN/APN-67 are a helicopter hovering detector for use in hunter-killer anti-submarine operations, and an automatic navigator adaptable to small Army reconnaissance and liaison planes.

Ryan further developed its welding techniques

*Ryan X-13 vertijet is flown near the Pentagon, Washington.*





*Ryan-Navy automatic navigation system.*

by perfecting spotwelding of huge, double-contoured aircraft panels under automatic positioning and welding control to meet production requirements of the Boeing KC-135 jet tanker-transport. Deep-throated welding machines are employed with automatic positioning tables to spotweld aluminum skins for sections of the massive aft fuselages.

More than 130,000 square feet of manufacturing and administrative space was added to the Ryan plant at its Lindbergh Field location during 1957 with construction of an Engineering Research and Development Center, a Tooling Fabrication Building, and extensions to existing structures. Cost was close to \$1-million. The addition gave Ryan a total of more than 1,000,000 square feet. Personnel total climbed to about 8500.

In addition to the Torrance plant acquisition, Ryan purchased a machine shop at Inglewood, California, containing specialized machine tools; and leased a new 30,000-square-foot plant on Kearny Mesa, San Diego, for its growing electronics section.

During 1957, the company also continued production of high temperature engine components. These include major units for the General Electric J79, Pratt & Whitney J57 and Wright J65 jet engines, and various components for a number of other projects.

### **SCHWEIZER AIRCRAFT CORPORATION**

Schweizer's principal work during the year was manufacture of component parts and assemblies for major aircraft firms. Among sub-contract items produced were ailerons, rudders, elevators and ramp doors for the Fairchild C-123; doors for Bell and Kaman helicopters; booms for a Grumman Navy plane; and gundeck assemblies for the Republic F-84F. In the fall of the year, the company

also worked on cabins for a new Bell helicopter.

The company also built a number of gliders for the Air Force Academy, where they are being used for preliminary flight training and recreation.

Schweizer also completed a contract calling for the reconditioning of a number of L-17 planes which were turned over to the Reserve Officers Training Corps.

### **SIKORSKY AIRCRAFT DIVISION UNITED AIRCRAFT CORPORATION**

Full production of S-55, S-56 and S-58 helicopters continued at Sikorsky Aircraft's Bridgeport and Stratford plants through 1957 and quantity deliveries of all three were made to both commercial and military customers.

The eight-passenger S-55 and twin-engine S-56 were produced in Stratford while production of the 12-place ship, the S-58, took place in Bridgeport. Ground was broken on a 490,000 square foot experimental and engineering addition to the Strat-

ford plant with a tentative completion date of fall, 1958. The overhaul and repair facility at the Bridgeport airport received departmental status within the Sikorsky organization.

Highlighting the year's personnel news was the retirement of Igor I. Sikorsky, founder of the company, and his immediate return to work as a consultant. Michael E. Gluhareff, associated with Mr. Sikorsky 30 years, was named to succeed him as engineering manager, while Ralph B. Lightfoot



*Sikorsky H-37A Mojave concludes 1000 hours testing.*

became chief engineer. Total employment at manufacturing plants and the overhaul department averaged 11,000 during the year. The flight test staff increased its personnel from 14 to 21 because of the greater frequency of mass delivery flights and requests for pilot training by foreign customers.

Continuing its experimentation in gas-turbine power, Sikorsky installed two General Electric T58 engines in a modified S-58 (HSS) and began flight tests early in the year.

Commercial S-58 helicopters were delivered to New York Airways and Chicago Helicopter Airways for passenger service, as well as to several oil companies for transportation of men and equipment between the mainland bases and offshore oil-drilling rigs. Two S-58's operated in New Guinea, where, in a matter of several weeks, they flew camp supplies, personnel, drill-rigs and other equipment

to oil sites—a job estimated at more than a year if accomplished through building roads. In California, an S-58 successfully concluded an experiment in which transmission line towers and necessary supplies were carried to the mountainous sites on which they were to be erected. Both S-55 and S-58 aircraft were in continuous duty in Canada, resupplying DEWline radar sites. Other S-55's were used in oil and mineralogical exploration throughout the world.

Regular deliveries of S-58 helicopters to the Army, Navy and Marine Corps were joined during the year by the first of quantities ordered by the French military and the West German and Japanese defense forces. Also leaving for foreign soil were Army helicopter companies organized around the S-58. Units formed in the United States began regular transportation duties in both Europe and the Far East.

### **STROUKOFF AIRCRAFT COMPANY**

During the early part of the year, flight operations of the company were devoted to completion of acceptance tests of the Stroukoff YC-134, combination Boundary Layer Control and Pantobase landing gear assault transport. The Pantobase system permitted the aircraft to take off from land, water, unprepared terrain, ice, snow, swamp or standard runways.

Initial tests were completed successfully and the airplane was delivered to the Air Force's Air Materiel Command. Work was started on a second airplane, which will incorporate a straight sucking BLC system manufactured by Stroukoff. The system employs a Westinghouse J30 engine evacuating aft. The No. 2 airplane was scheduled for

delivery early in 1958.

A study of the YC-134 and its less than six-cent-a-ton-mile cost figure for freight operations led to its selection by the Independent Airlines Association as the aircraft upon which IAA's Stand-By Airlift Freight Plan was based.

In late summer, negotiations were completed with the Air Force for continuance of the YC-134 program.

The company also completed the design of a four-engined commercial version of the YC-134, using Lycoming T55 turboprop engines. An alternate installation featured the Rolls-Royce Dart power package, similar to that used in the Vickers Viscount.

## TEMCO AIRCRAFT CORPORATION

Temco continued its policy of product diversification and climbed to new high backlogs during 1957.

At the company's various installations in the Dallas area, work continued on major components for nearly a dozen first-line military and commercial aircraft. Components ranged in size from a 58-foot aft fuselage section of the B-52 Stratofortress to ammunition boxes for a Navy fighter.

Development of a highly-classified missile system was under way and field engineers were testing a rocket-powered target drone. Jet engine (J57) compressor cases, vanes and shrouds were also being manufactured. The company continued its policy of total subcontracting by first designing major components of aircraft, then tooling up and manufacturing them.

Satisfactory progress was reported on various classified electronics projects. First production models of the TT-1 Pinto, the Navy's new primary jet trainer, rolled off the assembly line at the Dallas facility. Among new orders in the subcontracting field late in the year was a major one for approximately \$25-million for aft fuselages of the improved version of the Stratofortress, the B-52G.

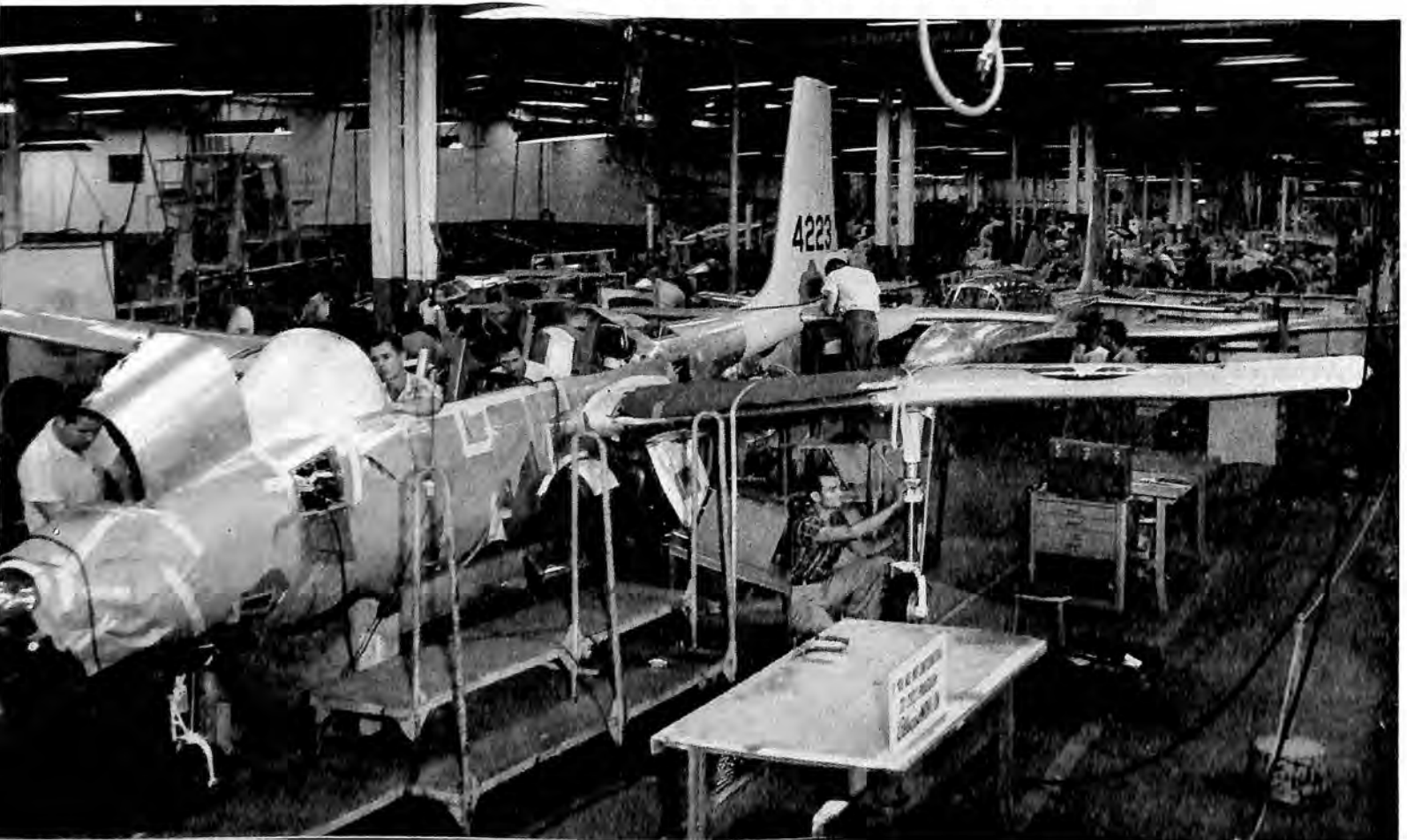
Company sales during the first nine months of

1957 totalled \$89,739,000, an increase of nearly 47 percent over the \$61,196,000 for the comparable 1956 period. Stepped up research and development outlay—\$3,725,000 for the nine months in 1957 as compared with \$1,610,000 in a like period of 1956—accounted largely for the lower net profits, \$1,750,000 through September compared with \$2,059,000 for the first nine months of 1956.

Due to diversification, defense cutbacks and stretchouts did not affect the company as drastically as might have been expected. However, a general "belt-tightening" policy got under way during the second quarter. Along with stretchout of aircraft procurement, the retrenchment reduced total employment more than 10 percent to approximately 8500.

The company personnel moved into a new 100,000 square foot engineering center at its Garland facility and another 100,000 square foot building, to house general offices, was under construction. A new antenna research laboratory also was being built on company-owned land at Garland. At Greenville, a 2000-foot extension of the runway gave Temco's facility there a 7500-foot runway and a capacity for the manufacture, overhaul and flight testing of jet aircraft.

*Final assembly line for the Temco TT-1 Pinto, Navy's new trainer.*



## UNITED AIRCRAFT CORPORATION

All three divisions of United Aircraft Corporation maintained a high level of development and production during the year. Because each of them functions autonomously, reports of the company's technical and manufacturing activities for 1957 are found under the names of the individual divisions: Pratt & Whitney Aircraft (engines), Hamilton Standard (propellers and turbine aircraft equipment), and Sikorsky Aircraft (helicopters).

In 1957, the United Aircraft Research Department completed construction of a new addition to its facilities which will house the largest industrial installation of new electronic data processing equipment in the United States.

The construction was another step in a decade-long building program during which United Aircraft spent \$210-million on company-financed facilities aggregating 4,877,000 square feet. The company, committed to an additional \$70-million construction program through 1958, will add another 1,162,000 square feet for a total of 9,928,000 square feet, not including leased facilities.

Total assets at December 31, 1956 (latest date available) amounted to \$291,347,288, compared with liabilities of \$152,975,592 at that date. Backlog at the same time was \$2.3-billion. Sales for 1956 totaled \$952,885,142 and produced a net income of \$37,082,493.

## VERTOL AIRCRAFT CORPORATION

The year 1957 marked Vertol's entry into the commercial market, when, in April, the company received a type certificate for its Model 44, largest helicopter currently available for civilian use. The certification program, conducted jointly by the Civil Aeronautics Administration and the Canadian Department of Transport, was accomplished in seven months. The Model 44 was offered in three versions: 44A, a 19-seat cargo-utility aircraft; 44B, a 15-seat airliner; and 44C, a deluxe executive transport. The plane is an advanced model of the military H-21. Vertol also continued production of the H-21 for delivery to the U. S. Army and Air Force and the French and West German governments.

The company received orders for two airline versions of the Model 44 from the French government. The planes were demonstrated in the U. S., then shipped to Paris where they participated in the Salon Aeronautique in June.

The Swedish government also purchased four of the cargo-utility versions of the Model 44 which will form part of the Swedish Navy's first operational squadron. The aircraft are scheduled for delivery early in 1958 and will be used primarily in anti-submarine warfare missions.

Nine modified H-21's belonging to the Royal Canadian Air Force were turned over to Spartan Air Services, Ltd., of Ottawa, Canada, at mid-year for the first commercial H-21 operation. They are being used to support Mid-Canada Line radar sites. Flown by the RCAF, these aircraft carried thou-

sands of tons of equipment and personnel during the building of the Mid-Canada Line. Modification work and training of aircraft pilots and maintenance crews, conducted by Vertol Aircraft Company (Canada), Ltd., at Arnprior, Ontario, began in September, 1957.

Research activities were directed toward product improvement as well as the design of new aircraft and vertical flight concepts.

Vertol made a series of major improvements on the H-21, contributing to improved stabilization, speed, power and payload. These improvements are being incorporated on the Vertol 44, along with steel-spar metal rotor blades, which materially reduce vibration.

The company broadened its experience with turbine power in its helicopters during 1957, as the H-21D with two General Electric T58 turboshaft engines was flown and a VTOL research aircraft, powered by a Lycoming T53, went into flight test. The company also installed two Lycoming T53 turboshaft engines in another H-21. Both turbine power plant packages will be offered to current or future users of the H-21 or Vertol 44.

The H-21D turbine program is being carried out under a contract awarded a year ago by the U. S. Army and the Navy's Bureau of Aeronautics. The second H-21 turbine program is supported with company funds and U. S. Army engines.

The Vertol tilt-wing VTOL (vertical takeoff and landing) aircraft was rolled out in April. The turbine-powered research aircraft is undergoing a

flight program to confirm the design principles of the tilt-wing. Designated Model 76, the aircraft was built under a contract funded by the Army in cooperation with the Office of Naval Research.

The wing of the Model 76 and two counter-rotating rotor propellers tilt as a unit through a 90-degree arc. The wing tilts to a perpendicular position for vertical takeoff and landing and rotates into horizontal position for forward flight. The wing can be rotated to any angle for STOL takeoffs.

Research and Preliminary Design engineers are

continuing other VTOL studies for high speed flight. In addition, studies of STOL (short takeoff and landing aircraft) are also being pursued. Extensive wind-tunnel tests of these new flight concepts are being conducted in conjunction with these studies.

During the first nine months of 1957, the company's investment in product development increased more than \$1.540-million over the same period in 1956. Sales and earnings for 1957 were expected to be second only to the record year 1956.

*Vertol H-21 helicopter retrieves Ryan Firebee target drone.*



## ENGINE MANUFACTURERS

### AEROJET-GENERAL CORPORATION

During 1957, Aerojet-General Corporation continued to expand its facilities and activities and estimated its sales at the end of its fiscal year, November 30, at approximately \$162-million, or 11 percent above 1956.

Major missile projects in which the company was engaged were power plants for the Air Force Titan ICBM (liquid engines), the Navy's Polaris IRBM (solid engines), the second-stage propulsion system for Vanguard (earth satellite program), and the Army's Hawk missile. The company also was producing components on power plants for many other major American missiles, including Sparrow II, Snark, Sparrow, Terrier, and Bomarc, and boosters for Regulus I and II. One of the year's highlights was delivery of the first production type engine for the Titan missile.

During the year the company completed construction on a 300,000-square-foot production building at Sacramento, a 40,000-square-foot engineering building and a 50,000-square-foot Avionics building at Azusa, as well as additional solid and liquid test facilities at Sacramento.

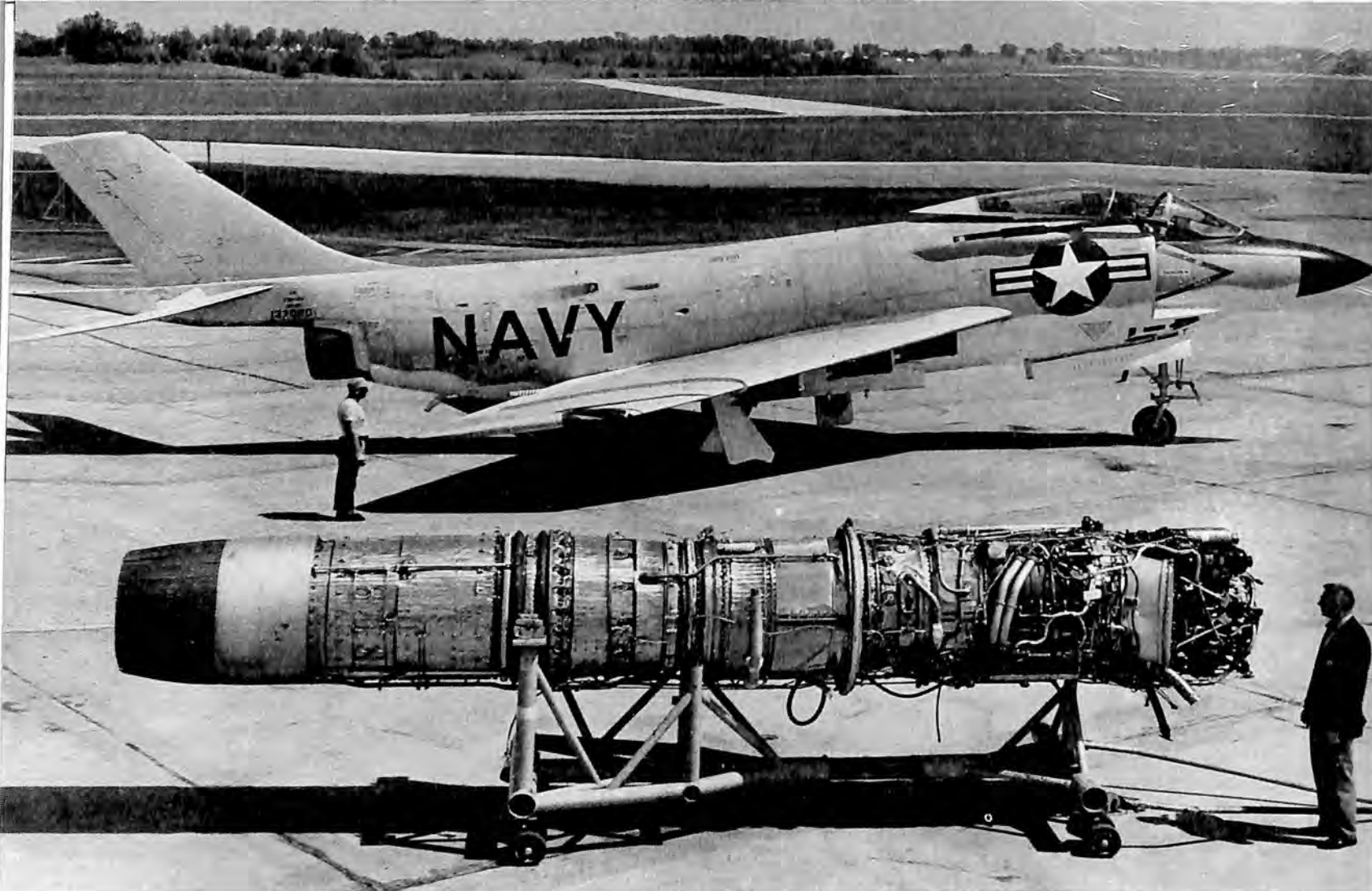
Aerojet's nuclear subsidiary, Aerojet-General Nucleonics at San Ramon, California, produced more than a dozen AGN-201 reactors, two of which were installed at the Navy's Postgraduate School at Monterey, California, and at the National Naval Medical Center, Bethesda, Maryland, respectively. The Bethesda installation was the first ever made in an American hospital for medical purposes.

Aerojet's mass-produced Aerobee and Aerobee-Hi rockets soared to new achievements during 1957. In April, an Aerobee-Hi launched by the Navy reached a new altitude record of 193 miles for single-stage boosted rockets. In July, an Aerobee-Hi participated in the International Geophysical Year by a spectacular flight from an enclosed launching tower at Fort Churchill, Canada, built by Aerojet-General's Architect Engineer Division. In October, an Aerobee launched artificial meteors into space, and in November an Air Force-launched Aerobee hoisted a sodium cloud 80 miles above Alamogordo, New Mexico, in a radio experiment.

Other company developments included the design and leasing of facilities on Aerojet's Sacramento site to Douglas Aircraft Company for testing of the Thor missile, development of an infrared anticollision device for aircraft, and organization of four new divisions: Chemical, Explosive Ordnance, Structural Plastics, and Turbo Machinery. During 1957, Aerojet-General acquired the Ordnance Engineering Corporation of Frederick, Maryland, an ordnance-electronics firm, which is now known as the Ordnance Engineering Division.

During 1957, Aerojet-General entered into an agreement with D. Napier & Son, Ltd., of England for the exchange of data on peroxide rocket engines. Another agreement was made with Stauffer Chemical Company of New York for the development of borane fuels under the partnership title of Stauffer-Aerojet Company.





*Allison J71-A-2 turbojet engine and McDonnell F3H-2N team up for Navy.*

#### ALLISON DIVISION GENERAL MOTORS CORPORATION

The Allison-powered Lockheed Electra prop-jet airliner took to the air December 6, 56 days ahead of schedule. This maiden flight culminated a year-long intensive program in preparation for the Electra's starting official CAA certification tests. The General Motors power team for the Electra received CAA certification in the Fall.

Also pointing the way to commercial operation of the Electra was the start of a rugged 1000-hour flight endurance demonstration of the Allison-Aeroproducts power package in the nacelles of a Convair YC-131C transport, a modernized military version of the twin-engine Convair 340 commercial airliner.

The accelerated flight endurance program, labeled "Operation Hourglass," was aimed at accumulating as quickly as possible 1000 hours of engine-propeller operating data for the military services, commercial airlines and airframe manufacturers.

Geared to actual commercial airline schedules,

"Operation Hourglass" paralleled commercial routes from "block to block," including shut-down of engines for the normal 20-minute debarking and embarking routines.

"Operation Hourglass" was the final phase of a year-long series of flight and ground endurance demonstrations on the 501-D13. Shortly before its start, a four-engine Lockheed Super Constellation called the "Elation" began flight endurance demonstrations from Lockheed's Burbank facility with the Allison power packages.

Earlier, Lockheed's Constellation "Old 1961" flying test bed began flights with an Electra power team in the right wing outboard position. In an equally important phase of the prop-jet program, Allison Turbo-Liner logged its 1000th flight.

More than 6000 hours of Simulated Flight Endurance testing was accumulated on the 501-D13 during the year, including one test of 625 hours, three of 1000 hours duration each and six others of varying lengths totaling 2500 hours.

Allison-powered Electra sales increased to 11 world airlines which have purchased a total of 144 four-engined Electras. Additionally, the 3750-horsepower Model 501-D13 was offered in a conversion kit to modernize Convair 340 and 440 piston-powered commercial airliners facing obsolescence in the jet-age.

On the military side of the ledger, the Air Force's Lockheed C-130 Hercules combat-cargo transport continued to log impressive air time with its four Allison T56 Prop-jet engines and AeroProducts Turbo-propellers.

The USAF B-17 Allison flying test bed, retaining its four conventional piston engines, was used to flight-test the advanced T56-A-7 prop-jet engine and AeroProducts Turbo-propeller which were mounted in the aircraft nose. This engine configuration is rated at 4050 horsepower and will power the C-130B.

Allison received an \$8-million Air Force contract to continue development of a greatly-advanced prop-jet engine. Details were not disclosed, but it was emphasized the Model 550 is an entirely new engine rather than an improved version of the T56 which is now rated at 3750 horsepower and soon will be qualified at 4050 horsepower. Although the new engine will have a horsepower rating substantially higher, there will be little if any increase in size or weight.

Two other Allison engines, a prop-jet and a turbo-jet, were under development for improved performance. They include the commercial Model 501-D15 Prop-jet, a 4050-horsepower engine for the Lockheed Electra, and the J33-A-24, a single-jet engine for the Navy's T2V-1 Sea Star.

Production began in 1957 on the J33-A-41, the J71-A-6 and the J71-A-13. The J33-A-41 replaces

the 4600-pound-thrust J33-A-37 as a 5200-pound-thrust power unit for the Martin TM-61A and TM-61C Matador missiles.

The J71-A-6 is a new installation for the Martin YP-6M SeaMaster and the J71-A-13 replaces the J71-A-11 as the current production installation in the twin-jet Douglas B-66 bomber, RB-66 photo reconnaissance and WB-66 all-weather reconnaissance aircraft.

Production was continued on Allison J71-A-2 turbo-jet engines for the Navy's McDonnell F3H-2N Demon all-weather day and night fighters. J71 production for the single-jet Demons is scheduled through 1958.

Production of J33 engines was continued for the Chance Vought Regulus guided missiles, USAF Lockheed T-33 and Navy TV-2 jet trainers.

During 1957, Allison accumulated 2,071,000 hours of gas turbine engine experience. Behind the overall aircraft engine development program is flight experience amounting to more than 13,000,000 Allison gas turbine engine hours.

Increasing use was made of the new Research and Development Center at Indianapolis, part of a \$75-million expansion of advanced engine experimental programs and testing facilities. During the year, Allison sales and engineering staffs completed their move into the multi-million-dollar office building. Radical improvements were made in component testing equipment. Air flow capacities were boosted for more intensive testing at simulated speeds and temperatures.

Employment figures for 1957 show 14,223 persons on the payroll at Allison-Indianapolis and 3248 at AeroProducts Operations in Dayton, Ohio, for a total of 17,471 employees.

## CONTINENTAL AVIATION AND ENGINEERING CORPORATION

During the year Continental continued production of its J69 series turbojets and gas turbine air compressor units for the USAF. Production applications for the J69 turbojet include the Cessna T-37A twin-jet AF trainer, the Ryan Q-2A Firebee target drone, and the Temco TT-1 Navy jet trainer.

Production of Continental's U. S. Air Force type MA-1 trailer-mounted turbine compressor unit was phased-out and superseded by the four-wheel trailer-mounted USAF type MA-1A unit. These units are used extensively throughout the USAF for starting the large jet engines on the "Century

Series" fighters, the B-66, and B-52 aircraft.

Continental was also working on "uprated" and redesigned versions of the J69 which will incorporate increased performance and new design features. Over 1000 J69's have been delivered to the USAF since this small turbojet was first placed on order. Commercially, the J69 has potentiality as the main power plant for jet-powered executive aircraft and as a booster unit for certain transport aircraft such as the C-46 and Convair 340 and 440. The J69-T-9, 920-pound thrust engine, completed its Civil Aeronautics Administration certification program.

## CURTISS-WRIGHT CORPORATION

Continued expansion of the company's commercial business in the aircraft industry and related fields during 1957 pushed earnings from these sales to approximately 65 percent of the total earnings of the company. A significant development in this area of commercial business was highlighted in May by the first public demonstration of the new Curtiss-Wright TJ38 Zephyr turbojet at the company's 80-square-mile Research and Development Center at Quehanna, Pennsylvania.

The basic Zephyr design reduces the exit velocity of jet gases more than 20 percent compared with other turbojets. Additionally, the engine incorporates a special jet nozzle which spreads the exhaust over a 50 percent larger periphery, and results in a basically quiet engine without loss in power or economy. Rated at 12,500 pounds thrust, without water augmentation, other Zephyr series engines have been developed in the 14,500 and 16,200 pound thrust class. The TJ38 was developed jointly by Wright Aeronautical Division of Curtiss-Wright and Bristol Aeroplane Co., of Filton, England, under an engineering agreement instituted in 1951.

During 1957 Curtiss-Wright Turbo Compound engines powered Lockheed Super Constellations and Douglas DC-7C's to new commercial non-stop records over global routes. In September, the long range capacity of Air France's new Lockheed 1649A Super Starliners equipped with EA series Turbo Compounds and Curtiss Electric Propellers was demonstrated by a 5025-mile flight non-stop from New York to Athens. The distance was covered in just 14 hours and 49 minutes, with 57 persons aboard. The following month a Pan American DC-7C bettered the existing record on a scheduled non-stop hop from New York to Rome by covering 4350 miles in the elapsed time of 11 hours and 30 minutes at an average speed of 380 miles per hour. In service with 41 of the world's airlines, the Curtiss-Wright Turbo Compound exceeded the 49-billion seat mile mark with a perfect safety record.

Production and development of the Curtiss-Wright J65 jet engine continued at the Wright Aeronautical Division as well as further development in a wide range of other jet types including turbojets of advanced design. Installations of the J65 included the Republic F-84F and RF-84F, the North American FJ-3 and FJ-4 Furies carrier-based fighters, the Martin B-57 twin-jet bomber, the Grumman F11F-1 supersonic fighter, and the Douglas A4D.

At the company's Marquette Division in Cleveland, a new line of Standard Precision Spring Clutches was introduced which makes it possible for clutch users to save time and costs inherent in "specials." Full production continued during the year on governors for diesel, gas and dual fuel engines for major marine and industrial engine manufacturers, aircraft windshield wipers and textile spindles.

In September, 1957, an agreement was signed by Curtiss-Wright and A. V. Roe Canada Ltd. covering rights for the manufacture, sale and further development of the new Iroquois jet engine in the United States. The agreement, which runs for seven years, also provided for the exchange of technical information between the two companies.

Completion of a new Nuclear Materials Laboratory consisting of a reactor and radio-active hot cells, designed and built by Curtiss-Wright, was a major addition at the company's Research and Development Center in Quehanna, Pennsylvania. Constructed with funds appropriated from corporate earnings and reserves, the new laboratory offers nuclear services in the support of defense production and in peacetime industrial applications of atomic energy.

Curon, a new multi-cellular material, developed and manufactured by the Curtiss-Wright Plastics Division was distributed on the market during the year in a variety of applications for both industry and the home. As a superior type seat cushioning, it was installed in Swissair's fleet of DC-7C airliners flying the blue ribbon global routes. Full scale acoustical testing of Curon to absorb and control noise levels both in aviation and related industries were being conducted by engineering and research teams at Curtiss-Wright and Pennsylvania State University. Development of marketing programs of this versatile material for thermal, acoustical and decorative applications was also under way.

A "third hand" for pilots in the form of the Curtiss-Wright Automatic Throttle Control which relieves them of continuous manual adjustments of critical engine speed during intricate maneuvers, particularly in helicopters, where precision control is required, was developed by the Propeller Division. During the year, major production at this division continued in Electric propellers for commercial and military aircraft, and Turboelectric propellers for the Douglas C-133A turboprop cargo airplane.

At the Curtiss-Wright Electronics Division, production was started on Boeing 707 and Douglas

DC-8 jet Simulators, which have been ordered by the Civil Aeronautics Administration, Pan American, Air France, Sabena, Lufthansa, American Airlines and Swissair. At the same time, the division announced receipt of an order from American Airlines and Swissair. At the same time, the division in the year shipments of 1649A flight Simulators were made to TWA and Air France while DC-7 Simulators were delivered to KLM and Eastern Air Lines and DC-6B Simulators to United Air Lines and Eastern Air Lines.

Production of the Dart anti-tank missile continued in volume at Utica-Bend Corporation, a wholly-owned subsidiary of Curtiss-Wright. New production contracts were also received for diesel engines and diesel engine parts.

The 12,000 ton horizontal steel extrusion press in operation at the Metals Processing Division in Buffalo, extruded modern steels and super alloys in sizes, shapes, and lengths previously unattainable in industry. Major production of High Integrity pipe extruded from any ferrous alloy in lengths up to 50 feet or more, and with virtually any wall thickness, was in high gear during 1957 for applications in the power, petroleum, chemical and other industries. Also produced in large quantities were jet engine blades that were forged, finish-machined

and tested by the division for Curtiss-Wright turbojets.

Also developed during 1957 was the Curtiss-Wright Thrust Reverser which will permit commercial jet airliners to operate from standard runways by reducing landing rolls approximately 50 percent.

A new missile research and development facility for Aerophysics Development Corporation of Santa Barbara, California, a wholly-owned subsidiary was dedicated during the year. The 55,000 square foot building represents one segment of the \$5-million expansion program of this division. During the year Aerophysics was awarded an Army contract for the design, construction and testing of a "flying jeep."

Propulsion Research Corporation of Santa Monica, California, which became a division of Curtiss-Wright in 1955, specializes in research, development and preliminary design of aeronautical and marine propulsion systems, accessories and auxiliary equipment. During 1957, the Division manufactured turbopumps, fans and specialized blowers, and a group of accessories being used on advanced aircraft of the Air Force and the Navy, including high volume pumps for jet air refueling.

## FAIRCHILD ENGINE DIVISION

### FAIRCHILD ENGINE AND AIRPLANE CORPORATION

Continued development, improvement and production of its family of small, high-performance, lightweight turbojet engines, as well as other propulsion developmental projects resulted in an expansion of the division's new Deer Park, L. I., facility and a personnel increase of more than 30 percent during 1957.

Particular emphasis was placed on the development and production of the new family of J83 turbojet engines, which are earmarked as powerplants for jet trainers, executive and medium size utility transports, VTOL and STOL aircraft, guided missiles, high-speed target drones and other types of pilotless aircraft. Development and pro-

*Fairchild J44 lightweight turbojet engines are readied for delivery.*



duction of the J83 proceeded on schedule during the year.

In May the division expanded its engine test cell facilities and added a two-story service structure for experimental test and test equipment personnel. Administrative and engineering personnel moved into a new, two story, 34,000 square foot addition to the present office building.

The division also expanded considerably its research and development facilities. A new laboratory, designed specifically to house special equipment required for research in aerothermochemistry, was completed in July. Later in the year an altitude chamber was added to the compressor and turbine test facilities which have been operational, along with a 15,000 horsepower air supply, for the last year and a half. These new facilities are important augmentations to the multi-million dollar gas turbine research laboratory, completed in 1956.

During the year product improvement on the J44 turbojet continued and the lightweight J44 engine was successfully used as thrust augmentation for commercial and military aircraft. Trans World Airlines installed a J44 atop the fuselage of its C-82 "flying maintenance base" at Orly Field, Paris.

The Air Force equipped a C-123 assault transport with wheel-ski landing gear and wingtip J44 engines for thrust augmentation, and after an intensive testing program in Greenland this spring and summer, ordered 10 of these aircraft for trans-

porting supplies and equipment to and from the islands in the Arctic area. An unofficial weight-lifting record of 60,000 pounds was set during the testing.

In October, the Navy announced additional orders to Fairchild, amounting to more than \$1.3-million for J44's to power the Ryan KDA Firebee target drone.

The division's subcontract production of large engine components was reduced as a result of industry-wide reductions in military procurement. Personnel engaged in production of J79 major components were utilized in the expanding small engine development programs.

The division has a continuing program in process to further develop the potential of the J44 and has received production orders in excess of \$7-million for the lightweight jet during the past nine months. Approximately 1000 J44's have been produced.

The Al-Fin Division continued the development and manufacture of new metallurgically bonded aluminum and magnesium bi-metallic castings. The newest applications were in the lightweight airborne electronic field. Jet engine and helicopter gear case components of cast magnesium with bonded-in ferrous alloy bearing retainers were put into initial production. These and other molecularly bonded bi-metallic products for aircraft, automotive, industrial and home appliance use are also being produced under license by fifty manufacturers.

## GENERAL ELECTRIC COMPANY

### JET ENGINE AND PRODUCTION ENGINE DEPARTMENTS

Both the J79 jet engine and its commercial counterpart, the CJ-805, were formally unveiled in 1957. The J79 was shown for the first time in Washington, D. C., and the CJ-805 made its public debut at the Salon International de J'Aeronautique in Paris.

The J79 powers the Convair B-58 Hustler, the Air Force's first supersonic bomber, the Lockheed F-104A Starfighter, the Grumman F11F-1F Tiger and the Chance Vought Regulus II missile. During 1957 the Hustler was shown publicly for the first time, the Starfighter went into production and the J79 became the powerplant for the production Regulus II.

General Electric's Aircraft Gas Turbine Division agreed to purchase the Electric Auto-Lite Company's manufacturing plant in Evendale, Ohio, a Cincinnati suburb. The property consists mainly of two manufacturing buildings containing approximately 3,300,000 square feet of floor space, and will bring General Electric's Evendale Plant holdings to 4,740,015 square feet. The company also operates for the Air Force an additional 1,109,346 square feet of floor space at Evendale.

The purchase will increase the total of General Electric-owned facilities at Evendale to more than \$140-million. Employment at the Evendale plant averaged 13,500.

The J79 engine reached production stage after undergoing more than 12,000 hours of testing—

factory, simulated-altitude, and flight testing—most of which was accumulated in one year.

The CJ-805 will be equipped with a thrust reverser rated at 5000 pounds reverse thrust and with a noise suppressor that will reduce the noise of the four-engine Convair 880 jetliner to the level of current four-engine piston-powered airliners. The reverser-suppressor will have a negligible effect on engine performance.

Circuits incorporating magnetic amplifiers and temperature sensors were applied to J47-17 and -33 engines to provide a signal warning of excessive temperature in critical engine areas. Both pilot signaling and direct-exhaust nozzle-control bias were provided by the type of circuits developed to increase the safety and contribute to the combat effectiveness of the F86D interceptor.

Also developed during 1957 was a new form of presentation of aircraft gas-turbine performance data on punched cards for digital computer operation. It allows comprehensive performance data to be transmitted to airframe manufacturers at a much earlier date and in a form more easily incorporated in installed-engine aircraft-performance studies.

A major gain was made in improving fatigue strength of cast jet-engine turbine buckets. By controlling grain size during the casting process, buckets are produced with fatigue strength comparable to that obtained from forged buckets, while still retaining the high-stress rupture strength of the cast products.

#### SMALL AIRCRAFT ENGINE DEPARTMENT

At the company's Small Aircraft Engine Department work began on a \$58-million Navy contract for development of what will virtually be two small gas-turbine engines in one—both a turboshaft and a turboprop power plant. Designated the T64, the new engine will employ a basic power section common to both engines. In the 2600-horsepower class, it will have more than a 3-to-1 power-weight ratio plus outstanding fuel consumption.

In October the Navy T58 turboshaft engine officially passed its 150-hour qualification test. Results of the test showed that the engine exceeded performance guarantees on both horsepower and specific fuel consumption. The T58 produced 1065 military horsepower, compared to the 1024 guarantee. The military performance guarantee of 0.66 SFC was also bettered.

At the Sikorsky plant in Bridgeport, Connecticut, the T58 made its first flight in January in a modified S58 helicopter. In September at the Ver-



General Electric adapts Civil War Gatling Gun to arm Lockheed's F-104A Starfighter.

tol plant in Morton, Pennsylvania, it powered the Vertol H-21D.

Prototype T58's delivered to Sikorsky and Vertol also bettered performance guarantees: average shipment engines delivered 1067 military shaft horsepower and 0.659 military specific-fuel consumption.

Work continued on the J85, a small, lightweight turbojet being developed for the Air Force for use in piloted and pilotless aircraft.

#### FLIGHT PROPULSION LABORATORY DEPARTMENT

Early in 1957 General Electric delivered first-stage X 405 rocket engines for the Project Vanguard earth-satellite program.

On October 23, 1957, one of these first-stage motors powered the Vanguard 3-stage missile to an altitude of 109 miles and a velocity of 4250 miles per hour during a test launching at Cape Canaveral, Florida.

The X 405 underwent hundreds of tests at General Electric's Malta Test Station in Schenectady during its development. Prior to delivery, the rocket engine consumed over 2-million pounds of liquid oxygen in static test runs.

The first-stage X 405 rocket engine, rated 27,000 pounds of thrust, powers the 3-stage 11-ton Project Vanguard missiles on the first leg of their journeys into space. Operating for about 150 seconds, they burn liquid oxygen and kerosene (RP-1). Their gimbal mountings permit changing thrust direction as much as 5 degrees.

#### AIRCRAFT ACCESSORY TURBINE DEPARTMENT

A completely self-contained accessory power system for missiles, utilizing modular components for versatility and flexibility of outputs, generate electric or hydraulic power—or both—in ratings from

1.5 to over 10 horsepower was developed during 1957. Fuel accumulators are sized for duty cycles as short as a few seconds or for extended periods of many minutes. Fine frequency control with +1 percent is obtained.

An answer to the heat problems of high-speed aircraft came in the form of a new product development called a turbonator, an air turbine and a-c generator on a single shaft. Turbine exhaust air is used to cool the generator, permitting its operation in high ambients independent of aircraft cooling systems. A complete 60 kva system weighs only 135 pounds.

An airborne hydraulic power system 60 percent lighter and containing only one-third as many parts as current production models was also developed. Unique design features include a finned reservoir housing that eliminates special cooling equipment, a high-speed ball-piston pump, and a fail-safe turbine wheel.

Designed to handle low-viscosity low-lubricity but highly corrosive fuels, a new pump weighs only 1.15 pounds and is less than 3 inches long. Intended for the high-temperature applications such as missiles, it can be used for fuel or low-flow hydraulic pumping. When used to pump corrosive monofuels, such as normal propyl nitrate, a great saving is possible in system weight.

Another department product added during 1957 was a new AS-18 fuel-air turbostarter which will bring jet engines up to idling speed within 25 seconds. Weighing only 46 pounds and measuring 12¼ inches in length and 8¾ inches in diameter, the self-contained turbostarter makes possible simultaneous starts of many jet fighter aircraft without the need for heavy conventional ground power sources.

#### AIRCRAFT NUCLEAR PROPULSION DEPARTMENT

During the year the company's Aircraft Nuclear Propulsion Department successfully operated a turbojet engine on nuclear power.

The department also revealed that it has installed the world's longest periscope at the AEC's National Reactor Testing Station to aid in development work on a nuclear propulsion system for aircraft. The 90-foot periscope allows workers to sit safely behind heavy shielding while they watch the performance of a nuclear reactor undergoing tests.

Also developed for the Idaho Falls test site was the world's first closed-circuit three-dimensional color television system. The color stereo system was developed to permit use of color-coded parts in reactor components and to provide the degree of precise depth perception required for their correct positioning in a shop designed for remote handling of radioactively "hot" equipment.

The 3-D color TV system was designed and built by the General Electric General Engineering Laboratory in Schenectady, New York, and by the company's Electronic Park, Syracuse, New York.

#### MISSILE & ORDNANCE SYSTEMS DEPARTMENT

The largest research and development contract ever awarded General Electric was formally let in June of last year by the Air Force. A \$158-million contract for the nation's ballistic missile program, it called for research leading to development of nose cones for the ICBM Atlas, and the IRBM Thor.

In Pittsfield, Massachusetts, scientists and engineers were at work on two of the Navy's missiles—the ship-to-surface Polaris and the Talos, a long-range surface-to-air missile.

The Polaris development involves fire-control

*A full view of General Electric's 10,000-pound-thrust-class J79 jet engine.*



equipment to launch the missile from a submerged submarine. In conjunction with Lockheed Aircraft Corporation, work also progressed on the missile's guidance system.

Talos will be installed in converted naval cruisers. Automatically selecting the missile from a storage area, its fire-control system will weigh more than 350 tons and take up space enough to house 10 freight cars.

An automatic data procuring and computation center was installed at a plant location in Philadelphia. The center was designed to reduce data from missile flight tests and environment and component tests and for scientific computations to aid advanced studies.

A new type of armament, designed to give helicopters defensive protection in battle, was introduced last May. It comprises 2 kits of 0.308-caliber machine guns and small rockets, attachable to any type of helicopter.

A booster unit used in the free-flight testing of missile nose-cones was developed to simulate separation of a nose cone from the missile airframe. It can be fired from a 5-inch gun. After separation, the nose cone model gives free flight data on nose cone afterbodies.

Temperatures more than twice as hot as the surface of the sun were achieved in the Aerosciences Laboratory. An advanced version of the fluid-stabilized electric arc, this model used water as the external "blanketing" agent and reached approximately 25,000°F. Future designs will use gases for the stabilizing agent, allowing for simulation of atmospheric conditions. The blast of hot plasma emanating from the arc chamber is being used for nose-cone research on the Air Force's ballistic-missile program.

Electronic equipment operated at 752°F without the use of a refrigerant or cooling system during 1957, direct result of two major high-temperature programs. The initial program revealed that airborne electronic equipment could be designed and packaged to operate over a wide temperature range — -65 to +450°F—and in other severe environmental conditions with a performance comparable to that of existing equipments designed to operate to 250°F. Additionally, size and weight penalties are relatively small, ranging from 0 to 10 percent. The second program, aimed at advancing the state of the art to 752°F, was an extensive investigation of temperature and nuclear radiation-tolerant parts, materials, and manufacturing processes for application in airborne electronic equipment. (To prove feasibility, a demonstrator model amplifier, de-

signed to drive a standard servo-motor was successfully operated at ambient temperatures up to 752°F.)

#### **INSTRUMENT DEPARTMENT**

Introduced last year was a new lightweight low-priced compass system for business aircraft, providing an electrically driven panel-mounted gyroscope of improved performance. Based on a combination of the magnetic compass and electric gyroscope, the system provides a stabilized heading reference accurate to 2 degrees or better.

A new-type fast-response thermocouple was developed in which conventional 2-wire elements are replaced by one element in the form of a tube encasing the other element, a wire.

A new aircraft flowmeter system in the 0 to 15,000-pounds-per-hour flow range is being made available for military and commercial jet transports. Incorporating many new design features, the system operates directly from the aircraft's 4-cycle supply without the use of separate special equipment. First application will take place in the Douglas Aircraft Company's DC-8 jet transport.

For small jet engines needing a miniaturized flowmeter system with a range to approximately 5000 pounds per hour, a transmitter was developed. The miniaturized transmitter has a 400-cycle motor, magnetically coupled to an impeller. Its indicator includes integral lighting and a self-synchronous receiver.

A very small electric tachometer for jet aircraft was developed in 1957. Weighing only 5 ounces, it is useful as a supplementary instrument for indicating engine speeds below or above the range of the speed indicator incorporated in an engine-performance indicator.

A new 4-gimbal 3-single-axis gyro, an all-attitude reference for aircraft application, went into production last year. Known as type SR-1, the device produces roll, elevation, and heading references at all plane attitudes for navigation, control, and bombing functions. This new gyro reference is designed to include not only compensation for the earth's rotation but also the aircraft's east-west ground speed.

#### **SPECIALTY CONTROL DEPARTMENT**

Development of the first static excitation systems for aircraft generators was completed. Static excitation systems were designed for the generators utilized in five new military aircraft and one large commercial plane. Generator ratings range between 20 kva and 90 kva at 400 cycles, 120/208 volts a-c. The new systems employ magnetic amplifiers and silicon rectifiers instead of rotating ex-



citors, vacuum tubes, or variable resistance devices.

Completely new controls were developed for the protection of aircraft electric generating systems. These controls employ magnetic amplifiers in place of sensitive relays to achieve greater reliability and to obtain more accurate performance.

A brushless d-c generating system was developed for use in aircraft. The generator is an inductor-type 800-cycle a-c machine; silicon rectifiers are used in place of a commutator to convert its output to direct current. It is equipped with a 600-cycle a-c permanent-magnet exciter.

A compact, rugged magnetic-amplifier voltage regulator which weighs only 3 pounds was developed for missile generating systems. It may be used to control 400-cycle generators with ratings up to 10 kva. This regulator maintains generator excitation under all generator operating conditions, including short circuits at the generator terminals. Generator voltage is held within  $\pm 1$  percent for all generator loads between zero and rated value and all temperatures between  $-55$  and  $+100^{\circ}\text{C}$ .

#### **CAPACITOR DEPARTMENT**

A new silicone-bonded reconstituted-micamat dielectric capacitor, developed in 1957, promises continuous high-temperature operation up to  $300^{\circ}\text{C}$  and short-time operation to  $350^{\circ}\text{C}$ . This development supplements the  $500^{\circ}\text{C}$  mica capacitor now commercially available on a development-order basis. In the presence of nuclear radiation, the  $500^{\circ}\text{C}$  capacitor exhibits satisfactory operation.

#### **CONSTRUCTION MATERIALS DEPARTMENT**

Developed for aircraft application were two new aircraft wires. First of these was a 600-volt fire-resistant wire for fire detection, related circuits that must operate without failure for short-time emergencies, and other critical circuits that may be subjected to a total temperature of  $750^{\circ}\text{F}$ . The second development is a 600-volt single-conductor silicone-insulated non-flammable wire. It can be used for ambient temperatures ranging from  $-75^{\circ}\text{C}$  to  $+200^{\circ}\text{C}$  total.

Four synchronous detection receivers were delivered to the Air Force during the year. Additionally, a synchronous detection adapter was designed to convert standard receivers to suppressed-carrier double-sideband operation. Synchronous receivers eliminate image problems, because no intermediate frequency is employed. Interference and fading that result from multipath effects are also absent.

A new re-entrant cavity offering higher efficiencies over ridged or line-over-plane cavities presently used in microwave equipment was also developed.

Currently being evaluated in airborne equipment, the new cavity is one-fourth the size and weight of present ridged units operating over the frequency range of 2000 to 4000 megacycles. Under consideration are proposed evaluations for the cavity's use in sweep generators and r-f sources for other applications.

Developed in 1957 was a simplified procedure for predicting the absorption of infrared by the atmosphere between a target and an observer. The estimation process previously used was replaced by a systematic solution of the problem. Through this procedure, a person inexperienced in atmospheric physics can calculate atmospheric absorption.

Production started during the year on the magnetic-temperature-control amplifier for General Electric J79 jet engines. Weighing approximately 6 pounds, the unit mounts directly to the airframe. It is part of the nozzle area control servo that maintains a pre-set turbine discharge temperature.

#### **GENERAL ENGINEERING LABORATORY**

Developed during 1957 was a high-pressure gas stabilized, arc driven plasma generator for specialized wind tunnels and materials studies. Some of the problems solved in its development were stabilization of the arc in the gaseous environment, development of nonconsumable electrodes, plus fabrication of an arc chamber to withstand high pressures and extremely high heat fluxes. The unit is similar in concept to the water-stabilized arc.

Fluid-vortex confined arcs were made with power gradients of about 50 kw per inch of arc length—or more than 6000 kw per cubic inch of space occupied by the arc. Most recent studies were made in structures so arranged that the vapor formed by the arc could be expelled through a nozzle in the form of a jet.

Recent applications of a water-stabilized arc were for study of aerodynamic problems involving high-speed jets.

One of the present limiting factors in rocket design is the extreme heating rates encountered, particularly when the missile re-enters the earth's atmosphere on its downward journey. A considerable portion of heat transfer is the result of radiation from extremely high-temperature air in the region occupied by the shock wave preceding the missile. To measure the intensity and distribution of this radiation under actual circumstances, a photoelectric rocket spectrometer was designed and built last year. It will be situated in the missile's nose cone, operating only during re-entry into the atmosphere.

*Lycoming engineer adjusts constant output speed drive in laboratory test cell.*



## LYCOMING DIVISION AVCO MANUFACTURING CORPORATION

Additions to its family of gas turbine and piston engines, development of new products in the aircraft accessory and electronic fields and expansion of facilities for precision sheet metal machining work marked Lycoming's year.

At the Stratford, Connecticut, headquarters the company developed the lightweight T55 free power turbine aircraft engine with a rating of 1650 equivalent shaft horsepower. Development work continued on both the T55 and the earlier T53.

The T53 won two competitions during the year. The turboprop version was selected by Army and Navy evaluation teams as power plant for the new Grumman high performance observation plane. The helicopter version was chosen to power the Kaman H43B, winner of an Air Force crash rescue helicopter competition. Progress was also made on use of the T53 in VTOL-STOL aircraft being developed by Doak, Ryan and Vertol.

During 1957, the T53 completed a 50-hour tie-down test and was readied for production. To facilitate development of the engine, Lycoming established its own flight test operation.

From the Williamsport, Pennsylvania, section of Lycoming came a new high-compression four cylinder aircraft engine, the 0-320-B, to be used as the powerplant for the new Piper Apache and Piper Tri-Pacer. With a six pound increase over its predecessor, the 0-320, the new engine achieved an increase of ten horsepower. It was the sixth in Lycoming's four cylinder, opposed engine family.

Lycoming entered a new helicopter during 1957: the Hughes Model 269, a two-man vehicle with an empty weight of only 900 pounds. Powerplant is the 180 horsepower 0-360. Another Lycoming helicopter engine, the 0-435, demonstrated its endurance capabilities as part of a test conducted by

Hiller on the new H-23D 'copter. The engine ran 750 continuous hours.

Establishment of a modern aircraft engine service center and training school at the Williamsport airport was also effected during the year. Instruction will be given customers' mechanics in the maintenance and service of both fixed and rotary wing Lycoming aircraft engines.

Four new products were added in the aircraft accessory and electronic fields. Developed at the Stratford plant, all four were placed on the market. A mechanical constant output speed drive, developed under a contract from the Navy Bureau of Aeronautics, was designed to maintain 400 cycle A-C generator speed constant in aircraft installations regardless of variation in input speed or electrical load. Other products included a temperature acceleration indicator capable of anticipating bearing failures in rotating machinery by detecting acceleration of temperature rise; a volt-ohm-frequency meter, portable and self-powered, which combined all necessary test instruments used in electrical aircraft maintenance and laboratory work into one small, six-pound package; and a portable and self-powered frequency meter.

At both Stratford and Williamsport facilities, Lycoming performed large quantities of precision sheet metal and machining work. The division produced compressor components, turbine case assemblies, gears and compressor blades, rotor assemblies, and tail rotor components, missile components, machined components and assemblies, major components of the J71, J47, J73, J79, J57, and J75 jet engines, components and assemblies for both reciprocating and jet engines, and Hydro-spun inconel components for classified nuclear projects.

## MARQUARDT AIRCRAFT COMPANY



*Marquardt's new ramjet production plant.*

Marquardt Aircraft Company recorded its best year in 1957 with sales, employment and backlog reaching all-time highs.

At Ogden, Utah, the company completed a new manufacturing plant designed exclusively for the production of supersonic ramjet engines. This production program supports the Boeing Bomarc IM99 interceptor missile system.

Less than 30 days after dedication of the Ogden plant, Marquardt delivered to the Air Force the first ramjet engine produced by production-line methods with production tooling. The delivery was one month ahead of schedule.

In addition to its ramjet development and production work, Marquardt increased its activity in the field of turbojet controls and accessories. Production quantities of ram air emergency power units are being produced for operational use on the Lockheed F-104 and the Chance Vought F8U, both supersonic fighters.

The company also holds contracts for the development of afterburners and reverse thrust devices, the latter for Douglas Aircraft Company for flight test on its A3D carrier based attack plane.

Marquardt was designated a prime contractor in the Air Force nuclear propulsion program, and during the year worked on a contract from General Electric Company for the development of a turbojet engine control system designed for use with GE's nuclear powered turbojet.

As a result of the continuous upswing in research development and production, Marquardt continued the expansion of its physical plant facilities at Van Nuys, California, and Ogden. A modernization program which more than doubles the capability of the Marquardt Jet Laboratory at Van Nuys neared completion at year-end. In Ogden, work was underway on the construction of a production acceptance test facility to support the ramjet manufacturing programs. At Newhall, California, the first increment of a research test facility was completed. The latter will permit exploration testing in higher supersonic and hypersonic ranges.

## PRATT & WHITNEY AIRCRAFT DIVISION UNITED AIRCRAFT CORPORATION

Simultaneous certification of Pratt & Whitney Aircraft's J57 and J75 gas turbines for commercial use, expansion of facilities, and renewal of its nuclear propulsion program marked the progress of United Aircraft's engine division in 1957.

Commercial certification of the J57 (JT3) and the J75 (JT4) by the Civil Aeronautics Administration opened the way for delivery of these engines to Boeing for its 707 series, and to Douglas for the DC-8. At the year's end orders for more than 600 of the JT3 engines delivering upwards of 10,000 pounds of thrust, and more than 1200 of the larger JT4 powerplants in the 20,000-pound thrust class, had been received for installation in commercial jet airliners. Initial shipments of prototype engines were made.

A major addition to the Andrew Willgoos Turbine Laboratory at East Hartford was started and was scheduled for completion in the fall of 1958. The expansion will add six new test cells to the facility which was built in 1950 for the testing of jet engines and components under a wide range of simulated flight conditions. Construction of a new fuel systems laboratory for the testing of fuel system components under simulated altitude conditions was completed during the year. It will be in full operation by mid-1958.

Pratt & Whitney Aircraft's nuclear propulsion development program was renewed under contract with the Atomic Energy Commission. A new laboratory was completed by the Air Force in Middletown, Connecticut, and became the headquarters of

the program, designated CANEL (Connecticut Aircraft Nuclear Engine Laboratory). The ultimate objectives are the completion of a reactor design for an advanced aircraft propulsion system and development of reactor components.

Preparation of the site for Pratt & Whitney Aircraft's Florida Operations in Palm Beach County, Florida, was completed, and construction of the new 650,000 square foot plant was started. This new facility will be used for the design and development of highly advanced turbine powerplants. It was scheduled for completion in 1958.

During 1957, Pratt & Whitney Aircraft added a new member of its twin-spool, axial flow jet engine family, the J52. This engine, similar in design to the larger J57 and J75 powerplants, delivers 7500 pounds of thrust and was designed to meet the requirements of a variety of naval aircraft and commercial jets in the medium-range class.

The durability of the rugged J57, in production since 1953, was demonstrated. At the Wright Air Development Center in Dayton, Ohio, a J57 installed in a Boeing B-52 bomber completed the equivalent of 20 flights around the world, an accumulated flight time of 1000 hours, without overhaul. The test covered three years of flying under actual service conditions.

More than 5200 of the Pratt & Whitney Aircraft designed J57 engines were delivered in 1957 to the military and commercial users by the end of the year, including those manufactured under license by the Ford Motor Company in Chicago.

Operational use of the T34 propeller turbine, producing 6000 equivalent shaft horsepower, was started in 1957. After accumulating more than 16,000 hours on two Boeing YC-97J transports and more than 11,000 hours on two Lockheed YC-121F aircraft, the engine was produced for Military Air Transport Service Douglas C-133 transports which



*Pratt & Whitney's J57 with afterburner.*

will be used in transatlantic logistical operations.

A total of 688 R-2800 piston engines were built during the year for both military and commercial users. Spare parts production for other piston engines also continued through 1957. The company built a limited number of J48 centrifugal flow jet engines for the Navy's Grumman F9F-AT advanced trainer.

Progress was made on a number of advanced gas turbine projects for both the Air Force and Navy.

At the year's end employment in the division stood at about 38,000 reflecting a five percent reduction during the last two months of the year.

## **REACTION MOTORS, INC.**

Research and development programs on liquid and solid propellant rocket engines and related components continued at a high rate during 1957, the sixteenth year of RMI's history.

A major project during the year was the development program for the rocket engine for the North American X-15 research aircraft. The company's Internal Combustion Catapult powerplant was in-

stalled for final testing at the Naval Ships Installations Test Facility at Lakehurst, New Jersey. A new 1,000,000 pound thrust all-attitude test stand was unveiled at the company's test area in Lake Denmark, New Jersey, bringing to twenty-one the number of test stands for static hot firing of rocket engines and components. The test area was also increased by the purchase of new land adjacent

to the new test stand. The test area now operated by RMI consists of over 300 acres.

Another major development during the year was an integral self-contained liquid powerplant rocket engine package, complete from propellants to thrust chamber. It is designed to be delivered ready to be fired upon installation in an airframe.

RMI also expanded its activities in development

of high energy solid propellant rocket engines by combining certain specialized facilities at its Denville plant with those of Olin Mathieson Chemical Corporation at Niagara Falls, New York, East Alton and Ordill, Illinois. This integrated group was working on development of improved solid propellants and engines.

### THIOKOL CHEMICAL CORPORATION

Thiokol opened a new integrated production facility at Brigham City, Utah, in October, 1957 and started production of large solid propellant rocket engines.

One of the company's highlights was its participation in the Air Force Office of Scientific Research Project Farside in which test vehicles were fired 2000 to 4000 miles into space. Thiokol provided a number of its Recruit engines for the first and second stages of the Farside vehicles.

The company also provided power for the Lockheed X-17 re-entry test missile, the Hughes Falcon, the Martin Matador B and others. Thiokol re-

ceived a contract early in 1957 to provide a solid propellant sustainer for the Nike-Hercules air defense missile and another for the Lacrosse surface-to-surface tactical weapon. The company also received a contract for development and production of a flight test vehicle engine in support of the Navy's Polaris Flett Ballistic Missile.

Net sales for the first nine months of 1957 totaled \$20,715,578. Government sales were up 51 percent from the preceding year. Employment in the rocket divisions climbed from 26 in 1949 to 2200 at the end of 1957.

### WESTINGHOUSE ELECTRIC CORPORATION

The company's aviation gas turbine division at Kansas City received a new Navy production contract for J34-WE-36 and J34-WE-46 jet engines. The -36 was placed in production and initial deliveries to the Bureau of Aeronautics made during the year.

The division was also working on the -46, power plant for the North American T2J all-purpose trainer. The improved version of the J34 features a curvic coupling-type steel compressor and modifications to permit use of the latest type JP-4 and JP-5 aviation fuels. A series of tests to determine compatibility of the -46 with the T2J-1 inlet duct was completed at the Olathe, Kansas, Naval Air Station.

A series of successful flight tests was also completed on the company's privately-developed J54 engine at the Westinghouse flight test center. A North American B-45 four-jet bomber was used as a flying test bed. High altitude tests on the engine were also run at the Naval Air Turbine Test Center in Trenton, New Jersey.

A new jet fuel storage and handling system was completed at the Kansas City aviation gas turbine division plant. It included two steel storage tanks with a capacity of 840,000 gallons; eight unloading stations; a cooling tower for temperature control; a special fire extinguishing system; and a push-button control station.



*Rig used to test the Westinghouse J-34-WE-46 and T2J-1 inlet duct.*

# SYSTEMS AND COMPONENTS MANUFACTURERS

## AERONCA MANUFACTURING CORPORATION

Aeronca continued in 1957 to be a major supplier of components for several military programs and the Boeing 707 commercial jet transport.

Production of wheel well doors, elevators, rudders, ailerons, bomb doors and spoilers for the B-52 and the Center Wing Section for the KC-135 and 707 airplanes accounted for a large volume of the company's shipments during the year.

Completion of the design engineering for the Martin P6M beaching vehicle was accomplished early in the year and deliveries of production units started soon thereafter.

Aeronca continued to produce stainless steel honeycomb brazed structural assemblies for the Convair B-58. The company is one of four qualified by Convair for this program.

Acquisition and activation of new facilities for

aluminum honeycomb bonding was accomplished during the year. This equipment includes autoclaves, precision core milling equipment and Dow 17 processing facilities.

An extensive research and development program was underway in the field of brazing and an expansion of facilities was planned.

The company was awarded a study contract to develop electronics packaging structures for one of the ICBM programs. Progress on this project indicates a solution to many of the existing problems of electronic packaging for missile systems application.

Aeronca, during the year, started several new research and development projects aimed at expansion into new areas of missile and manned aircraft development and production.

## AIRCRAFT RADIO CORPORATION

Expanding needs for airborne electronic equipment to cope with the safety hazards created by greater air traffic brought about a 1957 increase in demand for ARC's newest developments in airborne communication and navigation equipment. Sales increased to \$10.5-million, up 20 percent from 1956.

An energetic and productive development and

research program aimed at broadening ARC's product line was continued. The year 1957 saw 13,000 square feet of space added to the engineering and production facilities bringing the total to 14,861 square feet. Engineering personnel increased 40 percent to a total of 88.

Development work neared completion on an extended line of airborne communication and



*ARC's new 360-channel VHF Transceiver.*

navigation equipment with emphasis on transistorization. This equipment is expected to be ready for sale late in 1958.

Delivery was started late in 1957 on a major addition to ARC's expanding product line, the Type 210 VHF communication system. This consists of a 360-channel VHF Transceiver, power supply and control panel.

Another contribution to the industry this year was the development of a completely engineered communication and navigation instrument panel installation for light twins. These instrument panel boards combine the controls for several systems into one compact and readily accessible control panel. A typical example is ARC's C-77A control panel designed and developed through the co-ordinated efforts of the aircraft manufacturers and ARC.

### ALUMINUM COMPANY OF AMERICA

Highlights of Alcoa's 1957 year included completion of a \$54-million plant expansion at the Davenport (Iowa) works and installation of eight foil rolling mills; a \$10-million expansion program at its Wenatchee (Washington) works; development of a new lithium alloy that represents a major scientific achievement in light alloy research; production of a wing fabricating table part that is the largest cast aluminum assembly ever achieved; newly perfected forging techniques that have helped Boeing Airplane Company slash production costs for the B-52; and introduction to the commercial market of aluminum powder metallurgy products for high temperature applications.

At Alcoa's Davenport works the plant expansion virtually doubled the peacetime capacity of the mill. New production units include a 160-inch hot mill, largest in the industry; a plate stretcher with a pulling force of 16-million pounds; a 100-inch cold mill for finish rolling wide, coiled aluminum sheet; plate heat treating and aging furnaces able to accommodate plate in the king-size 60-foot lengths. Expanded Davenport operations permitted production of 36-million pounds of rolled products every 30 days.

Alcoa Research Laboratories accomplished a breakthrough in light alloy research with development of a new aluminum aircraft alloy that pushes ahead the thermal barrier by more than 100°F. Lithium, lightest of all the metallic elements, has provided the key to the new alloy which maintains

high strength up to 400°F. Alcoa's extensive research revealed that lithium also produces the effect of increasing the modulus of elasticity of aluminum alloys. New alloy X2020 is three percent lighter than aircraft alloys formerly available, and its modulus elasticity is eight percent higher. All mill products in the new alloy lend themselves to standard fabrication processes employed by the aircraft industry.

At Alcoa's Cleveland works, four aluminum castings weighing more than 12½ tons were made for North American Aviation, Inc. The sections became part of a wing fabricating table that holds wing panels for precision milling.

The main landing gear bulkheads of Boeing Air-

*Alcoa's aluminum sheet is packed in dry ice for trip to Douglas plant.*



plane Company's B-52 bomber were the target of an extensive cost-cutting and weight-saving program planned by Boeing. In support of the program, Alcoa developed and perfected new forging techniques for use with its Cleveland works facilities. The forgings that resulted cut total machining man-hour requirements by 62 percent, and saved thousands of dollars in machine-tool costs for each set of bulkheads produced. The amount of aluminum originally needed for one set of bulkheads now produces eight sets.

Aluminum powder metallurgy products, made commercially available during 1957, can withstand temperatures up to 900°F, an advance of 300 to 400 degrees above the point at which conventionally produced alloys can function efficiently. One of the new APM products already is in use in standard production parts employed in jet aircraft engines. Three APM alloys are available: M257, which is made of domestic aluminum powders, and M430 and M470, which are made of aluminum powders imported from Switzerland.

## THE B G CORPORATION

During the year B G Corporation placed in production its new series of platinum and non-platinum spark plugs of the all weather top type and was furnishing models RB39R (platinum electrode type) to the Navy and models 340 and 345 (mass electrode type) to the Air Force. Commercial service tests were also in progress.

During the year B G continued to manufacture ceramic terminal sleeves, spark plugs and ignition harness tests sets for use in conjunction with piston engine operations.

For the gas turbine engine field The B G Corporation continued to develop a line of tail pipe thermocouples and harnesses, both the integral and separable types. A new resistance temperature

measuring system was developed, including a thermocouple suitable for much higher temperatures than encountered in gas turbine engines currently in use. Research and development in the field of gas turbine engine igniters continued. Various models of semi-conductors were placed in production during 1957.

In the field of alumina ceramics for the aircraft electrical and electronic fields, B G made improvements on its metal-to-ceramic sealing process to furnish a true hermetic seal capable of withstanding high temperatures and with high mechanical strength. Further advances were made in the line of special high temperature alumina ceramics to customer design.

## BENDIX AVIATION CORPORATION

### ECLIPSE-PIONEER DIVISION

Major emphasis at Eclipse-Pioneer Division during 1957 was in the direction of systems refinement and development. The systems involved covered all phases of automatic flight control, integrated instrumentation, stabilization, and airborne data processing.

PB-20 Automatic Flight Control Systems that had been ordered during the previous year materialized as flyable systems. In May, the PB-20B installation in the Lockheed-built TWA Jetstream Starliner became the first fully transistorized system to be certificated by the CAA and in June the system became operational when TWA inaugurated service with the same airplane. In September the PB-20D successfully completed initial compatibility

tests on the prototype Boeing 707 commercial jet Stratoliner. Also during September, the Royal Canadian Navy completed evaluation of the PB-20F in the DeHavilland-built CS2F-1 Tracker airplane.

During 1957, the PB-20G was ordered for the Convair 880. This order raised commercial commitments for use of the PB-20 to four major airframes and 17 domestic and foreign operators.

Advances were also made in Flight Director equipment and preproduction types of single- and dual-axis servoed command indicators were completed and put on flying status.

Central Air Data Computers became operational and new models were developed to satisfy requirements of new aircraft. In addition to their use with automatic flight control systems and bomb-





*Bendix Eclipse-Pioneer's all-transistorized automatic flight control system.*

ing and navigation systems, these compact miniature computers provide a source of highly accurate data for operation of the new vertical scale instruments of the military's integrated instrument cockpit display program. By year end, the complex device, which contained over 500 precision gears, more than 800 miniature ball bearings, and nearly 50 tiny servo motors in only slightly more than a cubic foot of space, was installed on McDonnell's F-101B, Republic's F-105 and Convair's F-106 and was scheduled for several other new military aircraft still in the design stage.

Development of vertical scale instruments for the new Air Force integrated instrument cockpit display was also a major project at Eclipse-Pioneer during 1957. Working in cooperation with the Flight Control Laboratory, Wright Air Development Center, the new style instruments were developed to replace the array of conventional, and often incompatible, round clock-like style of individual aircraft instruments.

Another major development at Eclipse-Pioneer during 1957 was a 6" x 6" x 12", 16 pound, 2-gyro, 3-axis all-attitude control capable of uninterrupted precision performance throughout extreme ranges of flight maneuvers. The new instrument was designed for use as a master control reference in applications such as anti-submarine maneuvering, aircraft early warning, low altitude bombing, vertical takeoff and landing, medium range interceptor missiles, medium and long range aircraft navigation, and inertial platforms. The new control also had provisions for tie-in with autopilot, radar sta-

bilization, compass and attitude repeaters, and fire control equipment.

Considerable effort was devoted to the field of navigational computers of various types. One dead reckoning, great circle type computer with a distance range of 1000 miles and a speed range up to 1000 knots was successfully test flown. Work in this area also included a unique true heading computer system which provided true heading and magnetic heading outputs from either magnetic or gyro heading inputs. Manual settings included absolute magnetic variation, magnetic variation rate, present latitude and longitude, and latitude and longitude rate. The device automatically computed and applied proper convergence angle for correcting gyro heading.

Progress also continued in the field of radar antenna pedestals for missile programs. Latest development was a lightweight ground based tracking radar antenna pedestal mounting two four-foot diameter reflectors. It was designed for use in connection with the ground-to-air short range Hawk missile.

The year 1957 also saw Eclipse-Pioneer's complex B-58 Automatic Flight Control System begin to phase out of a pure engineering state and into production. The multi-million-dollar-a-year effort which involved three other Divisions of the Corporation (Radio Division, Friez Divison, and Research Division) and more than 400 individual subcontractors required the creation of a special B-58 Systems Department for administering all phases of the massive program.

### HAMILTON DIVISION

Hamilton expanded both personnel and facilities during the year and reorganized its sales and service departments. Greatest activity continued to be in production and design of pumps and hydraulic components.

In the research and development area, Hamilton pursued development of fuel and hydraulic pumps and fuel controls for jet engines in the lower thrust classes. Very small pumps capable of delivering large volumes at high pressure were successfully built and tested.

### MONTROSE DIVISION

Montrose, manufacturer of Autosyn indicators and transmitters, dynamotors, DC motors, pressure warning switches and synchros, continued on a planned expansion program. During 1957 the Engineering Department was enlarged to increase development and research activity. The Sales and Service Departments were also expanded.

The Type 7615 Synchro Pressure Transmitter and Warning Switch was designed, combining two instruments into one case. This combination resulted in a price and weight saving.

The Type 26800 One Inch Synchro Indicator was designed for the military. This instrument weighs 2¾ ounces and is hermetically sealed. An integrally lighted model was also developed.

A Hermetically Sealed Dynamotor-Inverter was developed for Raytheon's use in the Sparrow III missile featuring a pressurized helium atmosphere for high altitude operation and reliability.

Dynamotors were developed and put into production for use in the Talos missile. These dynamotors meet the rugged vibration and shock requirements of missile use.

New type Navy Ordnance synchros were developed to meet the needs of modern aircraft electrical and electronic equipment. These new synchros will withstand higher ambient temperatures and have improved accuracy. Development is continuing toward providing synchros which will withstand ambient temperatures of 1000° Fahrenheit.

The Montrose Division was cooperating with the military services in a program designed to study the effects of atomic radiation on aircraft instruments. The results of this program will be used to provide radiation resistant instruments.

### PACIFIC DIVISION

Pacific Division observing its twentieth year as a unit of the corporation, continued in 1957 its development and production of electronic, hydraulic and electromechanical equipment for both

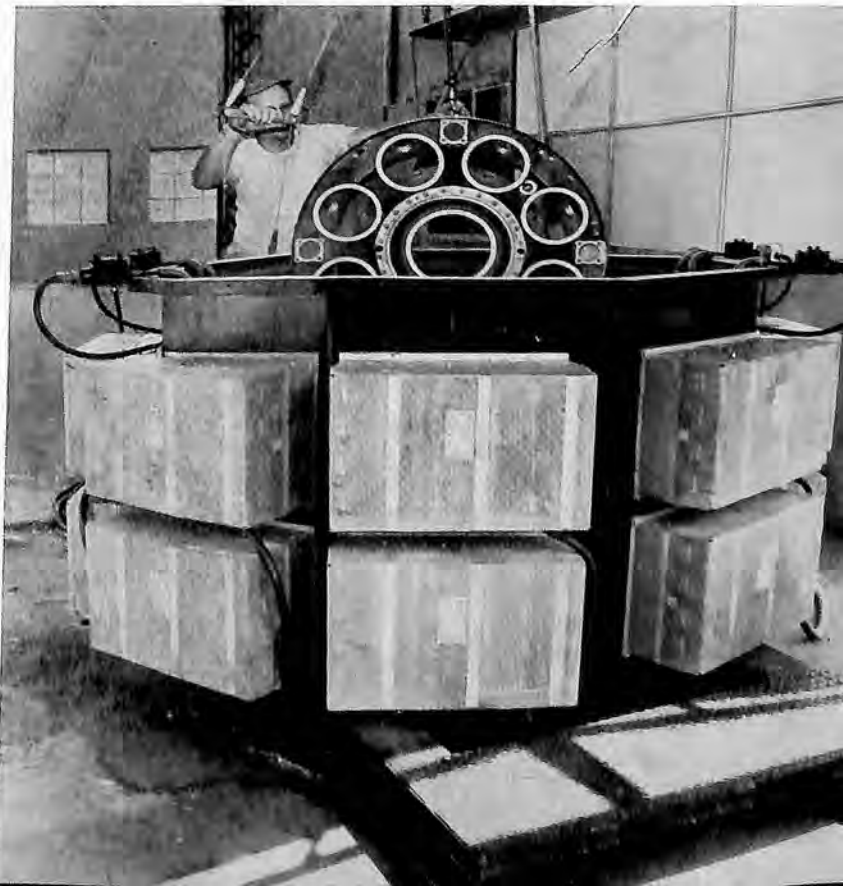
military and commercial markets. Plant facilities were expanded during the year with the addition of a new 12,000-square-foot building for missile hydraulic assembly. Occupied in December, the building was specifically designed to meet rigid standards in connection with atmospheric and oil contaminants necessary for missile hydraulic assembly and testing. Engineering space also was enlarged by moving a project group into 16,000 square feet of space in a new building near the main engineering facility.

Among the high points of the year was the development of a self contained instrument landing system for helicopters, in participation with Bell Helicopter Corporation. In flight tests with a Bell 47H-1, equipped with the Bendix-Decca Navigator, Bendix-Pacific developed sonic altimeter, and an improved attitude display, Bell pilots were able to take off, fly to any spot inside a 10,000 square mile area, and make an instrument landing within 10 feet of a pre-determined point without looking outside the helicopter cabin.

Pacific Division also developed a high resolution radar designed for use on helicopters, giving the helicopter all-weather capabilities for the first time. The NAV-Aid Radar weighs less than 100 pounds and is applicable to both rotary and fixed-wing aircraft.

Several new voltage controlled and resistance bridge telemetering sub-carrier oscillators, utilizing

*Sonic cleaning tank designed and built by Bendix-Pacific Division.*



transistors, went into production during the past year. Also in production was a complete line of newly designed, long life commutator switches. The motor driven units are used for telemetering, sampling and programming applications, in both aircraft and missile use.

The Division participated heavily in telemetry instrumentation for ICBM missiles, and put into production the portions of the Talos terminal guidance system which it designed and is building for the corporation's Missile Division.

United Signal Corps contract, development was completed on a two-way air-ground digital communication system for air traffic control. A new application of the Electro-Span digital supervisory control system, the new development eliminates voice communication and its high error potential, and reduces message time. Ground to aircraft messages are selective and registered only at the craft designated. Automatic verification of each decimal digit in the message is performed. Data is visually displayed in the cockpit, and all data is logged automatically on a printer at the control station. Electro-Span engineers also completed the study phase of a high speed data transmission system for the Signal Corps.

In the sonic processing field, Pacific Division completed development of a sonic cleaning system built especially for the requirements of the Air Force. Engineered and built by Bendix-Pacific for Wright Air Development Center evaluation at Norton Air Force Base, the system cleans large jet engine parts with high frequency sound waves in a fraction of the time normally required, and at a great saving in the cost of special cleaning chemicals.

Hydraulic developments during 1957 included an adaptable solenoid operated selector valve so designed that with minimum variance in tooling and use of similar parts, a complete line of selector valves can be produced from the basic four-way, three-position design. Applications included the Northrop T-38 jet trainer and the Boeing KC-135 tanker.

The Bendix-Pacific flow equalizer was modified to provide the high temperature, high flow accuracy necessary for split second actuation of speed brakes on the Lockheed F-104. The new unit is capable of handling more than twice the flow rate of former models, at almost half the pressure drop, and operating temperature range was increased by 50 percent at no increase in weight and size.

Also developed in the hydraulic line was a new dual brake valve designed for the Douglas DC-8

jet transport. Embodying a new design principle, the valve offers weight saving along with the ability to handle the high flow rate required in planes of the DC-8 size. Estimated total weight of the valve is 2.65 pounds; flow capacity is in the neighborhood of 50 gallons per minute.

A new air motor for missiles also reached the production stage early in 1957. A constant displacement rotary vane design, the motor is fabricated entirely of aluminum, with the exception of blades and bearings. The basic motor weighs only 1½ pounds, and develops 2¾ horsepower per 100 psi of inlet pressure.

A large portion of 1957 production activity was devoted to the power control system for the B-58 Hustler, which Bendix-Pacific designed and is producing in participation with Eclipse-Pioneer Division. The power control system is comprised of over 30 separate units, including hydraulic transfer valves, actuating cylinders and dampers, and electro-hydraulic servos.

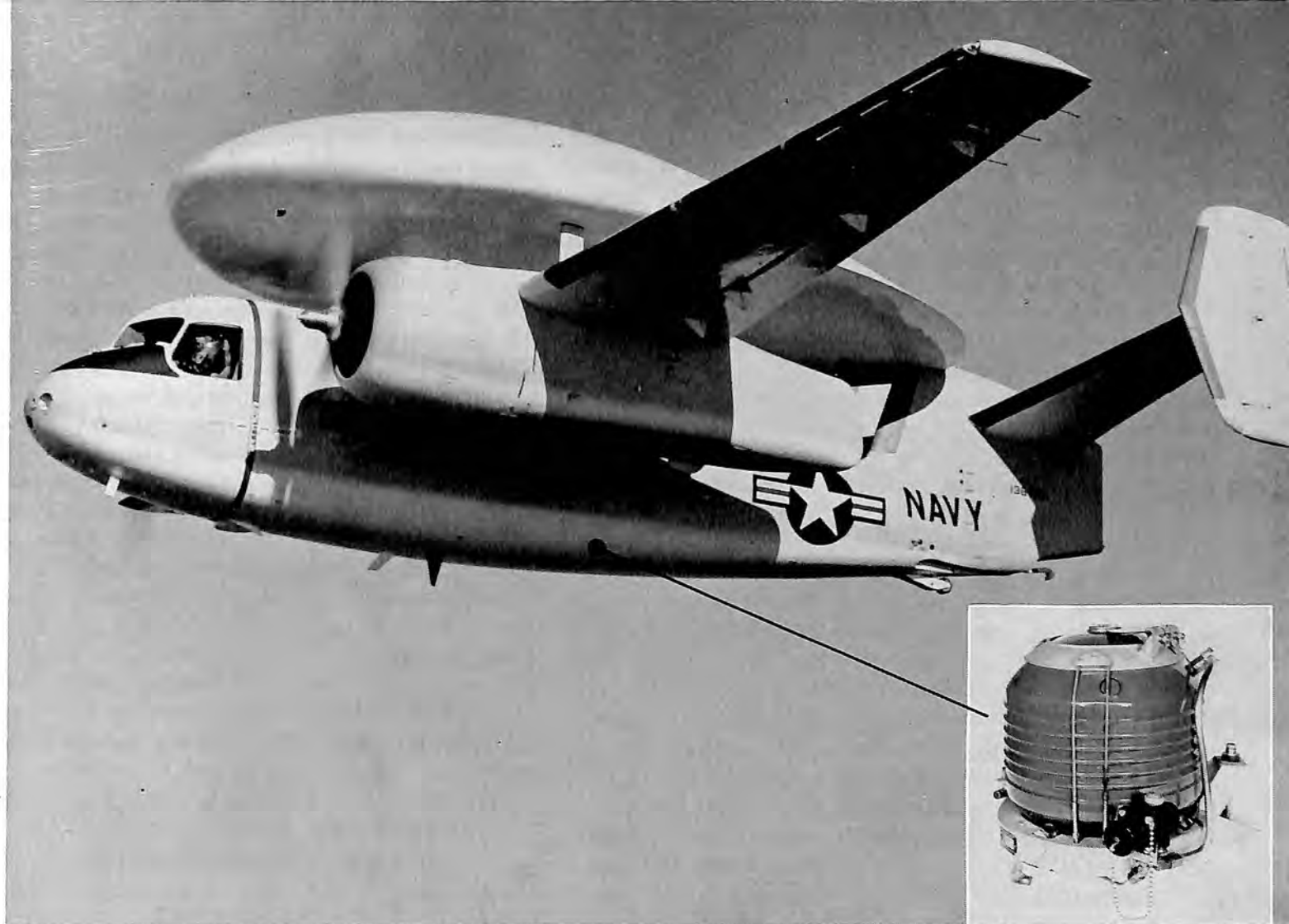
Hydraulic engineers continued development tests on high temperature servo valves, and supplied a number of valves for operation at 350°F for the Terrier and LaCrosse missiles and the Convair B-58. Qualification also was completed on an isolated foil type servo which operates over the temperature range of -40° to 275°F. Also under development was a servo valve program for application aboard submarines.

Pacific Division entered the missile launching field in 1957 with the development of a solenoid operated mass balance slide type valve approved by the Navy for the Tartar launcher installation. Another new development in this field was a series of hydraulic operated slide type valves designed for use in conjunction with the solenoid valve or for independent operation piloted remotely. These valves have also been approved for Tartar launcher installation, and the same design will be proposed for submarine applications.

#### PIONEER-CENTRAL DIVISION

Pioneer-Central developed a new Model 3922 turn and slip indicator, one of several flight instruments featuring integral lighting for sharper readability. Of reduced weight, the new model also provides for power failure indication.

The division was also supplying the Type 29024 10-liter converter for oxygen supply, a 16-pound unit used on the Navy's Grumman WF-2 early warning aircraft. Pioneer-Central also developed a new GU-12 altitude sensor parachute release for ejection seats or capsules. The compact release weighs less than one pound.



*Bendix-Pioneer Central supplied oxygen converter for Grumman WF-2.*

Progress was made in the research and engineering program of the Ultrasonic Products Section of Pioneer-Central directed at the development of equipment and techniques for applying ultrasonics to aircraft maintenance cleaning. In 1957, five more leading aircraft manufacturers and two more airlines adopted Bendix Ultrasonic Cleaning Equipment.

#### **BENDIX PRODUCTS DIVISION**

During 1957 the division put into operation a new ceramic laboratory which doubled the floor space previously available in engineering and development programming. Projects conducted in the new laboratory included bearing seals for jet engines and nose cone materials for guided missiles.

The engine equipment section continued manufacture of injection carburetors and direct fuel ignition systems which include injection pumps and master controls. Turbojet engine equipment included fuel metering controls, temperature control amplifiers, compressor guide vane control and discharge nozzle geometry positioners, afterburner controls and variable displacement fuel pumps. The divi-

sion also developed controls for solid and liquid propellant rocket engines, and continued work on landing gear systems for aircraft and recoverable missiles.

#### **BENDIX RADIO DIVISION**

The most important element in the sales picture during the year was the continued and increasing success of the RDR-1 Airborne Weather Radar System and the DFA-70 Automatic Direction Finder System. Sales of the RDR-1 System passed the 800 mark, and DFA-70 sales have reached 565. An increasing percentage of sales of these two products went to the business aircraft market.

Another sales development was the increased sales of Bendix commercial avionics equipment to government agencies. In August, the last units of an order of more than a million dollars worth of Bendix VHF Transmitters and Receivers were delivered to the Navy's Bureau of Aeronautics. In the same month, a contract was signed, under which Bendix Radio was to supply the Signal Corps with approximately \$170,000 worth of MN-100 Glide Slope Receivers.

Factory service facilities were increased by the addition of a new shop at Harbor Field. At the same time, the existing service facility at the Towson plant was improved and expanded with additional personnel and new test equipment. A "fly-in" factory service procedure was inaugurated permitting a business aircraft customer to fly in to Harbor Field and get immediate service on his Bendix avionics equipment.

Taking cognizance of the new forced-air techniques required for cooling electronic equipment in new jet and turboprop aircraft, Aviation Electronics Engineering designed and put into operation a new test facility. Using precision measuring instruments and specially designed fixtures, the Cooling Test Group determines the effectiveness of various cooling techniques on the various components of avionics equipment, under carefully simulated operational conditions.

A Special Projects Group was established in the Aviation Electronics Engineering Department. The unit was organized to handle advanced development work, including Doppler Radar Systems.

Development continued on a number of new avionics equipments. Among them was the TA-21A VHF Transmitter, a remotely-controlled, airborne communications transmitter which provides crystal-controlled operation on 360 channels, spaced 50 kilocycles apart, in the frequency range from 118.0 to 135.95 megacycles.

Other products under development during the

year included: The RA-21A VHF Receiver, a lightweight dual-purpose receiver specifically designed for aircraft installations where space, weight, power requirements, and reliability factors are of maximum importance; the NVA-21A Navigation unit, a fully transistorized unit for use in conjunction with the RA-21A VHF Airborne Receiver to provide complete VOR/LOC course information; the GSA-8A Glide Slope Receiver, a lightweight, 20-channel, UHF receiver designed to receive 90/150 cycle, tone-modulated, glide slope signals to provide vertical guidance information during ILS operations; the RDR-1D Airborne Weather Radar Transmitter-Receiver, a 1/2-ATR unit which incorporates virtually all of the excellent features of its larger RDR-1 predecessors, although power consumption, size, and weight are appreciably reduced; the ANT-1F (15") and ANT-1G (18") Radar Antennas, parabolic or "dish" type antennas designed for mounting in the nose of the aircraft, featuring line-of-sight stabilization of up to 20 degrees of roll or pitch, using voltages from the aircraft's gyro system; and the AMA-10A Passenger Address Amplifier, a fully transistorized audio amplifier for aircraft.

#### RED BANK DIVISION

New products developed by the division include a Transistorized DC Power Supply, Type 38B15, a small, lightweight power unit for planes and missiles; the Canistered Inverter, designed for missiles and other short duration flight equipment, en-

*Engineer instructing removal of inverter from canister at Bendix-Red Bank.*



vironment free and sealed against the effects of altitude up to 100 miles; and the Type 20B27 Transistor Type AC Voltage Regulator, which features printed circuit construction for great size reduction and weighs only three and three-quarter pounds.

#### **SCINTILLA DIVISION**

During 1957 Scintilla completed the first step of the largest plant expansion program in its history. A building addition of 63,000 square feet was erected to accommodate a completely integrated facility for the design, manufacture, and sale of electrical connectors for aircraft, electronic, and missile applications.

Scintilla developed a new type ignition system, called the High Frequency Ignition System, for the Curtiss-Wright R-3350 Turbo-Compound engine. This new system is designed to enable spark plugs to better withstand the harmful effects of fouling and corrosion.

The "Short-E" electrical connector was designed to provide a connector that would be smaller in length, lighter in weight, and more easily serviced. These connectors are moisture, vibration, and corrosion resistant, pressurized, and operate within the temperature range of  $-67^{\circ}$  to  $+257^{\circ}$ F.

A considerable amount of design and development work was conducted on ignition systems for large turbojet and turboprop engines. Important reductions in space and weight were accomplished with ignition systems for small gas turbine and rocket engines.

Protected wiring assemblies in many new configurations were developed for aircraft, missile, and electronic equipment applications.

#### **BENDIX-SKINNER DIVISION**

Bendix-Skinner successfully developed and supplied filters for Navy aircraft carrier use which removed sea water and iron oxide from the carriers' fuel tanks.

In carrier operation it is customary to fill the aircraft fuel tanks with sea water as fuel is with-

drawn, in order to minimize the danger from explosive vapor which would occur if fuel was allowed to surge in semi-empty tanks. This sea water must be later removed before the fuel can be placed in aircraft tanks.

To further complicate this filtration problem, in 1957 the Navy switched to JP-5 fuel for carrier based aircraft. This fuel has a viscosity double that of jet fuels previously used. This change, plus a gradual accumulation of rust in the fuel tanks, proved too much for the existing filters. Bendix-Skinner was able to develop and deliver replacement filter units ahead of the deadline established.

#### **SYSTEMS DIVISION**

Systems Division, while building new office and laboratory facilities in Ann Arbor adjacent to the University of Michigan Engineering Campus, carried forward full-scale systems analysis and development operations during 1957 in several important fields.

A supersonic, expendable target drone was designed for low-cost development and production. This aerial target system, designated PENNY, is capable of a speed-altitude and cross-sectional radar-IR envelope that more than adequately simulates enemy aircraft and missile targets. It can test the development and operational capabilities of the most recent and projected US weapon systems.

A significant study was carried out by the Division for defense against the intercontinental ballistic missile. Anticipating a defense largely dependent upon ground-based radar, which is open to confusion by decoys and by electronic jamming, an AICBM system, invulnerable to countermeasures, was devised. In addition, numerous other studies culminated in proposals to the military departments on such weapon system concepts as a combined passive-active system for air defense, a short-range optical-IR homing missile for targets of opportunity, and on an integrated data-processing and display system for ground control of air operations.

### **CLEVELAND PNEUMATIC TOOL COMPANY**

The company continued, during the year, its work in design and manufacture of aircraft landing gears and ball-bearing screw mechanisms for military and commercial aircraft. A new order was received for landing gear for the Convair 880 jet transport. Orders had previously been received for

Douglas DC-8 and Boeing 707 gears.

National Water Lift Company, purchased in 1956, added 125,000 square feet of floor space to its plant at Kalamazoo, Michigan. National Water Lift was engaged in design and manufacture of aircraft and control systems.



*Dow Chemical Company's giant extrusion press.*

## THE DOW CHEMICAL COMPANY

In 1957, Dow put in operation a giant new extrusion press and also continued its development of magnesium sheet, extrusion and casting alloys for elevated-temperature applications.

The new press, which has a capacity of 13,200 tons, is located at Dow's wrought products mill in Madison, Illinois. Leased to Dow by the Air Force, it is producing both magnesium and aluminum components.

The press produces integrally-stiffened sections from nine to twenty inches wide, I-beams from eleven to twenty-eight inches high and round tubing with outside diameter ranging from ten to twenty-four inches.

The Madison Mill began rolling production quantities of Dow's elevated-temperature alloy HK31A-H24 during the year. This has been designed into such aircraft as the Convair B-58 and such missiles as the Boeing Bomarc and the Van-

guard launching vehicle for the earth satellite. HK31A-H24 retains good strength properties up to 700° Fahrenheit. Dow also rolled developmental quantities of HM21XA-T8 alloy sheet, which has room-temperature properties inferior to HK31A-H24 but superior elevated-temperature properties.

A veteran Dow magnesium sheet alloy, AZ31B-H24, was designed extensively into the Chance Vought F8U-1.

Aircraft castings in HK31A-T6 and in Dow magnesium-rare earth alloy EZ33A-T5 were produced during the year at the Dow Bay City, Michigan, Foundry. This installation also produced complex and thin-walled castings with cast-in tubeless passages.

Also at Bay City, Michigan, Dow's magnesium fabrication plant produced aircraft components and electronics equipment.

## FORD INSTRUMENT COMPANY DIVISION OF SPERRY RAND CORPORATION

Ford increased its work area during 1957 by adding 100,000 square feet of building space in two Long Island plants. Employment went up to 3500.

In two production orders, Ford's Aeronautical Equipment Section received contracts totaling \$30-million for the ASN-7 Automatic Navigation Computer, to be used in such Air Force planes as the Boeing KC-135 jet tanker, the Republic F-105 tactical bomber, the McDonnell F-101 and the North American F-100F.

Ford Instrument was in full production of guidance and control systems for the Army's Redstone missile and was also working on components for the Jupiter.

Special exhaust temperature indicators and cruise control computers for jet aircraft were being developed under a Navy Bureau of Aeronautics contract.

The Ground Equipment Section was developing a Flight Control System, Surveillance Aircraft for the Army's Signal Engineering Laboratories.

The Marine Equipment Section built a prototype and made plans for production of launching computers for the Terrier and Tartar missiles.

Ford was also engaged in development of air traffic control instruments.

Ford coordinated for the parent company the formation of Sperry Farragut Company, Bristol, Tennessee. Initial construction provided for a \$2-million manufacturing facility of 116 acres. First production projects of the plant will be Army guidance and control systems.

*Ford's exhaust temperature indicator.*



## THE GARRETT CORPORATION

Garrett continued to supply pressurization and air conditioning equipment, pneumatic auxiliary power units and electronic controls for a number of turbine-powered commercial planes. The company's AiResearch Manufacturing divisions are making accessories and components for the Boeing 707, Douglas DC-8, the French Sud Aviation Caravelle, the British DeHavilland Comet, the Lockheed Electra, the Fokker-Fairchild Friendship, the Vickers Viscount and the Convair 880.

In the missile field, AiResearch was supplying such items as auxiliary power units, valves, refrigeration packages, control system regulators and actuators. AiResearch was also supplying complex electronic and electrical components for automatic pilot systems in classified missile programs. The division's Time Dwell Servo Valve was developed to convert electronic signals into powerful forces to move the control surfaces of guided missiles, drones or aircraft.

A corporation office was established in Geneva, Switzerland, to give European customers more direct service and Garrett personnel closer access to the market. This supplements associations already established with manufacturing licensees and servicing organizations in England and on the Continent.

AiResearch at Phoenix leased a new building adjacent to the main plant. Its 40,000 square feet is being utilized exclusively for the division's growing pneumatic control operations. Phoenix also completed a 14,000-square-foot addition to the main plant building to accommodate increased engineering activities, and leased a 40,000-square-foot warehouse.

AiResearch Los Angeles completed two new laboratory buildings, providing 12,000 square feet to broaden the electronic and instrument development programs.

A product development in 1957 was the cam-





*Twin motor actuator developed by AiResearch.*

piston air motor, produced by AiResearch Phoenix. Using bleed air as a source of energy, the air motor operates dependably far beyond the temperature limits of electronic and hydraulic units. Motor acceleration is accomplished in less than .05 second in most applications. Flexibility of basic design allows for a range of motor sizes from less than 1 horsepower up to 300 horsepower.

When coupled with a ball screw which may retract within the full length of the motor shaft, the cam-piston air motor has wide application as a compact, high-performance linear actuator in high temperature (1000°F.) pneumatic power control systems.

Other important developments at the AiResearch divisions included: a line combustion self-starting system for installation aboard the new jet airliners; an actuator which eliminates the tedious, time-consuming hand chore in trimming the pitch

of helicopter blades and does the job automatically in rapid time; a twin-motor actuator which permits a jet pilot to instantly override his autopilot controls in an emergency; a motor driven fan specifically for cooling the Boeing 707 cabin while on the ground.

AiResearch Aviation Service Division, Los Angeles International Airport, established separate quarters for its sheet metal fabrication department, and opened approximately 16,000 square feet of additional hangar space for modification, overhaul, repair and servicing of all types of private and business aircraft.

Aviation Service greatly increased its activity in the production of lounge sections, plus other modifications, for the planes of leading airlines.

An inflatable escape slide was perfected by the Air Cruisers Division at Belmar, New Jersey, to permit emergency passenger evacuation in 90 seconds from grounded aircraft.

Features of Air Cruiser's new 20-man life raft include a center container or torus, which serves as a deck float, and an integral storage space for accessories. This replaces a separate container on a line with its inherent possibility of interfering with operation of the raft during inflation. There are also two boarding ramps which facilitate entry even with a disabled arm or leg.

Consolidated sales of \$176,095,038 for the fiscal year ending June 30, 1957, were the highest in Garrett Corporation history, representing a 27 percent gain over last year. Largest contributor to this increase was AiResearch Phoenix in its sales of turbomachinery products, pneumatic valves, and electrical and electronic equipment. Backlog of orders at the end of the fiscal year totaled \$140-million.

#### **HAMILTON STANDARD DIVISION UNITED AIRCRAFT CORPORATION**

In 1957 Hamilton Standard neared completion of the tenth year of its planned program to diversify its product line. During the year it reached new peaks in the production of turbine aircraft and missile equipment while maintaining its position as a propeller manufacturer.

Highlighting the year were the following events:

Dedication of a new 410,000 square foot building to be used for the design, production and testing of fuel controls for turbine, atomic, and rocket engines.

Receipt of an order for new 54H60 Hydromatic propellers to equip the Air Force's C-130B, advanced version of the Lockheed "Hercules" propeller-turbine transport, with deliveries to start in June, 1958. The propeller was under development for two years.

Start of full production on the largest single order for propellers ever received in peacetime, intended for Boeing C-97 transports and KC-97 tankers.

Development of a new freon air-conditioning

system for the Convair 880 and Boeing 707 jet transports.

Employment rose to the highest level of the Division's history—11,500—approximately 15 percent above the peak employment of World War II. Completion of the new fuel control building brought total floor space in Connecticut to approximately 1,750,000 square feet, an increase of 75 percent over the size of the new plant originally built in 1952. The number of turbine-powered aircraft and missiles using one or more Hamilton Standard products rose to more than 50.

During 1957, Hamilton Standard continued to broaden its applications for the fuel control field. In addition to its advanced work on atomic and rocket fuel controls, development effort centered on the evolution of lighter, smaller units capable of major increases in fuel flow to meet the increasing powers of newer turbine engines.

For turbojet engines, Hamilton Standard produced electronic and hydromechanical main system controls for the J57, J75, J69, J52 and J83 engines; afterburner controls for the J52, J79, J73 and J75; emergency controls for the J57 and J79; temperature limiting controls for the A. V. Roe Orenda engine, and tailpipe nozzle controls for the J48, J52, J57 and J75.

In the propeller turbine field, main system controls for the T49, and helicopter turbine engines such as the T58 and T55 were included in the fuel control installation list.

In mid-1957 the division perfected a new aircraft air-conditioning system that drops the temperature

of air 1000 degrees in less than a second. Incorporating over 120 operating components and many new concepts in aircraft air-conditioning, the system is built by Hamilton Standard for the Air Force's supersonic bomber, the Convair B-58 Hustler.

The system was designed to meet heat problems created by the Hustler's tremendous speed. It receives large quantities of hot compressed air from the engines, cools it by use of heat exchangers and air cycle refrigeration units, and redistributes it at appropriate temperatures to cool the crew, electronic equipment, equipment in the external pods, tires, and ammunition. In addition, the system defrosts the windshield, clears it of rain by the use of air jets, and maintains air pressure within the cabin at a liveable level regardless of the airplane's altitude. Designing, developing, and testing the system to June of 1957 had required 550,000 engineering hours.

Air-conditioning systems for the new Convair "880" commercial jet transport ordered by four U. S. and foreign airlines were scheduled for delivery by Hamilton Standard starting in March of 1958. The systems will supply air-conditioned and pressurized air for the passenger cabin and flight deck of the "880," and will maintain a constant temperature of 75 degrees within the aircraft. Humidity will be held at 40 percent and cabin pressure at the equivalent of 8000 feet when the airplane is at 35,000 feet. A complete cabin air change will be provided every two and one half minutes.

The air-conditioning unit consists of two identical systems, each comprising a complete Freon cooling system, a supercharger and an electronic temperature control. Although cross-ducted, each system can operate individually. The dual system has a cooling capacity equal to the output of a refrigeration plant capable of producing 20 tons of ice in a 24-hour period, and removes 240,000 British thermal units of heat per hour from the air circulating in the aircraft. Its use of Freon vapor similar to the gas used in the average home refrigerator as its cooling source, marked a major departure from the air cycle systems produced by Hamilton Standard for more than 40 different types of turbine-powered fighters, bombers and missiles.

Compact air-conditioning systems for the A and B versions of the Lockheed F-104 Starfighter, one of the world's fastest and highest-flying fighter aircraft, went into production at Hamilton Standard during 1957.

The systems cool and pressurize the cabin and electronic compartment of the supersonic fighters, and defog the cockpit windshields and canopies.

*Hamilton Standard's hydromatic propeller.*





*Hamilton Standard's Freon system air conditions the Convair 880.*

Another new aircraft to incorporate Hamilton Standard air-conditioning was the Republic F-105 Thunderchief, new supersonic fighter-bomber. The Thunderchief's system cools both the pilot's cockpit and the electronics compartment.

Ten turbine engine starters were in production at Hamilton Standard during 1957, eight of them of the pneumatic type and the remaining two of the fuel-air type. Two more models were in development stages in each of the two categories.

Continued development of the pneumatic starter during the year resulted in light-weight models capable of operation at high temperatures with starting torques as high as 750 lb-ft and ratings up to 152 horsepower. The modern horsepower-to-weight ratio of 7.4 horsepower per pound represented a major improvement compared to the 2 horsepower per pound ratio of models with which Hamilton Standard entered the starter field in 1951.

Deliveries of fuel-air starters to the Air Force were accelerated during the year. These self-contained starters require no ground auxiliary equipment to effect engine starting and are capable of higher horsepower ratings. Development also was continued on propyl nitrate (monofuel) starters, which promise significant weight savings on a system basis.

Early in the year Hamilton Standard placed in production a hydraulic pump capable of operating at high temperatures while providing the needed auxiliary power to control supersonic aircraft. Four of the new pumps power the hydraulic system of the B-58. A smaller version of the same pump was ordered by Convair for its "880" jet transport.

Each of the four pumps, only nine inches long and seven and one-half inches in diameter, delivers up to 35 gallons of hydraulic fluid a minute to the hydraulic system at pressures up to 3000 pounds per square inch. When operating at its full speed of 4000 revolutions per minute, it delivers approximately 50 horsepower.

Development of Hamilton Standard's lines of low and high speed radial rotary piston pumps and of other newer products remained centered at the division's St. Petersburg engineering facility.

Appointments of Charles M. Kearns, Jr., as an assistant general manager and William E. Diefenderfer as engineering manager of Hamilton Standard, were announced early in the year. At the same time, Thomas B. Rhines was promoted to the post of chief engineer. Turner A. Sims, Jr., assistant general manager since 1951, continued in that capacity.

Typical of the work being produced by the electronics department was an advanced electronic propeller Synchronphaser unit for Lockheed 1649 Super-Constellation and Douglas DC-7 transports.

The Synchronphaser, which features seven printed wiring plug-in units, is capable of holding the phase relationship between rotating propellers to extremely close tolerances, reducing vibration and noise in the aircraft cabin.

A separate department of Service Overhaul and Repair was established late in 1957, with S. B. Sherwin as manager. The Service Overhaul and Repair Department places in one operation the functions involving three separate organizations, centering around production, service inspection, and products services sections.

## INTERNATIONAL TELEPHONE AND TELEGRAPH CORPORATION

IT&T's year was marked by considerable expansion to keep pace with developments in radio air navigation, missile guidance, electronic countermeasures and aircraft components. Federal Telecommunication Laboratories, Nutley, New Jersey, Farnsworth Electronics Company, Fort Wayne, Indiana, and Kellogg Switchboard and Supply Company, Chicago, Illinois, all added new buildings during the year, with FTL opening a new research center at San Fernando, California, to establish closer liaison with west coast air frame manufacturers. The San Fernando plant will specialize in research and development of inertial navigation and infrared guidance systems.

One of the high points of the year was receipt of an \$11.4-million contract for the manufacture of Tacan ground equipment for Vortac, the new U. S. common air navigation system adopted by the Civil Aeronautics Administration. The equipment, to be built by IT&T's manufacturing arm, Federal Telephone and Radio Company, Clifton, New Jersey, was developed at FTL.

Also completed was development by FTL of a non-voice, ground-air communication system which can be integrated with Tacan. Known as Tacan Data Link, this new aid enables a single ground control station to dictate the flight patterns of any number of aircraft that could reasonably be aloft in a given area. Ground consoles advise the controller of the bearing, distance, speed, altitude and heading of each plane. Via dual purpose instruments in the cockpits of the planes, the ground controller can order individual changes to best effect safe and swift air travel in his area. Tacan Data Link incorporates a push-button arrangement for exchange of printed messages, eliminating any possibility of language confusion—particularly on international flights.

Another new aviation aid which provides overseas flights with up-to-the minute weather informa-

tion via airborne teleprinter was under test in the latter part of the year aboard a Canadian airliner. Known as Narcast, this system eliminates existing delays of transmitting vital weather reports on crowded radiotelephone circuits.

In the field of long-range navigation, the Company's Navarho system was evaluated by the Air Force and resulted in its being one of the systems presented to the International Civil Aviation Organization by the U. S. Government. Following these tests, however, FTL developed a completely transistorized version of the bearing portions of Navarho which, after long tests at the Bureau of Standards Station, Colorado Springs, exhibited an accuracy twice that of older equipment tested by the Air Force.

In the field of low-approach and landing, the Labs worked on the development of site-free glide slope equipment. Sites adversely affecting this important function had long been a problem with the ILS equipment. Tests at most of the worst sites in the U. S. demonstrated that the new equipment was capable of providing accurately flyable glide paths regardless of adverse terrain.

FTL and Farnsworth, in cooperation with FTR and Kellogg, carried on IT&T's vital work in the development of electronic "brains" for many of the nation's most important guided missiles.

IT&T continued important work in the missile field, including the guidance systems for Talos and Terrier, the entire computing, ground, air and tracking system for Lacrosse, launching and firing controls, test and checkout equipment for Bomarc and air-to-ground communications for the second stage of the IGY satellite.

Many of these systems were dependent on newly developed IT&T traveling-wave-tubes, semiconductors and other components. Under development at FTL was a minute silicon semiconductor device, a switching diode, which is able to reverse electrical current 200,000 times a second.

*FTL-developed Tacan ground installations guide Air Force pilots in Alaska.*



**KAISER AIRCRAFT & ELECTRONICS DIVISION**  
**KAISER INDUSTRIES CORPORATION**

In October, the aircraft and electronics business formerly conducted by Kaiser Aircraft & Electronics Corporation became an operating division of Kaiser Industries Corporation.

The division continued to expand its activities during 1957 in the fields of research, engineering and production in the aircraft, missile and electronics industries. A new electronics plant was established in Phoenix, Arizona, and first occupied during October. This brought to six the number of plants operated by Kaiser Aircraft & Electronics Division. In addition to the Phoenix plant, the division had facilities engaged in electronics work at Palo Alto, California, and Toledo, Ohio. It was also operating three plants performing aircraft and missile work in the San Francisco Bay area. The latter three plants had an aggregate of 334,000 square feet of floor area.

The Richmond Machining Plant, Richmond, California, continued to devote a major portion of its effort to the manufacture of component parts for the Boeing B-52, KC-135 and Model 707 aircraft. In the latter part of the year, arrangements were completed for the installation of an initial

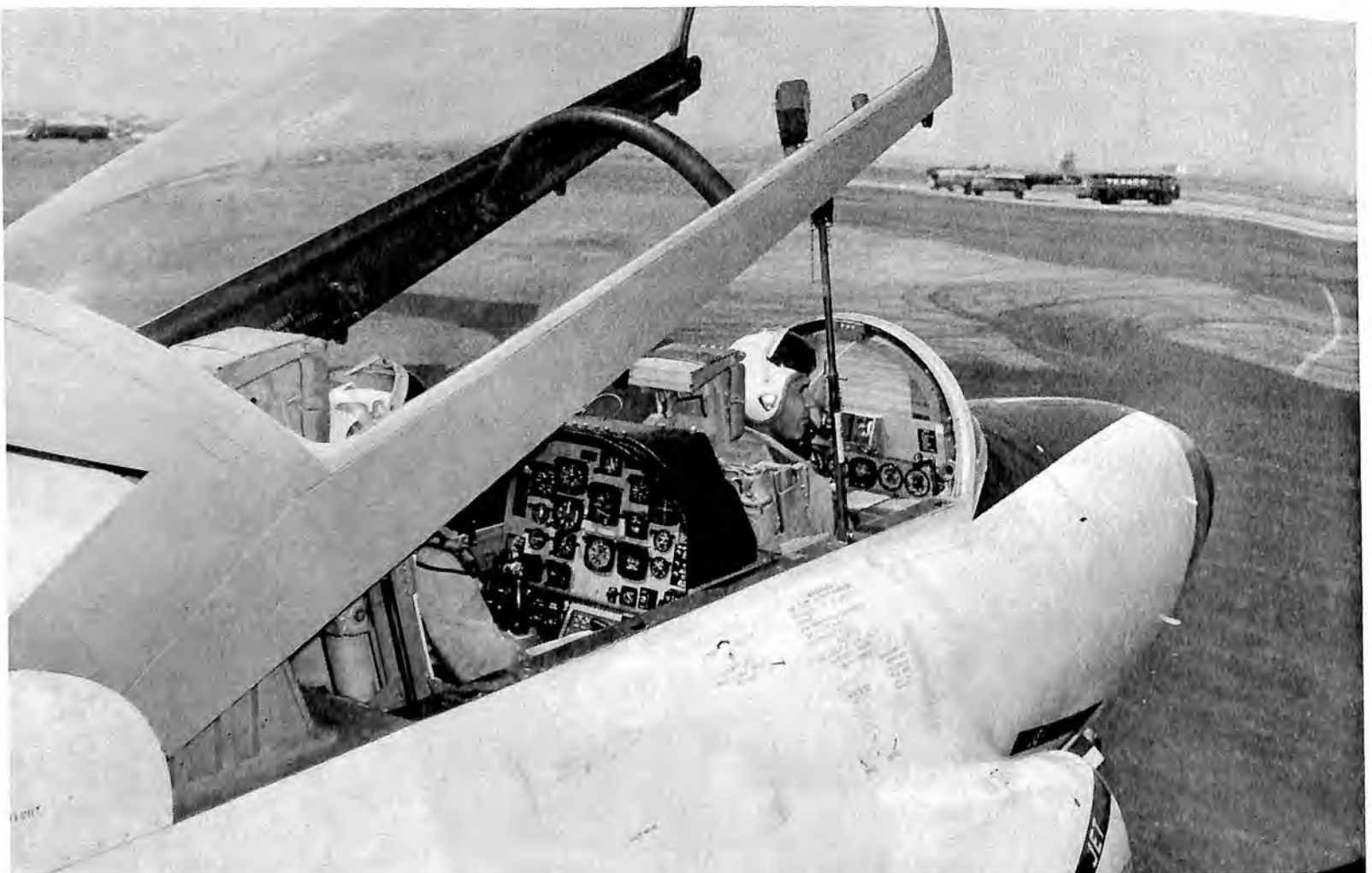
complement of two numerically controlled machine tools. Operation of the tools was scheduled for early 1958.

The San Leandro, California, plant, specializing in precision machining, angular and longitudinal milling, airframe fabrication and assembly and missile component machining, added a number of machine tools as part of a \$500,000 expansion program in support of production of jet aircraft and missile components.

Highlighting the activities at the West Coast Electronics Laboratory at Palo Alto was progress on the Kaiser-Aiken thin cathode ray tube, of which three configurations were being produced in prototype quantities for military airborne applications. Additional research during 1957 was directed toward development of other tubes for both military and commercial applications.

At the Toledo Electronics Plant, a complete environmental test laboratory was added during the year to provide a means of proving reliability of design and adherence to environmental specifications. The Toledo plant specialized in design and manufacture of missile systems testers.

*Cockpit panel of the future (front) uses Kaiser's thin television tube.*



**KOEHLER AIRCRAFT PRODUCTS COMPANY**  
**DIVISION OF NEW BRITAIN MACHINE CORPORATION**

Kochler continued as a major supplier of precision valves and accessories to practically all military and commercial aircraft in production or under development.

Following the industry trend, slow-down of orders in the last half of the year necessitated a slight personnel reduction in the manufacturing division.

A new Valve Testing Laboratory was put in operation early in the year. It facilitated production testing and aided product development and improvement programs.

As the year ended Koehler was developing a new series of high performance valves for the ballistic missile programs and investigating special items for ground support equipment.

**KOLLSMAN INSTRUMENT CORPORATION**

Increasing expansion in the manufacture of complex automatic navigation and flight control systems necessitated a reorganization of Kollsman's executive functions, a realignment of production forces, and an increase in manufacturing personnel.

Activities of the Kollsman Research and Engineering Laboratories continued to intensify. Additional engineering and technical personnel were added to the staff to round out the complement required for the Laboratories' programs, which cover a wide range of automatic systems for manned aircraft and for guided missiles. Research was in electronic, electrical, mechanical, optical, and chemical areas, with many of the systems combining several of these engineering arts.

Early in the year Kollsman started working on a \$26-million Air Force production contract for the Automatic Astro Compass. Designed to increase the strategic effectiveness of high speed, long range aircraft, the system automatically tracks celestial bodies and computes precise aircraft direction.

A second procurement by the Air Force of the Kollsman automatic celestial navigational systems in 1957 was a contract for the pilot production of the AN/AVN-1 Astro Navigational Set, known as the Kollsman Astro Tracker. This system is particularly suited for use in high speed, long-range fighter-bombers although it has application in many other types of aircraft. It automatically and continuously tracks a celestial body, measuring its altitude angle and relative bearing, both required for computing the position and true heading of the aircraft. This relieves the navigator of manual sighting, saves time, and greatly reduces the possibility of human error.

Quantity production orders for high performance air data computers and for various types of special

devices were received from the military as well as from airframe manufacturers and industrial firms.

Substantial orders were also received for various advanced types of Kollsman Cabin Pressure Systems which will be used in the new Douglas DC-8, the Fairchild F-27 twin turboprop as well as in other aircraft.

There was a large increase in orders for the company's Integrated Flight Instrument System. Known as KIFIS, it provides the extremely accurate flight instrumentation necessary for the solution of flight separation problems. Over 140 of these systems were on order for use on the Douglas DC-8, the Boeing 707, the Convair 880, and the DeHavilland Comet IV.

Growing activity in the field of guided missiles has resulted in a stepped-up program of production in the Kollsman Synchrotel transmitters and servo torque units. Because of their extremely light weight and short response time, Synchrotel transmitters have become important components in the production of control and guidance systems as well as of telemetering and other flight testing devices. They are currently components in such guided missile programs as the Regulus, Snark, LaCrosse.

Volume production continued on the Kollsman line of sensitive and high range precision altimeters, Mach airspeed indicators, airspeed indicators, true airspeed indicators, and Machmeters. Substantial orders were filled for thrust meters, tachometers, vertical speed indicators, pitot and pitot static tubes, and various types of special flight research units.

Also in quantity production were combination differential and absolute pressure instruments, baroswitches, weather instruments, periscopic and hand-held sextants, and other precision optical devices

and components. Pressure switches and pressure monitors were in wide demand for guided missile application. Motor production continued high with a concentration on precision induction motors and rate generators.

Kollsman's new 160,000-square-foot plant in Syoset, Long Island, was completed in the fall of 1956.

The number of employees in all plants rose from 4400 at the beginning of the year to 5555 at the end of the first ten months.

Orders received during the first ten months of 1957 amounted to \$33-million. The backlog of unfilled orders for the same period amounted to approximately \$60-million.

### LAND-AIR, INC.



*Interior view of Land-Air's hangar space at Cheyenne.*

During 1957, Land-Air acquired Stepper Motors Corporation and subsequently operated the company as a division. Stepper's basic product is a bi-directional, incremental motor with applications in missiles and machine tool automation.

The Cheyenne Division was certified by the Civil Aeronautics Administration to perform unlimited repair on Class I, III and IV airframes and Radio Class I with limited navigation.

Land-Air also completed a CAA study contract on an Airborne Automatic Navigation Aid Check System which checks accuracy of ground stations in such systems as VOR, DME and TACAN. Under the same contract, the company developed a Navigation Aid Performance Evaluation System which analyzes data recorded by the airborne system to evaluate the performance of the same ground stations.

### LEAR, INC.

Lear, Inc., entered its twenty-eighth year of business in 1957. Shipments for the year were estimated at \$65-million and new business at \$70-million. As of November 1, backlog was approximately \$60-million, and employment was 4200.

Development and production of guidance and control systems and components for missiles received priority at the company's domestic operating divisions at Grand Rapids, Michigan; Elyria, Ohio; and Santa Monica, California. Volume pro-

duction was started on guidance system components for Boeing's Bomarc, and the company furnished automatic flight control systems for various drones. In addition to several major classified programs, the following missile developments were reported: coordinate converters; data link receivers; various gyroscopic reference systems including three-axis data generators and two-, three-, and four-axis stable platforms; high-temperature pneumatic motors; pressurizing equipment for electronic devices, cool-

ant units, dehydrators, desiccators, pumps and fueling devices. An Army research contract was awarded the company in connection with a north-seeking gyroscope.

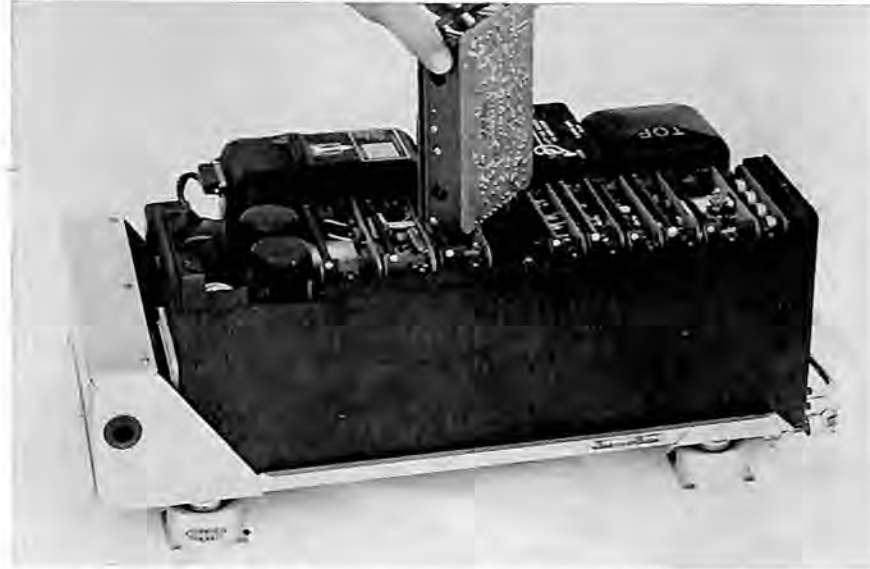
Increased emphasis was placed on air transport equipment, and the product line for both military and commercial transports was substantially augmented. Among the new systems added to the basic line of products in this category were the L-102 all-transistorized automatic flight control system, an Integrated Flight System providing easily-read "natural flight" indication (which Lear calls "Naffli"), the Lear NavCom system, modularly combining basic requirements for reliable radio navigation and communication for aircraft in IFR and VFR conditions, the transistorized ADF-100, and the Super ARCON (Automatic Rudder Control).

The L-102 was installed in the Lockheed JetStar, Fairchild Friendship F-27, and in various business aircraft, including a Learstar which was the first business aircraft to fly the transpolar route from the U. S. to Europe. The L-102 was produced in quantity for the French Sud Aviation Caravelle jet airliners ordered by Air France.

Lear engaged in volume production on the following systems as a result of initial or follow-on contracts received during 1957: AN/AJB-3 Low Altitude Bombing System, Master Attitude Reference System (MARS), Vertical Gyro Indicator, MC-1 Autopilot for the Boeing KC-135 tanker-transport, Damping System for the Lockheed F-104 Starfighter, Air Inlet System for the Republic F-105 Thunderchief, and electronic guidance components for the Bomarc interceptor missile.

The Lear "whole panel" development program was carried forward under an Air Force contract for cockpit improvement. The design philosophy of the "pilot-centered cockpit" calls for integrating instruments as a part of the cockpit rather than as separate components, in order to make readily available to the pilot all of the information he requires.

Simplification of pilots' monitoring duties is also the concept behind a new flight director-attitude indicator, developed by Lear in 1957, combining



*Lear's L-102 flight test electronic package and 3-axis data generator.*

in one instrument attitude reference, glide path director, slip or skid, and rate of turn.

First orders were received in 1957 for a remote control trimming system for turbojet engines. The system affords a method of engine trimming by the ground crew at the cockpit or other remote position, and provides for a quick mounting and uncoupling to the fuel control.

The company's Electrolink remote positioning system was ordered in quantity for diverse applications in industry. Work progressed under a development contract on a remote-controlled guidance system, which was applied to various USMC tracked vehicles. Using such systems, unmanned landing craft can be maneuvered through dangerous surf conditions and onto a beach by drivers riding in helicopters.

Overseas business accounted for an increasing proportion of total volume in 1957. The Munich division, Lear Electronic GmbH, obtained orders from the German Air Ministry for more than \$1.5-million for automatic direction finders. The Geneva division, Lear S.A., obtained orders for stabilization systems which were installed in the Swiss Air Force jet fighter, the P-16. To licensees of Lear products in France and Italy was added a British firm, licensed to produce Lear automatic stabilization equipment.

## THE LIQUIDOMETER CORPORATION

Liquidometer extended its research and development activities in connection with capacitance and other types of liquid measuring systems, during 1957. As a result a number of entirely new princi-

ples of gaging were developed including an "all attitude" type which will measure fuel accurately on an aircraft or a missile regardless of attitude.

During the year, deliveries were made to Douglas



Aircraft Company of Liquidometer "true weight" gaging systems for installation on DC-8 airplanes. This system measures fuel accurately regardless of the density of the fuel.

Numerous installations were made of Liquidometer's transistorized fuel gaging equipment which features silicon transistors exclusively and which will withstand high temperature environ-

ment up to 125°C. In addition, many of the newest types of aircraft and missiles were equipped with other Liquidometer products such as thermistor liquid level sensors, position indicating systems and miniature magnetic amplifier relays.

During 1957, Liquidometer occupied its newly constructed building in Los Angeles which provides sales, engineering and repair services.

### **MINNEAPOLIS-HONEYWELL REGULATOR COMPANY**

Minneapolis-Honeywell opened a new engineering facility in St. Petersburg, Florida, designed and constructed exclusively for the development and manufacture of inertial guidance systems and components. The 98,000-square-foot plant cost \$2.5-million and included more than \$2-million in equipment. Employment reached more than 500 by year-end, including more than 200 engineers.

The Aeronautical Division, together with Honeywell's Ordnance Division and Boston Division, were grouped administratively into a new Military Products Group for better responsibility for weapon system contracts. Resources of the Group include 9000 employees (about 2000 professional engineers) and 12 major plants in seven cities from coast to coast which have more than 1,400,000 square feet of engineering and production space. Stephen F. Keating, vice president in charge of the Aeronautical Division, was named head of the Group.

Honeywell was working on prime contracts for two missile development programs: (1) "Wag Tail" the air-to-ground guided rocket for the Air Force Armament Center, and (2) The "ASROC" missile program for the Navy; this contract is held by the Ordnance Division. In addition, the Aeronautical Division was supplying guidance systems

and major components for many missile and rocket programs including the Vanguard, Titan, Thor, Snark and others, plus several Army missile programs.

The Aeronautical Division was also supplying systems for the F-100, F-101, CF-100 and was designing new systems for several other Air Force and Navy aircraft. Honeywell was an associate prime to RCA in developing a new Integrated Electronic Weapon System for the Canadian supersonic CF-105 fighter. Honeywell Low Altitude Bombing Systems (LABS) were being supplied to all Air Force fighter-bombers, to the Royal Air Force and Royal Navy. LABS was also adapted for use on the B-47.

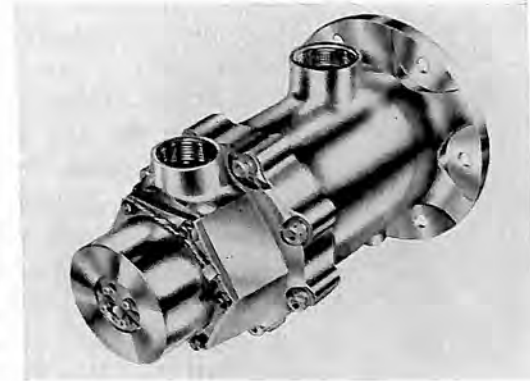
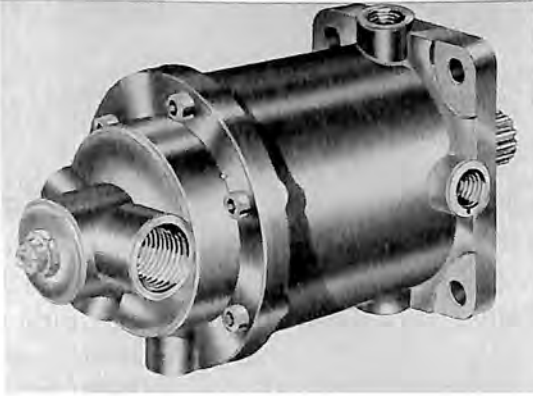
Advances in the field of hermetic integrating gyroscope (HIG) or "floated" gyro development and manufacture were made during the year with Honeywell's design and initial production of a miniaturized HIG (called MIG) that weighs less than a half-pound and its companion accelerometer (the MPIA—Miniature Pendulous Integrating Accelerometer) that weighs less than .4 pound. Research work was conducted at both the Aeronautical Division's Minneapolis and St. Petersburg plants on new inertial-grade gyros and gyros utilizing new electronic concepts.

### **THE NEW YORK AIR BRAKE COMPANY WATERTOWN DIVISION**

Three new pump series, to expand the division's existing product line of constant and variable flow, axial piston hydraulic pumps and pump-motor combinations, were developed during 1957.

The Rotodynamic Pump, a high-speed, high-pressure, two stage, "scoop" pump delivering 10 to

25 gallons per minute at 3000 pounds per square inch, was designed for operation at 35,000 revolutions per minute and -65°F to 500°F. This new design features continuous air and vapor ejection and optimized scoop design. The Over-center Pump, a rotating cylinder-block pump with over-



center cam, offers the advantage of reversible flow, close control with little pulsation, and small size (19 pounds). High temperature pumps were also produced for use at temperatures above 400°F.

*New York Air Brake adds three new pumps to its line: the Over-center pump (left); the Rotodynamic pump (middle); and the High Temperature pump.*

### PACIFIC AIRMOTIVE CORPORATION

Pacific Airmotive continued to expand the scope of its commercial operations during 1957. Under the terms of the first commercial jet engine overhaul agreement in history, PAC will overhaul the Pratt & Whitney J57 engines powering Continental Air Lines' fleet of Boeing 707 jet transports. These engines and their accessories will be overhauled at PAC's main plant in Burbank, California, where new jet engine facilities are under construction.

Distributor for Grumman Aircraft Engineering Corp.'s turboprop powered "Gulfstream" business transport scheduled for delivery in 1958, PAC sold the first production model to Sinclair Refining Company, Tulsa. Sales and service of the "Gulfstream" are handled by both PAC's Burbank Aircraft Division and the company's wholly owned

subsidiary, PacAero Engineering Corp., Santa Monica, California.

On July 1, the company's test and ground support equipment division located at Linden, New Jersey, became a wholly owned subsidiary. The new company, Flight Support, Inc., moved into a completely modern new plant at Metuchen, New Jersey, in November.

West Coast test and ground support equipment manufacturing facilities for the company were consolidated at PacAero in September. Design and manufacture of specialized rocket and missile test equipment was accelerated and test equipment of more general application was also expanded.

A standard production model Learstar transport built by PacAero Engineering Corp. became the

*The Learstar is manufactured by PacAero Engineering Corporation.*



first twin-engine aircraft, as well as the first business aircraft, to fly the trans-Polar route from Los Angeles to Dusseldorf, Germany. Only refueling stop was at Frobisher Bay, Northwest Territories. Total elapsed time for the flight was 23 hours, 58 minutes.

D. Napier & Son, Ltd., London, awarded contracts to PacAero covering the conversion and flight testing of Eland-Convairs. Valued at approximately \$1-million, the agreements covered conversion of three Convair 340's and one Convair 440, plus certification of both aircraft.

A sustained performance record of 630 C-47 aircraft overhauled, modified and delivered on schedule was achieved by PAC's military aircraft facility at Chino, California. Last aircraft under the company's third C-47 IRAN (inspect and repair as necessary) contract rolled off the production line at Chino and was accepted by the Air Force in October.

During 1957, PacAero was named exclusive U. S. manufacturer and distributor of Spraymat, a development of D. Napier & Son, Ltd., of London, England. Manufacture of Spraymat, a patented system for electrical de-icing and anti-icing, was scheduled to begin in PacAero's new plant late in 1957.

Another PAC subsidiary, Pioneer Aircraft Leasing Corp., signed a five-year engine-leasing contract with Slick Airways. The contract provides for the leasing of 24 R-2800-CB engines for DC-6A aircraft operated by the fleet carrier. Periodic overhaul of the engines is accomplished in PAC's Burbank engine shop.

Consolidated sales for Pacific Airmotive Corporation and its wholly owned subsidiaries were \$24,467,215 for the nine-month period ended August 31, 1957. This compares with sales of \$14,759,926 for the same period in 1956.

## RADIO CORPORATION OF AMERICA



*RCA's lightweight weather-radar system.*

Weather radar for small planes; modification to single-sideband operation for a widely-used high altitude, long-range communications system; perfection of the "data link" system for controlling and guiding interceptor aircraft; development of a 25-pound transponder beacon radar for use in air traffic control; and the possibility of modifying weather radar into additional usage as an airborne proximity warning indicator keynoted the RCA's aviation work during 1957.

A new weather avoidance radar system for small planes (the AVQ-50) was developed. Weighing only fifty pounds, this unit enables pilots to "see"

and avoid storms up to eighty miles ahead. Braniff International Airways became the sixth major U. S. airline to install regular RCA weather penetration radar (AVQ-10).

RCA successfully modified for single-sideband operation the ARC-21 high-altitude, long-range airborne communications system. Known as the ARC-65, the single-sideband version provides for 44,000 frequency channels, spaced at 500 cycle intervals throughout the high-frequency spectrum, from 2 to 24 megacycles. Used in a Strategic Air Command B-52, the ARC-65 made continuous station contact at ranges from 3,000 to 5,000 miles.

The newly-developed transponder radar beacon automatically broadcasts aircraft's identity to traffic control center when triggered by ground interrogation equipment. Employing printed wiring and compact packaging concepts, the AVQ-60 has a receiving and transmitting range of more than 200 miles.

Presented as a discussion item at 1957 airlines meetings was exploratory work on the possibilities of modification of RCA's weather radar, which would be required to utilize this equipment as a Proximity Warning Indicator. This would permit changing the scope presentation to a short-range scale and different polarization techniques for rain clutter suppression. Ground clutter at low altitudes may be overcome by integration techniques,

while surveillance to the rear could be provided by adding rear-looking antenna. RCA continued studies of the feasibility of these changes.

Other RCA achievements included development of a 10-ounce "noise barrier" ear protector to enable ground crews and maintenance personnel at military and commercial airfields to work around jet aircraft without danger of hearing loss or ear

damage; receipt of an Air Force product improvement contract under which RCA will develop industrywide design and reliability standards for various types of airborne electronic equipment; and development of a high-intensity noise system for quick, economical pre-flight lab tests on survival capacity of electronic components and assemblies for jet aircraft and guided missiles.

### ROHR AIRCRAFT CORPORATION

Rohr continued its production of power packages and also turned out high strength steel weldments, brazed stainless steel honeycomb sandwich panels, metal bonded panels, flap tracks, large fuselage sections, horizontal stabilizers and elevators. Components were being manufactured for Boeing Airplane Company, Douglas Aircraft Company, Convair Division and Lockheed Aircraft Corporation for use of five military and six commercial airplanes.

Rohr was also working on a thrust reverser and noise suppressor for jet engines.

The company added during the year an electronically controlled profile milling machine at the Chula Vista, California, plant, and a Sheridan combination transverse and longitudinal and stretch forming press, a 250-ton punch press and a large press brake at the Riverside, California,

plant. For metal bonded structure work, a second large autoclave was added at Riverside in 1957.

Late in the year, Rohr completed construction of a company-designed and fabricated press with a capacity of 25,000 tons as an aid in cost cutting on tools and production parts.

Expansion of engineering and research facilities continued through 1957 as part of the company's diversification program.

During the year, Rohr opened a new assembly plant at Auburn, Washington, where jet pods for Boeing's KC-135 tanker and 707 commercial transport are assembled from parts furnished by the California plants. Rohr also expanded its assembly plant at Winder, Georgia, for Lockheed C-130 power package work. Employment at all plants rose from 10,000 to 12,500.

### SIMMONDS AEROCESSORIES, INC.

During 1957 Simmonds made substantial gains in the packaging and circuitry of capacitance liquid measurement and management systems which resulted in increased reliability, and decrease of weight and size of the components. The M-2 free-flooding tank unit was designed to provide a homogeneous mixture of fuel within the tank unit or probe, insuring that this mixture is the same as the fuel contents in the fuel tank. This improvement assures that the fuel gage is measuring actual fuel content. Simmonds' transistorized indicator-amplifier-bridge was considerably shortened so that the overall length is approximately two inches. This substantially decreased the weight of the unit and consequently the over-all weight of the fuel gage installation.

A dual-function transistorized counter-pointer in-

dicator-amplifier-bridge was designed to meet latest specifications. This unit incorporates a duplexing device which permits one amplifier to serve two distinct fuel gage functions. A multi-plexing device was also designed to permit one amplifier to serve more than two fuel gage functions. Simmonds Load Limit Control was successfully installed on

*Simmonds' SARAH Beacon was redesigned in 1957.*



the Viscount aircraft operated by Capital Airlines and was scheduled for the French Sud Aviation Caravelle.

Simmonds Search and Rescue and Homing equipment, which transmits a distress signal permitting searchers to "home" on a location, was repackaged and redesigned to American standards in 1957. This equipment was considerably lightened through the use of transistors and improve-

ments in circuitry. The final design of the LOCAR—Location & Rescue—beacon was completed. The LOCAR beacon was designed to transmit signals which could be picked up on continuous wave or pulse wave receivers.

Simmonds fuel injection equipment was installed on several prototype light aircraft engines. These injection systems incorporate newly designed altitude compensation fuel flow cut-off devices.

## SOLAR AIRCRAFT COMPANY

Early in 1957 Solar began work on the smallest gas turbine aircraft engine ever built. The new 55-horsepower Titan engines, planned in both variable-speed and constant-speed versions, were designed for use in one-man helicopters and flying platforms under military study. The engine will weigh only 50 pounds, and will have a maximum diameter of 15½ inches, a maximum height of 22½ inches. It is being developed under joint Army-Navy contract.

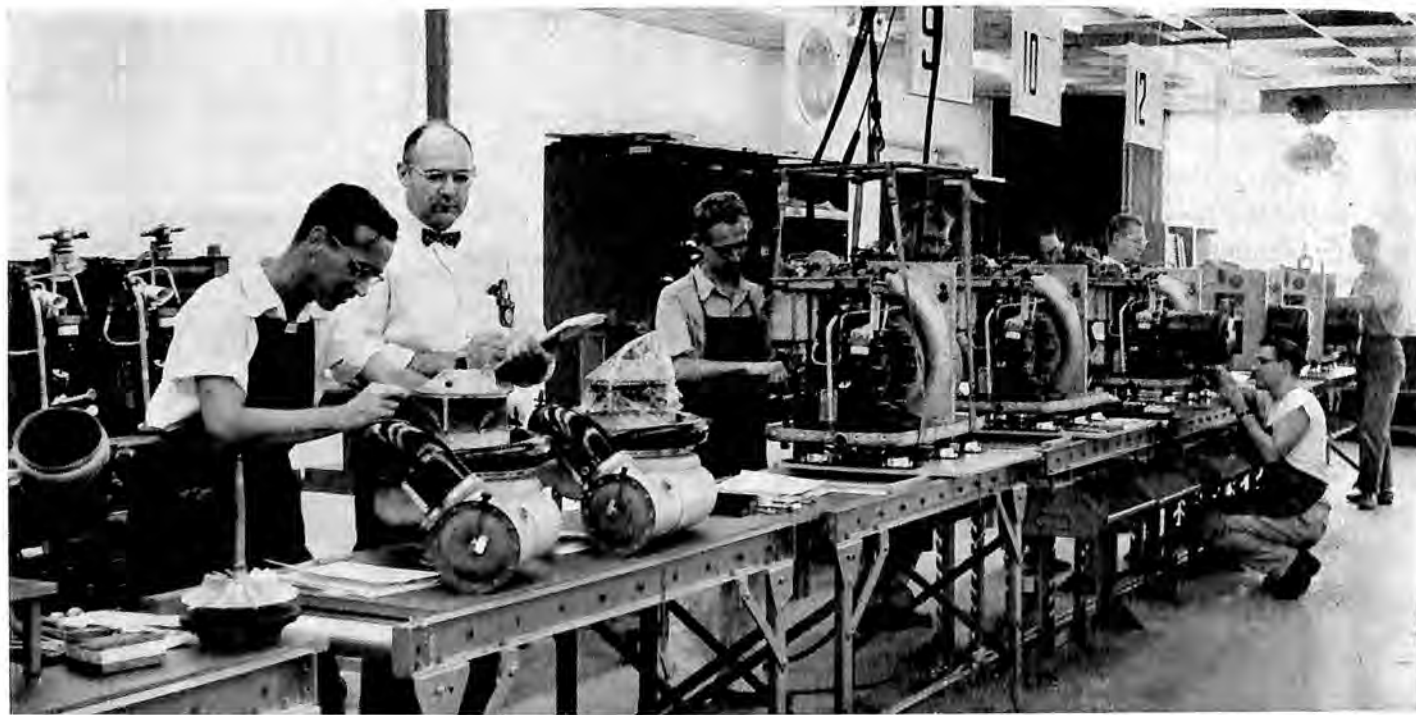
Solar undertook a major expansion of the company's missile and nuclear development activities during 1957. As part of this expansion the company formed a research and development engineering group devoted entirely to missile and nuclear technology. The group was assigned advanced missile development studies of complete weapons systems for the military services and for non-military scientific research.

The company's research and development activities were stepped up considerably in the area of

high-temperature brazing during 1957. A thermal process for effecting the atomic bonding of solid surfaces by means of a fused filler material, high-temperature brazing is an increasingly important manufacturing technique. High-temperature brazing was used by Solar in the manufacture of both fabricated parts and heat-resistant all-metal honeycomb sandwich structures that provide the strength of high alloys with the weight of lighter metals, plus the ability to stand up under temperatures as high as 1800°F. Many new brazing materials and methods were developed by Solar for the program, as well as new high-temperature brazing furnaces.

New assembly lines for gas turbine engines were established by Solar in 1957. The lines will allow the company to turn out production quantities of 50 horsepower Mars and 500 horsepower Jupiter gas turbine engines for use in a wide variety of aircraft and missile applications. Uses include pod-mounted electric supply, ground support for jet aircraft, guided missile ground support, auxiliary power for air operations and others.

*Solar's assembly line for production of Mars generator sets.*



## SPERRY GYROSCOPE COMPANY

A highlight of Sperry's 1957 year was the formation within the company's Air Armament Division of a special countermeasures section. Sperry has important assignments in the field which are classified.

Sperry was assigned follow-on production of the primary navigation and guidance systems for the Air Force's Convair B-58. The virtually automatic control systems are for flight path direction of the B-58 and accurate release of its detachable pod. Sperry was also assigned the design and manufacture of ground check-out equipment for the B-58.

An inertial navigation system, designed for use in determining ship position for firing the Navy Lockheed Polaris missile, was undergoing test and evaluation during the year aboard the experimental ship *Compass Island*. The system, which pinpoints the ship's location and plots true course and speed continuously, is a joint Navy-Sperry project.

A year-long field test program on CYTAC (Loran-C) hyperbolic radio navigation system for air and sea was completed. The system requires a small number of ground transmitters to provide a complete 24-hour, all-weather air and sea navigation blanket over the United States and adjacent sea lanes. The tests, conducted by the Air Armament Division with Air Force and Bureau of Standards cooperation, confirmed a range capability of 1500 miles over land routes and 2200 miles over the sea.

Sperry received an Air Force contract in 1957 for the development of a Twin Gyro "stable platform," differing in major respects from conventional two and three gyro platforms. The Twin Gyro employs a new concept of two identical directional groups, set at right angles to each other, instead of the usual combination of one vertical and one directional gyro.

The company continued its work on inertial guidance systems during the year and started production of new gyroscopes and other inertial components of high accuracy. The systems are designed for long range missiles, atomic ships and submarines and supersonic aircraft. Successful achievement of new production line precision in millionths demanded redesign of many factory areas and methods and the creation of new super-sensitive test devices to insure accuracy.

Sperry also moved into initial production of its new SP-30 flight control systems for the Convair 880 and Douglas DC-8 jetliners and the Martin SeaMaster, multi-jet attack seaplane. Developed over an eight-year period to meet precise jet flight

requirements, the transistorized SP-30 system has wide application for automatic precision control of future jet aircraft, over the needed wide range of a "slow" 100-miles-per-hour to sonic speeds and above.

For military jets, the Air Force called for continued production of MA-2 automatic flight control systems for B-52 Stratofortresses. Latest orders brought to \$9.15-million the amount of contracts to produce these advanced systems. The MA-2 provides strategic bomber crews with automatic "K-System" bombing control, as well as "hands-off" control on long flights to targets and on instrument landings.

Sperry continued work on "super-radars" for the Navy's fleet-defense guided missiles *Terrier* and *Talos*.

The year also brought successful completion of quantity production requirements on all elements of the Navy's introductory air-to-air missile system, *Sparrow I*. Deliveries adequate for several years' fleet usage of this combat-ready weapon—complete with airborne radar guidance gear, shorebased and shipboard check-out equipment, complete missiles with various warheads, launching racks and other system components—were finished on schedule about mid-year.

In the same period, another Sperry assignment to complete a missile system got under way, with initial planning and first pilot production of components for an advanced, but un-named Army surface-to-surface missile with new high performance capabilities.

During 1957, Sperry created a new laboratory which developed smaller and lighter gyro devices for future missiles. These eliminate the need for heavy power supplies, by self-contained explosive or hot-gas generators to drive high-speed gyroscopes, servos and actuators. Some of these miniature devices can accelerate instantaneously, without warm-up time, up to 50,000 revolutions per minute in two-tenths of one second or less.

Other gyro advances brought into production a new lightweight Gyrosyn (R) compass system of unprecedented accuracy six to fifteen times more precise than previous types.

The new C-11 Gyrosyn Compass achieves its accuracy with a non-floated gyro having greatly-reduced random drift rate, even under stress and vibration not exceeding one-half degree per hour. Such stability is particularly valuable at high latitudes where the earth's magnetic field makes ordi-



*Sperry-developed microwave dual lens.*

nary magnetic compasses unreliable, and ground navigation aids are virtually non-existent.

A revolutionary method of calibrating aircraft compass systems—expected to save millions of dollars in ground maintenance and flight costs—was provided for the Air Force late in 1957. The equipment electronically “rotates the world” around a parked aircraft, to provide more reliable compass calibration in as many as 24 directions.

New integrated instrument combinations, incorporating many improved features, have now been specified for use on America’s fleet of turbine airliners—the Douglas DC-8, Convair 880, Boeing 707,

Lockheed Electra and Fairchild Friendship.

These new instruments replace many separate cockpit indicators, and display pre-computed flight data. Principal elements are an R-1 Pictorial Deviation Indicator, a basic radio navigation and landing control instrument; the HZ-3 Horizon Flight Director, a combined artificial horizon and Zero Reader (R) flight director for accurate navigation and attitude control; and a Gyrosyn Compass master indicator combining basic magnetic and radio direction information.

In 1957 the Air Force adopted world-wide usage of Sperry engine analyzers of both ground and airborne types, to obtain more efficient continuous performance of all piston aircraft.

Sperry started production of new Turbine Vibration Indicators, to help maintain the full high-performance capability of turbine engine types. The equipment has been specified by American Airlines for continuous monitoring of the turbine engines on its Lockheed Electra and Boeing 707 jetliners. Further development continued on other types of needed automatic controls for both turbojet and ramjet power plants.

Sperry’s Air Armament Division continued volume production of the APN-69 airborne homing beacon used in refueling operations of Air Force planes. The system enables bombers to pinpoint the exact location of their tankers while still hundreds of miles away.

The company expanded production of integrated test equipment for monitoring and checking performance of missiles and early warning radars, operating at frequencies from 400 to 36,000 megacycles. Manufacture continued on other microwave sub-systems and special dual antenna systems for missile radars.

Sperry developed new types of RACE (Rapid Automatic Checkout Equipment), a tester for complex missiles and aircraft. The company delivered to the Atlas ICBM project RACE 101, capable of checking out in 90 seconds every circuit in a room-size computer. Newest types will also check out ground stations, factory and depot quality control and flight line tests of aircraft systems.

The company’s Electronic Tube Division expanded its facilities to include volume production of multi-megawatt transmitter klystrons for super-radars, transponder klystrons for long-range missiles, metal-ceramic traveling wave amplifiers for new airborne weapons and special oscillator tubes for radar equipment. Production also continued on transmitter klystrons for the TACAN air navigation system.

## SUNDSTRAND AVIATION DIVISION SUNDSTRAND MACHINE TOOL COMPANY

Sundstrand maintained a high level of production of constant speed drives and associated electrical controls. Other Sundstrand Aviation products included a line of high speed, low weight, continuous duty hydraulic motors, high temperature hydraulic pumps and motors, special hydraulic motors, and field test stands.

High temperature work dominated Sundstrand's research program during the year. Several hydraulic pumps and motors designed to operate in the 600°-700°F range were developed. A constant speed drive was successfully operated in an ambient temperature of 800°F with oil-in temperature of 600°F.

Extensive high temperature tests of jet engine lubricants and hydraulic fluids continued during the year. Other high temperature development work continued on individual components such as filters, journal and anti-friction bearings, static and dynamic seals, and gears. Much of this work is presently aimed at the 1200°F level.

A million dollar, 17,000-square-foot environmental test laboratory was nearing completion.

This facility was designed and built specifically to house equipment for development and testing of components and systems. The entire facility is devoted to combating the problem of heat, in conjunction with other adverse environmental conditions. Test equipment provides for testing from -100°F to 1200°F, altitudes to 200,000 feet, and vibration tests to a 15,000 pound force level.

A new plant specializing in the production of all types of Sundstrand housings was opened this year. A new Sundstrand Aircraft Service Corporation Office was also established in Seattle, Washington. Preparations were completed for the opening of an area representative's office in Dallas, Texas, early in 1958 to serve the Southwestern area. Other expansion increased engineering space 50 percent and almost doubled model shop facilities.

Sundstrand-Denver continued to be a substantial second source for Sundstrand constant speed drives and continues development work in the fields of cryogenics, pumps, nuclear reactor controls, fuel system components and hydro-mechanical equipment for the chemical industry.

## THOMPSON PRODUCTS, INC.

Thompson Products continued in 1957 to expand its research, development and manufacturing facilities, and made comparative advances in product and manufacturing areas relative to the aircraft, missile and rocket equipment fields.

Thompson Products Staff Research and Development, New Devices Group, installed a new analog computer available for commercial or military work. The principal use of the computer was in the simulation of control components, systems and complete units. This analog simulator was also used to develop a Director-Controlled machine

tool. Complete simulation of systems from conceptual design to prototype development is possible with the simulator.

More pronounced interest in designing, developing and producing components, systems and complete sub-assembly units for missile applications was evidenced in 1957. In conjunction with the Ramo-Wooldridge Corporation, an affiliate, radio control units, radar homing controls and autopilots mechanisms were developed.

Thompson Products Electronics Division developed advanced electronic countermeasures de-

*Thompson Products' new analog computer facility was installed in 1957.*





vices and new design coaxial switches covering wide frequency ranges.

The West Coast Division of Thompson Products continued production of components made from thin wall tubing through the use of the metal gathering and flotrusion processes. One-piece integral construction of rods and pistons, tubular forms of all sizes and shapes are possible using these methods. Flotrusion makes possible closer tolerances in thin walls and eliminates the use of expensive machinery and polishing practices.

The Accessories Division opened a new laboratory facility at Roanoke, Virginia, Advanced auxiliary power units and new pump concepts for handling high energy and exotic fuels for future jet engine and missile uses were undergoing development and testing in this laboratory. A number of

test cells were in use testing auxiliary power units of present and advanced design.

One of the major expansion programs of Thompson Products began in February, when ground was broken for a new Staff Research and Development Science Center in Cleveland, Ohio. Areas of research at this new Center will include Metallurgical and Chemical Laboratories, New Devices Development and Research Groups, Nuclear Products Department, Machine Tool Automation, Metal Cutting Laboratory and Automotive Research and Development Laboratories.

Research under way during 1957 in the missile and rocket fields included studies of cermet materials, mono- and bi-propellant fuels, auxiliary power units, gas generators, liquid/vapor fuel systems, alternators and regulators for missile applications and nuclear propulsion power plants.

### **VICKERS INCORPORATED DIVISION OF SPERRY RAND**

Organizational changes aimed specifically at meeting the expanding needs of the aircraft industry and its changeover to rocket and missile production highlighted the 1957 year for Vickers Incorporated.

The Aero Hydraulics Division was set up under the guidance of B. W. Badenoch, Divisional Manager, to streamline product design and development, sales, service and production for the specialized aircraft and missile industry. This newly created division was provided its own design and development, application engineering and production facilities.

The reorganization also brought along the establishment of three new regional offices in Seattle, Long Island, and Washington, D. C. Other regional offices include those in Miami, Florida, Arlington, Texas, and Torrance, California. Creation of these offices, as well as extensive representation in the newly created Vickers International Division, gave the Vickers Aero Hydraulics Division world wide engineering and service representation.

In January, 1957, a new production facility was opened in Jackson, Mississippi. This plant added approximately 130,000 square feet of manufacturing area to the main plant in Detroit and the production facility in Joplin, Missouri.

The completion of the Torrance plant in February, 1957, added another 100,000 square feet of new facility in the heart of the California aircraft

industry. The Torrance group is spear-heading the packaging, or manifolding, of electro-hydraulic units into self-contained power and control packages.

The year also saw the complete activation of the facilities at the new Administration and Engineering Center in suburban Detroit. This facility houses a complete concentration of hydraulic laboratory and research facilities. Plans called for completion by early 1958 of a new addition, capable of testing complete hydraulic systems at ultra-temperatures (ranging to 1000°F).

Along with high temperature research, an extensive development program was under way leading to hydraulic components utilizing higher pressures. A 4000 psi aircraft pump resulted and was being delivered for operational use. Another concentrated program included the miniaturization of hydraulic power units, both piston and vane type.

Development work entered the final stages and production started on the hydraulic components—main system pumps, etc.—for the new round of turbojet and turboprop airliners. Vickers hydraulic products have been specified for use on Boeing 707, Douglas DC-8 and the Lockheed Electra. The latter aircraft will use a new oil cooled motorpump of revolutionary design. A hydraulic ground starting package for airline and military use was also successfully developed and demonstrated extensively.

An across-the-board increase in rotating speed of

approximately 11 percent for all Vickers piston type pump and motors was achieved. Also, special units were developed for applications requiring input speeds upwards to 20,000 revolutions per minute. Continued progress was made in the design and development of electro-hydraulic constant speed drives. A laboratory mockup was run successfully and total evaluation units are now being pro-

duced. A high response, low weight and reliable servo valve was also developed. This unit is a two-stage, dry coil valve, weighing 9.3 ounces and capable of up to five gallons per minute flow. Vickers was meeting another expanding market with paralleling development progress on packaged radar drives for airborne, shipborne and stationary applications.

## WESTINGHOUSE ELECTRIC CORPORATION

The company's 41st year of activity in the aviation industry was marked by expansion of facilities for development and production of aircraft equipment.

A new wing that adds 100,000 square feet to the Westinghouse Electric Corporation's air arm division in Baltimore, Maryland, was completed. The wing represented the seventh expansion program at the plant since the air arm building was completed in 1951.

The two-story addition to the building includes nearly 70,000 square feet of office space for some of the plant's engineers. Located on top of the new wing is a "penthouse"—a roof top laboratory where airborne electronic systems being built for the Navy and Air Force will be evaluated.

Westinghouse also received an amended lease from the Navy for the huge Naval Industrial Reserve Aircraft Plant in Kansas City which may lead to an increased production volume for the company's local aviation gas turbine division.

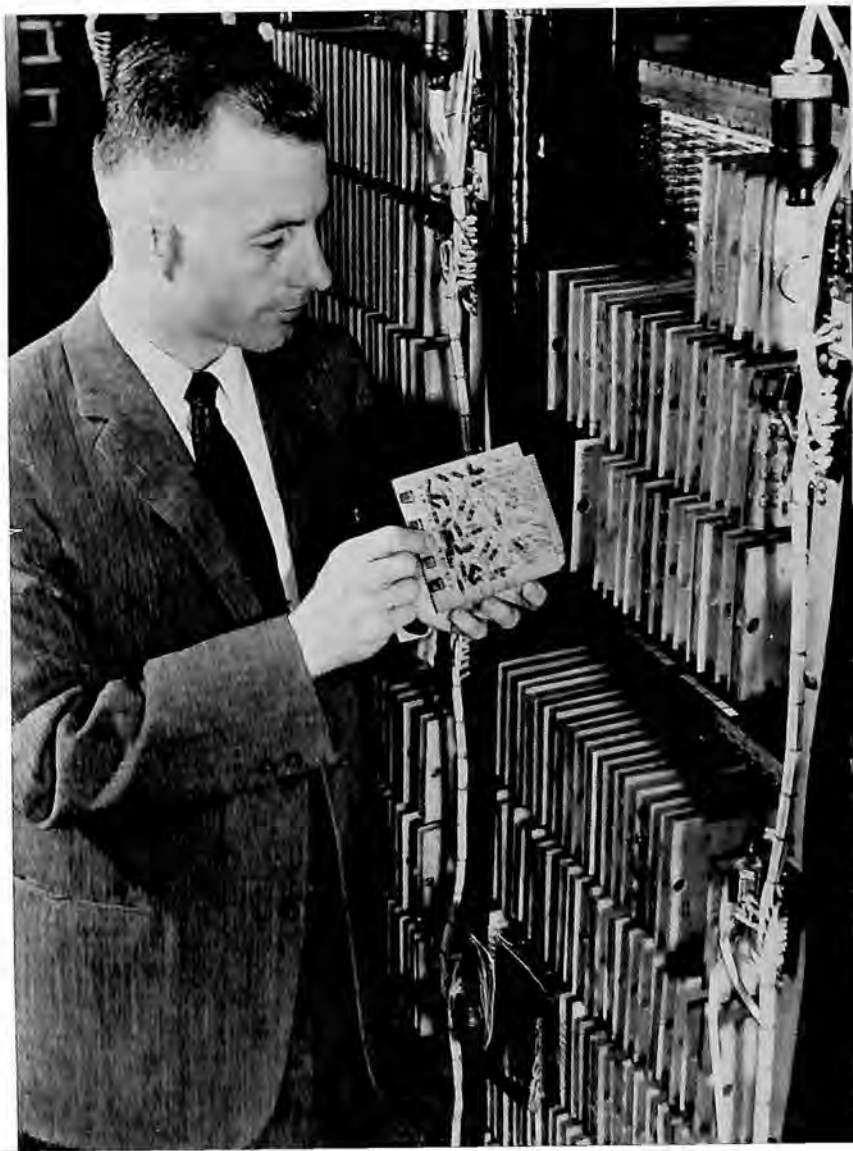
Under the new lease terms, the aviation gas turbine division will be permitted to do subcontract work in all areas of the plant which are not required for engine and spare parts production for the Bureau of Aeronautics.

A new plant to design and build electronic transformers was put into operation in Los Angeles by Westinghouse in the past year. With this specialized facility the company will be able to provide on-the-spot design and manufacturing service to west coast aviation and electronic industries. The new plant is completely equipped to manufacture small quantities of sample and prototype transformers.

In the field of aircraft metals, Westinghouse scientists developed a new high-strength, high-temperature metal which is designed to help push back the "heat barrier" encountered by jet engines in new supersonic aircraft.

The new Westinghouse metal is intended as a structural material for use in the turbine section of the jet engine, where the hottest moving parts are found. It offers special promise as a material for constructing turbine discs. The new material, which is referred to simply as W545, is an alloy of six essential elements: iron, nickel, chromium, and in smaller proportions, molybdenum, titanium and boron.

*Westinghouse radar track-while-scan system.*



Tests showed W545 to be an outstanding high-strength, high-temperature alloy. When heated to a temperature of 1200 degrees Fahrenheit and subjected to a stress of 75,000 pounds per square inch, the W545 test samples withstood these conditions for as much as 300 hours without breaking. Under equivalent conditions, standard turbine disc materials would probably have a lifetime of less than ten hours.

Airborne computers were undergoing a weight and size reduction program at the company's air arm division.

The Westinghouse Electronic Tubeless Analog Computer (WETAC) was a typical example. The weight of a major element of this computer, the servo amplifier, was reduced from 33 to 4 ounces by a new all-transistorized amplifier that replaces five molded units using vacuum tubes. The transistors are made of silicon to operate through a wider temperature range, and the amplifier also employs a feed-back loop to correct for any temperature deviations in transistor characteristics.

To study the effect of high temperatures on structural parts of aircraft and missiles, Westinghouse developed a complete elevated temperature test facility. The equipment consists of banks of tubular infrared lamps which serve as the heating source, a three-channel ignitron controller, strip chart temperature recorders, regular control (computer) channels, master control desk, unit substitution and bus duct distribution.

A new device developed by Westinghouse is a dual-fuel manifold that eliminates vapor lock in the J46-WE-8 afterburner fuel system. The manifold performs the usual function of spraying fuel into the turbine exhaust gases. The fuel is then burned in the combustor portion of the afterburner, providing a large thrust increase for short periods of operation. When installed, the dual-fuel manifold will help to raise the altitude ceiling for planes using the J46-WE-8.

During the past year, Westinghouse received two multimillion dollar contract awards from Boeing Airplane Company to manufacture the terminal guidance systems for the Air Force IM-99 Bomarc guided missile. A number of the systems for the pilotless missiles will be manufactured at the air arm plant in what is believed to be a long term program.

Through another contract Westinghouse will design and manufacture experimental seagoing handling and launching systems for the Navy-Lockheed Polaris ballistic missiles. This contract calls for development of various mechanical and elec-

trical systems for the launching of Polaris from submarines or surface ships.

In other work associated with aviation, Westinghouse, under contract with the Navy, was designing a nuclear propulsion plant for an atomic-powered submarine capable of carrying and firing guided missiles.

For another Naval project, Westinghouse will manufacture the main steam propulsion machinery for the nuclear powered aircraft carrier (CVAN). This will include turbines, gears, condensers and associated machinery.

A radar track-while-scan system, which automatically tracks up to 72 targets in three dimensions, was developed by the Westinghouse electronic division in Baltimore, Maryland. This is a hybrid digital-analog system in which error sensing is a completely analog function accomplished under the control of a digital computer which computes, controls and displays information on all 72 tracks. The result is a reduction of equipment required and an increase in accuracy of track over ranges considerably in excess of other types of tracking systems currently undergoing test.

The first 16-inch all-glass radar picture tube for military use was developed for production by Westinghouse. The new cathode-ray tube is intended for new display equipment used with radar, missiles, and computers, or for replacement of 16-inch metal cone tubes in existing military equipment. The new tube, with a 75 percent greater screen area than the previous 12-inch all-glass tube, enables radar systems to discern faster flying objects at greater distances.

The electronic tube division was producing 3600 magnetron tubes that will generate the powerful radar pulses for airborne radar sets. The work was being done under a contract awarded to the company by the Dayton Air Force Depot.

Westinghouse also continued to manufacture Aero 21-B tail turret bomber defense systems for the Navy Bureau of Aeronautics and advanced air-search, ship-borne radar sets for the Bureau of Ships. The Aero 21-B defense system directs the unmanned tail turret by detecting enemy aircraft and automatically aiming and firing the tail guns at enemy planes approaching from the rear. The defense system will be produced for use aboard the Navy's A3D, the carrier-based bomber. The new advanced air-search equipment will succeed other air search radar developed by the company's Baltimore operations.

A new aircraft electrical system will be an integral part of America's first jet airliner when the

Boeing 707 goes into commercial service early in 1959. Four air-cooled brushless generators—the first of that type developed for the aircraft industry—will supply power to operate pumps, blowers, lights, air conditioning, food warmers, radar, radio and other equipment for the comfort and safety of the 707's passengers. Westinghouse received a contract for the electrical system for all of the 141 Boeing 707's that have been ordered to date.

Generating and control systems, built by Westinghouse, will be used in the Air Force bomber, the B-58 Hustler. These a-c systems are capable of operating at extremely high altitude and at supersonic speeds. Cooling of the equipment, which includes three completely enclosed 40-kva generators, is accomplished by circulating oil sys-

tems. Skin friction heat, at supersonic speeds, precludes use of conventional air cooling.

Westinghouse was also working on generating and control systems for the Fairchild F-27 turbo-prop transport. Two 15-kva a-c generators, plus associated regulating and control equipment, will be used. Each generator weighs only 41 pounds—the lightest known in the industry for that design and rating.

A new and lighter molded aircraft current transformer was being made by Westinghouse. For metering and relaying on aircraft electrical systems, the new unit has a 250/2-amp current ratio and operates on 115-volt, 3-phase, 4-wire, 400-cycle systems. The transformer is molded from a new lightweight high-temperature insulating resin, and has a smooth, metallic finish and rounded edges.

### WYMAN-GORDON COMPANY

Wyman-Gordon placed major emphasis on research and development activities in 1957, due to increasing changes in forging technology. Development work on steel, particularly high temperature alloys, was intensified with the direction toward closer tolerances, greater accuracy and less draft.

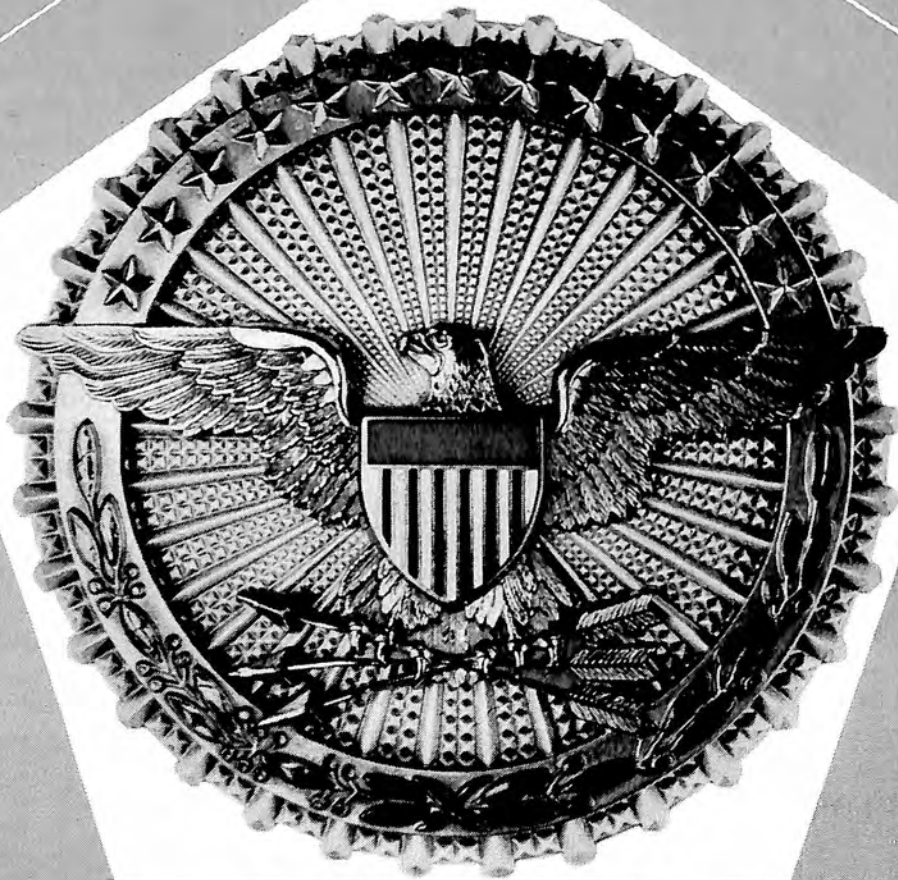
The company was also exploring the possibilities in non-metallics and other materials not previously

prominent in forging operations. Work in this area covered all types of forgings weighing from a few ounces to large aircraft and automotive forgings weighing in the hundreds of pounds.

The company's North Grafton plant continued operation of the largest single unit in the Air Force heavy press program with a 35,000 ton and a 50,000 ton closed die forging press.

*Forging structural aircraft components on the Wyman-Gordon 35,000-ton press.*





**MILITARY AVIATION**

## DEPARTMENT OF DEFENSE

The Defense year was marked by a general force reduction, greatly increased activity in the testing and operational use of guided missiles by all three services, and a number of top echelon personnel changes.

The year saw the first change in a Secretary of Defense since the beginning of the Eisenhower administration in January, 1953. Charles E. Wilson, whose tenure of four years and eight months almost equaled the total service of his four predecessors in that office, resigned in October and was succeeded by Neil McElroy of Cincinnati, Ohio, who had been president of Procter and Gamble.

Earlier in the year, in May, Donald A. Quarles, who had been Secretary of the Air Force, moved up to Deputy Secretary of Defense, succeeding Reuben Robertson who returned to civil life. Taking Quarles' place in the Air Force post was James H. Douglas, who had been Under Secretary.

In the Navy, Under Secretary Thomas S. Gates, Jr., became Secretary in April upon the resignation of Charles S. Thomas.

In August, General Nathan F. Twining, former Chief of Staff of the Air Force, was appointed Chairman of the Joint Chiefs of Staff, succeeding Admiral Arthur W. Radford, who retired.

General Thomas D. White succeeded Twining as Air Force Chief and General Curtis E. LeMay, commander of Strategic Air Command, became Vice Chief.

In prolonged debate over fiscal year 1958 appropriations, the Congress provided new obligational authority in the amount of \$36.8-billion and authorized expenditures of \$38.4-billion, including funds carried over from previous years.

In late summer, Secretary Wilson ordered a 192,000 man personnel cut in the armed forces, to bring them to a total strength of 2,608,000 by June 30, 1958. A number of lesser military and naval installations were closed or earmarked for inactivation, as were several Navy ships, an Army division and several Air Force wings.

Despite these reductions, Wilson reported at his final news conference that the combat capability of the armed forces was higher than it had ever been, because of increased mobility, flexibility and firepower. Missiles became integral combat weapons in all services, most of them possessing a nuclear capability.



*Neil H. McElroy*



*Donald A. Quarles*



*James H. Douglas*



Thomas Gates



General Nathan F. Twining

By year-end, 18 missiles had attained operational status. They included:

**ARMY:** Nike-Ajax and Hawk, surface-to-air; Corporal, Redstone, Lacrosse, Little John and Honest John, surface-to-surface.

**NAVY:** Sidewinder and Sparrow I, air-to-air; Petrel, air-to-surface; Regulus, surface-to-surface; Terrier and Talos, surface-to-air.

**AIR FORCE:** Matador, surface-to-surface, and Snark, intercontinental surface-to-surface; Rascal, air-to-surface; Falcon and Genie, air-to-air.

In an address to the nation in November, President Eisenhower laid down the four current and future goals of the Department of Defense:

"Our military defenses have been largely re-

shaped over the years since World War II. I assure you . . . that for conditions existing today they are both efficient and adequate. But if they are to remain so for the future, their design and power must keep pace with the increasing capabilities that science gives to both the aggressor and the defender. They must continue to perform four main tasks:

"1. As a primary deterrent to war maintain a strong nuclear retaliatory power. The Soviets must be convinced that any attack on us and our allies would result, regardless of damage to us, in their own national destruction.

"2. In cooperation with our allies, provide a force structure so flexible that it can cope quickly with any form of aggression against the free world.

"3. Keep our home defenses in a high state of efficiency.

"4. Have the reserve strength to meet unforeseen emergency demands."

An important event during the year was the completion of a report by a committee on pay and personnel policies created by the Secretary of Defense. The committee was headed by Ralph Cordiner, president of General Electric Company, and its report was generally referred to as the "Cordiner Report."

The committee, organized in 1956, made a thorough study of the alarmingly high turnover rate among personnel of the military services, a turnover that had contributed to wasted manpower, high operating costs and decreased efficiency. In mid-year, the Cordiner group came up with some proposed solutions.

Essence of the Cordiner proposals was that skill, talent and responsibility should be recognized with adequate pay, prestige and authority and that performance and contribution, rather than longevity, would determine rewards.

Included in the committee's recommendations were proficiency pay increases for airmen with critical skills, retention pay for active duty reserve officers, and two new pay levels for enlisted men. The report was expected to result in an appeal for new personnel legislation.

At year-end, the Army had 17 divisions, of which 14 had been converted to the new "Pentomic" organizations, nine regimental combat teams, 122 anti-aircraft battalions and two atomic support commands. The Navy had 17 carrier groups, 10 anti-submarine squadrons and 49 other combat air squadrons. The Air Force had 128 combat wings including missile units and a total of about 25,000 aircraft, roughly half of them jets.

## AIR FORCE

For the Air Force, 1957 had special meaning. August 1 marked the 50th anniversary of the activation of an aviation section in the Signal Corps, a three-man unit under Captain Charles De Forrest Chandler which in half a century evolved into today's 128-wing force.

To commemorate its Golden Anniversary and to demonstrate the progress achieved since its founding, the Air Force ran a year-long series of special events. Notable among these events were the following:

- "Operation Powerflight," in which three Boeing B-52 jet bombers flew non-stop around the world in January. Refueled in flight, they com-

pleted the spectacular flight in slightly more than 45 hours.

- In May, a Boeing B-47 demonstrated for the first time the ability of a multi-engine jet bomber to deliver nuclear weapons by means of the Low Altitude Bombing System.

- In the same month, as part of the Air Force participation in the 350th Anniversary Celebration at Jamestown, Virginia, six North American F-100C jet fighters of Tactical Air Command flew non-stop from England to Jamestown. Three of the planes continued their flight to Los Angeles for the longest non-stop single-engine flight on record.

- Also in May, Charles A. Lindbergh's famed

*Boeing B-52 Stratofortresses move into Strategic Air Command.*





solo flight from New York to Paris was duplicated by Major Robinson Risner in a North American F-100F. Risner made the trip in six and one-half hours, compared with the "Lone Eagle's" 33 and one-half hours.

- In October, the USAF participated in "Aviation Week" at Buenos Aires, Argentina. Highlight of the participation was a non-stop Washington-Buenos Aires flight (and a non-stop return) by General Curtis E. LeMay in a Boeing KC-135 jet tanker. During the week, President Pedro E. Aramburo became the first head of state to fly faster than sound. He joined the "Mach Busters" with a supersonic flight in a USAF North American F-100F. Later in the week, Doctor Juscelino Kubitschek, President of Brazil, duplicated the feat in the same plane.

- "Operation Sun Run," in November, set new transcontinental records. In a demonstration of

*General Thomas S. Power climbs out of Convair B-58 supersonic bomber after test flight.*



Tactical Air Command's supersonic reconnaissance capability, McDonnell F-101 Voodoos flew from Los Angeles to New York, two of them returning non-stop. Best west-east transcontinental time was three hours five minutes; best round-trip time was six hours 42 minutes.

- In "Operation Mobile Zebra," TAC demonstrated its flexibility by flying Douglas B-66, McDonnell F-101 and North American F-100 aircraft non-stop from George Air Force Base, California, to the Philippines.

- In the final event of the year, the USAF brought the world's speed record back to the United States with a 1207 mile-an-hour officially-timed flight in a McDonnell F-101.

In the operational field, Strategic Air Command continued to maintain its 24-hour alert system. As part of a regular training program, SAC units were constantly rotated around the world—from California to Okinawa, Texas to England, Africa to Greenland.

The never-ending SAC re-equipment program was continued. Convair B-36's were gradually being phased out of service during the year as Boeing B-52's rolled off the line to replace them at a 15-per-month rate. A missile training wing was created and guided weapons joined the SAC inventory for the first time when the Bell Rascal air-to-surface missile and the Northrop Snark surface-to-surface pilotless bomber were given operational status. In another major move, the Air Force assigned SAC responsibility for the intermediate range and intercontinental ballistic missiles.

Air Force officials, however, stressed the fact that increasing emphasis on missile weaponry does not indicate a planned phasing-out of piloted aircraft. Missiles, they said, would join the inventory as supplements to, rather than replacements for manned bombers and fighters.

Tactical Air Command was concentrating a good deal of its training effort on perfecting the mobile striking force concept, in which TAC units are maintained on a readiness status to fly to any part of the world to bolster defenses or to support allied ground forces. World-wide maneuvers, simulating combat emergencies, demonstrated the ability of the "composite strike force" to cover great distances in short order and to continue sustained operations for extended periods.

Creation of new bases permitted TAC to spread its strength over a more widely dispersed area. The command also devoted considerable effort during the year to a study of the problems connected with support of the North Atlantic Treaty Organization

or other allied forces. A major addition to TAC's future combat strength was provided by an order for production of the Republic F-105 supersonic fighter-bomber. TAC relinquished some of its short-range tactical assignments to the Army, which will handle these duties with missile units.

Air Defense Command devoted a major portion of its training effort to checking out radar operators, pilots and control center technicians in the use of new airplanes and electronic devices. The radar networks across the northern air frontiers of the North American continent were expanded and their operations improved, while a joint U.S.-Canada unit for northern defense was organized.

Major plane types in service included the Boeing B-47 and B-52, and the Convair B-36; the North American F-86 and F-100, Northrop F-89, Lockheed F-94, McDonnell F-101 and Convair F-102; the Douglas C-124 and C-133, and the Lockheed C-130. Newer planes scheduled for early service included the Convair B-58 and F-106, the Lockheed F-104 and Republic F-105. In-service missiles, besides Rascal and Snark, included the Martin Matador, Hughes Falcon and Douglas Genie. Slated for service in 1958 were the Redstone-Chrysler Jupiter and the Douglas Thor.

Personnel-wise, the major problem continued to be the turnover of trained personnel. A concerted campaign to persuade airmen with critically needed skills to re-enlist was initiated, while at the same time standards for re-enlistment were tightened in a move to boost the level of ability. A number of measures were taken to raise the prestige of the non-commissioned officer and new Congressional legislation designed to make service careers more attractive was enacted.

Top command concern with the relationship between length of service and operational proficiency was reflected by a new directive requiring aircrew trainees to agree to serve for five instead of three years. There was also a continuing trend to replace military with civilian personnel wherever possible.

National budgetary problems forced two manpower cuts during the year. The USAF's assigned personnel goal for the end of the fiscal year 1958 was 875,000.

The reserve forces were also affected by reductions. Ten Air Force Reserve and three Air National Guard squadrons were eliminated. Due to the development of more advanced radar and communications networks, reducing the need for visual observation, the Ground Observer Corps was placed on a stand-by status. Strong support continued, however, for the Civil Air Patrol.



*Captain Jack Bryant leads London-Los Angeles flight of three North American F-100C's.*

Changing missions and new combat techniques resulted in a number of reorganizations and adjustments in major commands. Notable among these changes was the inactivation of the Far East Air Force.

The appointments of Generals Thomas D. White and Curtis E. LeMay as Chief of Staff and Vice Chief, respectively, brought about other top level personnel changes in the USAF. General Thomas S. Power took over Strategic Air Command while General Frank Everest assumed command of Air Force units in Europe. General Laurence S. Kuter, former FEAF commander, went to Pacific Air Force, while General Leon Johnson joined the NATO staff under General Lauris Norstad. General O. P. Weyland continued to head Tactical Air Command, General Edwin Rawlings remained at Air Materiel Command and General Earle Parttridge remained in charge of Continental Air Command.

## ARMY

The Army's year was characterized by a reorganization of the divisional structure, introduction of new missiles in both the air defense and ground support fields and considerable progress in modernizing integral aviation units.

The major move during the year was the conversion to the new "Pentomic" division, designed to "provide flexibility, mobility and control to facilitate command and insure effective execution of the wide-ranging, dispersed operations required on the modern battlefield."

The word "Pentomic" comes from "penta" (five) plus "atomic" and refers to the fact that the new division has five major subordinate forces instead of the former three, and it also has atomic weapon capability. It features increased front-line strength, improved conventional weapons and maximum air-transportability. The airborne division is completely air transportable, the infantry division has a high degree of air transportability.

At year-end, the Army had converted 14 of its 17 divisions to the new Pentomic structure.

Firepower for the new divisions was greatly increased by the addition of new missile weaponry. During the year, the first operational Redstone heavy missile unit was formed. Redstone is a medium range surface-to-surface missile with atomic capability. The 69-foot missile, developed by Army Ordnance and Redstone Arsenal, is a 200-mile

weapon. Production is being handled by Chrysler Corporation in conjunction with North American Aviation's Rocketdyne Division.

Another weapon added to the Pentomic division arsenal was Little John, a heavy artillery rocket which can be transported by helicopter. Little John is a 12-foot solid propellant rocket with a 12 and a half inch diameter.

Also introduced to service was Lacrosse, a field artillery missile designed for tactical support of troops in forward combat areas. Lacrosse, produced by The Martin Company, uses a solid propellant rocket and is fired from a launcher on a standard truck.

Placed in production during 1957 was the Dart, a small low-level anti-tank missile.

The Army Air Defense Command (ARADCOM) also strengthened its capability. At year-end, ARADCOM had Nike battalions protecting 19 major target complexes in the United States. Nike battalions increased by 25 percent during the year, to a strength of 42,000 officers and men.

Plans were completed for the early introduction of a new and important air defense weapon, the Nike-Hercules. Hercules has roughly three times the range of the earlier Nike-Ajax and in addition has atomic capability. It will be operated from the same stations now handling Nike-Ajax. Western Electric Company and Douglas Aircraft Company

*The Cessna L-19, Army Observation plane.*





*Bell's H-13H is Army's standard reconnaissance class helicopter.*

are the major contractors involved in Hercules' production.

For defense against enemy bombers attacking at low altitude, the Hawk (Homing All the Way Killer) was added to the defense system. The 17-foot, air transportable Hawk employs a radar homing system. Raytheon Manufacturing Company is prime contractor for production, with Northrop Aircraft, Inc., as major subcontractor.

ARADCOM was also conducting tests of the Navy-developed Talos for possible future introduction to the defense system.

Late in the year ARADCOM was further strengthened by the assignment of the Martin Missile Master to the Washington-Baltimore target complex. Missile Master is an electronic control and coordination system designed for operation with air defense missile batteries. Where formerly batteries were controlled and coordinated by voice control from a central post, Missile Master receives, correlates and transmits all information relative to an attacking force and presents it on a TV-like picture in simplified form. Missile Master also assigns pre-selected targets to each battery so that there will be no duplication of firepower, and each battery commander has access to all information in the system.

The Army also continued to increase its aircraft support to ARADCOM and at year-end had about 50 light planes as control, courier and supply planes for the widely-scattered defense system.

Work continued on the programmed expansion of the Army Aviation Center at Fort Rucker, Alabama. Ozark Army Air Field was expanded by the

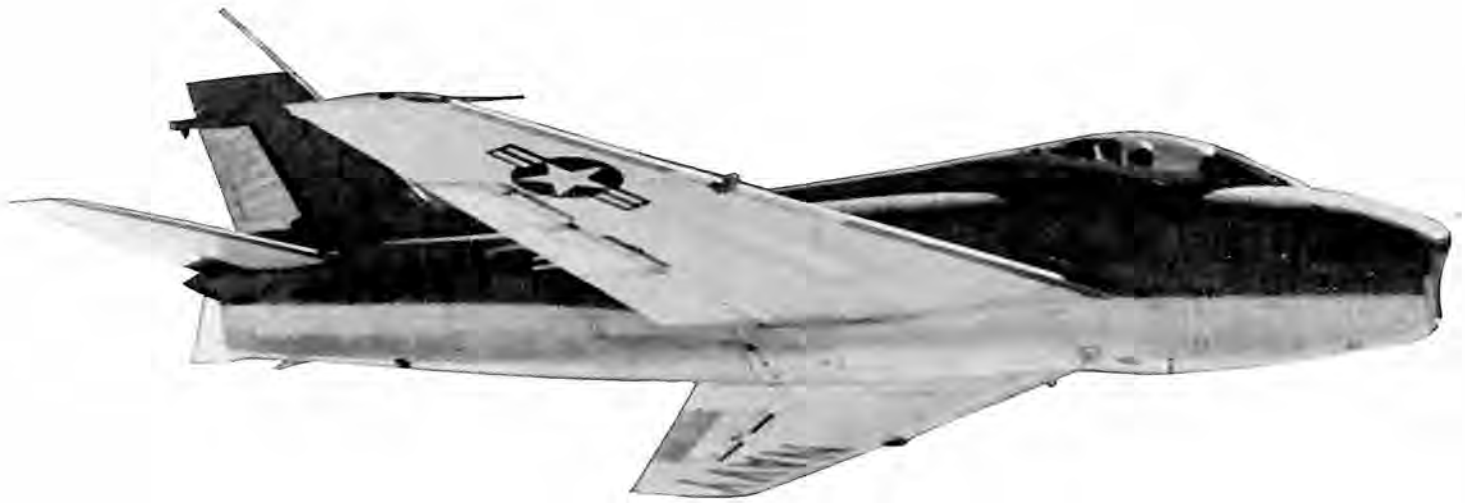
addition of two large maintenance hangars and 256,000 square yard of taxiways, landing pads and parking aprons. Fiscal year 1958 funds (\$7,549,000) were to go principally for enlisted barracks and administration buildings.

A major expansion program was also under way at Davison Army Air Field, Fort Belvoir, Virginia. Construction consisted of a heliport, complete with parking aprons, runways, an operations building, supply building and crash and rescue station. Also being added were a new control tower and a field maintenance hangar. The new facility was expected to be completed by year-end.

In addition, the Army was authorized \$20.6-million for improvement of aviation facilities at 18 other installations.

Aircraft in service included the Cessna L-19 Bird-Dog, for observation work; the DeHavilland (Canada) L-20 Beaver utility plane; the Beech L-23 Seminole command aircraft; the DeHavilland (Canada) UI-A Otter cargo plane; the Bell H-13 Ranger observation helicopter; the Sikorsky H-19 Chickasaw utility helicopter; the Vertol H-21 Shawnee transport helicopter; the Hiller H-23 Raven observation helicopter; and the Sikorsky H-34 Choctaw light transport helicopter. Coming into service was the Sikorsky H-37 Mojave medium transport helicopter.

At year-end, the Army had more than 5000 aviators on active duty flying status. Of the officers, more than 50 percent were helicopter qualified and 30 percent had instrument ratings. In addition, the National Guard had 1015 aviators on flying status.



*North American's FJ-4B reached fleet units in June.*

## NAVY

For the aviation arm of the Navy, 1957 was a year of considerably increased activity both at home and abroad. The Suez crisis and other international developments underscored the importance of sea-going air power as a major element of the nation's striking power.

Participation in world events by the Sixth Fleet in the Mediterranean and continued operations of the Seventh Fleet in the uneasy waters of the western Pacific raised the tempo of flight activity and stepped up the rate of overseas deployment of air units well above normal operating schedules.

Despite these increases in activity, naval air strength remained at a level roughly equivalent to that of the preceding year. The operating aircraft inventory totaled 9600 planes and Navy and Marine Corps aviation manpower stood at 30,000 officers and 177,000 enlisted men.

At mid-year, a realignment of forces was begun, operating schedules were adjusted and procurement programs were revised. In July, the Secretary of the Navy disclosed plans to close or reduce 60 naval activities within six months, including eight supporting naval air operations. Earlier, in June, two airship patrol squadrons had been decommissioned. In September, the first Barrier Patrol Squadron was decommissioned and in the following month two air facilities were closed.

Technological advances and increasing costs were

major factors responsible for changes in aircraft and missile production announced in August. These revisions involved cancellation of a few contracts and slowdown of delivery schedules in others. Keynote of the reductions was the goal of "doing more with less." New emphasis was therefore given to building greater force effectiveness and versatility through better and more powerful weapons and improved techniques for their employment.

In terms of striking power, noticeable gains were realized. Aircraft carrier strength was increased when the *Saratoga* joined the *Forrestal* as a fully operational unit of the Atlantic Fleet. The *USS Ranger*, third ship of the same class, was commissioned August 10 and began operating aircraft in October. Keel of the *USS Constellation* was laid in September.

Four attack carriers, *Kearsarge*, *Ticonderoga*, *Intrepid*, and *Midway*, completed angled deck conversion and rejoined the fleet. The seaplane tender *Albemarle*, converted to support the operations of large jet seaplanes, was recommissioned in October. The *Oriskany* and *Coral Sea* went into the yard in February and April as the last of the World War II carrier types scheduled for major conversion. And in August, a contract was awarded to the Newport News Shipbuilding and Drydock Company to build an 85,000 ton nuclear powered carrier, heralding a new era for naval aviation.

Capability for attack and defense was also increased by new aircraft assigned to the operating forces. Both the Vought F8U Crusader and the Grumman F11F Tiger completed the Fleet Introduction Program in March and were delivered to squadrons. Notable was the assignment of the F8U two years to the day after the first flight of the experimental model. These supersonic fighters mount heavy firepower including 20mm guns, the air-to-air missile Sidewinder, and 2.75 rockets.

The North American FJ-4B, a Fury modified to carry an assortment of bombs externally, added further punch when it reached fleet units in June.

In February the Grumman TF-1Q, equipped with the latest electronic countermeasures gear including jammers, added yet another facet to carrier force versatility. A modification of the cargo-transport TF-1 to the early warning WF-2 successfully completed preliminary evaluation in May.

The HR2S-1 Sikorsky assault helicopter, which

*Navy's Chance Vought Regulus II missile.*



earlier had demonstrated its high performance with new world records in speed and weight lifting, was assigned to Marine Corps units in March. An early warning version of this helicopter, delivered in May, was placed under test to determine its adaptability to the warning phase of fleet air defense. Two new utility helicopters, the Bell HUL and HUS Sikorsky, became operational.

Progress in guided missiles was marked by their assignment to more ships and squadrons and an acceleration in their everyday use. By the beginning of the year a full missile arsenal was available to fleet commanders including Sparrow I, Sidewinder, Terrier, Regulus I, and Petrel. A milestone of missile progress was passed in April when the Sperry Farragut Company delivered the last Sparrow I on order. Facilities used for its manufacture were immediately turned over for conversion to Sparrow III production.

Missiles in the last stages of development such as the surface-to-air Talos and air-to-air Sparrow III, achieved significant objectives in test firings. In the air-to-surface category, Bullpup, a small missile designed for use by carrier and shore based tactical support aircraft against such targets as pillboxes and tanks, showed particular promise. Regulus II, a supersonic bombardment missile with longer range than the presently operational Regulus I, set new records in reliability and performance as it neared the operational stage ahead of its scheduled date.

The Fleet Ballistic Missile Program was given added impetus in October with award of a new contract insuring continued development of the solid propellant Polaris through fiscal year 1958. The USS Compass Island, commissioned last December and first ship converted to support the fleet ballistic missile program, operated at sea evaluating the precise navigation equipment required for the operational employment of Polaris, a 1500-mile range ship-or sub-launched weapon.

On the operating front, naval air elements participated in fleet exercises in both oceans. In addition to national exercises, there were several with fleets of the various NATO and SEATO nations. Dawn Breeze II in the Atlantic tested the ability of forces from five nations to protect merchant convoys on the open sea under conditions of atomic war. Beacon Hill in the Philippines area, involving the landing of Marines on Luzon, was the largest land-sea-air exercise held in the Far East since World War II. Deepwater in the Mediterranean brought together forces from five nations in combined assault exercises in the Saro Bay area of



*Grumman WF-2 early warning aircraft.*

Turkey. And Strikeback employed large NATO naval and naval air forces for extended operations in the Iceland-Norwegian Sea area of the North Atlantic. These, and others of similar nature, were practical tests in which the workability of combined plans, doctrine and tactics were explored. Through them allied naval forces were brought into closer working relationships and valuable experience in combined operations was gained.

Navy responsibility for a share of continental air defense was reflected in continued emphasis on early warning operations to protect the country against attack from the air and from under the sea. The Distant Early Warning Line that guards the country against air attack from the north was extended eastward over the Atlantic and westward over the Pacific by station ships and by long range air patrol flown by Airborne Early Warning Squadrons. Exercises to test the entire defense system and the command relationships it involves were conducted in both oceans. Antisubmarine groups made up of air, surface, and sub-surface units, also patrolled the approaches to the coast.

Naval air units continued their support of United States participation in the International Geophysical Year. In the period from July through September, a detachment of Heavy Photographic Squadron Sixty-One completed a glaciological survey in Alaska. In Manitoba, Canada, on the shores of Hudson Bay, Navy scientists launched a series of Aerobee-Hi rockets to gather data from the ionosphere. The first, launched in July, reached an altitude of 160 miles. In February, at the other end of the earth, VX-6 completed its second tour in support of Deepfreeze operations which included a historic landing at the South Pole. In October, the same squadron returned for its third tour in Antarctica with a Skymaster flight from Christchurch, New Zealand, delivering Rear Admiral G. J. Dufek, CTF 43, to McMurdo Sound.

Lives and money were saved through significant progress in aviation safety. An intensive campaign launched in 1951 had shown successive improvements which halved the accident rate in six years. A rate of 3.06 major accidents per 10,000 flight hours achieved in the year ending June 30 was a new all-time low for naval aviation. Much of the credit for recent gains was attributed to the angled carrier deck and wide use of mirror landing systems for carrier air operations.

Greater future gains were promised in tests of the Automatic Carrier Landing System. Developed by Bell Aircraft under direction of the Bureau of Ships and thoroughly tested ashore, this equipment was taken aboard the *Antietam* for trials at sea. The system, which works electronically, takes over the controls of the plane as it is brought into range and brings it aboard without help from the pilot. In an eight day period during August, over 50 fully automatic landings were completed aboard the *Antietam* by a specially configured Douglas Sky-night. Although still in the development stage, success in the initial tests suggested possibilities not only for greater safety but also for true all-weather operating capability.

Greater margins of safety were also promised by the low altitude ejection seat developed by the British. In a public demonstration at Naval Air Station Patuxent River in August, a live ejection was made from an F9F-8T flying at 120 miles per hour at ground level. Its possibilities for saving lives of pilots forced to jump at low, and usually fatal, altitudes make it a most significant development in safety and survival gear.

Naval aircraft of several types again demonstrated their ability to perform with the world's best. Airships began the year with impressive records. In a practical test of their ability to op-

erate in all weather, ZPG's operating in relays from South Weymouth, Massachusetts, maintained a continuous airborne radar patrol from January 15 to 25 over the North Atlantic in some of the worst storms experienced in the area in years. In March, one of these airships under command of Commander J. R. Hunt, set new world records for distance and endurance. On a flight from South Weymouth which circled the Atlantic Ocean toward Portugal, the African Coast and returned to Key West, Florida, this airship covered 9448 statute miles and remained airborne for 264 hours and 12 minutes without refueling.

Heavier-than-air craft performed at equally high levels. In March a Douglas A3D Skywarrior bettered two transcontinental speed records with marks of nine hours 32 minutes 59.7 seconds for the round trip between Los Angeles and New York, and five hours 13 minutes 49 seconds for the westward leg.

Two of the same carrier attack planes streaked across the Pacific in July in a new mainland-to-Hawaii time by flying from Moffett Field to Honolulu in 4 hours 45 minutes and in October another Skywarrior lowered the time another 15 minutes. In June, two F8U Crusaders and two A3D Skywarriors completed an ocean to ocean flight from the carrier *Bon Homme Richard* off San Diego, California, to the *Saratoga* off Jacksonville, Florida, in under four hours elapsed time. A transcontinental record in the supersonic range was set in July when an F8U-1P piloted by Major J. H. Glenn, USMC, crossed the continent from Los Alamos to New York in three hours 22 minutes 50.05 seconds, averaging 723.517 miles per hour. Major Glenn's record was broken later in the year, as was the A3D round-trip mission.

*The Saratoga became a fully operational unit of Atlantic fleet.*





**RESEARCH AND**



# DEVELOPMENT

NOTE: Space limitations permit touching only the highlights of the great amount of activity in the area of military research and development. Accounts of other research projects are included in the individual company sections of the Industry chapter and in the Aviation Events chapter.

## MILITARY

*Commander Jack Morrissey, USN,  
wears new Goodrich flight suit.*



The dawn of the space age, the maturing of a number of new missile projects and continuing requirements for higher performance in manned aircraft combined to make 1957 a year of bustling activity in the research and development field.

A barrage of information about Soviet developments in the area of guided weaponry focused attention upon the United States' most spectacular answers to the Russian threat—the intermediate and intercontinental ballistic missiles which reached firing stage during the year and achieved a considerable degree of success after the early growing pains.

Two IRBM's, the Air Force's Douglas Thor and the Army's Redstone-Chrysler Jupiter, reached firing stage by mid-year and after a few initial aborts reached high degrees of range and accuracy capabilities. Late in the year, a Department of Defense decision was made to place both missiles in production for use by the Air Force.

Two early attempts to launch the intercontinental USAF-Convair Atlas also failed, but in December a short-range "shoot" at the Air Force Missile Test Center in Florida was pronounced successful.

Work progressed on two other important ballistic-type missiles in earlier stages of readiness. Aerojet-General delivered the first production-type rocket power plants for the USAF-Martin Titan, second of the nation's ICBM's, expected to reach firing status during 1958.

Aerojet-General also conducted a successful test firing of the largest solid propellant rocket engine ever built, the power plant for the Navy's Lockheed Polaris FBM (Fleet Ballistic Missile), a weapon designed for launching from surface vessels or submarines.

In another area of missile research, the Army

and the Air Force were working on parallel approaches to the highly important anti-missile missile systems (AMM), designed to detect, monitor and destroy enemy ballistic weapons. The Army project was named Nike-Zeus; the Air Force gave the code name Wizard to its system. Each project involved several companies.

Among the new missiles which made their debuts during the year were the Navy-Chance Vought Regulus II, an advanced supersonic version of the Regulus I already in Navy service; the 16-foot Army-Raytheon Hawk, an air defense missile with nuclear capability designed for use against low flying attackers; the Navy-Martin Bullpup, a radar-homing air-to-surface missile; and the Air Force-Douglas Genie, an air-to-air missile capable of carrying an atomic warhead.

A number of missiles graduated from development to operational status, among them the Army-Chrysler Redstone, short-to-medium range surface-to-surface missile; the Navy-Bendix Talos, a beam riding air defense missile; and the Air Force's Northrop Snark and Bell Rascal, the former a long range surface-to-surface weapon, the latter a short range air-to-surface missile.

One major missile project, the North American Navaho long range pilotless bomber, was canceled in a mid-year economy drive.

There was considerable public interest in a number of space projects. The clamor following the successful launchings of two Russian *Sputniki* resulted in a Department of Defense decision to permit the Army to go ahead on a separate and parallel project to the Navy-Martin Project Vanguard.

The Army was to use a modified Jupiter C test missile as its launcher and, instead of Vanguard's "basketball" type satellite, planned to fire a bullet-shaped, 30-inch payload weighing about the same as Vanguard's ball. At year-end, the Army was modifying the launcher components and preparing for assembly, with first launching tentatively scheduled for March.

Meanwhile, work was progressing on Project Vanguard. After considerable test work on individual components throughout the year, a "shoot" of the complete launcher was scheduled for December. It was not to carry the complete 22-pound instrumented satellite, but instead a small six and one-half inch transmitting ball.

The first try to launch this test vehicle ended in failure due to malfunction of an unidentified component of the vehicle's first stage system. It exploded and burned on the launching pad at the Cape Canaveral test center.

At year-end the test pad had been repaired and another launcher was being readied for a second try with the small ball. The initial failure had no effect on the Navy's plans to launch the full-size satellite in March.

Another space program which enjoyed a greater degree of success in 1957 was Project Farside, sponsored by the Air Force's Office of Scientific Research. Farside consisted of a four-stage launcher, fired from a balloon, designed to push a 10-pound instrumental payload 4000 miles out into space.

A series of six Farside vehicles was fired during September and October at Eniwetok Atoll in the Pacific. Two of the shots were failures, two more were partially successful. The final two launches were believed to have at least achieved an approximation of the design altitude, but failure of the telemetry transmitters in both cases caused confusion as to the exact altitude attained. From data available, OSR scientists concluded that the sixth and best "shoot" went at least 2000 miles and probably the full 4000.

Prime contractor for Farside was Aeronutronic

*Vanguard, satellite launching rocket, designed and built by Martin Company.*



Systems, Inc., a subsidiary of Ford Motor Company. General Mills Company was balloon contractor and power was provided by Grand Central and Thiokol.

Late in the year, the Air Force's Cambridge Research Center revealed that it had successfully fired artificial meteorites into space. The meteorites, small aluminum pellets encased in a container, were hurled to an altitude of 54 miles by an Aero-bee rocket, where the container was detonated and the accelerating pellets sprayed into space. Cambridge scientists believed that some of the pellets achieved velocities sufficient to escape from Earth's gravitational pull—about 25,000 miles per hour. The project was undertaken as a test of extra-atmospheric density and temperature.

Throughout the year, a great many organizations were conducting studies on various aspects of space research, including moon rockets, manned orbital vehicles, space platforms and, in the field of propulsion, ionic power (see NACA). One such study, more advanced than most, seemed likely to reach hardware stage in the not too distant future.

This was the system given the code designation WS-117, which calls for a reconnaissance satellite. At year-end, the Air Force was preparing to let a contract for at least one such system.

In the area of manned exploration of space, there was one project under way during the year—the Air Force-North American-NACA X-15 special research plane, designed to investigate an area from 40 to 100 miles above the surface of the Earth. The rocket-powered plane was under construction in 1957, but few details were released.

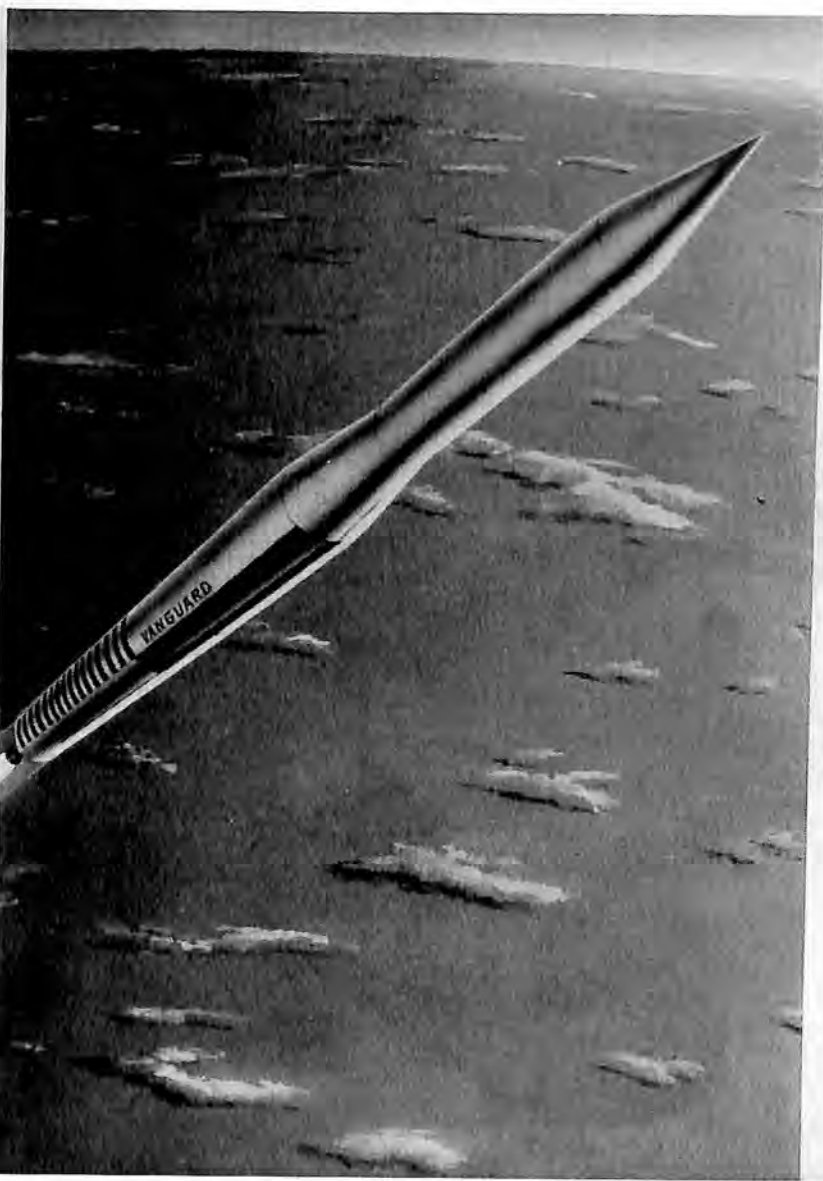
A number of studies in the aeromedical field were under way. One of the most dramatic was a high altitude research program conducted by the Air Force's Aero Medical Field Laboratory at Holloman Air Development Center, New Mexico.

To study the physiological effects of prolonged high altitude operation and to gain other data, such as cosmic ray effect, the Laboratory's Major David Simons ascended to 102,000 feet over Minnesota (the area in the U. S. where the greatest cosmic radiation is found), setting a new altitude record for balloons in the process. Simons stayed aloft for 32 hours.

In another type of research, Litton Industries, Inc., working under Air Force contract, built a vacuum chamber and placed a man in it at a simulated altitude of 95 miles. For survival under such near-vacuum conditions, Litton also designed and built a new space suit with a two-way system which feeds in breathing oxygen and pressurization and draws out moisture and carbon dioxide. The suit, made of aluminum and rubber, is not considered flight gear, but it is a forerunner of extra-atmospheric equipment which will be used in space exploration. In addition to aeromedical research, the Litton chamber was also being used for testing missile components under near-vacuum conditions.

Navy personal equipment researchers designed a new full pressure high altitude suit for use in new high performance aircraft. The suit, built by B. F. Goodrich Company, protects against loss of cabin pressure in the stratosphere and retains pressure during a bailout. It is also a flotation and anti-exposure suit in case of bailout or ditching in cold water. A similar suit was devised by the Air Force.

At Wright Air Development Center and at Lockheed Aircraft Corporation's Georgia Division, another type of aeromedical research was in progress. This consisted of placing air crew members in a confined chamber, simulating a long range aircraft or space ship cabin, for periods of as long as five days. Subjects were studied by camera and wired



for physiological responses. Goal of these tests was to determine the effects of prolonged isolation on crew members and to find out what type of person was best suited for operations involving such conditions.

Also in progress during the year was research on weightlessness, a phenomenon of space flight, and work on sealed environmental space cabins. Both projects were being conducted by the Air Force's School of Aviation Medicine. Both the Air Force and Navy were running centrifuge tests to determine man's tolerance and ability to perform under conditions of high acceleration and deceleration which will also be encountered in extraterrestrial flight.

In the field of atmospheric aircraft, development work progressed on higher performance modifications of existing operational plane types. New planes which made their formal debuts during the year included the Republic F-105 supersonic fighter bomber, the Convair F-106A and F-106B interceptors, both Air Force craft, and the Navy's Chance Vought F8U-2, a higher performing version of the Crusader in fleet service. The Army also introduced a number of light plane types.

A major contract award went to North American Aviation, after a design evaluation, for development of a chemically fueled long range Mach 3 Air Force bomber designated WS-110A. North American was also working on a new USAF long range interceptor project, designated initially WS-202A and later YF-108.

Budget economies caused cancellations of two major airframe projects, the Republic XF-103 high performance fighter and the Douglas XC-132 super-size transport.

Work continued toward development of a nuclear propulsion system for aircraft, but no progress details were disclosed.

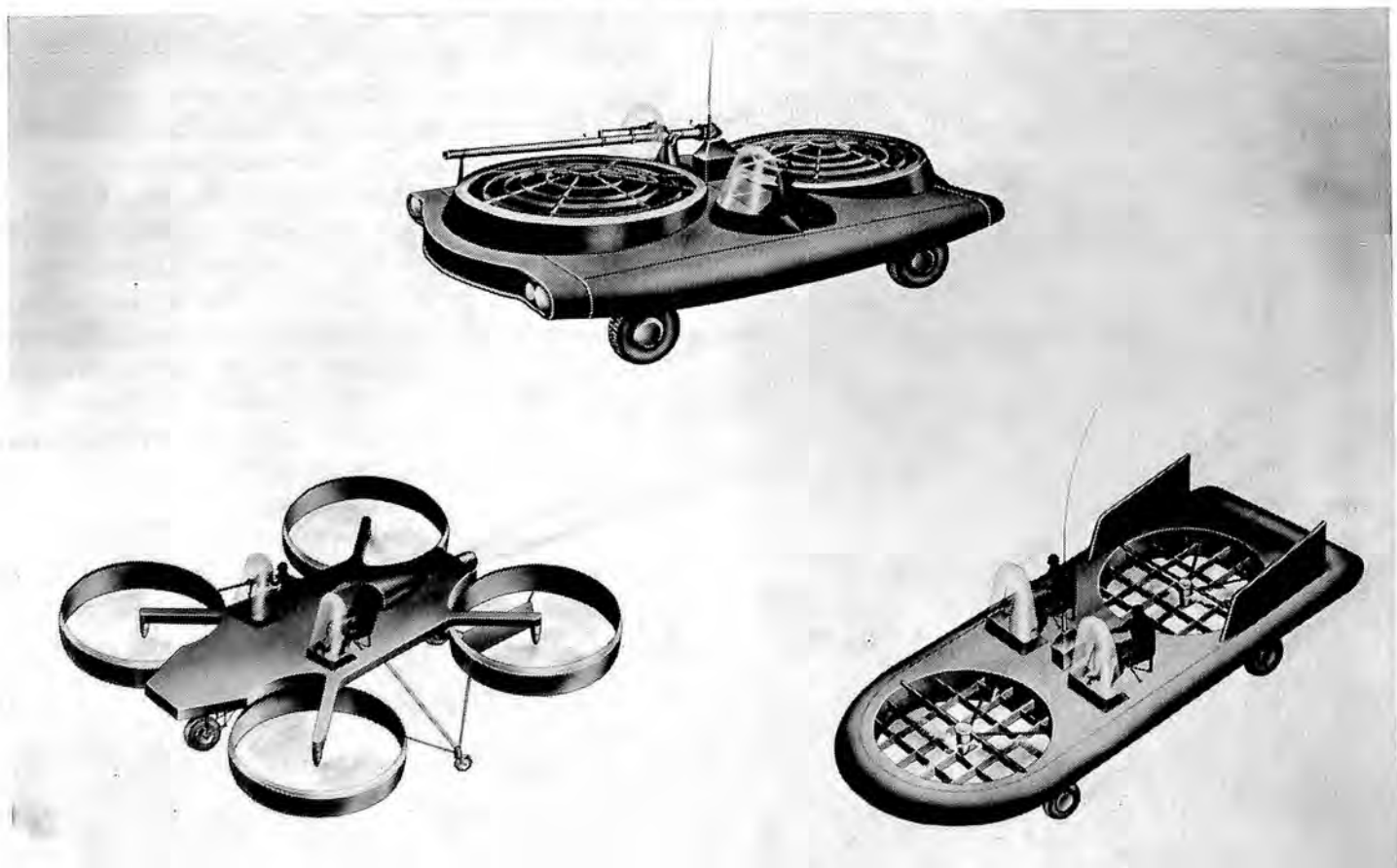
The year saw considerable activity in the field of vertical takeoff and landing aircraft. Vertol was working on a tilt-wing design which started transition flights late in the year. Hiller completed free flight wind tunnel tests and neared completion of the prototype model of its X-18 large transport VTOL, also a tilt-wing design, powered by two 4850 horsepower Allison turboprop engines.

Ryan Aeronautical made the first public demonstrations of its tail-sitting Vertijet and also rolled out the Army Vertiplane. The latter, powered by the Lycoming T53 turboprop engine, features huge wing flaps which deflect propeller slipstream and provide vertical lift.

Bell Aircraft Corporation made first flights of its X-14 jet VTOL, which employs a deflecting tail-pipe to divert the thrust flow downward for vertical flight. The X-14 is an Air Force project.

The Army conducted a competition for an aerial jeep research vehicle and in July awarded three contracts for construction of prototypes. Contract winners were Piasecki Aircraft Corporation, Aerophysics Development Corporation (a subsidiary of Curtiss-Wright Corporation) and Chrysler Corporation.

*Army contracted for construction of aerial jeeps in July.*



## NATIONAL ADVISORY COMMITTEE FOR AERONAUTICS

The research centers of the National Advisory Committee for Aeronautics in 1957 were engaged in accelerated programs to provide solutions for the many difficult problems surrounding development of the intermediate- and long-range ballistic missile. Similarly, the facilities and staff of the NACA were marshaled to give all possible assistance to several companies in competition for the design and production of a new, high-performance bomber.

At the same time, the NACA concentrated on basic problems that can be solved only after years of intensive effort. In rare instances, such as the discovery and development at the NACA's Ames Aeronautical Laboratory of the blunt-nose theory to minimize the missile re-entry heating problem (described in more detail below), a breakthrough is achieved. More often, the value of such long-range research lies in the systematic accumulation of new information. In this latter category is the work begun in 1946 at the NACA's Lewis Flight Propulsion Laboratory on high-energy or "exotic" fuels, also described below.

NACA support was given to the International Geophysical Year satellite program, both directly and indirectly. The direct contribution was development of a 30-inch diameter "sub-satellite" to be used in measuring the resistance, or drag, experienced by artificial earth satellites, and by deduction, the density of the atmosphere at the satellite altitudes. Indirect support was primarily in the field of rocket propulsion.

The sub-satellite is made of a laminate consisting of a plastic film 0.00025-inch-thick bonded to aluminum foil 0.0005-inch thick. A small tank of compressed nitrogen, hardly bigger than a lady's lipstick, inflates the sub-satellite, when it is released

from its storage space just below the satellite itself. The sub-satellite weighs only 0.25 pound and with its container and the nitrogen bottle, weighs only 0.69 pound. William J. O'Sullivan, research scientist at the NACA's Langley Aeronautical Laboratory, developed the sub-satellite which is scheduled to be used in 1958.

Respecting the turbojet engine, it was first predicted its maximum speed capabilities would be limited to less than a Mach number of 1, the speed of sound (600 mph at altitude). Then a Mach number of 1.5 was thought possible; then 2.5. Now a Mach 4 turbojet appears possible. The engine NACA engineers visualize for flight at 2600 mph would be more compact and far more efficient than present turbojets. Great care would be required in designing the inlet and exhaust ducts, which would vary in size and shape with change in speed.

Because of the high temperature (about 1200° Fahrenheit) resulting from the inlet air being rammed into the engine by the airplane's great speed, the compressor will be troubled by material problems much more severe than those affecting today's engines. Recent NACA studies of special fuels and increased knowledge of combustion-chamber design indicate that the engine can have shorter and more compact combustion chambers. The fundamental knowledge on which to base the design of such an engine is well defined, but construction will be very difficult because of the high temperatures at which it must operate. Among the many details that must be investigated are high-temperature lubricants, bearings, and seals.

In seeking to attain hypersonic speeds (more than Mach 5, 3300 mph), the only air-breathing engine that might now be considered for the lower



*Scientists check model in test section of NACA wind tunnel.*

hypersonic range is the ramjet. Lacking both compressor and turbine, and utilizing booster arrangements for takeoff and climb, this engine type is inherently simple in its design and working principles.

The main problems requiring solution before the ramjet or any alternate propulsion system will become satisfactory for hypersonic flight are those of high temperature. For example, at Mach 5, air temperatures rise to about 2000°F on the engine surfaces; at Mach 7 the air temperatures are about 4000°F. NACA researchers have found extensive

cooling can be accomplished with minimum losses, provided the fuel can be used in the coolant, in much the same manner as in the liquid-fuel rocket engine. Much research is now being directed toward evaluation of various cooling methods.

Converting the energy of the fuel being burned into useful thrust becomes very difficult at hypersonic speeds. The extremely high internal air and combustion temperatures are sufficient to cause the air and the products of combustion to break down or dissociate. This process ties up large quantities of energy, which cannot contribute to useful thrust

unless the dissociated particles can be recombined inside the engine.

Much research is being devoted to study of the above-mentioned problem. One of the great difficulties has been to build facilities where air can be heated to correspond to the temperatures of the test speeds and then be expanded through nozzles to reach the desired test speed. The Lewis Laboratory now is using a rocket-tunnel, and a pebble-bed air-heater to provide these conditions.

Before flight into outer space can become practical, propulsion systems must be studied under conditions likely to be found beyond the earth's atmosphere. At extreme altitudes, air-breathing engines will not operate; therefore, space engines must be capable of operating in a vacuum. In re-entering the atmosphere, future aircraft will be exposed to temperatures as high as 30,000°F, where the behavior of matter changes. To simulate such conditions, new high-temperature facilities are being constructed at the NACA's research centers.

One such facility is the electric-arc tunnel, in which a high-current discharge occurs in an arc chamber. When a working fluid, such as air, is injected into the chamber, it is heated by the arc, and then is expanded through a nozzle to produce a high-speed stream at temperatures of 10,000° to 20,000°F, in which re-entry problems are studied. This apparatus has the advantage that it can be operated at usefully long periods of time at high speeds and temperatures.

One propulsion device that has been suggested for outer-space flight is the ion jet. If a stream of ions, as in an arc jet, can be accelerated to high velocity by use of electric or magnetic fields, a small amount of thrust will be produced. The ions are tiny bits of matter, carrying electrical charges. They are formed when an electron is added or removed from an electrically neutral atom or molecule. They constitute most of the weight of the atom, and if they can be accelerated to high velocities, their energy can give useful thrust in outer space, for gradual acceleration to speeds measured in many thousands of miles an hour.

Petroleum fuels burned in today's jet airplanes are relatively cheap, plentiful, and safe. The energy content of these hydrocarbon compounds is, however, limited to about 18,500 Btu per pound. This figure is too low to satisfy the maximum range requirements of the military services for high-speed missiles and airplanes.

Since the end of World War II, the NACA and other organizations in this country have been searching for new fuels that would have higher

energy contents. This work has been given increasingly strong support from the armed forces. In 1957, for the first time, the NACA disclosed its part in this effort which has included study of theoretical fuel performance, compounding new fuels and determining their properties and those of fuels suggested by others, and tests of the potential new fuels in operating engines.

Approaches to the problem have been many-sided. Work has included investigation of light metals as fuels, although the gains would be in higher thrust instead of greater range. This is because such metals as aluminum and magnesium burn to higher temperatures and at higher over-all fuel-air ratios than hydrocarbons, but do not contain as much heat energy per pound. Studies were made of the burning characteristics of the light metals as solids and as finely suspended particles in petroleum-base slurries.

Much of the research interest has been centered upon boron and its compounds. In addition to its high-temperature burning, boron has a high energy content per pound and thus is attractive as a means of extending range as well as increasing thrust. In a theoretical study of a ramjet missile flying at an initial altitude of 60,000 feet and a speed of 2100 miles per hour, it was calculated that use of boron could extend range 40 percent over that calculated for JP-4 fuel.

Early in the NACA work on boron fuels, slurries of metallic boron and jet fuel were studied with disappointing results. A practical solution to the problem of obtaining high combustion efficiency under the difficult conditions of high altitude could not be achieved.

The energy content of boron-hydrogen compounds, the boron hydrides or boranes, is considerably higher than that of boron alone. Further, many of these compounds can be prepared in liquid form, and thus are more conveniently handled in aircraft tanks and fuel systems.

Only small amounts of boron have been produced in the past, but large quantities of boron-containing salts are available, notably in California. Because of the elaborate and difficult processes in their manufacture, liquid boron hydrides have been priced in the hundreds of dollars per pound in the quantities produced to date.

NACA research has been aimed at evaluating the effectiveness of borane compounds over a wide range of conditions, including, in 1957, limited use in full-scale ramjet and turbojet engines. There are difficult problems remaining. Boron compounds can be quite toxic, and the products of combustion





*NACA 16-inch ramjet is elevated in Lewis Unitary Plan Wind Tunnel.*

can produce deposits within the engine which cut performance. It may be necessary to modify the borane fuels by chemical means to minimize these characteristics.

It is one thing to accomplish satisfactory use of a radically new type of fuel under the precisely controlled conditions of a laboratory, and something perhaps entirely different to achieve similarly satisfactory results in actual flight. In 1957, the latter step was taken in a small way; speeds greater than Mach 3 were recorded in free flight by an experimental full-scale ramjet test missile burning a boron-compound fuel. Not until the multi-million-dollar plants now being constructed can produce relatively large amounts of the new high-energy fuels will it be possible to complete the large-scale research that remains to be done before these fuels can be applied effectively to aircraft propulsion.

Development of ballistic missiles capable of spanning intercontinental distances is a matter of great national urgency, requiring the investment of hundreds of millions of dollars. Without understating the difficulty or complexity of such problems as guidance, structures, or propulsion, it may be said with some confidence that solutions for these problems are being found as a result of the very great research and development effort being made.

Far different have been the problems posed by aerodynamic heating. The ICBM, moving at many thousands of miles per hour as it enters the earth's

atmosphere, encounters aerodynamic heating of great magnitude. So serious and so large are these problems that success or failure of the entire long-range ballistic missile program has hinged on their practical solution.

In 1957 the NACA disclosed a significant advance made at the Ames Laboratory toward eventual solution of the heat problem for missiles. It was the new concept, by H. Julian Allen, which called for use of blunt-nose cone. This work, essentially completed in 1952 but carefully protected for security, resulted from an analysis of the fundamental forces acting upon missiles entering the earth's atmosphere at high supersonic speeds. Allen found that by blunting the missile nose cone to produce a high pressure drag, it becomes possible to deliver large quantities of the total heat generated into the air surrounding the missile nose, leaving much smaller amounts to be absorbed by the missile shell.

Another important development at the Ames Laboratory was the design and construction of an entry simulator, in which the varying conditions of altitude and speed experienced by a missile descending on its target can be accurately simulated. The work of Dr. A. J. Eggers, Jr., the simulator uses tiny models which can provide accurate heat data equivalent to that experienced by missiles ranging in size up to a 3-ft.-diameter missile weighing 5000 pounds.

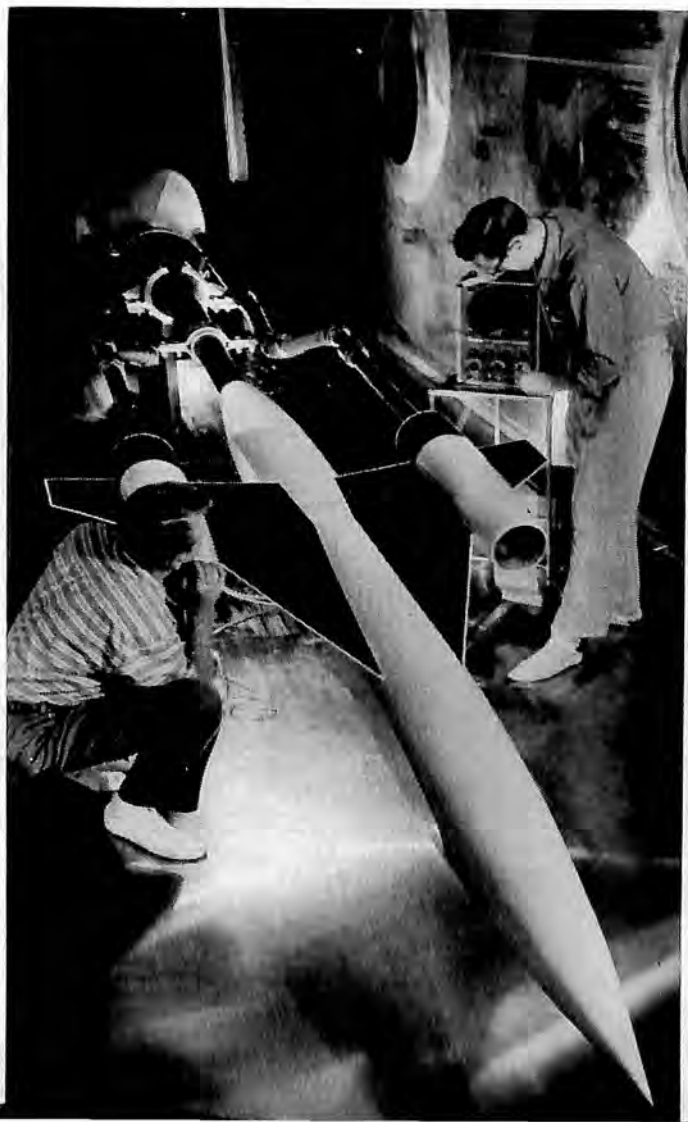
The work at Langley Laboratory on the missile heat problem has included laboratory force and

pressure measurements on a series of models with various degrees of nose bluntness and varying angles of flared skirt on the afterbody, at speeds ranging from subsonic to a Mach number above 10. Similar studies, at considerably higher speeds, have been possible using the rocket-propelled model technique at Wallops Island.

The arc-jet was found particularly useful in finding out how materials react to the extreme conditions of atmospheric entry. At the Langley laboratory, it was used to determine such matters as the time lapse between the presence of heat and the beginning of melting; the rate of loss of surface material; chemical interaction between the metal and the hot air jet; spalling due to thermal shock, and other phenomena which must be understood in detail.

Cooling methods also commanded attention. Studies at the Ames and Langley laboratories demonstrated usefulness in a method of transpiration (or sweat) cooling in which a coolant is forced through a porous outer surface of a missile. Another possible technique would employ a film of liquid or gas which can be spread over the missile surface so as to absorb heat and at the same time shield the metal skin from the intense heating.

*Experimental supersonic aircraft model.*



At the other end of the speed scale, the NACA continued to work on problems of lift, stability and control, and structures that are peculiar to the VTOL and STOL types of aircraft. As with its other researches, the NACA distributes findings from these investigations to both the aircraft industry and the military services.

During 1957, the Lewis laboratory also did considerable work on the problem of turbojet-engine noise. A basic question is what causes the greater noise of the turbojet engine. It might be reasonable to suspect that the combustion of fuel at tremendous rates, and the whine of the compressor blades could be the principal causes, but actually these noises are not the prime offenders. The "big noise" is created outside the engine by the exhaust jet as it mixes with the atmosphere. The exhaust jet and the air do not mix smoothly; hot gas and air roll up into irregular swirls and eddies, producing fluctuating pressures that are radiated as sound waves.

A simple "cure" for the jet noise problem would be elimination of the turbulent mixing, but fundamentally there is no way to accomplish this. However, it is possible to reduce the strength and size of the turbulent eddies. Intensive research was conducted on various nozzle shapes, some of which will lessen the noise substantially by reducing the peak sound levels at certain frequencies. Difficulties are encountered in the design of such nozzles in keeping drag, weight and engine performance penalties at a minimum while at the same time accomplishing the desired noise reductions.

A basically different approach to the problem is to reduce the velocity of the exhaust jet. A small reduction in jet velocity will produce a substantial reduction in noise. Today's engines, designed to provide the maximum performance requirements of the military services, cannot operate efficiently at lower jet velocities. It would be possible to design new engines that would operate efficiently at low jet velocities and thus with lower noise, but development of such new engines required additional research and would be both costly and time consuming.

There is the further possibility of combining the noise-reduction potential of special nozzle shapes with that of the lower jet velocity. The factors of cost, thrust losses, and weight are of great importance in considering devices that may be used on the commercial jet transports. Much research is still necessary to produce economically practical noise suppression.



**CIVIL**

# AVIATION

## THE AIRLINES

As the scheduled air transport industry approached its 20th anniversary under the Civil Aeronautics Act of 1938, the year 1957 saw further steps in the continual growth of the airlines which has been accelerating since the Korean war. The year was also one of preparation for the civil jet age in the United States.

While complete data for the last half of the year was not available, there was every indication that 1957 would top the preceding year's all time high. In 1956, the industry flew nearly 46,000,000 passengers, was responsible for a 3.5 percent increase in domestic intercity passenger traffic carried by the nation's commercial transportation system, and handled more than 1,200,000 air freight shipments. The latter figure represented an increase of more than 1000 percent over 1947.

Some indication of 1957's growth is contained in the statistics below:



*Stuart G. Tipton  
President, ATA*

### CONSOLIDATED AIRLINE INDUSTRY SUMMARY, UNITED STATES

*(Add 000 to all figures)*

ITEM	1955	1956	First 6 Months 1956	First 6 Months 1957
Revenue ton-miles .....	3,042,327	3,547,351	1,683,361	1,915,185
Available ton-miles .....	5,235,742	6,087,070	2,868,415	3,430,618
Ton-mile load factor % .....	58.11	58.28	58.69	55.83
Revenue pass.-miles .....	24,340,431	27,615,179	13,272,003	15,065,181
Avail. seat-miles .....	38,545,109	43,645,569	20,658,496	24,329,400
Pass. load factor % .....	63.15	63.27	64.24	61.92
Operating Revenues .....	\$ 1,634,712	\$ 1,876,055	898,522	\$ 1,022,682
Operating Expenses .....	\$ 1,490,847	\$ 1,742,314	830,140	\$ 984,127

Despite the gains, the airlines in 1957 were trapped in what appears to be a period of diminishing return. In 1956, traffic revenues increased 11 percent over the previous year, but at the same time net income dropped 10 percent. The steady decline of the profit margin is apparent when one notes that, for the 12 months ending September, 1955, profit amounted to 6.29 cents on the dollar, while the comparable figure for the 12 months ending in July, 1957, was a meager 2.82 cents.

The reasons are simple: everything involved in running an airline—wages, parts, fuel, cost of aircraft—has gone up, while fares remained the same. Airline fares today are actually less than they were nearly 20 years ago, a situation unique among the nation's common carriers. A recent study shows that the average airline fare in 1938 was 5.32 cents per passenger mile. In 1957, it averaged 5.28 cents.

In August, 1957, the Civil Aeronautics Board denied a six percent fare increase sought by seven of the 12 trunkline carriers, who argued that the proposed increase was one of many steps necessary to meet the critical financial problems arising out of the coming jet and turboprop re-equipment programs.

As the Civil Aeronautics Board prepared to renew hearings in the matter of the General Fare Investigation, president Stuart G. Tipton issued a statement of position and objectives of the Air Transport Association of America. In part, it said:

"This proceeding comes at a critical time in the advancement of this nation's air transport industry. The situation demands that the Civil Aeronautics Board act with the utmost keenness of perception and consciousness of its responsibilities to discharge its mandate from Congress to encourage and develop the air transportation system which best fulfills the needs of the public—and the national defense—for service.

"The Airlines today stand on the threshold of the jet age.

"The first stage of this jet program will require, by the end of 1961—virtually overnight—that the domestic airlines more than triple their investment in flight equipment.

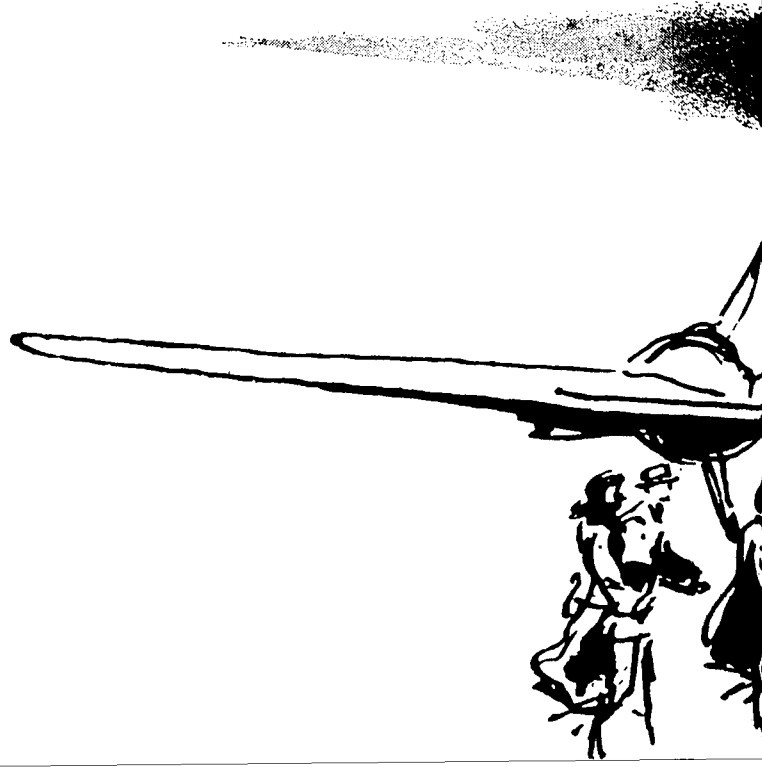
"These financial requirements are, by any realistic terms, staggering. They can be met—particularly with respect to the needed additional purchase of jets—only as airline securities become more acceptable to investors than is now the case. This means substantially better earnings, and more regular dividends, than the airlines have hitherto found possible at the fare levels permitted by the Board—fares which today, after two decades of in-

flation, average out at less per passenger mile than in 1938!

"To put the matter in the simplest terms: it is of urgent importance, both for national defense and for service to the public, that the domestic airlines put their jet fleets into operation as soon as possible, and on as large a scale as possible. The importance of making these jet fleets operational transcends any savings of pennies on airline fares that might be possible by curtailing jet orders and prolonging the use of older, slower piston-engine aircraft. Since 1938 fares will not pay for 1958 aircraft—and clearly they will not—it is incumbent upon the Board (charged, as it is, with promoting the improvement of air transportation) to permit adjustment of fares to the levels which will, in terms of today's dollar, attract the investment needed for modern jet aircraft."

The industry's turbine re-equipment program was massive in proportions. Three times since 1946 the airlines have undertaken equipment revolutions, using more than 80 percent of all funds available to the industry in the process.

At the end of 1957, the industry had committed itself to the purchase of 502 turbine powered aircraft (340 of them turbojets) with additional orders in the offing. The estimated cost of these programs topped \$3-billion, including the standard 20 percent for parts purchase. This figure doubles the cost of all property owned by the airlines today after three post-war re-equipment cycles. The \$3-



billion does not even include piston-engined aircraft still on order. Further, the equipment investment, including ground equipment, is expected to grow to nearly \$5-billion during the next nine years.

Planes involved in the turbine re-equipment programs for the various scheduled airlines include:

#### TURBOPROPS

1. Vickers Viscount, powered by four Rolls-Royce turboprop engines, capable of carrying 48 passengers at a cruising speed of about 385 miles per hour for a maximum range of 1500 miles (59 of these were in service in the U. S. as of May 15, 1957).

2. Lockheed Electra, powered by four Allison 501 D13 propjet engines, capable of carrying 77 to 85 passengers at about 415 miles per hour cruising speed for a maximum range of about 2200 miles.

3. Bristol Britannia, a long-range aircraft powered by four Proteus turboprop engines, capable of carrying from 92 to 133 passengers at a cruising speed of about 400 miles per hour.

4. Fairchild F-27 Friendship, powered by two Rolls-Royce engines, a high wing 40 passenger short- and medium-range airliner with a cruising speed in excess of 280 mph.

#### TURBOJETS

1. The Boeing 707 in three versions, as follows:

(1) the 120 series, carrying from 124 to 150 passengers, cruising speed about 500 miles per hour, powered by four Pratt & Whitney JT3C-4 engines, with nonstop transcontinental and transatlantic range; (2) the 220 series, carrying from 124 to 150 passengers, cruising speed 605 miles per hour, powered by four Pratt & Whitney JT4A-3 engines, designed for nonstop transcontinental and transatlantic range; and the 32 series powered by four Pratt & Whitney JT4A-3 engines designed essentially for intercontinental range.

2. Douglas DC-8, two models, domestic and intercontinental, both capable of a cruising speed ranging from 550 to 600 miles per hour. The domestic DC-8, powered by four Pratt & Whitney J57 engines, will carry as many as 144 passengers with a range of 3700 miles. The intercontinental version, powered with the Pratt & Whitney J75 jet engines, will be capable of flying 4600 miles nonstop.

3. The Convair 880, a medium to transcontinental range aircraft, capable of carrying from 80 to about 140 passengers at a cruising speed of 615 miles per hour, powered with four General Electric CJ805 engines.

4. Comet, British, capable of carrying 68 to 74 passengers in the 500- to 550-miles-per-hour cruising speed range. It will be a medium-distance airliner powered with four Rolls-Royce jet engines.

The ability of these jets to produce airlift is impressive. For example, a typical big jet airliner



will have a lift capacity of 40,000 pounds—nearly twice that of a typical airliner today. As designed for tourist service, it will offer up to 162 seats, as compared to the 95 seats available on a large tourist-class plane today. The cruising speed of the turbojet will be as high as 615 miles per hour, as compared with about 350 miles per hour for the fastest piston airliners today. The largest turbojets will have a non-stop intercontinental range. This combination of size, speed and range sets up a geometric progression, resulting in an estimated 8 billion ton miles of airline airlift capacity by 1961.

The preparations that have been, and are being, made by the airlines, Government agencies, and ATA for insuring safe, comfortable, fast and reliable operation of the country's large fleet of jet airliners when they go into service will run into hundreds of thousands of man hours. Among the subjects that were studied during 1957 and are still under study are proper use of the American air space, personnel policies, improved handling of passengers, paying for the jets, operations, maintenance and ground handling of the new equipment.

Also under study during the year were some of the problems that must be coordinated to insure the proper handling of large scale movements of passengers at an air terminal. Among these are improvements in passenger and baggage flow, handling of auto traffic and parking, waiting rooms, ticketing and baggage checking areas, outbound baggage rooms, passenger concourses, boarding control points and departure rooms, baggage claim areas, special service room, facilities for safety, comfort and convenience, utilities and airline areas to mention but a few. And each of these items in turn has to be broken down into many individual items that require major consideration to insure satisfactory service to the traveling public. And in the case of each item it is necessary to plan for peak operations with attention given to the additional factor that one must recognize a peak will occur within a peak hour.

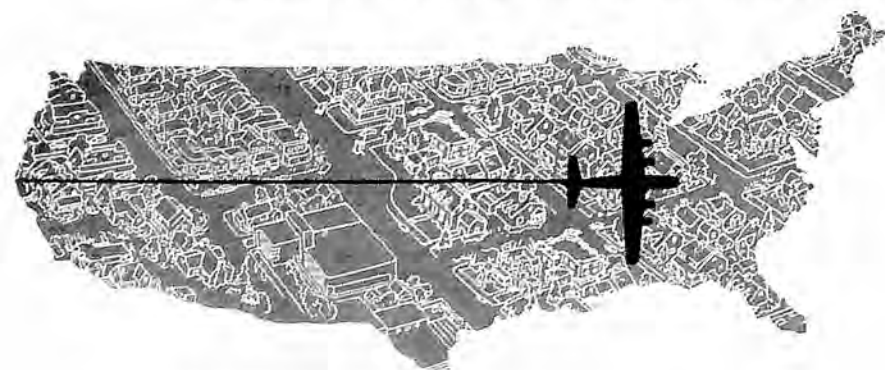
In 1957 the special assistant to President Eisen-

hower for Aviation Facilities Planning released his report. Edward P. Curtis had been appointed to make a study and suggest methods of speeding up the research and planning necessary to strike the "handcuffs and leg irons" from the country's Air Navigation Traffic Control System. In his report Curtis emphasized the dangers to the national economy and defense of the present inadequate management of air space which often required the sacrifice of volume to safety. He proposed a consolidation of all Federal Government activity concerned with air traffic control and navigation into one independent unit—a new Federal Aviation Agency. He suggested an interim plan to make certain that as many improvements as possible start immediately in advance of comprehensive Government reorganization and proposed a system that would allow greater control of more aircraft by ground controllers and increasingly greater use of automatic devices to provide accurate information quickly.

During 1957, as a part of a positive separation program, the scheduled airlines, working through ATA and ALPA worked out a plan for full control of all scheduled airline traffic flying at altitudes from 9500 feet up within an area bound by the airways between Washington, New York and Chicago. The procedures effective in this control area, known as the "Golden Triangle," constituted the second step in a long range program to provide positive separation of aircraft by air traffic control facilities on the ground. The first step, in which all airline flight above 18,000 feet in the continental limits of the U. S. have positive separation from each other by filing and operating under instrument flight rules procedures was initiated earlier.

At their annual meeting in June the Board of Directors of the Air Transport Association of America passed a resolution condemning the policy of the State Department in granting additional routes to certain foreign air carriers as destructive of a sound United States air transport system and as unjustifiable under the long-established bipartisan United States air transport policy and urged that such grants should be stopped.

During 1957 the Universal Air Travel Plan under which airline travelers are able to carry a credit card honored for air transportation by 96 airlines throughout the world reported that more than 77,000 customers had been added to their list. This brought the total number of users of the only world wide credit plan now in operation by any industry to nearly 800,000.



For many years the scheduled air transport industry has been working to simplify international border crossing procedure and paper work. Each year has seen some success, but 1957 saw a stepped-up effort to streamline procedures to insure that international travel would be accomplished with a minimum of restriction in the jet age.

The year 1957 saw the scheduled airlines calling for a new partnership concept with the Department of Defense so as to enable them to make a greater contribution to national defense. The concept calls for an increased airline carriage of military traffic so as to free defense Department resources for other tasks and will expand the national airlift without cost to the taxpayer. This increased use of airline facilities would also aid in increasing the Civil Reserve Air Fleet or CRAF program. Under that CRAF program the airlines have earmarked for military use in time of emergency some 320 four-engined planes. The airlines also point out there are more than 600 additional four-engined planes in the combined airline fleet which are capable of performing the same kind of work. By the start of 1958 this additional airlift capacity would be enough to more than double the capacity of the present fleet. By 1961 the fleets will be increased sufficiently to increase the civil airlift capacity by more than four times the 1957 figure, and that a major part of the anticipated airlift will be in terms of jet aircraft, which will start entering the airline fleets in 1959-60.

In 1957 the system under which a passenger must pick up his ticket within a deadline set by the airline exceeded airline expectations both in making seats available and acceptance by the public. Adopted late in 1956, the ticketing time limit plan was part of a three-stage program designed to cope with the no-show problem, which resulted in airliners departing with empty seats while at the same time passengers who wanted those seats were unable to buy them. The second stage of the program put a reconfirmation rule into effect in July of 1957 and later in the year added additional assurance that "sold out" flights taking off with empty seats would be eliminated. A penalty plan was adopted. Under this plan, the airline passenger who inconvenienced fellow passengers by being a "no-show" had to pay a \$3.00 penalty.

Among the many other efforts to improve service was the commitment of about \$25-million in leases and rentals over the next 10 years to insure continued improvement of passenger reservations and space control.

The airlines continued to cooperate with the Post Office during 1957 in the experiment to improve postal service by flying first-class mail on a space available basis between certain points. In the first six months of 1957 compared with the same period of 1956 this non-priority mail showed a gain of 7.7 percent and thus hundreds of millions of letters reached their destination on an average of nearly half a day sooner than if they



had moved by surface. The airlines got three-tenths of a cent out of each three-cent stamp affixed to a first-class mail that went by air, and the Post Office got the rest. The airlines were not satisfied that the payment received is up to the value of the service provided. But there was no question as to the value of the experiment as such — particularly since so many foreign countries move first-class mail by air whenever air carriage will expedite delivery.

The interest of the scheduled airlines in a proximity warning and collision avoidance system continued in 1957. During the year, proposals for the use of infrared techniques for air collision avoidance systems and proximity warning systems were presented to the industry. As the year neared its end, following specific proposals for such a system, it was evident that an infra-red system would be test flown by several of the scheduled airlines.

Due to an increase in the number of bomb hoaxes reported, Congress in 1957 changed the public law dealing with wilful destruction of aircraft. The change brought the Federal Enforcement agencies into action in case of a bomb hoax as well as the destruction of aircraft. In addition, the law made bomb hoaxing a criminal offense punishable by a year in prison, or \$1000 fine, or both.

Through ATA the scheduled airlines established an award program in which any airline employee who materially assists authorities in their efforts to apprehend a hoaxer will be given a cash award of up to \$1000 depending upon the extent of the employee's help.

An ATA membership list and summary of individual airlines operations follows.



## MEMBERSHIP LIST

### AIR TRANSPORT ASSOCIATION OF AMERICA

#### (HEADS OF AIR LINES LISTED)

Mr. Howard J. Korth  
President  
*AAXICO Airlines, Inc.*  
P. O. Box 875  
Miami International Airport  
Branch  
Miami, Florida

Mr. Chas. F. Willis  
President  
*Alaska Airlines, Inc.*  
2320 Sixth Avenue  
Seattle 1, Washington

Mr. O. F. Benecke  
Co-Manager  
*Alaska Coastal Airlines*  
2 Marine Way  
Juneau, Alaska

Mr. Leslie O. Barnes  
President  
*Allegheny Airlines, Inc.*  
Washington National Airport  
Washington 1, D. C.

Mr. C. R. Smith  
President  
*American Airlines, Inc.*  
100 Park Avenue  
New York 17, New York

Mr. Edmund Converse  
President  
*Bonanza Air Lines, Inc.*  
McCarran Field, P. O. Box 391  
Las Vegas, Nevada

Mr. C. E. Beard  
President  
*Braniff International Airways, Inc.*  
Love Field  
Dallas 35, Texas

\*Mr. G. W. G. McConachie  
President  
*Canadian Pacific Airlines, Ltd.*  
Sea Island Airport  
Vancouver AMF, B.C., Canada

Mr. J. H. Carmichael  
President  
*Capital Airlines, Inc.*  
Washington National Airport  
Washington 1, D. C.

\*Mr. Dionisio Trigo  
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*Caribbean Atlantic Airlines, Inc.*  
P. O. Box 6035  
Loiza Street Station  
Santurce, Puerto Rico

Mr. Keith Kahle  
President  
*Central Airlines, Inc.*  
Meacham Field  
Fort Worth 7, Texas

Mr. John S. Gleason  
President & Treasurer  
*Chicago Helicopter Airways, Inc.*  
5240 W. 63rd Street  
Chicago 38, Illinois

Mr. Robert F. Six  
President  
*Continental Air Lines, Inc.*  
P. O. Box 9063  
Denver 16, Colorado

Mr. Merle K. Smith  
President & General Manager  
*Cordova Airlines*  
P. O. Box 1499  
Anchorage, Alaska

Mr. C. E. Woolman  
President & General Manager  
*Delta Air Lines, Inc.*  
Atlanta Airport

Mr. E. V. Rickenbacker  
Chairman of Board &  
General Manager  
*Eastern Air Lines, Inc.*  
10 Rockefeller Plaza  
New York 20, New York

Mr. R. E. Ellis  
President  
*Ellis Air Lines*  
P. O. Box 1059  
Ketchikan, Alaska

Mr. Robert W. Prescott  
President  
*The Flying Tiger Line, Inc.*  
Lockheed Air Terminal  
Burbank, California

Mr. C. A. Myhre  
President  
*Frontier Airlines*  
Stapleton Airfield  
Denver 7, Colorado

\*Mr. A. D. Lewis  
President  
*Hawaiian Airlines Ltd.*  
Honolulu International Airport  
Honolulu 17, Territory of Hawaii

Mr. Gwin Hicks  
President  
*Lake Central Airlines*  
Weir Cook Municipal Airport  
Indianapolis 44, Indiana

Mr. C. M. Belinn  
President  
*Los Angeles Airways, Inc.*  
Box 45155, Airport Station  
Los Angeles 45, California

\*Associate Member

Mr. Jos. C. Mackey  
President  
*Mackey Airlines, Inc.*  
Broward County International  
Airport  
Ft. Lauderdale, Florida

Mr. Robert E. Peach  
President  
*Mohawk Airlines, Inc.*  
Oneida County Airport  
Utica, New York

Mr. G. T. Baker  
President  
*National Airlines, Inc.*  
3240 N. W. 27th Avenue  
Miami 42, Florida

Mr. Robert L. Cummings, Jr.  
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*New York Airways, Inc.*  
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LaGuardia Airport Station  
Flushing 71, New York

Mr. Hal N. Carr  
President  
*North Central Airlines, Inc.*  
6201 - 34th Avenue, South  
Minneapolis 23, Minnesota

Mr. George E. Gardner  
President  
*Northeast Airlines, Inc.*  
Logan International Airport  
E. Boston 28, Massachusetts

Mr. Raymond I. Petersen  
President & General Manager  
*Northern Consolidated Airlines,  
Inc.*  
414 Fourth Avenue  
Anchorage, Alaska

Mr. D. W. Nyrop  
President  
*Northwest Airlines, Inc.*  
1885 University Avenue  
St. Paul 1, Minnesota

Mr. Laddie H. D. Hamilton  
President  
*Ozark Air Lines, Inc.*  
Box 6007, Lambert Field  
St. Louis 21, Missouri

Mr. A. G. Woodley  
President  
*Pacific Northern Airlines*  
1626 Exchange Building  
Seattle 4, Washington

Mr. Andrew B. Shea  
President  
*Pan American-Grace Airways, Inc.*  
135 E. 42nd Street  
New York 17, New York

Mr. J. T. Trippe  
President  
*Pan American World Airways, Inc.*  
135 E. 42nd Street  
New York 17, New York

Mr. T. H. Davis  
President  
*Piedmont Airlines*  
Smith Reynolds Airport  
Winston Salem 1, North Carolina

Mr. Robert C. Reeve  
President & Superintendent  
Operations  
*Reeve Aleutian Airways, Inc.*  
420 D Street, Box 559  
Anchorage, Alaska

Mr. Harold L. Graham, Jr.  
President  
*Resort Airlines, Inc.*  
Suite 326  
1346 Connecticut Avenue, N.W.  
Washington 6, D. C.

Mr. John Paul Riddle  
President  
*Riddle Airlines, Inc.*  
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Miami International Airport  
Branch  
Miami 48, Florida

Mr. Raymond A. Norden  
President  
*Seaboard & Western Airlines, Inc.*  
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New York 4, New York

Mr. D. W. Rentzel  
Chairman of the Board  
*Slick Airways, Inc.*  
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Oklahoma City, Oklahoma

Mr. Frank W. Hulse  
President  
*Southern Airways, Inc.*  
1140 Brown-Marx Building  
Birmingham, Alabama

Mr. John H. Connelly  
President  
*Southwest Airways Company*  
San Francisco International  
Airport  
San Francisco, California

\*Mr. W. Gordon Wood  
Vice President—Traffic  
*Trans-Canada Air Lines*  
Room 422  
International Aviation Building  
1080 University Street  
Montreal 3, Quebec, Canada

Mr. R. E. McKaughan  
President  
*Trans-Texas Airways*  
1221 Commerce Building  
Houston 2, Texas

Mr. Warren Lee Pierson  
Chairman of the Board  
*Trans-World Airlines, Inc.*  
806 Connecticut Avenue  
Washington 6, D. C.

Mr. W. A. Patterson  
President  
*United Air Lines*  
5959 S. Cicero Avenue  
Chicago 38, Illinois

Mr. Nick Bez  
President  
*West Coast Airlines, Inc.*  
Boeing Field  
Seattle 8, Washington

Mr. T. C. Drinkwater  
President  
*Western Air Lines, Inc.*  
6060 Avion Drive  
Los Angeles 45, California

Mr. Sigurd Wien  
President & General Manager  
*Wien Alaska Airlines*  
Box 649  
Fairbanks, Alaska

\*Associate Member

## AMERICAN AIRLINES

American completed a number of steps in its jet-age program during 1957. President C. R. Smith stated that the company's conversion to an all-turbine fleet would be completed by 1961. Under the re-equipment program, American planned to buy 15 long range and 15 intermediate range jet transports, in addition to 30 long range Boeing 707's and 35 medium-range Lockheed Electras.

Smith stated that American's turbine program was based upon annual earnings of \$25-million, which would require the proposed 15 percent fare increase.

The company also completed plans for a \$14-million terminal at New York International Airport, which the airline said "would be built around the passenger and not the airplane." The terminal design features one-level accessibility for passengers, complete protection from the elements and individual departure lounges with an enclosed telescopic passenger corridor between lounge and plane.

Major items of the AAL year were dedication of a new \$1-million stewardess college located midway between Dallas and Fort Worth, Texas; completion of a nationwide educational program for leading travel agents; and completion of plans for a \$20-

million expansion of the airline's maintenance and overhaul base at Tulsa, Oklahoma.

Other developments during the year included:

A proposal to the Civil Aeronautics Board that the nation's trunk lines not be subsidized.

Recording of the 50,000,000th reservations inquiry by the Magnetic Reservisor, an electronic device which expedites reservations processing through automation.

Installation of an automatic "telecard" system for relaying passenger information faster and more accurately between American Airlines' major reservations centers.

Inauguration of a luxury air service—called "The Captain's Flagship"—between New York and Chicago and New York and Detroit.

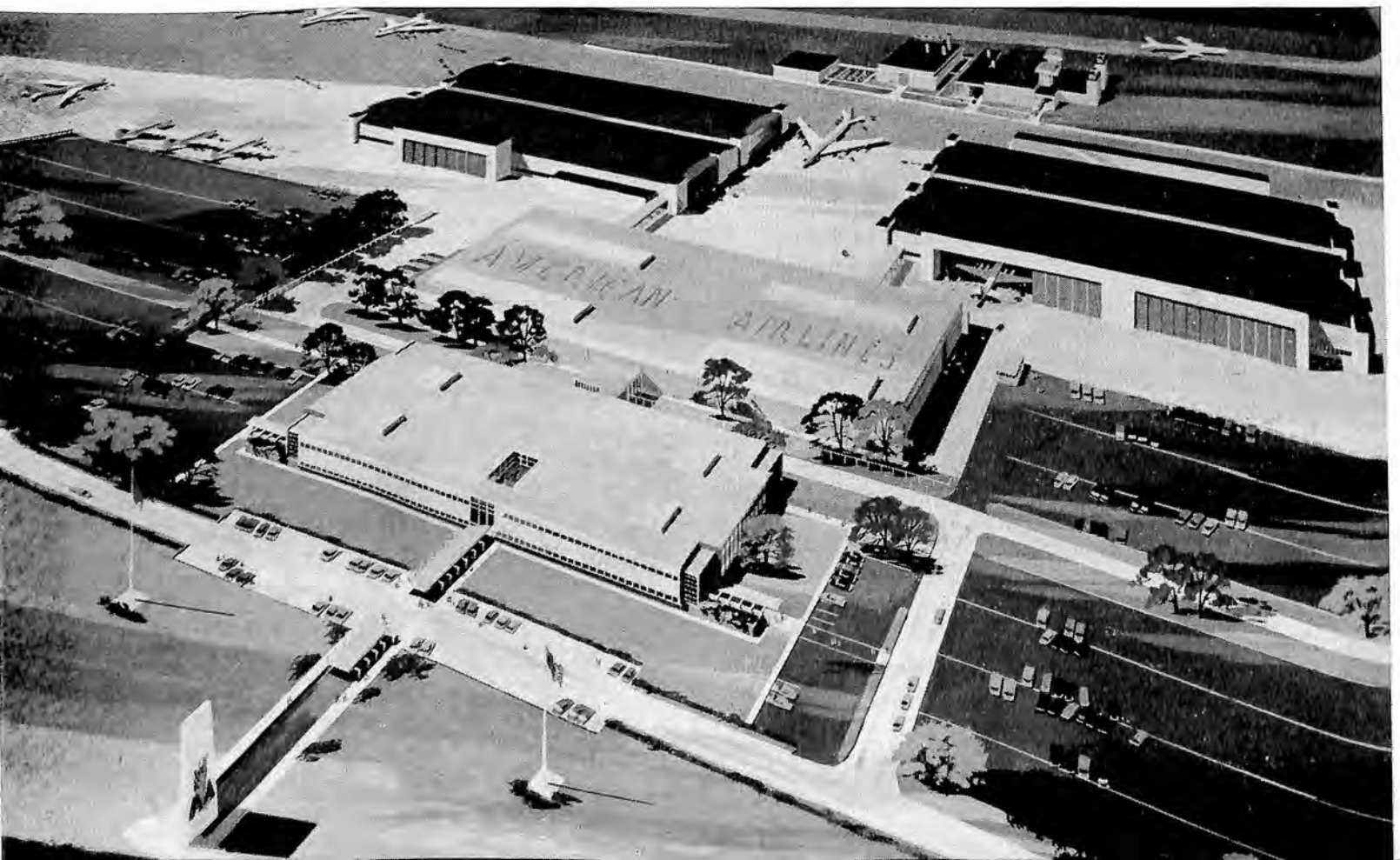
Expansion of the "Mercury," American's luxury first class service, to some 20 of the nation's major cities.

Expansion of DC-7 luxury aircoach service—The Royal Coachman—to about 15 major American cities.

Inauguration of four-engined nonstop commuter service on the heavily-traveled Boston-New York-Washington routes.

Inauguration of DC-7 "Mercury" nonstop service between St. Louis and New York.

*American Airlines plans this new base at Tulsa, Oklahoma.*



## CAPITAL AIRLINES

Capital Airlines reached a new plateau of progress in 1957 as the company celebrated its 30th year of operation and completed the integration of 59 jet-prop Viscounts into its fleet of 103 aircraft.

Although 1957 recorded a heavy gain in passengers carried by Capital, the year was also characterized by a correspondingly heavy increase in expenses, which forced the airline to defer an order of 15 additional Viscounts and 14 Comet jetliners.

The company's policy during the year was one of consolidating and strengthening its route system and schedules to take full advantage of its Viscount fleet. With this program there was also an attendant expansion of non-flight equipment.

A major asset in the transitional training of pilots for the jet-prop aircraft, was the purchase of a \$200,000 electro-mechanical flight simulator. Purchased from Air Trainers Link Ltd., of England, it is the first turbo-prop simulator to be used in the United States. Basically an analog computer, the simulator is a perfect working mock-up of a Viscount cockpit, capable of reproducing almost every inflight engine failure or emergency likely to be encountered. Since the simulator allows the release of an actual Viscount from training, it has been estimated that this training aid saves Capital \$159 for each hour of operation.

Capital's communications network was improved by the installation of a new Sequentially Coded Automatic Transmitter Start system. Often referred to as SCATS, the system more than doubled the capacity of the company's teletype coverage which, at year's end, contained 18 circuits. It proved to be a tremendous time saver, since in the past receiving sets in the field carried every message being sent on the Capital system. This "party line method" required an agent to maintain a constant vigil for a lull to dispatch any outgoing message. Now agents merely cut a tape, feed it in the machine and walk away. A segment of SCATS in the Washington headquarters automatically seeks out stations waiting to transmit and picks up the taped messages.

The problem of keeping an up to the minute tally of seats available on a system wide basis was well on the way to being solved as a result of an agreement to install a Univac File Computer system to be used as a reservations inventory. Initially, Capital planned to install 192 agent sets in the reservations offices of the company's 12 largest stations. A master unit in Washington will provide a nearly instantaneous check on every seat for sale on the airline, with a lapse of no more than

three seconds between inquiry and answer. At a later date Capital plans to place more agent sets in airport ticket offices and operations.

The company continued its heavy advertising with an emphasis on the advantages of Viscount flight and used all available media. A particularly effective direct mailing campaign won Capital its eighth national award in 1957.

In April, Capital celebrated its 30th Anniversary by re-enacting its first regular mail flight between Pittsburgh-Youngstown-Cleveland. For this purpose the company used the original Waco-9 biplane and pioneer pilot Merl Moltrup.

Operating revenue for the first nine months of 1957 was \$69,657,723 as compared to \$45,514,822 for the same period of the previous year. However, a continuously rising expense level and increased interest payments combined to record a net loss of \$1,248,861 for the first nine months of 1957.

A total of 2,936,020 passengers was carried during the first three quarters of last year as compared to 2,180,588 for the nine month period of 1956. Passenger miles flown for the same period last year totaled 1,118,819,910 as compared to 731,988,926 for the nine month period of the previous year.

In addition to Viscounts, the airline was operating 20 DC3's, 12 DC4's and 12 Constellations.

## CENTRAL AIRLINES

In 1957, Central inaugurated service to three cities: Harrison, Arkansas; Guymon, Oklahoma; and Lamar, Colorado. It was the first scheduled airline service for each of the cities.

Guymon and Lamar are located on routes from Oklahoma City to Denver, awarded Central by the Civil Aeronautics Board in 1956. Harrison is on the route from Fort Smith to St. Louis, awarded in 1955. Service to all three cities had been held up pending completion of necessary airport improvements.

A major personnel change was the promotion of operations manager R. L. Wageneck to vice president in charge of operations. Wageneck was also named a director of the company, as were A. S. Aldridge, vice president—traffic and sales, and T. Patrick Carr, Texas oilman.

Central boarded its 500,000th passenger in late November. The company also dropped its "Winged-C" symbol and replaced it with a more modern design. At year's end, Central was serving 33 cities (17 of them exclusively) in Texas, Oklahoma, Arkansas, Missouri, Kansas and Colorado. The company employed 13 aircraft over a route system of 3429 miles.

## CHICAGO HELICOPTER AIRWAYS

CHA completed its first year of passenger service in November and carried about 9000 passengers during the month, compared with 429 in its first month of operation a year earlier.

A highlight of the company's year was inauguration of service from Chicago's two major airports—Midway Airport and O'Hare Field—to the downtown Loop area. With this service, Chicago became one of two U.S. cities receiving scheduled helicopter service in their downtown districts.

CHA was operating seven-passenger Sikorsky S-55 and 12-passenger Sikorsky S-58 helicopters.

## CONTINENTAL AIR LINES

Continental completed construction at Los Angeles International Airport of a maintenance base designed specifically for reception and upkeep of jet aircraft. The base was activated in the spring, ahead of completion and was used during the remainder of the year for maintenance of the company's fleet of Douglas DC-7B's.

The \$1.25-million base consists of a 42,425 square foot hangar with a clear height of 40 feet, a 35,000 square foot two-story reinforced concrete structure housing the maintenance shops, offices and personnel training space and underground storage for 200,000 gallons of aviation fuel. The base was designed primarily for Continental's Boeing 707 transports which will be delivered in 1959.

Continental also completed plans for an engine test cell for the Rolls Royce RDA-1 and RDA-8 Dart engines which power the airline's Vickers Super Viscount transports. The turbine transports were scheduled for delivery starting March, 1958.

Continental inaugurated its Chicago-Kansas City-Denver-Los Angeles route in April. The carrier also requested Civil Aeronautics Board authority to operate a route from Dallas to the West Coast.

## DELTA AIR LINES

Delta completed its 28th year of passenger operations with new company records in all categories of traffic. Available seat miles increased 28 percent over 1956, and revenue passenger miles rose 20 percent to 1,299,000,000 with an average load factor of 58.90.

Operating revenues of \$78,596,003 were 18 percent above the previous year, but operating expenses increased 23 percent to \$72,510,934. Net profit of \$2.622-million after taxes was equal to \$2.34 per share.

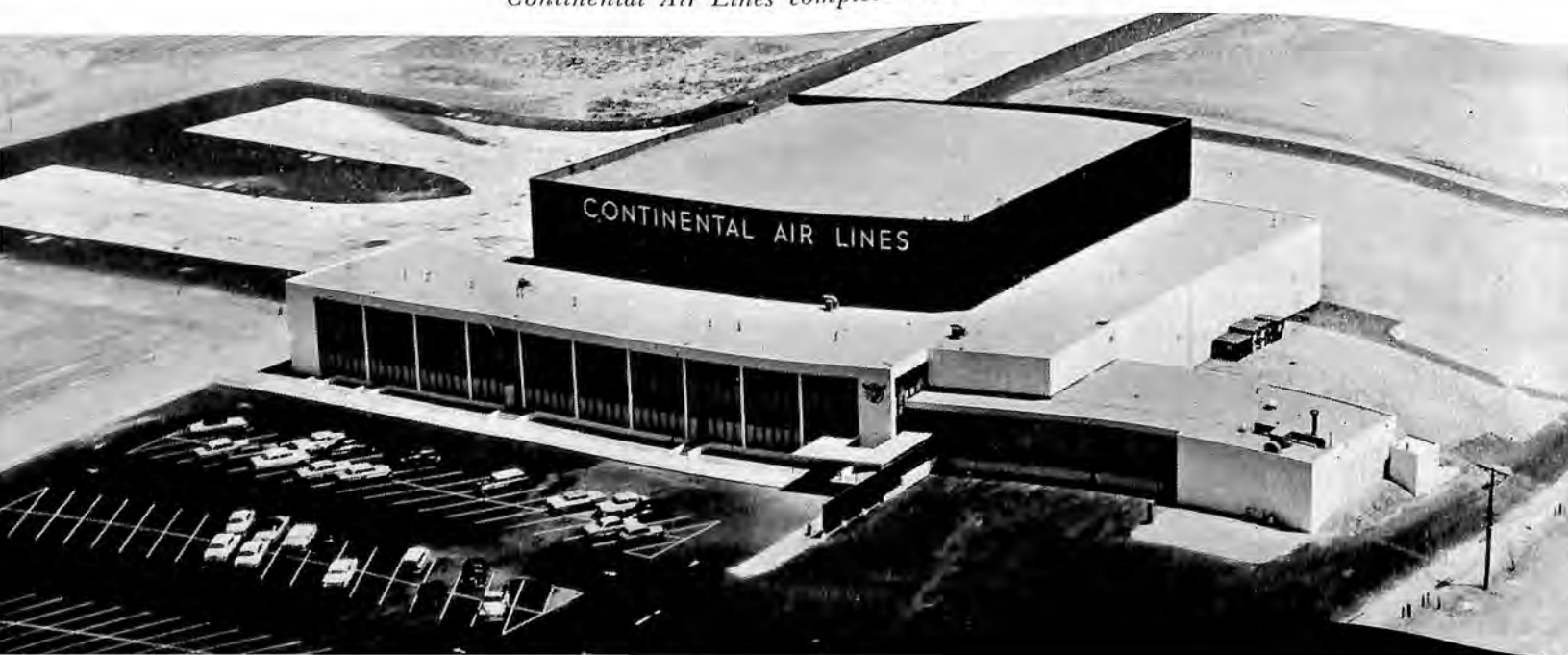
On February 1, Delta completed the first anniversary of its inauguration of service between the South and Southwest and the New York-Washington area. During the year, the airline expanded its service pattern over its entire 10,765-mile system serving 20 states, the District of Columbia and six Caribbean countries. Service was greatly increased between Chicago and the resorts of Florida and the Caribbean, and new flights were added to Washington, Baltimore, Philadelphia and New York. New non-stops went into operation between Houston and New York, as well as between these key Northeastern cities and Atlanta and other major centers served by Delta.

Delta pressed applications to the Civil Aeronautics Board for new operating authority between Dallas and the West Coast, between the Southeast and St. Louis, the Twin Cities, and Detroit.

The company joined other major carriers in seeking an interim six percent passenger fare increase, and when the Board denied this in August, filed application for a 15 percent fare boost in the General Fare Investigation under hearing at year's end.

Moving to meet the expanding airfreight shipping needs of the booming South, Delta in October inaugurated all-cargo service between 13 key cities

*Continental Air Lines completed its new base in Los Angeles.*





*A German Porsche is loaded into a Delta C-46 airfreighter.*

of its system. The new all-cargo fleet increased the company's cargo capacity by more than 600 percent.

In March, Delta, in cooperation with General Electric Company's Aircraft Gas Turbine Division in Cincinnati, opened the first airline jet training school. A coordinator of jet planning was named and the company engaged a New York engineering consultant firm to survey its jet requirements, including location of jet maintenance facilities. Company management personnel, supervisors, pilots and maintenance personnel received special training in these courses—conducted at the firm's Atlanta headquarters and elsewhere—to prepare for the inauguration of DC-8 service in 1959 and Convair 880 service in 1960. Delta has ordered 10 Convair 880's and 8 DC-8's, a \$100-million order.

During the year, Delta's total employment mounted past 6000 in the 60 cities it serves. Half of the work force is located in Atlanta.

A new \$350,000 general office building was completed at the Atlanta Airport, the first permanent building to be constructed there in a decade. A \$400,000 temporary concourse was dedicated at the Atlanta Airport to provide increased passenger

facilities pending completion of a new municipal terminal in early 1960. A \$1-million overhaul facility was begun at Dallas, and similar facilities were being contracted for at Newark and Idlewild. Expanded facilities at Miami and Atlanta were also being planned at year's end.

Delta added flights to New York International Airport during the year for the first time, supplementing its services through the Newark Airport. A new reservations office in greatly expanded quarters was opened in a Madison Avenue office building. New ticketing facilities were opened in Chicago, Houston and Atlanta.

The company's stock was listed on the New York Stock Exchange on April 17.

Coach service was greatly expanded during the year over Delta's system, rising to 40 percent of all flights.

Delta won the National Safety Council's Award of Honor for a perfect safety record during 1956.

The airline ordered an IBM 305 RAMAC system to handle reservations electronically, and inaugurated an equipment research program.



*Four of Frontier Airlines' DC-3's at Farmington, New Mexico.*

### FRONTIER AIRLINES

Backing up the booming developments in uranium, natural gas, and oil throughout the seven states in the Rocky Mountain South-West, Frontier Airlines set new company records for passengers, mail, and air cargo carried throughout its system. During the 12 months ending September, 1957, Frontier carried 208,390 passengers which was a 14 percent increase over the number of passengers flown in the previous year. This best 12-month period in Frontier's history saw 56,555,000 revenue passenger miles chalked up by the airline.

Frontier's fleet of 16 Douglas DC-3's flew over 100,000 ton miles of air express, close to 300,000 ton miles of United States mail, and over 700,000 ton miles of air freight during the same period.

In dealings with the Civil Aeronautics Board, Frontier was involved in three service cases which would effect new service over parts of Frontier's present system and could add additional route miles to Frontier's operations. In the Seven States Area Case, Frontier applied for new service into Nebraska, North Dakota, South Dakota, and Minnesota. In the Montana Service Case, the company asked for additional new service throughout western Montana, central Idaho, and into eastern Washington. In the Phoenix Service Case, Frontier was awarded two-stop authority for new service between Phoenix and Denver.

### HAWAIIAN AIRLINES

In October, Hawaiian Airlines carried its five millionth passenger.

During the year, the company also completed conversion of five of its Douglas DC-3's to the "Viewmaster" configuration, featuring five foot seven inch picture windows for better sightseeing over Hawaiian's island routes.

A request for extension of Hawaiian's half-fare family plan was granted by the Civil Aeronautics Board in October.

During the year, an interchange agreement was effected with Ansette Airways of Australia calling for Hawaiian's use of Ansette equipment during



*President of Hawaiian Airlines greets five millionth passenger.*

the peak summer months and a reciprocal arrangement during the Australian carrier's peak months of January and February.

Hawaiian received a National Safety Council award for its 623,000,000 passenger miles over a 27 year period without a passenger or crew fatality.

At year's end the airline was operating five Convair 340's, five DC-3 Viewmasters, one unconverted DC-3 and two cargo DC-3's.

### LOS ANGELES AIRWAYS, INC.

LAA added helicopter service to four new California communities during 1957. In May, service was started between Maywood and Los Angeles International Airport, with initial schedules calling for six flights daily.

In September, the airline started similar service on a five-a-day basis to Whittier and in October a four flight a day service between the airport and Monrovia was inaugurated. Final new service for the year was started to Azusa in November.

The additions brought to 22 the number of stations served by LAA's Sikorsky helicopters. Service to five additional stops was contemplated in the near future.

In June, LAA received the National Safety Council's Award of Honor for a fatality-free record in the preceding year. At year end, LAA was operating about 115 schedules daily.

## MOHAWK AIRLINES

Mohawk physically extended its service beyond its previous western terminal of Buffalo, New York, to Erie, Pennsylvania, and Detroit, Michigan, and also northward to Ogdensburg, New York, on the western end of the St. Lawrence Seaway and Power Development Area.

Mohawk traffic, at the end of the first nine months of the year, showed a 21.7 percent increase over the similar period in 1956.

The airline also placed in service the first group of its newly-modified, 46-passenger Convairs, providing a 15 percent increase in seating capacity per transport. The carrier now operates 11 Convair 240's and 11 Douglas DC3's.

Construction was begun and work progressed during the year on Mohawk's new \$2.8-million headquarters and maintenance facility at Oneida County Airport midway between Utica and Rome, New York. Work was scheduled for completion in 1958. The unusual cantilever construction will become the sixth structure of its type in the country. It will have two hangars capable of housing six Convairs and also will contain all shops, operating personnel, and general offices.

Early in 1957, Mohawk began operation of a new communications system designed for economical use of equipment, circuits, and employees' time. The private line teletypewriter system is known as the Sequentially Coded Automatic Transmitter Start (SCATS) system. It was developed by AT&T and was adapted for use by the local service airline by Remington R. Taylor, Mohawk superintendent of communications, and his staff.

In the fall, Mohawk began a formal management trainee program, designed to attract potential management talent, from the employee group in particular, and to train and develop this talent so the company will have a continuing source of industry or college trained personnel. Mohawk has successfully pursued an informal development program, whereby approximately 86 percent of the members in the management group were promoted from basic jobs in Mohawk to their present positions.

Mohawk continued its program of leasing aircraft as flying electronic "test beds." One such plane recently became the first aircraft to be equipped with a complete closed-circuit TV installation. Future applications of this may lie in the inflight inspection by pilots of landing gear, wing and tail assemblies. Another Mohawk plane was used to demonstrate GPL's new RADAN (Radar Doppler Automatic Navigator) unit, which received first airline trials late this year.



*National adds Lockheed Super Constellation to fleet.*

## NATIONAL AIRLINES

National's new "jet age" hangar at Miami International Airport was completed late in the year and put into service. The hangar, featuring a self-supporting poured concrete cantilever roof, was designed to house six Douglas DC-8 jet aircraft.

Deliveries on National's \$117-million expansion program started in the fall with acceptance of the first four Lockheed 1049H Super H Constellations. The other three were delivered later and at year end were in "Super Club Coach" service between New York and Miami. Also delivered were four Douglas DC-7B's.

The eight new radar-equipped planes gave National an increase of 2000 seats daily on its routes between Florida and northern cities.

In August, a Civil Aeronautics Board examiner recommended an award to National in the Dallas to the West Service Case. If approved by the Board, National would start service from Dallas to Los Angeles and San Francisco. In November, another examiner recommended an award to National in the Great Lakes-Southeast Service Case which would give the airline new routes between Chicago and Miami.

In August, a new \$1.5-million executive and general office building was opened at Miami International Airport.

Winter Package Vacations to Florida and the Caribbean increased 42 percent over the previous year. In April, the company ordered a \$1-million Link Electronic Flight Simulator for the Lockheed Electra.



In June, National received the National Air Council's Award of Honor.

At year end, National was operating 42 planes, including four each of the Lockheed 1049H and Douglas DC-7's and -7B's, eight Douglas DC-6B's, four Douglas DC-6's, six Convair 440's and 12 Convair 340's. On order were six Douglas DC-8 jets and 23 Lockheed Electra turboprops.

### NORTHWEST ORIENT AIRLINES

During the year the company received first deliveries on a \$55-million new equipment order. The equipment delivered consisted of eight Douglas DC-7C's and seven Douglas DC-6B's, part of an order for 14 DC-7C's and 10 DC-6B's.

The deliveries brought to 53 the total transport aircraft available to Northwest. The inventory included five DC-3's, 15 DC-4's, 16 DC-6B's, eight DC-7C's, and nine Boeing 377's. The company was studying the merits of the Boeing 707-320 and Douglas DC-8 jet transports and had ordered 21 Pratt & Whitney J75 turbojet engines for delivery in 1960.

Northwest also completed, during the year, equipment of all its post-war, pressurized aircraft with Bendix X-Band Radar.

Trans-Pacific DC-7C service between Seattle-Tacoma and Manila, via Tokyo and Okinawa in combination first class and tourist configuration was introduced and at year's end Northwest was operating daily Seattle-Tokyo service. The airline also completed 10 years of service to the orient and received a National Safety Council commendation for fatality-free operation to that area.

Also introduced was non-stop DC-7C service between New York and Seattle and one-stop (Chicago) service between New York and Portland. The Northwest Family Plan was extended to include Saturdays.

A permanent certificate was received for the

*Northwest stewardesses on Hawaiian run.*



"inside" route to Alaska from Twin Cities and other mid-west and eastern points. The airline had been operating the route since 1947 on temporary authority. Permanent authority was also received for the "outside" Alaska route from Seattle to Anchorage. DC-6B service was introduced on the "inside" route, and a permanent certificate was received for service between the United States and Tokyo.

Receipt by TWA of authority to extend its route structure from India and Ceylon to Manila made possible a "12-year dream" of using the combined facilities of the two transcontinental and international carriers to provide round-the-world service in cooperation with TWA (Northwest's orient flights end in Manila). Service was expected to start January 1.

Among Northwest's service innovations were "Imperial Service," first class luxury air travel featuring complimentary champagne, reserved seating and other extras; Silver Dollar Coach Service, featuring reserved seats and hot meals; a new "Fly Now-Pay Later" plan with an interest rate of two thirds of one percent per month; and the Bank Ticket Service Plan in the Twin Cities, whereby passengers may purchase tickets at their banks to save time. The company also opened a unique ticket office located in Minneapolis' Southdale Shopping Center.

Negotiations were continued for construction of the new \$18-million general office and overhaul base in Twin Cities. Heavy construction was slated for the spring of 1958.

### PACIFIC NORTHERN AIRLINES

The year marked the company's 25th year of service to Alaska (Pacific Northern was founded as Woodley Airways at Anchorage, Alaska, in April, 1932).

The company was honored during its anniversary celebration by an award from the Seattle-King County Chapter of the National Safety Council commending the airline for 25 years of regular passenger-carrying operations without a passenger or crew fatality.

Pacific Northern also successfully concluded a 17 year quest for permanent certification when the President signed H.R. 4520 granting certificates to PNA and two other carriers for operation of the States-Alaska routes.

At year's end, the airline was operating four Lockheed Constellations on the States-Alaska routes and two Douglas DC-4's and four Douglas DC-3's on the intra-Alaska routes.



*In October, Pan American became the first commercial airline to operate a flight to the Antarctic when a Boeing Strato Clipper landed on the ice at McMurdo Sound.*

#### PAN AMERICAN WORLD AIRWAYS

The year 1957, 30th anniversary year for Pan American World Airways, was marked by extension of the company's routes and services, the approval of plans for an \$8-million passenger terminal at New York International Airport and intensive preparations for the introduction of jet transports.

One of the more important routes inaugurated by Pan American during the year was the Polar Route linking the major cities of the West Coast of the United States and the capitals of Europe, with DC-7C Clippers making the trip in 19 hours.

In 1957 Pan American also started nonstop service to Rome and Frankfurt from New York and direct service to Rome and Paris from Chicago and Detroit. Direct service between New York and Nassau and New York and Barbados was inaugurated and Baghdad, Iraq, was added to the airline's worldwide routes.

In October, Pan American became the first commercial airline to operate a flight to the Antarctic when a Boeing Strato Clipper landed on the ice at McMurdo Sound with members of the Navy's Antarctic Mobile Construction Battalion (Sea Bees) and some civilian passengers.

Pan American established a trans-Pacific commercial speed record in February when a DC-7C covered the 4920-mile route between Tokyo and Seattle in 14 hours and two minutes.



PAA completed plans for its revolutionary new passenger terminal at Idlewild, designed to handle a fully loaded 160-passenger airliner every 15 minutes. The terminal, which will be completed late in 1958, features two major new developments: a cantilever roof extending out over the airplanes to protect passengers from the weather and a streamlined design to speed passengers through the terminal to their planes without the usual long walks and stair climbing.

On October 28, the 30th anniversary of Pan American's first flight from Key West to Havana, the first American-built jet transport, a Boeing 707 consigned to Pan American, was rolled out at Renton, Washington.

Pan American had on order 23 Boeing 707 Stratoliners and Intercontinentals at a cost of approximately \$140-million and 21 Douglas DC-8's costing more than \$135-million. It was anticipated that Pan American will have jet transports in service by the end of 1958 or early in 1959.



*Panagra flies over the Andes.*

### PANAGRA

In July, Panagra inaugurated the first regularly scheduled one-plane all cargo service between the United States and the west coast of South America.

A highlight of the year was the company's 25,000th crossing of the Andes, highest mountain range in the Western Hemisphere, on service between Chile and Argentina. The record for the greatest number of crossings by a single pilot was achieved by Captain Warren B. Smith, who had a total of 1680. Panagra accumulated its record number of crossings in 28 years from the start of service between Santiago, Chile, and Buenos Aires, Argentina, on October 12, 1929.

During the year, Panagra completed installation of the Bendix RDR-1 radar system on all four engine planes in its passenger fleet.

In June, the company put into effect new South American excursion fares which save passengers as much as 30 percent of the regular fare.

### RIDDLE AIRLINES

During 1957, Riddle completed its transport category version of the Curtiss C-46. Designated C-46R, the Riddle T-category modification is capable of carrying an extra ton of payload at 230 miles per hour in cruise flight.

To take care of increasing amounts of air freight, the all-cargo line also installed a new electronic

system for handling air waybills. Under the new system, known as "Telebill," all information contained on the old standard waybill is electronically transmitted to the destination and to Riddle's main accounting office at Miami, Florida. The company estimates savings in the thousands of man-hours, since agents will no longer have to compute each waybill.

Riddle's 1957 operations showed a marked increase in poundage flown, as the company proceeded with development of new routes in the mid-west and along the east coast. Sears, Roebuck Company established an airlift between its Atlanta warehouse and 29 cities in Florida. As many as three Riddle planes a night were moving orders to catalog stores. Florida Fashions, a mail order house, also expanded its flight operations. Orders were being flown to New York, Chicago, Dallas and San Francisco.

Also in 1957, Riddle received a 39 percent increase in mileage on its USAF contract for the LOGAIR program, airlifting military supplies between 31 bases. Fifteen aircraft and 125 persons were engaged in this operation, which had its headquarters at Macon, Georgia, with a satellite base at Dayton, Ohio.

### SEABOARD & WESTERN AIRLINES

Seaboard & Western completed 10 years of continuous trans-Atlantic all-cargo service in 1957. The decade saw a 500 percent increase in trans-Atlantic air freight.

During the past year, Seaboard increased its flight schedule to include daily service in each direction between the U.S. and western Europe. Monday through Saturday flights were made with Lockheed Super Constellations and the Sunday flight with a DC-4.

Five Lockheed 1049H's were added to Seaboard's fleet during the year. The inventory also included four 1049D's, one 1049E, three Douglas DC-4's and one Curtiss C-46. During its decade of operation the company grew from an initial investment to a publicly-owned company with a net worth of more than \$8.1-million.

In 1957, Seaboard applied to the Civil Aeronautics Board for route extensions to Berlin, Warsaw and Moscow, as well as points in Turkey, Italy, Lebanon, Iraq, Iran, Kuwait, Saudi Arabia, Pakistan and India.

The airline flew a record 7,957,433 ton miles in scheduled freight during the first nine months of 1957, an increase of 35 percent over the comparable

period in the preceding year. Estimate for the year was 12 million ton miles, also a new high.

Seaboard appointed Railway Express Agency, with its 23,000 offices, its general sales agent for the U.S. British Overseas Airways Corporation acted as sales agent in the United Kingdom, while Air France served in the same capacity in countries of the French Union and Mexico.

### SLICK AIRWAYS

Slick's emphasis during 1957 was on an extensive program of research into schedules, methods, routes and procedures. Ground handling and in-transit procedures also came in for a good deal of study.

The "Flying Guardsman" program, providing for personal supervision over cargo loading, off-loading and en route, by a Slick cargo handling expert assigned to each flight, was introduced. The services of the Guardsman were provided for all Slick air freight. His supervision extended to checking and expediting paper work. The program was designed as a further safeguard to shippers against short-shipping, over-carrying, damage and pilferage.

Another program stemming from the year's research was "SurfAir." This tied in local and regional trucking firms who handle pick-up and delivery and helped expedite shipments with a coordinated service under which one call sufficed to move them door-to-door from origin to destination. It gave the shipper the convenience of a one-responsibility, one-bill operation covering 5000 production and market points.

During the year, D. W. Rentzel, who had been serving as chairman of the board, again assumed active guidance of the company's policies as president, carrying out the duties of both offices. Alwin W. Johnson was named a member of the board of directors.

### TRANS WORLD AIRLINES

TWA's year was highlighted by inauguration of service with the new Lockheed 1649A "Jetstream," 64-74 passenger very long range transport with a 350 mile per hour cruise speed.

Service began in June on both transcontinental

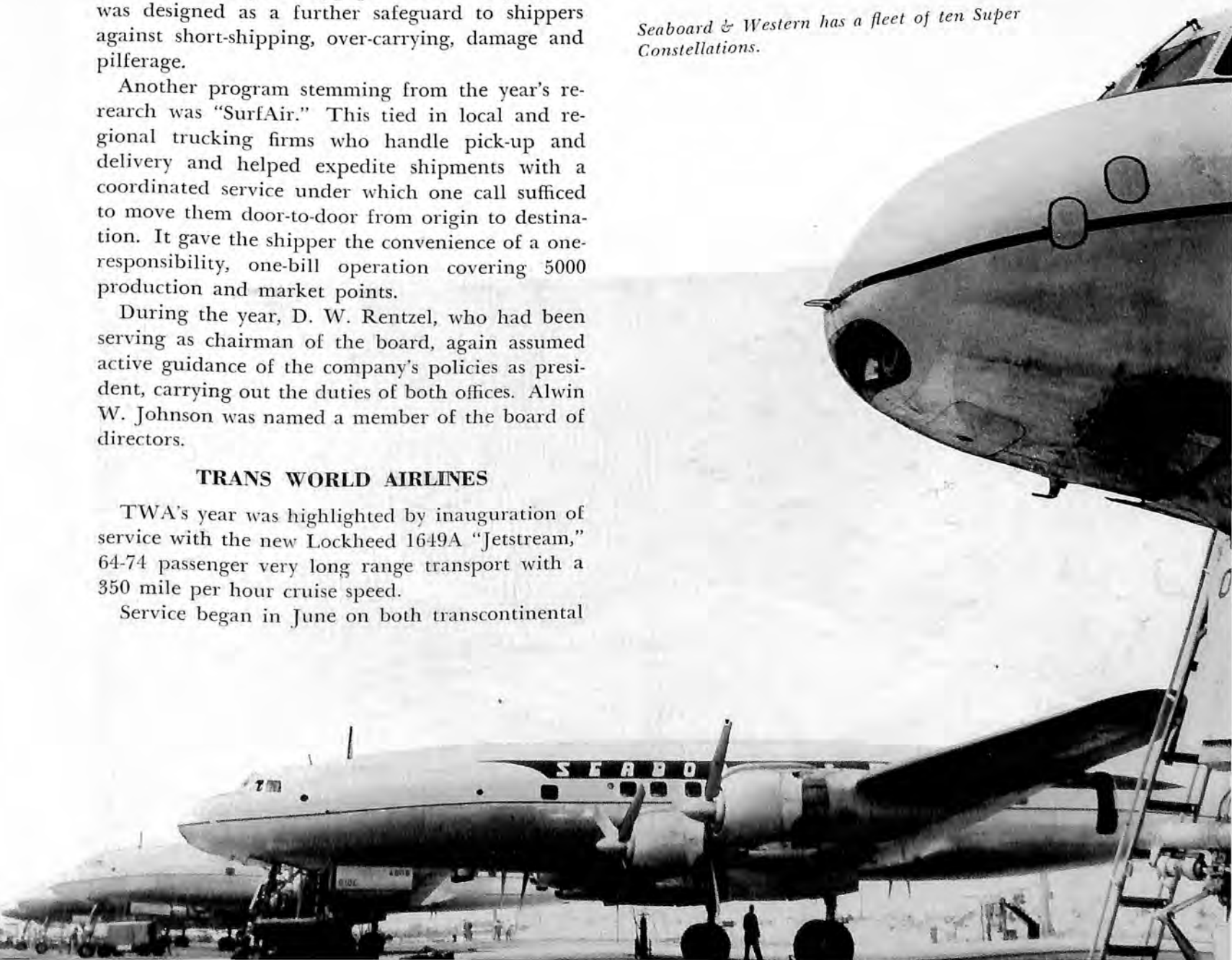
and trans-Atlantic routes. In October, Jetstreams were placed in service on TWA's polar route from California to European capitals. At year-end, TWA was flying 1649A's on non-stop transcontinental routes, non-stop from New York to London, Paris, Frankfurt and Rome, and on the polar route. Service between New York and Zurich and New York and Madrid, both non-stops, was planned for early 1958.

Another service innovation was installation of Siesta Sleeper seats on first class sections of the transcontinental Jetstream flights. These seats are provided at no additional cost.

TWA increased its winter capacity, first class-domestic, by 40 percent over the preceding year. Trans-Atlantic and international route capacity was increased by 109 percent.

In 1957, TWA received authorization from the Civil Aeronautics Board to extend its international routes beyond India and Ceylon to Bangkok and Manila. In conjunction with Northwest Orient

*Seaboard & Western has a fleet of ten Super Constellations.*



Airlines, TWA planned to inaugurate a new, all U.S. flag, all radar-guided, round-the-world service on January 1, 1958.

The airline's big new overhaul base at Mid-Continent International Airport, Kansas City, Missouri, was completed and put into partial operation during the year. First operations at the \$25-million base started in the summer, while formal dedication was planned for the spring of 1958.

Major components of the new base included the Airframe Overhaul Building, 1000 by 420 feet, housing two complete hangars and related shops for overhaul of radio equipment, instruments, hydraulic and electrical accessories, and the Power Plant Overhaul Building, with a total area of 200,000 square feet on two floors.

TWA also unveiled plans for its new \$12-million terminal at New York International Airport. Construction was scheduled to start in April, 1958, and first phase of the facility was scheduled for completion by mid-1959. The terminal, designed by Eero Saarinen and Associates, creators of the award-winning General Motors Research Center, was expected to be in full operation in 1960.

### UNITED AIR LINES

United Air Lines completed its \$5-million airborne radar program in November, making radar

standard equipment on every plane. The radar installation was foremost among a number of company advances registered in the year.

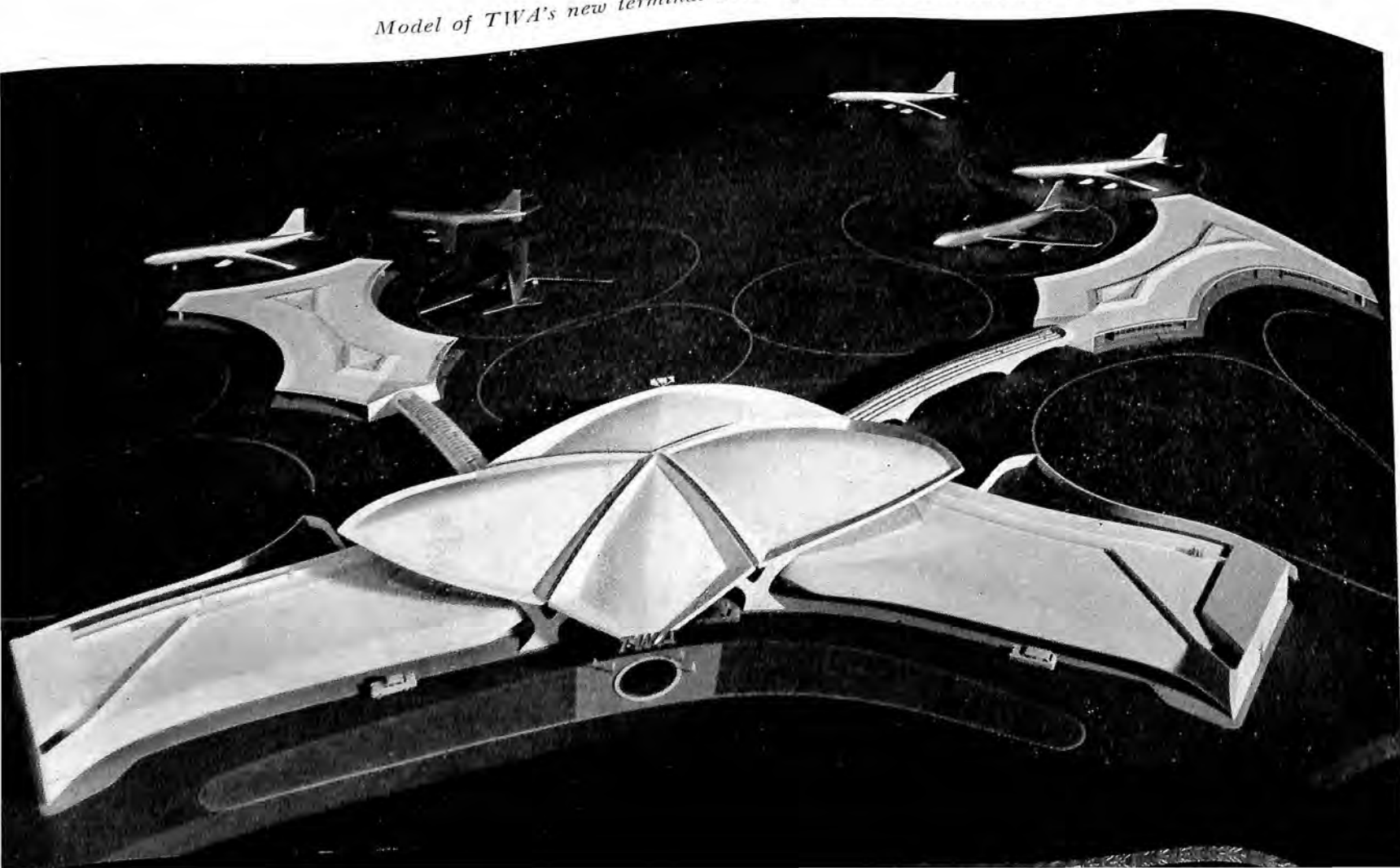
Traffic volumes were well above the record highs of 1956 in all categories except express. In August United flew 518,500,000 passenger miles—more traffic than any airline had ever carried in a single month.

Traffic totals for 1957 (last three months estimated) were: revenue passenger miles, 4,903,000,000; freight ton miles, 56,304,000; mail ton miles, 29,495,000; express ton miles, 10,565,000. A decline in express ton miles reflected labor troubles experienced by the express agency early in the year.

Twenty-seven new four-engine aircraft were delivered to United in 1957, expanding the fleet to 186 planes. The year-end fleet consisted of five DC-6A's, 37 DC-6B's, 42 DC-6's, 47 DC-7's and 55 Convair 340's. The last DC-4 was withdrawn from schedules in October and the company's fleet became all-pressurized.

The exteriors of some 50 Mainliners were repainted in the year as part of a company-wide program, developed by Raymond Loewy Associates. Loewy, famed industrial designer, previously had devised new styling for Mainliner cabins. He also created a new decor for ticket offices and new uniforms for pilots and stewardesses.

*Model of TWA's new terminal building at New York International Airport*





*Radar is standard equipment on United's planes.*

First nonstop flights between Los Angeles and Omaha were scheduled by United in April, followed in September by the first nonstop flights between New York and Seattle/Tacoma. Nonstop service between Detroit-Los Angeles also was introduced. Operations on the company's new eastern route were inaugurated with flights between Boston-New York and New York-Washington.

DC-7 Custom Coach was introduced in April, offering such innovations as bassinets for babies and meal service at nominal cost. Initial service in 86-passenger DC-7's was between New York and San Francisco. Nonstop Custom Coach flights between New York-Los Angeles were added later and the new service also became available at Chicago and Boston.

Shippers in the New England area welcomed the extension of DC-6A Cargoliner service in July. The all-cargo flights operated from Boston and Hartford-Springfield to Cleveland and Chicago, where connections were made with DC-6A flights to California. Return trips from the West Coast stopped at Chicago and New York en route to Boston.

Agreements with Consolidated Freightways and North American Van Lines enabled United to offer new air-truck and air-van service. The latter was designed for fast shipment of household goods. The

air-truck service extended the advantages of air freight transportation to hundreds of communities which lacked direct air service.

A multi-million dollar expansion of United's maintenance base got under way in early spring on a 40-acre site near San Francisco's International Airport. The construction program, to be completed in 1958, includes a flight kitchen, an aircraft washer, various line maintenance facilities and a hangar large enough to house two DC-7's and four DC-8 jet transports.

A \$2-million hangar, designed to United's specifications by the Port of New York Authority, was begun at Newark. Arrangements also were completed with the Port Authority for construction of a \$10-million passenger terminal on a 27-acre site at New York's International Airport. This building, the largest passenger handling facility ever operated by United, will be ready for use in 1959.

An "Aero-Gangplank," developed by Lockheed Air Terminals, Inc., had its first airline testing when United installed the structure at O'Hare International Airport, Chicago. The so-called gangplank is a self-powered telescoping span which bridges the gap between the aircraft door and the second level of the passenger concourse. Travelers are sheltered against the weather and spared the effort of climbing stairs.

United's motorized loading stand represented another innovation in boarding and deplaning passengers. Unlike ordinary stands which have to be shoved and pushed across the ramp, the motorized versions have two electric motors. One provides forward or reverse speed of two miles an hour; the other raises or lowers the top of the stairs to the height of the plane door.

Two RAMAC machines were installed at the customer service center in the company's Denver Operating Base for more efficient control of system-wide reservations. At any given time, each RAMAC contains detailed data on approximately 600,000 reservations. Together, the giant IBM machines can "memorize" 10,000,000 units of information.

Preparing for the jet age, United also tested many other types of new equipment and conducted extensive research to facilitate the inauguration of DC-8 jet service in 1959. A closed-circuit television system was ordered as an accessory of the DC-8 electronic flight simulator the company would receive from Link Aviation in 1958. Pilots training in the simulator would see a realistic airport via television projection as they landed and took off.

United closed the year with 21,000 employees at 80 cities on a 14,000-mile system.

# HELICOPTERS

The year 1957 marked increased utilization and acceptance of the helicopter as a transport vehicle on many fronts—Government, airline, commercial, corporate and in the export market.

One of the biggest boosts for the acceptance of the helicopter came during 1957 when the White House accepted assignment of a helicopter for the President's use in civil defense and short haul transportation. Helicopter enthusiasts saw in this move a tacit admission on the part of those responsible for the President's safety that the single-engine helicopter—even under power failure conditions—was as safe a vehicle as the twin and four-engine planes he had been flying.

In 1957, Tennessee became the first state to procure a helicopter under the Civil Defense matching funds program. Under this program, states buying helicopters and making them available on a stand-by basis to Civil Defense for rescue and local disaster emergencies benefit by Civil Defense sharing the cost 50/50. Tennessee's Highway Patrol now operates three helicopters on this basis.

Among other civilian governmental agencies operating helicopters during 1957 were the U. S. Forestry Service, the U. S. Geological Survey, the

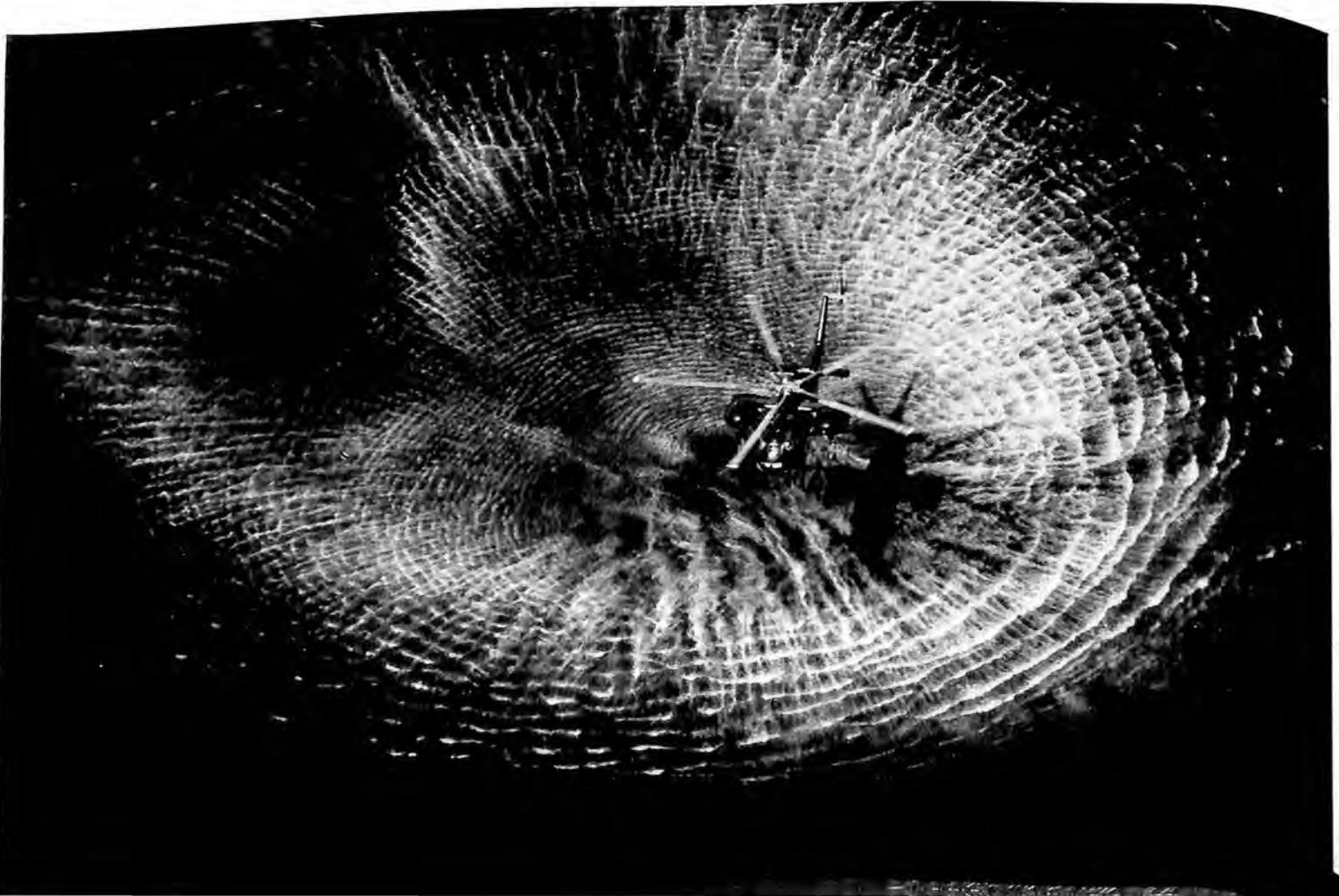
Coast and Geodetic Survey, the Department of Agriculture and the Tennessee Valley Authority. At the local level, the New York and Los Angeles police departments and the Port of New York Authority were using helicopters for traffic survey, personnel transport and rescue missions.

Chicago Helicopter Airways became the third scheduled helicopter airline to provide airport to downtown passenger service. Certificated in 1949 to carry mail and cargo within a 50-mile radius of Chicago, CHA inaugurated passenger service in November, 1956, carrying 429 passengers. In October, 1957, the line transported 7885 passengers over its triangular route—Midway-Chicago Loop-O'Hare-Midway—bringing the total passengers transported since November, 1956 through October, 1957 to 44,276.

Chicago Helicopter Airways' monthly passenger operation was equal to 37,000 miles per month or one and one-half times around the world, yet the helicopters on the 86 daily passenger flights were never more than 16 miles from their base of operation at Midway Airport.

The two other domestic scheduled helicopter airlines—Los Angeles Airways, Inc. and New York

*Sikorsky helicopter creates wave patterns as it hovers near water.*





Late in the year, three new world altitude records were set by Captain James Bowman in a Cessna YH-41 Seneca helicopter.

Airways, Inc.—reported a continuing increase in their passenger service. For the first nine months of 1957, Los Angeles Airways recorded a 23 percent increase in the number of passengers carried compared to the twelve months of 1956. New York Airways, Inc. showed a 25 percent increase in passengers for the comparable period.

Based on a survey conducted by the Helicopter Council of AIA, more than 380 helicopters were being operated by the 89 commercial helicopter operators in North America. About 50 percent of these companies are operating one or two helicopters. The world's largest operator had 43 helicopters.

Following the advent of the first commercial helicopter in 1946, a handful of pioneers began using the helicopter in agricultural flying in 1947. From this modest beginning, a world-wide industry emerged and in 1957 commercial helicopter operations reached an annual level measured in many millions of dollars.

A small but prophetic trend is the increasing use of helicopters by private corporations. A few years ago, there were but three corporations operating helicopters in their executive aircraft fleet. In 1957 there were more than 40.

Use and acceptance of helicopters in the foreign markets showed a definite increase in 1957. U. S. exports for the first nine months of 1957 increased 57 percent in value and 30 percent in units over the same period in 1956. Value of helicopter exports during the January through September period was \$32.246-million for 179 units compared with \$20.511-million for 138 in the first nine months of 1956. These figures did not include used or new helicopters exported by dealers, owners or through military aid but direct factory shipments only.

The military services continued the dominant user of helicopters during 1957; 80 percent went to the Department of Defense in 1956. However, in the Helicopter Council's special report "Helicopters in the Air Traffic Control System, 1957-1965," submitted to the Aviation Facilities Planning Group, forerunner of the Airways Modernization Board, the following forecasts were made: by 1965, helicopter utilization will be divided as follows: 40 percent will go to the Department of Defense; 27.5 percent to corporations; 22.5 percent to the commercial users; 8 percent to the air carriers and 2 percent to private owners. The corporate market was thus estimated to become the largest user of non-military helicopters by 1965.





*Kaman H-43B uses its external cargo hook for easy loading.*

In the 11 year period from 1946 to 1957, helicopter sales averaged 550-600 units per year. For the period 1957-1965, helicopter sales from all sources were expected to average 1100 to 1200 annually.

To keep pace with this growth, the Helicopter Council cited the following requirements in its report to the Aviation Facilities Planning Group:

1. Special Civil Air Regulations developed from rotary wing performance criteria and tailored to comply with anticipated usage.
2. Exclusive low altitude air space, through which areas all fixed wing flight will be prohibited.
3. Self-contained navigational systems, acceptable as to weight and space limitations, based upon hyperbolic engineering concepts.
4. Navigational accuracy under flight conditions now designated I.F.R., which will permit safe "on-off" heliport operations without reduction in acceptance rate.

To meet this future expansion in the use of helicopters, city-center and suburban heliports will be urgently needed to permit the full utilization of the helicopter as a transport vehicle. To assist city planners in establishing heliports in their communities, a special Heliport Committee of the Helicopter Council was named. The Committee was preparing a "Heliport Design Guide" which was scheduled for distribution early in 1958.

In many states today, the helicopter is still categorized and regulated under the laws adopted for "aircraft" in the days prior to the introduction of rotary-wing flight. The Helicopter Council in 1957

continued its work with the American Society of Planning Officials, the National Association of State Aviation Officials, the Urban Land Institute, the Helicopter Association of America (operators) and other civic groups to bring about needed revisions in many state and local laws to recognize the unique flight characteristics of the helicopter and free it from regulations applicable to and suitable for fixed wing craft, but unduly restrictive in the helicopter field.

Federal recognition of the importance of scheduled helicopter passenger operations was a feature of Public Law #85-307, passed during 1957, providing Government guaranty of 90 percent of equipment loans up to \$5-million to air carriers. This will enable many of the smaller carriers, fixed wing as well as helicopter, to adequately modernize their air carrier fleet.

Under the terms of the will of the late Lawrence D. Bell, an award in memory of his brother Grover Bell, one of the early pioneers of aviation, was established. To foster and encourage research and experimentation in the important and relatively new field of helicopter development, an award will be made annually to the person or persons making an outstanding contribution to helicopter development during the preceding calendar year in the United States.

The nominations for the award shall be made each year by the Presidents of the Institute of the Aeronautical Sciences and The American Helicopter Society and the Chairman of the Helicopter Council of the AIA.

## GENERAL AVIATION

General aviation, defined as all civil aviation with the exception of the airlines, continued its phenomenal growth throughout 1957. At year-end, the active general aviation fleet approximated 65,000 units and flights were being conducted at the rate of 10,000,000 annual hours.

Greatest percentage of the general aviation fleet continued to be in the single engine category. About 70 percent of Class I and Class II aircraft (large multi-engine and light twin engine) was used for business transportation and another 17 percent was used for charter and air taxi work. More than one-half of the Class III units (single engine, three or more places) and about one-fourth of the Class IV planes (single engine, one or two places) were also used for business transportation. Only about 10 percent of Class I and II and 30 percent of Class III were used for non-business personal purposes.

About 43 percent of Class I and II fleet units was owned by companies and about 33 percent individually owned. The aviation base operation business maintained the balance for taxi, cargo and charter work.

There were more than 200,000 pilots flying in the general aviation fleet.

Deliveries of utility aircraft during 1957 were estimated by Aircraft Industries Association at 6200 units. This was down slightly from 1956 deliveries, but dollar volume of sales climbed to about \$125-million from the preceding year's \$100-million level. A five-year comparison showed a better reflection of growth. In 1952, 3000 units valued at \$33-million were delivered.

New studies of the growth trend of general aviation indicated that the fleet will number between 105,000 and 120,000 units by 1976 and that flying hours will reach a 25,000,000 annual level in that year.

At year-end, the business aircraft fleet numbered some 25,000 aircraft and another 10,000 planes did some business flying during the year. The National Business Aircraft Association reported that the fleet consisted of 3500 multi-engine aircraft and 21,500 single-engine planes, most of which were in the four-five place high-performance category. The trend, however, was away from single-engine planes.

Ownership of this fleet was divided among 10,000 companies who own and operate their own aircraft as an integral part of their operations, and 10,000

individual owners.

Operationally, business flying during 1957 logged 5,000,000 hours, 800,000,000 miles and two billion passenger miles.

In recognition of the safety records amassed by member organizations, NBAA gave Safety Award Certificates to 131 pilots, 43 of whom had flown 1,000,000 miles or more in business aircraft without an accident. The remainder had flown more than 500,000 miles.

Some 15,000 business aircraft were equipped with instruments necessary for Civil Aeronautics Administration IFR flight. About half of all pilots who hold an air transport certificate were engaged in general aviation flying, largely in the business aircraft category. There were 9000 professional pilots engaged in business flying.

Total investment by business plane owners was, at year-end, about \$800-million. About \$500-million was spent during the year in direct support of business aircraft operations.

The percentage of acceptance of business aircraft by various industry groups was in the following order during 1957: manufacturing, contract, construction, wholesale trade, mining, transportation, communication, public utilities, services, agriculture, forestry and fisheries, and finance and real estate.

*Business aircraft display at NBAA convention in Denver.*



# GOVERNMENT



# AND AVIATION

## AIR COORDINATING COMMITTEE

As in previous years, a great deal of the Committee's work was generated by United States membership in the International Civil Aviation Organization. During 1957, 13 formal positions for as many major international technical conferences were developed and approved. Positions were also approved with regard to U. S. approval or disapproval of amendments to eight of the technical annexes to the Chicago Convention.

Two of the ICAO conferences were of special interest. As a result of the special ICAO North Atlantic Fixed Services Meeting held in January, three "forward scatter" radio stations and a new Atlantic cable will be combined to provide a direct voice and four teletype channels between Europe and North America. Under a jointly-financed program, the forward scatter stations will be built in Canada, Greenland and Iceland with the cable laid between Iceland and Scotland. The entire network is to be in operation early in 1960.

Another international responsibility of the Committee was to furnish United States positions for our representatives on the NATO Committee on European Airspace Coordination (CEAC). Positions for seven meetings of CEAC were supplied.

Domestically, the Committee approved a new National Standard for Taxiway Lighting and accepted the final report of the Joint Industry/Government Tall Structures Committee (JIGTSC) which was created by the Committee in 1955. This report represents agreement between the aviation and broadcast interests on principles, procedures and criteria to guide and protect both industries from the hazards inherent in the erection of very tall antenna towers into the airspace.

In the field of air traffic control and navigation aid planning, the Committee, through its Air

Traffic Control and Navigation Panel, approved Common System operational requirements for VORTAC. These requirements establish the dimensions of VORTAC airways and system accuracies for both the azimuth and distance-measuring functions as well as minimum performance limits for ground and airborne equipment, and piloting allowance. These limits will make possible better radio navigation on the airways, improvements in air traffic control, and improved use of the nation's airspace.

Component characteristics for the Common System Air Traffic Control Radar Beacon System (ATCRBS) were approved, and the system adopted for application in the United States Common System of air traffic control and navigation.

A proposal by the CAA to provide navigational aid coverage for VFR flight down to 700 feet above terrain on Victor airways was approved and incorporated in the Federal Airways Plan for F.Y. 1957-1961. Approval was also given to: a CAA proposal to incorporate both voice and code identification at all federally-owned VOR facilities; publication of a technical description of TACAN prepared for the ACC by the Radio Technical Commission for Aeronautics; acceptance of the NBS reports on coverage characteristics and channel requirements for VOR and TACAN in combination; and CAA progress reports on evaluating means and methods of integrating air traffic control and air defense functions.

Actions processed in the Committee's Airspace Panel during 1957 exceeded the 1956 figure by approximately 27 percent. Meetings held in 1957 exceeded the number covered in 1956 by approximately 42 percent.

In 1957, the Committee's Airport Use Panel, charged with the responsibility of recommending the actions necessary to insure the most feasible

development and use of the nation's airports, completed the following actions: solved the problems in connection with the placing of military air reserve training units at seven different airports; reviewed problems involved in the establishment of twenty new municipal airports and thirteen new military fields; studied the problems in connection with runway improvements at ten different locations; and coordinated the three military construction programs and the Federal-aid Airport Program.

In the economic area during 1957, coordination was effected on four quarterly programs covering domestic and foreign civil aviation requirements for priorities in the production of civil transport aircraft and concurrent spare parts. These programs, developed under the Committee's policy providing for equality of treatment for the production of civil transport aircraft with that of similar military aircraft, were recommended to the Aircraft Production Resources Agency of the Department of Defense for implementation by the allocation of critical raw material and common components. These recommendations covered the construction and delivery of 978 multi-engine civil transport aircraft as follows:

1957 .....	385
1958 .....	255
1959 .....	274
1960 (1st quarter) .....	64
	<hr/>
	978

The Committee continued to advise the Export-Import Bank regarding proposals for financing the sale of aeronautical equipment exported by United States manufacturers. During 1957, ICAO received the recommendations and conclusions of the Final Report of the International Airport Charges Conference held late in 1956. It was agreed that charging systems at international airports must be non-discriminatory and should take into account the cost of providing the services and facilities required, as well as the earning capacity of the aircraft or other value accruing to the operator of the aircraft from the use of the airport; charges should not be imposed in such a way as to discourage use of facilities necessary for safety; and the charging system should, insofar as possible, be simple and suitable for general application in international airports.

The Committee's member agencies of the Facilitation Subcommittee, in keeping with ICAO's program and in support of United States policy

to speed up and simplify clearance of international traffic at border crossing points, revised their regulations and administrative practices and procedures resulting in the following actions:

Revised and simplified United States immigration and nationality regulations, to become effective December 1, 1957, relating to the entry and departure of passengers and air-crewmembers; eliminated the requirement for presentation of a passenger manifest by air carriers; reduced the amount of information and eliminated two signatures from the passenger arrival/departure cards; as to aliens in direct and continuous transit through the United States on a bonded carrier, eliminated the requirement of a valid passport, substituting therefor only the necessity that the alien have a document establishing his ability to enter some country other than the United States; extended to all countries in the world the waiver of passports and visa requirements and any additional documentation for resident aliens visiting abroad for less than one year; continued to press for expansion of the present preflight inspection procedures in effect in Canada and Bermuda, to include Mexico City, Havana, and Nassau; waived the fingerprinting requirement in the case of certain non-immigrant aliens.

In the legal field, certain ICAO States believed that clarification of the Warsaw Convention was required in order that it might deal adequately with a problem arising from the growing practice of international operators to increase utilization of their aircraft by hire, charter and interchange arrangements. The difficulty involved arises from the fact that it is not clear whether the term "carrier," when used in the Convention and the Protocol, refers to the person who contracts with the passenger or shipper or to the person who actually performs the transportation. During 1957, the Committee studied and advised ICAO concerning the nature and extent of the problem in this country, and prepared United States positions for two ICAO legal meetings on the subject which culminated in a proposed international convention.

In September 1957, the Eleventh Session of the ICAO Legal Committee was convened at Tokyo, Japan. In addition to the subject of charter and hire mentioned above, the Committee prepared a United States position on other agenda items including the law and jurisdiction applicable to crimes committed on aircraft in international flights, future course of action regarding an aerial collisions convention, and the legal aspects of the rules for electing representatives to the ICAO

Council. The Committee also considered and approved legislation proposed by the Federal Communications Commission, authorizing the Commission to control the installation, height and location of receiving antenna towers.

At year-end the Air Coordinating Committee was composed of members of eleven Government Agencies having an important interest in aviation.

### **AIRWAYS MODERNIZATION BOARD**

Airways Modernization Board was established August 14, 1957 to fill an urgent need for unification of research and development effort on the nation's aviation facilities.

Formation of AMB followed reports to the President in 1956 and 1957 by the Rockefeller Committee, headed by William Harding, and the Aviation Facilities Planning group headed by Edward P. Curtis on needs of growing U. S. aviation activity.

Recommended to the President was a Special Assistant for Aviation Planning to advise on aviation matters and prepare draft legislation leading to a national aviation agency. First move was to appoint Elwood R. Quesada as Special Assistant and establishment of AMB with three board members.

These are Louis S. Rothschild, Under Secretary of Commerce for Transportation, Malcolm A. McIntyre, Under Secretary of the Air Force, and Quesada.

AMB is intended to bridge the gap between now and establishment of a similar technical organization as part of a joint civil-military aviation agency. The new agency planning will be presented to Congress in 1959, and may be known as the Federal Aviation Agency.

### **AGRICULTURAL RESEARCH SERVICE**

#### **DEPARTMENT OF AGRICULTURE**

The Agricultural Research Service used both commercially and federally-owned aircraft to combat agricultural pests during 1957, and shared its "know-how" in agricultural aviation with other countries. USDA researchers explored new uses for aircraft, improved techniques for dispersal of agricultural chemicals, and weighed some of the special problems of agricultural aviation in the jet age.

More than 4½ million U. S. acres were treated with insecticides by aircraft under joint Agricultural Research Service and State contracts during 1957. Almost two-thirds of this acreage was in the

Northeast, where a large-scale eradication campaign was carried out against the gypsy moth. Grasshoppers, the Mormon cricket, the Mediterranean fruit fly, and the Japanese beetle were other principal targets. ARS pilots and aircraft flew 144,000 miles in supervising contract spraying. In addition, they surveyed almost 28,000 square miles of forest land to assess gypsy-moth damage and need for control.

Preparations began for eradication of the screw-worm, a serious livestock pest, in the southeastern United States. It was planned to release from the air some 50 million screw-worm flies a week over a 50,000-square-mile area, mainly in Florida. Leased airplanes fitted with automatic dispensers will release the insects at an altitude of about 1000 feet. Mating of female flies with sterilized males is expected eventually to exterminate the species.

A fan-shaped spreader was developed by USDA in cooperation with the Texas Agricultural Experiment Station to distribute granulated insecticides evenly from aircraft to control the white-fringed beetle, and possibly a number of other insects.

Another distributor for application of both granular materials and dusts was developed in cooperation with the Oregon Experiment Station. Flight tests with the triangular distributor produced no undesirable flight characteristics and reduced the amount of drag to approximately that produced by a full wingspan underwing spray boom.

Aerial spraying of herbicides by commercial planes, to control brush on range land, gave good results in experimental flights. Land sprayed with 2,4,5-T yielded 3 to 8 times as much forage as did unsprayed vegetation.

Other countries benefitted from knowledge of U. S. techniques in agricultural aviation. A civil aviation representative of the Australian government spent two months on a USDA-planned tour, studying agricultural uses of aircraft in the United States. Visitors from other countries have made similar studies in the past.

In Tunisia, USDA pilots in light planes sprayed 40,000 acres with insecticides to control destructive swarms of locusts (grasshoppers). Pilots and technicians trained by USDA personnel have helped to make other countries of the Middle East largely self-sufficient in insect control by aircraft.

To prevent transportation of live insect pests on aircraft of the future, scientists explored insects' tolerance to heat and cold. If the heat generated by friction of supersonic aircraft, or of planes



*Agriculture Department reloads "flying boxcar" with insecticide for aerial spraying.*

parked in the sun for long periods, reaches 60°C. (about 140°F.) for as long as 15 minutes, it will kill all insects not protected from it, tests showed. Cold of high altitudes was similarly fatal. Insects in unpressurized and unheated areas of jet fighter aircraft, except near electronic equipment, were dead after 45 to 55 minutes at 26,000 to 45,000 feet, and in such areas of jet bombers after 3 hours at 40,000 feet.

A plant inspection station was established at New York International Airport to afford better protection against escape of agricultural pests and to render better service to importers. More than 290,000 lots of prohibited plants and plant products were intercepted by plant quarantine inspectors at airports—an increase of almost 19 percent over the previous year. Of the 111,000 airplanes inspected on arrival from overseas, 38 percent carried unauthorized plant materials. Airborne baggage inspected for contraband plant material totaled 7,500,000 pieces.

The trend toward export shipment of livestock to foreign countries by air rather than by ocean vessel continued, necessitating assignment of additional animal quarantine inspectors to airports for inspecting and testing animals for export. Also inspected by animal quarantine inspectors were 76,000 airplanes arriving in foreign commerce.

#### **CIVIL AERONAUTICS ADMINISTRATION**

Vigorous planning and buying in the program of modernizing the nation's airways was the fea-

ture activity of the Civil Aeronautics Administration during 1957.

Equipped with a record appropriation of \$278,425,136 for fiscal 1957 and a five-year program of improving and equipping the airways, the CAA concentrated on purchase and installation of more and better airway aids, the planning of airways and air traffic control methods to handle the expected normal increase in air transportation, and the appearance on the airline routes of the new and larger jet transports. Midway in the year, the advance plan was revised to look six years ahead in line with the policy of anticipating aviation's growth continuously in order to have facilities ready to serve it.

The CAA committed \$75.7-million for establishing new airway aids in fiscal 1957, and was steadily increasing personnel for installation and operation of airways facilities. CAA employment had climbed to 21,000 by July 1, with an indication that it would reach 24,000 by the same date in 1958.

The importance and the difficulty of planning for the future was emphasized by James T. Pyle, Administrator of Civil Aeronautics, when he said in a speech, "The most changeable thing in the world seems to be a civil aviation statistic. We're in a fast league forecasting in an industry that shows such growth as civil aviation."

Report of Edward P. Curtis, Special Assistant to the President for Aviation Facilities Planning, and organization of the interim Airways Modernization Board brought CAA duties into larger focus na-

tionally, and had an important effect on the agency's program of airway aids improvement and advance planning.

Growth of the industry was reflected in the figures by which the CAA measures its workload in operation of the federal airways, such as landings and takeoff operations at the 189 airports where the CAA operates the control towers. Against 22,045,731 such operations in 1956, there were an estimated 25,262,000 in 1957 recorded at CAA towers. Instrument approaches (the part of a flight from when a pilot leaves his en route altitude until he starts on his actual landing) have increased rapidly, from 429,374 in 1953, to 816,756 in 1956, and an estimated 1,188,000 in 1957.

In an effort to keep a finger constantly on the pulse of the growing aviation industry, the Planning and Development Office was established. It was assigned responsibility for spearheading studies of such matters as requirements for civil jet flying, air traffic control, airport runway and design requirements for jet use, aeromedical factors associated with high performance aircraft operations, and other problems which must be solved for the future. This office was ordered to work closely with the Airways Modernization Board, the research and development and planning organizations of the military departments and other agencies both within and outside the Federal Government, to make sure that CAA needs are known and accomplished.

The CAA continued its active part in the U. S. technical assistance program for friendly nations, with this and other international activities conducted by its reorganized Office of International Cooperation. Opening of a Central American Flight Information Region in Honduras, where the top personnel were all graduates of U. S. training given by the CAA, was a good example of the effectiveness of this kind of standardization on world airways.

For its own training, the CAA enlarged and expanded the Aeronautical Training Center at Oklahoma City, with that city cooperating in the construction of buildings costing some \$10-million to be used in giving CAA personnel refresher training—particularly in jet-powered planes—and for initial training of thousands of personnel in airways operations and maintenance work. This Center is virtually a "University of the Air" with intense emphasis on the practical needs of government aviation organizations.

At its other major facility, the Technical Development Center at Indianapolis, the CAA was deep

in development of urgently needed airways improvements such as daylight radar display, and of aircraft safety methods and equipment. The CAA leased a computer from the Canadian Government, which had spent \$5.5-million in its development, for \$1 a year for 15 years. The computer will be converted to an air traffic control simulator.

The CAA prepared standards for high speed turnoff taxiways on airports to speed up landings and ground handling of aircraft and delved into the difficult problem of better runway lighting with tests at Washington National Airport and Andrews Air Force Base.

New planes lifted the CAA's airway checking activities to altitudes never before explored. Two Martin B-57 jet-powered bombers, loaned to the CAA by the Air Force, went into service checking flight aid signals at 40,000 feet and up, while the first CAA Convair started its work in the altitudes between 10,000 and 20,000 feet.

New problems in helicopter operation, including those of traffic control and instrument flight, were placed under study. The question of safe helicopter routes over cities was also being studied.

Pilots were given new types of examinations to qualify for licenses, examinations that teach, as well as test. A study to find out whether beginners can be taught elementary instrument flying while learning to pilot a plane was put in operation. Pilots flying in from other countries were briefed by the CAA to ease their way in strange lands and to increase safety on our port-of-entry fields, and a "package" of aids to U. S. pilots ferrying planes abroad was made available.

#### **CIVIL AERONAUTICS BOARD**

The year 1957 proved to be a record one for air traffic in U. S. scheduled domestic, overseas and foreign operations. The Civil Aeronautics Board estimated that more than 50 million passengers would be carried during this period, which represented an increase of 8.7 percent over 1956. In the field of air safety 1957 also proved to be an outstanding year with less than one passenger fatality per 100 million passenger miles flown, a record maintained for the past six years by all U. S. scheduled domestic, overseas and foreign operations.

During 1957 a number of major trunkline route cases were completed by the Board and substantial progress was made toward completing a review of trunkline service in a series of major area proceedings.



Included among major route decisions of the Board was the *Eastern Route Consolidation Case* which authorized two additional competitive non-stop services between St. Louis and New York by Eastern Air Lines and American Airlines, in addition to the service provided by Trans World Airlines. In the same case the Board authorized competitive nonstop air service between St. Louis and Cincinnati by American, and competitive nonstop air service between Cincinnati and Washington by Trans World Airlines and competitive nonstop air service between Louisville and Washington by American.

Following the signing of the first bilateral air transport agreement between the United States and Mexico early in 1957, the Board was able to authorize service by American Airlines between Chicago and Mexico City; by Eastern Air Lines between New York/Washington and Mexico City; and by Western Air Lines from Los Angeles to Mexico City. To these three new routes now operated by U. S. air carriers four existing routes were also formally established under the U. S.-Mexico Air Agreement: Eastern Air Lines from New Orleans to Mexico City and the remaining three by Pan American World Airways from New Orleans to Merida, Mexico, and Guatemala; from Houston-Brownsville-Tampico to Mexico City and Tapachula, Mexico, and Guatemala; and from Miami to Merida and Guatemala.

Thus, the seven routes approved by the Mexican Government for U. S. air carriers became operational. At the same time the Board authorized reciprocal service for air carriers selected by the Mexican Government for service between Mexico City and Washington/New York; Mexico City-Los Angeles; Mexico City-New Orleans; Mexico City-Miami and Mexico City-San Antonio, all via intermediate points in Mexico.

The Board also announced its decision in the *Service to Phoenix Case*, approving new trunkline service by Western Air Lines between Denver and San Diego and between Phoenix and Los Angeles provided such flights originate in Phoenix and terminate at Portland/Seattle or originate in Seattle/Portland and terminate at Phoenix.

In August the Board authorized the establishment of the first mid-Atlantic U. S.-Europe air route for an American air carrier by authorizing Pan American to serve Madrid, Spain, as a stop on that carrier's New York-South Africa route. This new mid-Atlantic route will link Miami, San Juan, Madrid and Rome and will provide improved U. S. flag carrier service to Europe from Puerto Rico

and other points in the Caribbean area.

In the *Service to Puerto Rico Case*, the Board's third review of air transportation for the Commonwealth of Puerto Rico in 11 years, the Board authorized Trans Caribbean Airways to be the first U. S. supplemental air carrier to receive a certificate of public convenience and necessity authorizing the carriage of persons and cargo. Under its certificate the carrier can operate scheduled service, without mail pay, between New York and San Juan for a five year period.

In the same case the Board made Eastern Air Lines' temporary New York-San Juan route permanent and, by making Miami an intermediate stop rather than a terminal point, made it possible for the carrier to provide direct or nonstop service between San Juan and nearly every major city in the eastern half of the United States. The Board also authorized Pan American to serve San Juan direct from Boston, Philadelphia, Baltimore and Washington, in addition to its present San Juan-New York route.

The Board renewed the authority of Riddle Airlines, an all-cargo carrier, to fly its freight route between New York or Miami and San Juan for a period of five years but denied Riddle's request to carry passengers and non-subsidy mail on its overseas route.

Many other lesser adjustments were completed by the Board on the overall route structure for domestic trunk airlines, U. S. flag air carriers and local service carriers.

The Board continued its review of local air service throughout the United States and at year-end had eight area proceedings under way which involve local air transportation in 44 of the 48 states: Northeastern Area Investigation, Piedmont Local Service Case, Great Lakes Local Service Case, Pacific Northwest Local Service Case, Montana Local Service Case, Seven States Area Local Service Case, South Central Area Local Service Case and Southeastern Area Local Service Case.

Air carrier improvements in 1957 made it possible for the 12 domestic trunk airlines to operate without subsidy, although in October Capital Airlines petitioned the Board for subsidy assistance. The 13 local air carriers, on the other hand, all required subsidy which in 1957 approximated a total of \$25.5-million. The three certificated helicopter carriers, all of which the Board had authorized for passenger operations, also required a subsidy totaling approximately \$5-million for the same period. Internationally, the Board found that our American flag carriers were subsidy free, with the

exception of one carrier in the Latin American area that was expected to require \$871,000.

The Board's investigation into the overall passenger fare level of the 12 domestic trunk airlines, begun late in 1956, was temporarily deferred early in 1957 when seven domestic trunkline air carriers filed tariffs with the Board proposing a fare increase of six percent. In order to pass upon this emergency request, the Board directed its attention to this immediate problem and upon the conclusion of a formal hearing denied the request for the requested six percent increase. Immediately thereafter the Board ordered that the general investigation of the passenger fare level be resumed on an expedited basis and by November the case had proceeded to public hearing before a Board examiner.

New problems concerned with air traffic control came to the forefront in 1957 as the U. S. air transport industry and the Board prepared for the advent of high altitude, high speed jet transports. In addition, the consistent and rapid growth of air traffic coupled with the greatly increased performance characteristics inherent in the newest type of piston-engine aircraft in use in 1957 generated increased demand upon the use of airspace in the United States.

Consequently, the Board promulgated new air traffic rules to provide expanded control of aircraft at high altitudes and provided for the establishment of controlled airspace above 24,000 feet over the continental United States to be known as the Continental Control Area. Within this area the minimum visibility of flights under visual flight rules was increased to five miles and the minimum clearances from clouds to 1000 feet vertically and one mile horizontally. This latter step was taken

as an air collision preventive measure for aircraft flying at high speeds at altitudes where the rate of closure does not provide pilots with adequate time for evasive action.

The Board also took action to insure greater safety in connection with low altitude air traffic problems. For the preceding year the Board had been examining the air traffic separation problem of aircraft approaching and leaving major metropolitan areas. Consequently, the Board had established, in 1956, a High Density Traffic Control Zone in the Washington area as a positive experiment in air traffic separation. This system required that even under visual flight rules all air traffic under 3500 feet report to the Washington National control tower at a measured distance from the airport and observe specific navigation and communications procedures. This experiment proved so successful that the Board delegated authority to the Administrator of Civil Aeronautics to establish other High Density Traffic Control Zones over major metropolitan areas of the nation and at year-end this program was now being placed in operation by the CAA.

#### FEDERAL COMMUNICATIONS COMMISSION

The Commission continued its work in regulation and licensing of all non-Government radio facilities. In the aviation field, these included aeronautical en route, aeronautical operational fixed, airdrome control, flight test, flying school, aeronautical advisory, radio aids to navigation, Civil Air Patrol, and all communications equipment and navigation aids aboard private and commercial aircraft of United States registry.

*Civil Aeronautics Board: (left to right) Harmar D. Denny; Chan Gurney; James R. Durfee, Chairman; G. Joseph Minetti; Louis J. Hector.*



During fiscal 1957, the Commission received applications for stations in the aviation services field from 26,565 sources. This represented an increase of more than 3000 over the previous year. Applications for 1957 were broken down as follows: aeronautical and fixed group, 2076; aircraft group, 20,112; aviation auxiliary group, 182; aviation radio navigation land, 175; and Civil Air Patrol, 4020. There were increases in all categories over 1956. Largest increase, 1820 applications more than the previous year, was in the Civil Air Patrol category.

At year-end, aviation radio authorizations were approaching 50,000, with over 62,000 transmitters.

The Commission also participated in the work of various interagency coordinating and policy groups during the year, including the Air Coordinating Committee, the International Civil Aviation Organization and the Radio Technical Commissions for Aeronautics.

FCC during 1957 was represented on eight subordinate components of the Air Coordinating Committee. Working with ICAO, the Commission took an active part in the preparation of U. S. positions for 10 separate international conferences.

With RTCA, the Commission during 1957 participated in special technical subcommittee studies of the following subjects: operational-special service communications; implementation of the VHF utilization plan and review of transition period communications requirements; helicopter air navigation, communication and traffic control; channeling requirements of short-distance navigation aid system; and aviation's present and future use of the radio frequency spectrum.

### FISH AND WILDLIFE SERVICE

During the fiscal year 1957 the U. S. Fish and Wildlife Service operated a fleet of 52 aircraft, composed of 30 Pipers (Supercubs, Pacers, and J3C's), 12 Grumman Gooses, 4 Grumman Widgeons, one Stinson V77, 5 Cessnas (180 and 170), and one Twin Beechcraft. Seventeen were based in the continental United States and 35 in Alaska.

The twin-engined amphibians were used extensively in Alaska for fisheries enforcement patrol, for freighting materials incident to the establishment of camps in isolated areas and later servicing of these camps, and for the transportation of personnel where other facilities were not available. They were also used on waterfowl surveys in the U. S., Canada and Mexico.

All employees of the Service who pilot Service aircraft must hold Letters of Flight Authority. During fiscal year 1957, 79 employees held such authority. These pilots flew more than 12,000 hours and the territory covered included Alaska, Canada, and Mexico, as well as the United States.

The maintenance and repair of Service aircraft operating in the United States was handled through commercial shops. In the Territory of Alaska, however, where 35 Service aircraft were used during the fiscal year, the Service maintained overhaul and repair shops of its own.

### FOREST SERVICE

#### DEPARTMENT OF AGRICULTURE

Air support for ground fire-fighters appeared to be the new "wonder drug" of forest fire control in 1957. Use of new techniques for cascading water and chemicals from the air was effective repeatedly in helping to stop fires that otherwise would have spread to large and costly size.

The Forest Service's "smokejumper" corps of parachute-jumping fire-fighters, maintained during the fire season for service in National Forests of the western States, totaled nearly 300 men. In 1957 they made jumps to 116 fires. A new smokejumper base, with 23 jumpers, was set up by the Forest Service at Redding, California, in 1957. Smokejumper units also were stationed during the fire-danger season at Missoula, Montana; Grangeville, Idaho City, and McCall, Idaho; Silver City, New Mexico; Illinois Valley, Oregon; and Winthrop, Washington.

In the Forest Service's and cooperating agencies'

*Forest Service air tank*



programs to control outbreaks of forest insects, aircraft were used to apply 1½ million gallons of insecticide to 1,479,000 acres of forest land in 1957. Experiments conducted during the preceding year indicated that insecticide could be released, with effective results, from a higher elevation than had previously been considered feasible. As a result, some of the insecticide in 1957 was released at about 750 feet above tree tops instead of the 200 to 300 foot height used previously. This permitted the use of larger aircraft such as the Fairchild C-82, Douglas DC-3, Convair B-24, Martin PBM, and Ford Trimotor. Observation ships used were Beechcraft, Cessna, and Travelaire.

In 1957, air tankers were used by the Forest Service on a large number of forest fires in the Rocky Mountain and West Coast States. In California they were used also by State forestry agencies. Numerous reports gave the tankers credit for keeping fires from reaching large size. A number of threatening small fires were held down by cascading water and chemicals until ground forces could reach them to complete control.

Air tankers also were used to support ground crews on difficult large fires. In the Pacific Northwest, for example, air tankers dropped 800 gallons of borate "slurry" and wet water just ahead of a 60-acre fire racing through a dense growth of forest. When the "crown" fire hit the treated strips it dropped to the ground, making it possible for a 75-man ground crew to establish quick control.

The Forest Service used aircraft in connection with the protection and management of 149 National Forests, located in 39 States, Alaska, and Puerto Rico. Chief uses included the transporta-

tion of men and supplies during fire emergencies, fire detection and aerial reconnaissance of going fires, supplying remote and inaccessible stations, aerial survey, reseeding or revegetation of burned-over and denuded areas, surveying and spraying for insect control, and search and rescue.

Latest available yearly figures (1956) showed use of fixed-wing aircraft by the Forest Service totaled 19,595 hours. This included 3064 flights, totaling 4879 hours, by Forest Service airplanes; 8652 flights, 14,617 hours, by commercial planes under charter or contract; and 61 flights for 99 hours flown by military aircraft for the Forest Service. Use of helicopters totaled 1950 hours, an increase of some 50 percent over the previous year.

### POST OFFICE DEPARTMENT

Use of the domestic airmail service continued to increase during the fiscal year ending June 30, 1957. Preliminary figures indicated the Post Office Department transported nearly 1,500,000,000 pieces of airmail and air parcel post, weighing almost 95,000,000 pounds. This was an increase of slightly over 4 percent over the previous year.

There was a corresponding increase in the mail-ton-miles performed by air carriers, who received approximately \$34,000,000 for transporting airmail, exclusive of any subsidy payments from the Civil Aeronautics Board.

At year-end there were 58 air routes operated by 35 air carriers over 256,041 domestic route miles.

The experiment of transporting first class mail by air was continued during the year with 24 carriers serving 205 cities in 31 states and the District of Columbia.

The volume of foreign airmail from the United States, to and from U. S. possessions and territories, and to and from military post offices in foreign countries, increased approximately 10 percent over the previous year.

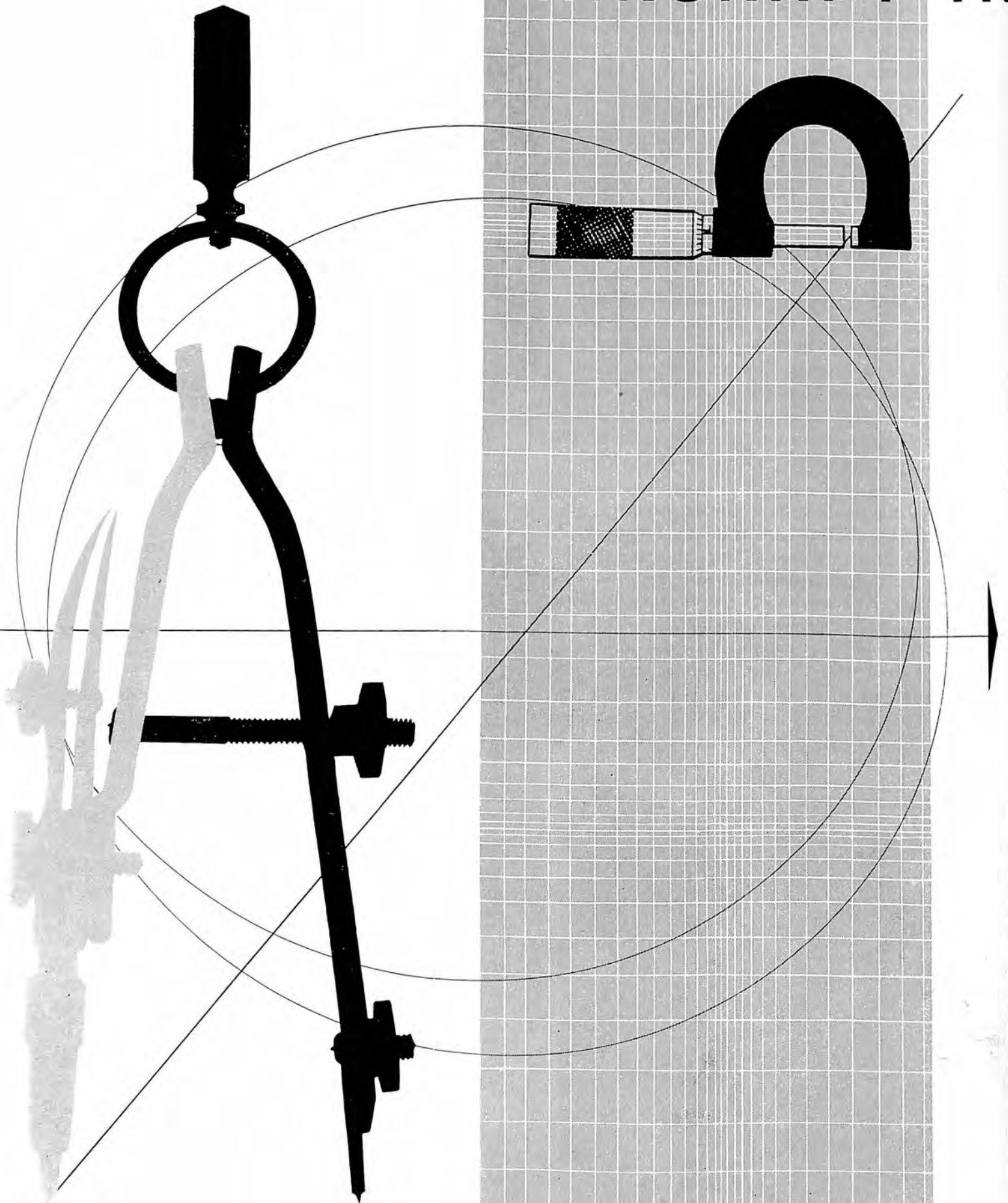
Foreign flag carriers transported 11 percent of the total foreign mail from the United States to other countries, except Canada. Mail to Canada was divided almost equally between U. S. and Canadian air carriers. There was no increase in the volume of military airmail over the previous fiscal year.

At the end of 1957 there were 15 United States flag carriers operating 295,000 route miles from the continental United States to overseas and international points.

*loads with water for forest fire.*



# AIRCRAFT IN



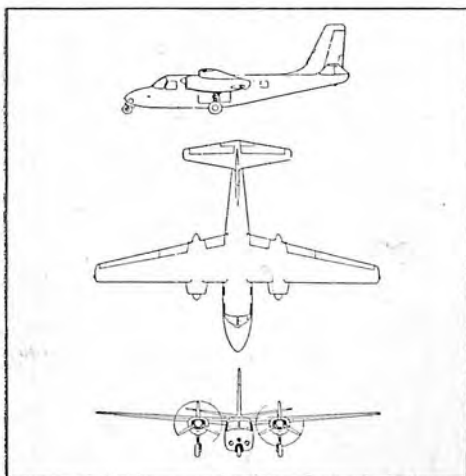
# PRODUCTION

AERO DESIGN & ENGINEERING CO.

BETHANY, OKLAHOMA



Aero Commander 680 Super



## REMARKS

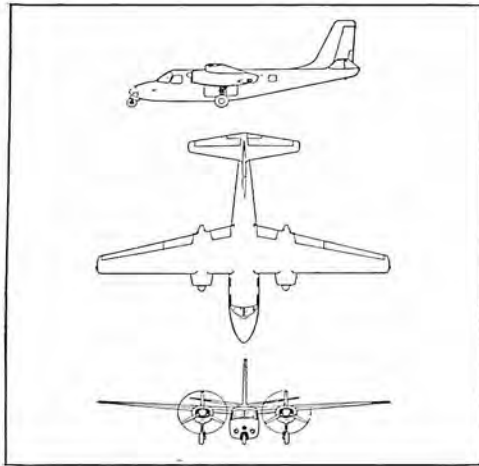
The five-seven place 680 is basically the same structure as the 560E and is first in its category to use supercharged engines. It has a 15,000-foot single engine ceiling and is convertible to cargo in minutes. Oxygen system and three-blade propellers are standard equipment.

## SPECIFICATIONS

Span 44 ft.; Length 35 ft. 5 in.; Height 14 ft. 9 in.; Empty Weight 4330 lb.; Gross Weight 7000 lb.; Overload Gross Weight 7000 lb.; Wing Loading 28.8 lb. per sq. ft.; Power Loading 10.3 lb. per bhp; Engines Two Lycoming GSO-480-B1A-6, 320 hp normal rated, or 340 hp at 3400 rpm takeoff; Fuel Capacity 223 gal.; Propeller 3-blade Hartzell HC-83X20-2A/9333C; Wing Area 242 sq. ft.; Aileron Area 20.52 sq. ft.; Flap Area 32.70 sq. ft.; Fin Area 38.20 sq. ft.; Rudder Area 15.40 sq. ft.; Stabilizer Area 33.06 sq. ft.; Elevator Area 20.54 sq. ft.

## PERFORMANCE

Maximum Speed 260 mph at 15,000 ft.; Stall Speed 71 mph; Rate of Climb 1625 fpm at Sea Level; Service Ceiling 25,567 ft.; Range with Maximum Payload 1600 mi.; Range with Maximum Fuel Load 1600 mi.



#### REMARKS

The new Aero Commander 560E is designed to help today's executive meet the ever increasing demand on his time. The high speed and long range performance of this five-seven place twin-engine executive aircraft make possible one stop, high speed coast-to-coast flights, in a single day.

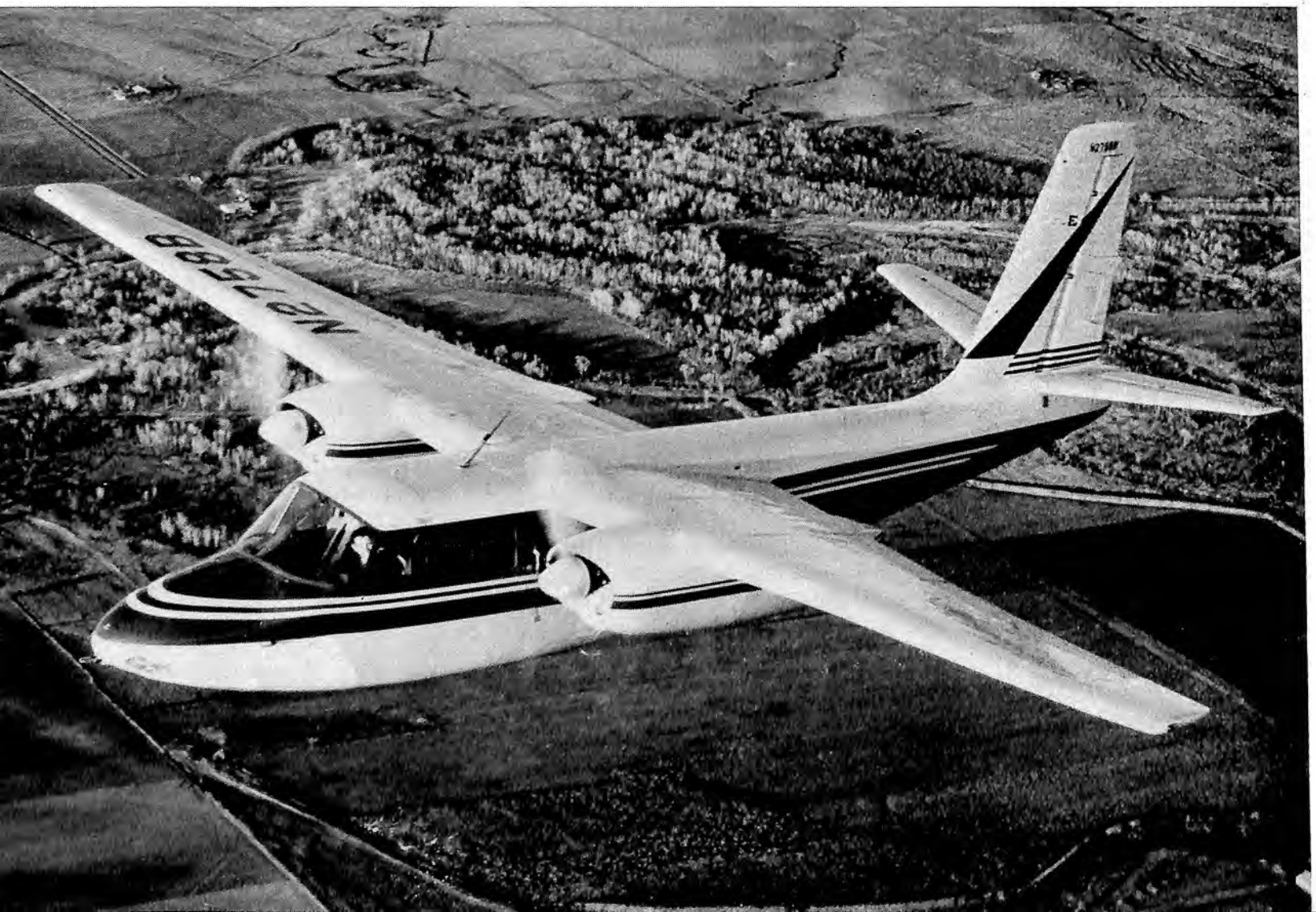
#### SPECIFICATIONS

Span 49.56 ft.; Length 35 ft. 2 in.; Height 14 ft. 9 in.; Empty Weight 4300 lb.; Gross Weight 6500 lb.; Overload Gross Weight 6500 lb.; Wing Loading 24.7 lb. per sq. ft.; Power Loading 10.9 lb. per bhp; Engines Two Lycoming GO-480-D1A 260 each hp normal rated, or 275 each hp at 3400 rpm takeoff; Fuel Capacity 223 gal.; Propeller Hartzell 3-blade; Wing Area 254 sq. ft.; Aileron Area 20.52 sq. ft.; Flap Area 32.70 sq. ft.; Fin Area 38.20 sq. ft.; Rudder Area 15.40 sq. ft.; Stabilizer Area 33.06 sq. ft.; Elevator Area 20.54 sq. ft.

#### PERFORMANCE

Maximum Speed 222 mph at Sea Level; Cruise Speed 210 mph at 70 percent hp at 10,000 ft.; Stall Speed 66 mph; Rate of Climb 1450 fpm at Sea Level (2 engines); Service Ceiling 22,500 ft. (2 engines); Range with Maximum Payload 1625 mi. with 30 min. reserve; Fuel Capacity 223 gal.

#### Aero Commander 560E

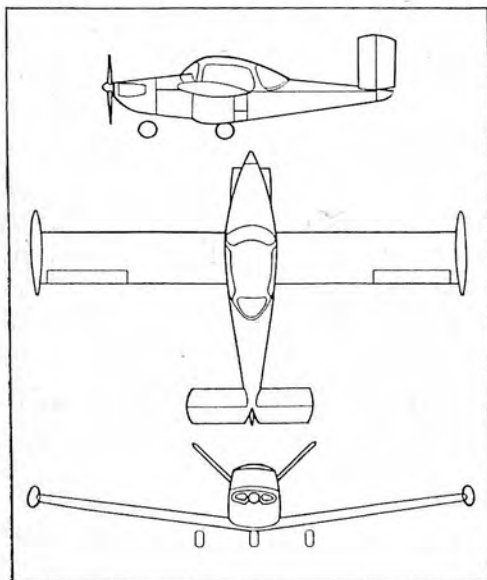


## BEE AVIATION ASSOCIATES

MONTGOMERY FIELD  
SAN DIEGO 11, CALIFORNIA



Queen Bee



### REMARKS

The four-place Queen Bee carries all fuel in sturdy wing tip fuel tanks for safety. It features a 43-inch wide cabin with plenty of head room. Operating costs are as low as .013 cents per seat mile based on an average of only two hours flying per day.

### SPECIFICATIONS

Span 32 ft.; Length 21 ft. 10 in.; Height 7 ft. 7 in.; Empty Weight 1190 lb.; Wing Loading 16.5 lb. per sq. ft.; Power Loading 14.3 lb. per bhp; Engine Lycoming O-320-A1A, 150 hp normal rates; Fuel Capacity 42 gal.; Propeller Hartzell HC-8ZXG-1B; Wing Area 130 sq. ft.; Aileron Area 5.8 sq. ft.; Tail Area 34.3 sq. ft.

### PERFORMANCE

Maximum Speed 160 mph at 150 hp at 2750 rpm at Sea Level; Cruise Speed 155 mph at 75 percent hp at 8000 ft.; Landing Speed 55 mph; Rate of Climb 900 fpm at Sea Level; Service Ceiling 15,000 ft.; Absolute Ceiling 19,000 ft.; Range with Maximum Payload 650 mi.; Range with Maximum Fuel Load 650 mi.

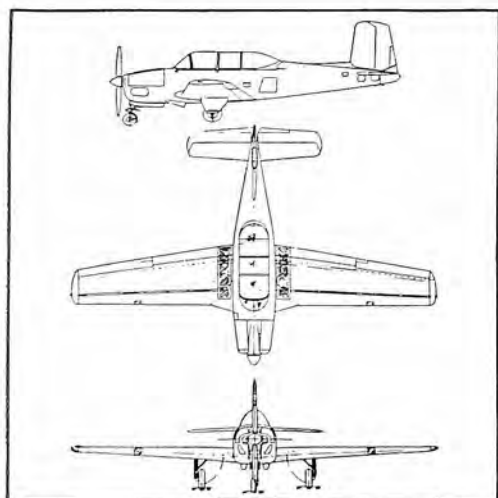


## BEECH AIRCRAFT CORP.

WICHITA 1, KANSAS



**Beech T-34 Mentor**



### REMARKS

The T-34 Mentor, developed by Beech as a private venture, has now been adopted as the official primary trainer for the U. S. Air Force, U. S. Navy, and the air services of Canada, Chile, Colombia, El Salvador, and Japan. The Beechcraft T-34B is the official primary trainer of the U. S. Navy. This airplane is a modified version of the USAF T-34A also used by the air services of many foreign nations. First production aircraft deliveries to the Navy began in December, 1954.

### SPECIFICATIONS

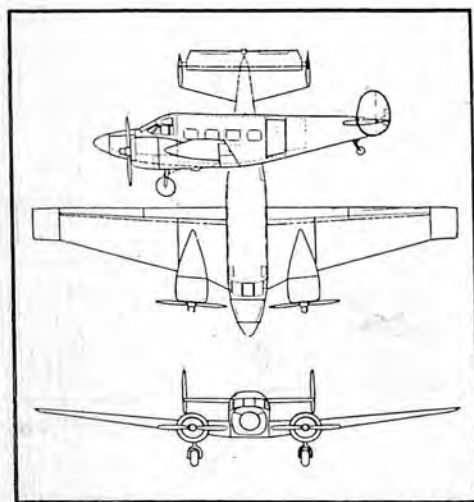
Span 32 ft. 10 in.; Length 25 ft. 11 in.; Height 9 ft. 7 in.; Empty Weight 2246 lb.; Gross Weight 2975 lb.; Wing Loading 1675 lb. per sq. ft.; Power Loading 13.2 lb. per bhp; Engine Continental O-470-13, 225 hp at 2600 rpm; Fuel Capacity 50 gal.; Propeller Beech constant speed; Gear tricycle; Wing Area 177.6 sq. ft.; Aileron Area 11.5 sq. ft.; Flap Area 23.3 sq. ft.; Fin Area 10.39 sq. ft.; Rudder Area 6.54 sq. ft.; Stabilizer Area 22.25 sq. ft.; Elevator Area 15 sq. ft.

### PERFORMANCE

Maximum Speed 187 mph at 225 hp at 2600 rpm at Sea Level; Cruise Speed 170 mph at 135 hp at 2300 rpm at 10,000 ft.; Landing Speed 54 mph; Rate of Climb 1160 fpm at Sea Level; Service Ceiling 19,500 ft.; Range with Maximum Payload 727 mi. at 10,000 ft., 60 percent power.



**Beechcraft Super 18**



**REMARKS**

The eight-place Super 18 is a bigger version of the standard Model 18 which has been a commercial and military model since it was first put on the market in 1937. Over 6600 units in military and commercial configurations of the Model 18 series have been built to date. The current model features external drag reduction plus many interior improvements.

**SPECIFICATIONS**

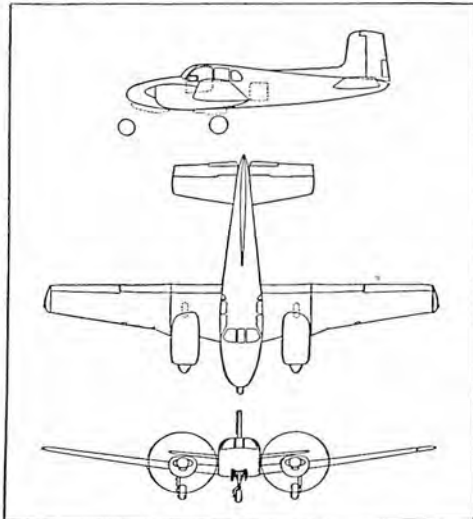
Span 49 ft. 8 in.; Length 35 ft. 2½ in.; Height 9 ft. 6 in.; Empty Weight 6050 lb.; Gross Weight 9300 lb.; Wing Loading 25.75 lb. per sq. ft.; Power Loading 10.32 lb. per bhp; Engines Two Pratt & Whitney 450 hp at 2300 rpm takeoff; Fuel Capacity 286 gal.; Propeller Hamilton Standard hydromatic; Gear conventional; Wing Area 361 sq. ft.; Aileron Area 17.48 sq. ft.; Flap Area 28.12 sq. ft.; Fin Area 20.08 sq. ft.; Rudder Area 13.50 sq. ft.; Stabilizer Area 49.58 sq. ft.; Elevator Area 22 sq. ft.

**PERFORMANCE**

Maximum Speed 234 mph at 450 hp at 2300 rpm at 3300 ft.; Cruise Speed 215 mph at 300 hp at 2000 rpm at 10,000 ft.; Landing Speed 86 mph; Rate of Climb 1490 fpm at Sea Level at 8750 lb. gross; Range with Maximum Payload 1626 mi. at 10,000 ft., 200 hp; 45 min. reserve.

#### REMARKS

The Twin-Bonanza, a six-place executive transport, is equipped with supercharged engines instead of the high-compression engines used in the Model D50 Twin-Bonanza (also in production). This increase in power provides improved performance. The gross weight of the Model E50 is increased to 7000 pounds and there is a 50-gallon increase in fuel capacity.



#### SPECIFICATIONS

Span 45 ft. 3 $\frac{3}{8}$  in.; Length 31 ft. 6 $\frac{1}{2}$  in.; Height 11 ft. 4 in.; Empty Weight 4440 lb.; Gross Weight 7000 lb.; Wing Loading 25.2 lb. per sq. ft.; Power Loading 10.9 lb. per bhp; Engines Two Supercharged Lycoming G50-480-ATA6, 320 hp normal rates, or 340 hp at 3400 rpm takeoff; Fuel Capacity 230 gal. with optional tanks; Propeller Hartzell, 3-blade constant speed-full feathering; Wing Area 277.06 sq. ft.; Aileron Area 13.89 sq. ft.; Flap Area 37.80 sq. ft.; Fin Area 14.25 sq. ft.; Rudder Area 12.77 sq. ft.; Stabilizer Area 47.25 sq. ft.; Elevator Area 17.49 sq. ft.

#### PERFORMANCE

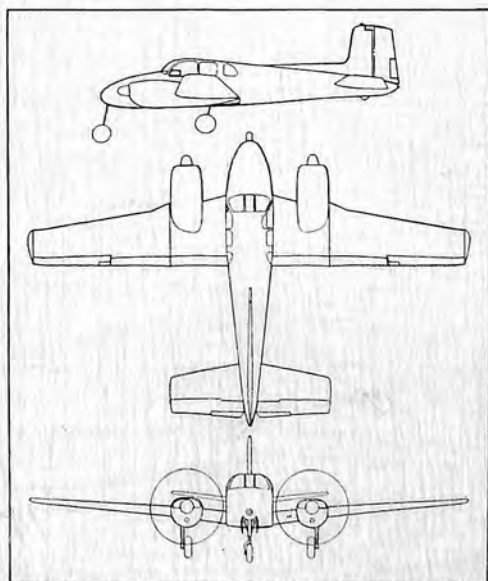
Maximum Speed 240 mph at 320 hp at 3200 rpm at 9000 ft.; Cruise Speed 228 mph at 248 hp at 2750 rpm at 13,300 ft.; Landing Speed 80 mph; Rate of Climb 1620 fpm at Sea Level; Service Ceiling 24,800 ft.; Range with Maximum Payload 1650 mi.

#### Beech E50 Twin-Bonanza





**Beech L-23D Liaison Transport**



**REMARKS**

The Army during the year ordered additional quantities of the L-23D command transport, military version of the Model E50 Twin-Bonanza business plane, extending L-23 production into 1959. In October, Beechcraft also began deliveries of rebuilt L-23's under a separate contract calling for the remanufacture of early A and B models to the new Army L-23D configuration.

**SPECIFICATIONS**

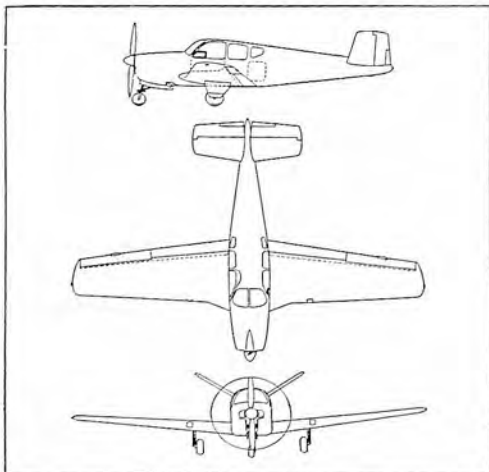
Span 45 ft. 3.38 in.; Length 31 ft. 6.47 in.; Height 11 ft. 6.5 in.; Empty Weight 4974 lb.; Gross Weight 7000 lb.; Wing Loading 25.3 lb. per sq. ft.; Power Loading 10.9 lb. per bhp; Engine Lycoming Model O-480-1, 320 hp normal rates, or 340 hp at 3400 rpm takeoff; Fuel Capacity 230 gal.; Propeller Hartzell HC93Z20-2C/10151B8; Wing Area 277.06 sq. ft.; Aileron Area 15.51 sq. ft.; Flap Area 37.80 sq. ft.; Fin Area 14.25 sq. ft.; Rudder Area 12.77 sq. ft.; Stabilizer Area 47.25 sq. ft.; Elevator Area 17.49 sq. ft.

**PERFORMANCE**

Maximum Speed 232 mph at 320 hp at 3200 rpm at 9000 ft.; Cruise Speed 202 mph at 208 hp at 2600 rpm at 10,000 ft.; Landing Speed 80 mph; Rate of Climb 1560 fpm at Sea Level; Service Ceiling 26,300 ft.; Absolute Ceiling 28,000 ft.; Range with Maximum Fuel Load, 1650 mi.



Beechcraft H35 Bonanza



#### REMARKS

The four-place Bonanza was first flown December 22, 1945. It holds the lightplane non-stop world's distance record of 4957.240 miles. Popular with the business executive, the Bonanza has also had a successful feederline operational history.

#### SPECIFICATIONS

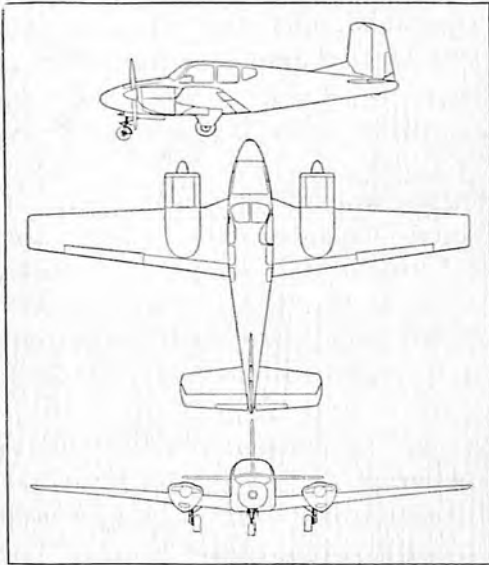
Span 32 ft. 10 in.; Length 25 ft. 2 in.; Height 6 ft. 6½ in.; Empty Weight 1833 lb.; Gross Weight 2900 lb.; Wing Loading 16.8 lb. per sq. ft.; Power Loading 12.1 lb. per bhp; Engine (standard) Continental O-470-G, 240 hp takeoff; Fuel Capacity 39 gal. (59 gal. with auxiliary tank); Propeller Beech electrically controlled; Gear tricycle, fully retractable; Wing Area 177.6 sq. ft.; Fin-Stabilizer Area 23.8 sq. ft.; Rudder-Elevator Area 12 sq. ft.

#### PERFORMANCE

Maximum Speed 206 mph at 240 hp at 2600 rpm at Sea Level; Cruise Speed 196 mph at 180 hp at 2300 rpm at 5000 ft.; Landing Speed 57 mph; Rate of Climb 1250 fpm at Sea Level; Service Ceiling 19,800 ft.; Maximum Range 1170 mi. at 10,000 ft. at 160 mph.

#### REMARKS

First flown on August 6, 1956, the Travel Air marked Beechcraft's entry into the four-place, twin-engine business airplane field. This airplane is noted for its quiet flight and operational economy.



#### SPECIFICATIONS

Span 37 ft. 10 in.; Length 25 ft. 4 in.; Height 9 ft. 6 in.; Empty Weight 4000 lb.; Wing Loading 21.6 lb. per sq. ft.; Power Loading 11.1 lb. per bhp; Engines Two Lycoming O-360-A1A, 180 hp normal rates; Fuel Capacity 112 gal.; Propeller 72 in. Hartzell, hydraulically controlled, continuously variable pitch, full feathering; Wing Area 193.8 sq. ft.; Aileron Area 11.5 sq. ft.; Flap Area 21.3 sq. ft.; Fin Area 16.97 sq. ft.; Rudder Area 6.63 sq. ft.; Stabilizer Area 27.4 sq. ft.; Elevator Area 15.0 sq. ft.

#### PERFORMANCE

Maximum Speed 208 mph at 180 hp at 2700 rpm at Sea Level; Cruise Speed 200 mph at 135 hp at 2450 rpm at 7500 ft.; Landing Speed 66 mph; Rate of Climb 1330 fpm at Sea Level; Service Ceiling 19,700 ft.; Absolute Ceiling 20,900 ft.; Range with Maximum Fuel Load 1400 mi.

Beech Model 95 Travel Air



## BELL HELICOPTER CORP.

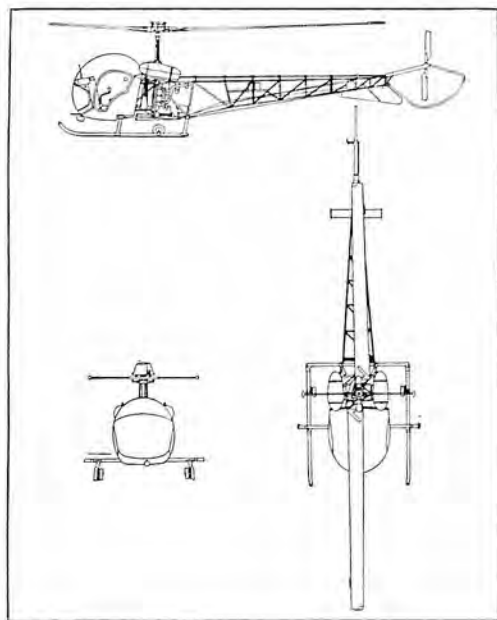
FORT WORTH, TEXAS

### REMARKS

The Model 47G has hydraulic cyclic boost control as standard equipment. This is similar to automotive power steering and greatly improves the flight handling characteristics while reducing pilot fatigue. Standard equipment includes complete VFR flight and engine instruments, 28/volt/50 amp generator, electric starter, ground handling wheels, heavy-duty batter, and synchronized elevator. The 47G is shown in the 3-view drawing on this page.

Another model, the 47H Bellairus two-passenger helicopter, features automobile-width seat, ample leg room with foot rest and cabin sound-proofing. Streamlining of tail boom, fuel tanks, cabin, and arched skid gear, plus hydraulic boost control, synchronized elevator, and Bell's semi-rigid rotor system combine to produce a helicopter with exceptional stability and flight handling characteristics.

The 47G-2 (Army H-13H) model has a Lycoming VO-435 engine, giving it increased weight, speed, and range. An ideal hot-weather, high-altitude helicopter, capable of hovering in ground effect at more than 10,000 feet with maximum gross weight. The three-place commercial model is ideal for crop-dusting and spraying patrol, and survey, rescue, and mercy missions. The military employs it for evacuation, observation, reconnaissance, wire-laying, training, and other duties. Both civilian and military models are available with a wide assortment of auxiliary kits.



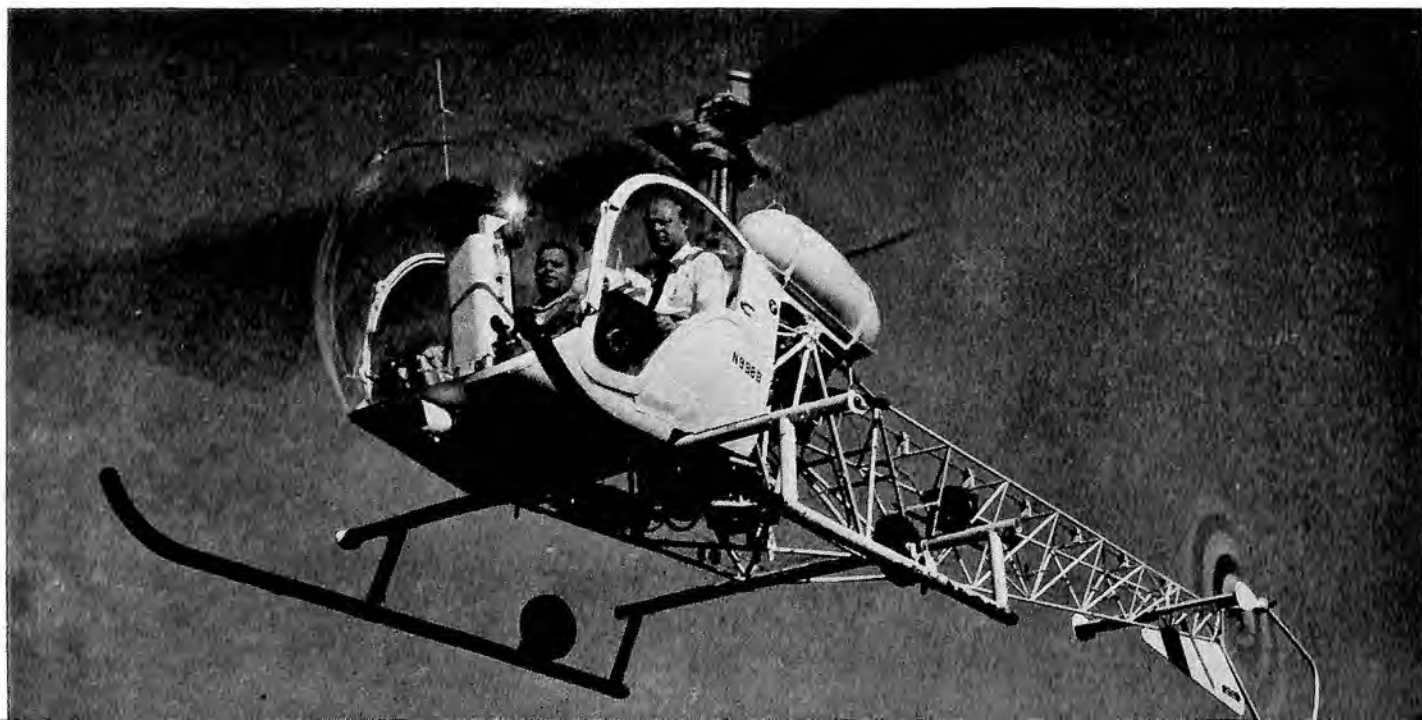
### SPECIFICATIONS

Main Rotor Diameter 35.125 ft.; Anti-torque Rotor Diameter 5 ft. 8.125 in.; Length 27 ft. 4 in.; Empty Weight 1434 lb.; Maximum Gross Weight 2350 lb.; Engine Franklin 6V4-200-C32.

### PERFORMANCE

Maximum Speed 86 mph; Cruising Speed 70 mph; Normal Range 212 mi.

Bell 47G: H-13G (Army); HTL-6 (Navy)





**Bell 47J Ranger**

**REMARKS**

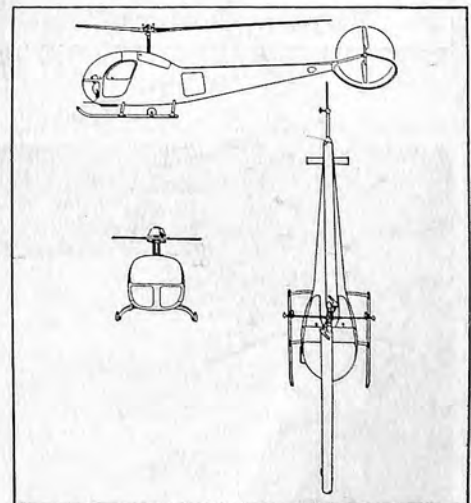
The Model 47J Ranger carries a pilot and three passengers. The commercial Ranger comes with standard or deluxe passenger interiors and can be equipped with an internal hoist in a matter of minutes without use of special tools. The Air Force version, designated the H-13J, is used by the President and staff. Navy models of the Ranger are called the HUL-1 and are employed as utility helicopters with the fleet.

**SPECIFICATIONS**

Main Rotor Diameter 37.167 ft.; Anti-torque Rotor Diameter 5 ft. 10 in.; Empty Weight 1615 lb.; Gross Weight 2800 lb.; Engine Lycoming VO-435.

**PERFORMANCE**

Maximum Speed 105 mph; Cruising Speed 99 mph; Normal Range 200 mi.





## BOEING AIRPLANE CO.

SEATTLE 14, WASHINGTON

### REMARKS

The Boeing 707 prototype was built as a private venture by Boeing Airplane Company at a cost of more than \$16-million. It first flew July 15, 1954. A military version of the Boeing 707 Prototype, the KC-135, was ordered into production for the Air Force as a tanker-transport a month and a half after the initial flight of the prototype. Satisfied that commercial production would not interfere with nor delay scheduled delivery of KC-135's, the Air Force on July 13, 1955, advised the Boeing Company that there was no objection to its building commercial jet transports. The Boeing Company then proceeded with its campaign to sell to the airlines of the world advanced commercial versions of the Boeing 707 Prototype.

Including the prototype, there are five Boeing jet airliners; the others are the 707-120, the 707-220, the 707-320, and the 707-420. Weighing in at more than 245,000 pounds as compared with the prototype's 190,000, the 120 is principally intended for continental use. The 220 member of the Boeing 707 family is identical in airframe and body size to the 120, but will be powered by Pratt & Whitney JT4 turbojet engines, larger and of greater thrust than the JT3, and will weigh more than 245,000 pounds, fully loaded.

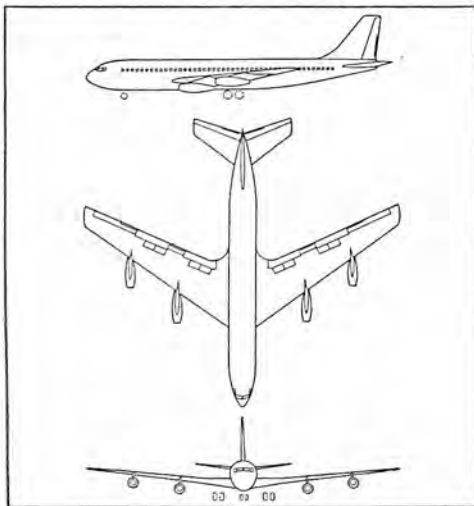
The 320 and 420 are the Intercontinental 707's, and with this airplane the dimensions change. It's the big boy of the brood, partially fulfilling the growth potential Boeing designed into the basic 707 series. Weighing more than 295,000 pounds, it is 8 feet, 5 inches longer overall than the 120 and 220, has 11 feet, 7 inches more wing span and 500 square feet of additional wing area. Fuselage diameter, 148 inches, is the same in all models. Only difference between the 320 and 420 is in the engines, the former using Pratt & Whitney JT4's and the latter Rolls-Royce Conways.

### SPECIFICATIONS

Span 130 ft.; Length 128 ft.; Height 38 ft. 3 in.; Engines Four Pratt & Whitney J57, 10,000 lb. thrust.

### PERFORMANCE

Cruise Speed 550-600 mph; Absolute Ceiling more than 42,000 ft.

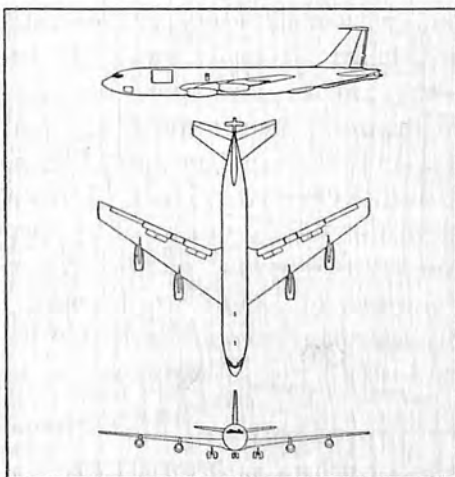


Boeing 707 Prototype





**Boeing KC-135 Jet Tanker-Transport**



#### **REMARKS**

The first production model of the KC-135 Stratotanker was rolled from the Renton, Washington, plant July 18, 1956, and made its maiden flight August 31, 1956, spending an hour and 19 minutes in the air before landing at Boeing Field in Seattle. KC-135's are now in service with the Air Force and will supplant the KC-97 as the Air Force's standard multi-purpose aerial refueling tanker-transport. The last of 888 KC-97's built by Boeing at Renton was rolled out only moments before the first appearance of the KC-135. The high-speed Flying Boom refueling equipment with which the KC-135 is equipped was flight-tested earlier on the Boeing 707 prototype.

#### **SPECIFICATIONS**

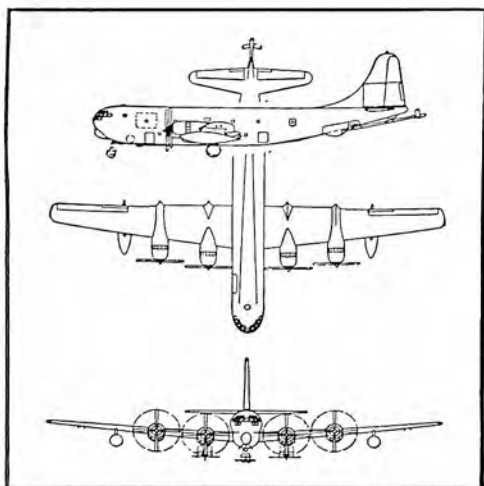
Span 130 ft. 10 in.; Length 136 ft. 3 in.; Sweepback 35 deg.; Height 38 ft. 5 in.; Weight more than 250,000 lb.; Engines Four Pratt & Whitney J57 turbojet, 10,000 lb. thrust class; Gear tricycle, main undercarriage units, four-wheel trucks, dual nose wheels.

#### **PERFORMANCE**

Speed more than 600 mph; Ceiling more than 35,000 ft.; Range more than 4000 mi.



Boeing KC-97G Stratofreighter Tanker Transport



#### REMARKS

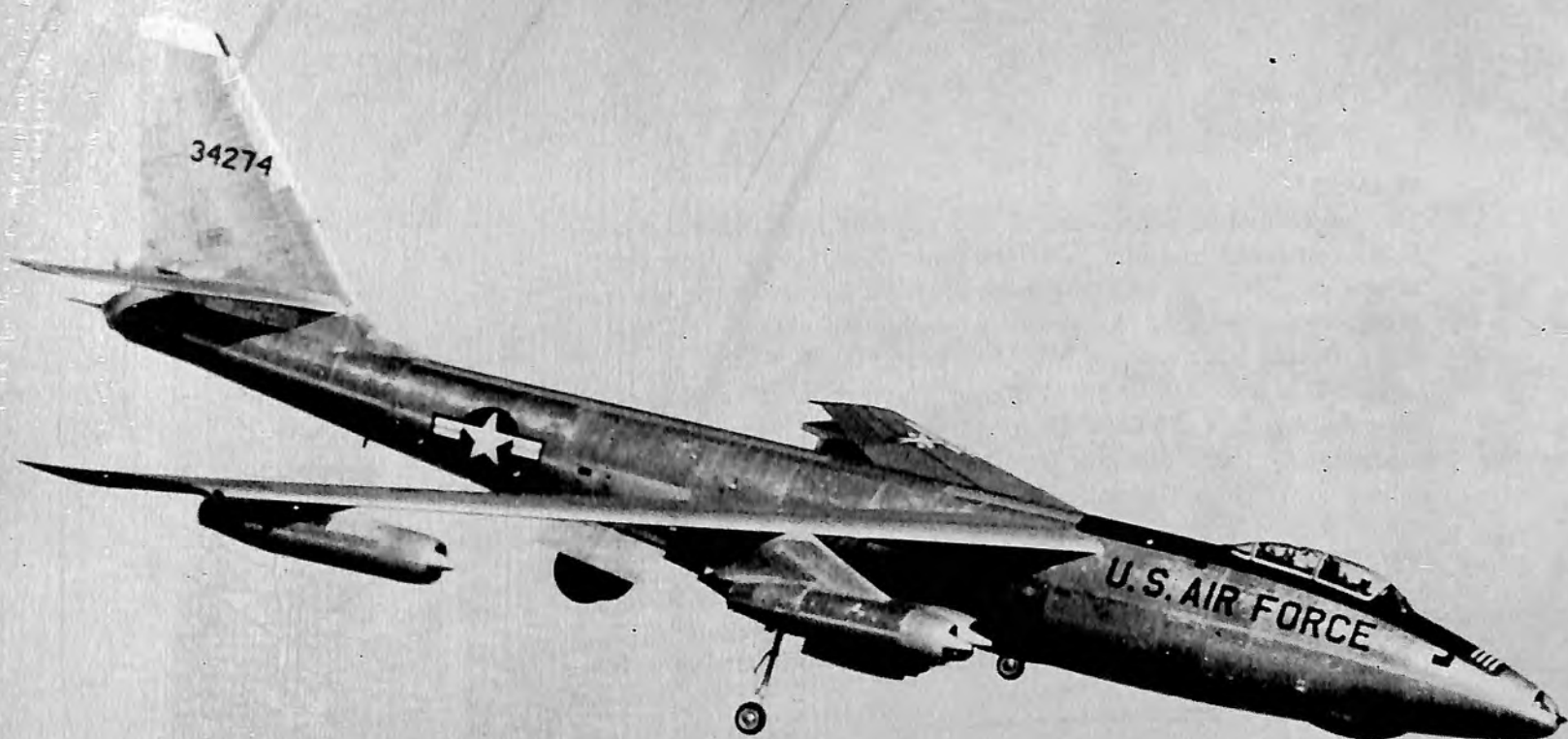
Flying boom controls and boom operator's station are mounted in the plane as a single unit which can be easily removed. Internal fuel tanks are located so that the airplane may also carry cargo while in the tanker configuration. By removing the pod and installing cargo doors in its place, the airplane can serve as a cargo, troop or hospital transport. Chief difference between G and earlier models is the provision for two droppable wing tanks and the relocation of internal fuel tanks. Cargo version carries a maximum of 68,500 pounds of heavy cargo such as jeeps, trucks, and artillery. Passenger version carries 130 men, ambulance model up to 79 litter patients and attendants.

#### SPECIFICATIONS

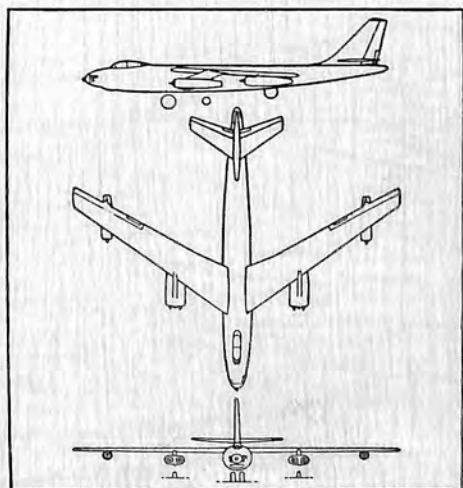
Span 141 ft. 3 in.; Length 110 ft. 4 in.; Height 38 ft. 3 in. (foldable tail); Gross Weight 153,000 lb.; Maximum Weight 175,000 lb.; Engines Four Pratt & Whitney R-4360-59 Wasp Major, 3500 hp at takeoff; Fuel Capacity 9190 gal.; Propellers Hamilton Standard, four-blade, full feathering and fully reversible.

#### PERFORMANCE

Maximum Speed 375 mph; Cruising Speed over 300 mph; Service Ceiling over 35,000 ft.; Range 43,000 mi.



Boeing RB-47E Medium Bomber



#### REMARKS

The first XB-47 flight took place December, 1947, and more than 1200 have been built. The RB-47E differs from the standard model in having longer nose, more windows, and air-conditioned camera compartment in place of bomb bay. Crew for this model is pilot, copilot riding in tandem, and observer-photographer. Among the features of the B-47 are the thin flexible wings which have a dropped appearance on the ground changing to a slight dihedral in flight. A B-47 set a new jet endurance record during 1954 with a 21,000 mile flight in 47 hours and 35 minutes with the aid of aerial refueling. Crew: three.

#### SPECIFICATIONS

Span 116 ft.; Sweepback 35 deg.; Length 107 ft.; Height 28 ft.; Gross Weight more than 200,000 lb.; Normal Bomb Load more than 20,000 lb.; Engines Six General Electric J47, 6000 lb. thrust normal rated; Provisions for 33 external ATO units, 1000 lb. each and water injection systems providing 17 percent power increase; Gear dual main wheels in tandem with a single outrigger under each inboard pod.

#### PERFORMANCE

Maximum Speed more than 600 mph; Service Ceiling over 40,000 ft.; Range more than 3000 mi.

#### REMARKS

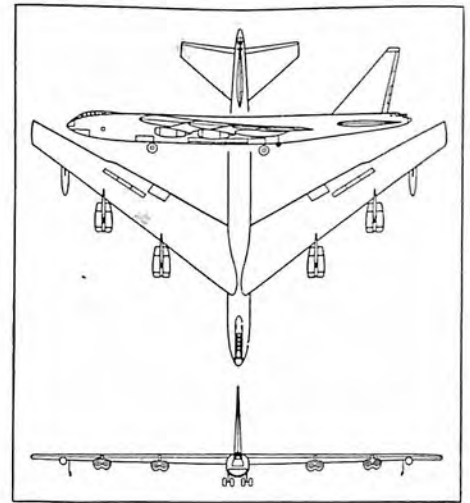
Two experimental prototypes of this airplane and a number of B-52's continued to undergo Boeing and Air Force test programs at year end. First initial flight April 15, 1952. Reversing the usual order, it was ordered in quantity production before the first flight. Boeing has produced B52A's, B's, and C's at Seattle, Washington. It is now building B-52D's there and at Wichita, Kansas. First deliveries of B-52's to USAF Strategic Air Command were made during 1955. The first B-52D was rolled out of the Boeing factory at Wichita December 7, 1955.

#### SPECIFICATIONS

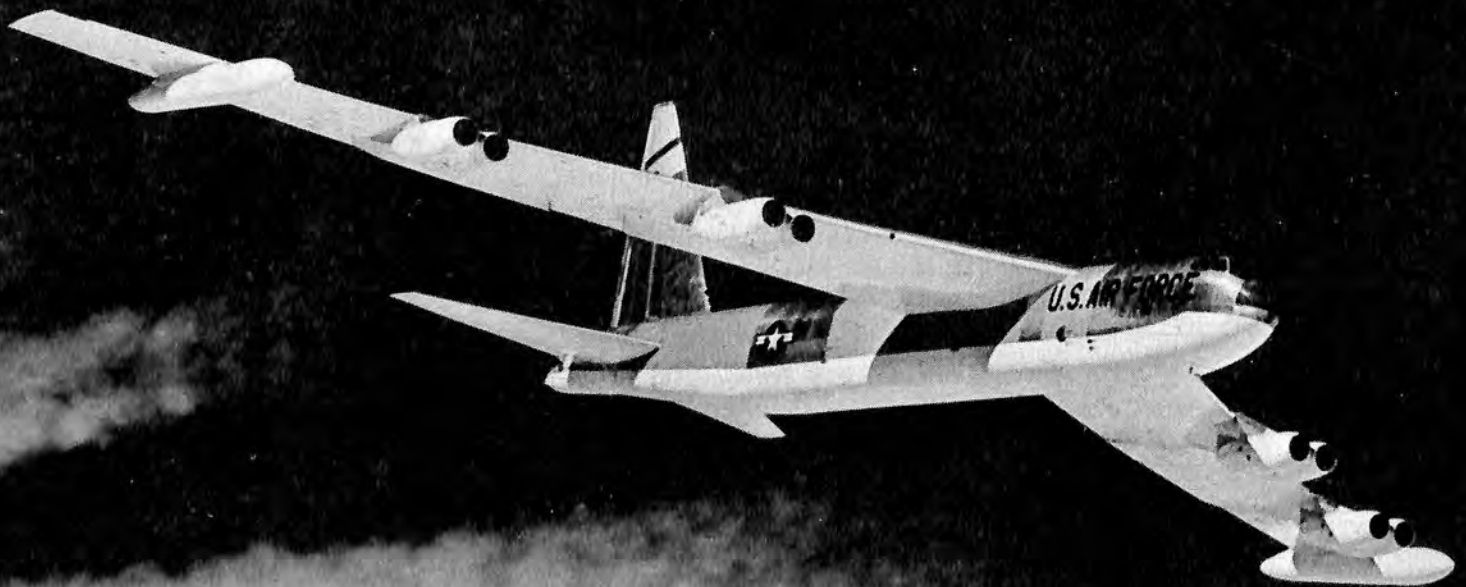
Span 185 ft.; Sweepback 35 deg.; Length 156 ft.; Height 48 ft.; Gross Weight more than 400,000 lb.; Engines Eight Pratt & Whitney J57 turbojet, 10,000 lb. thrust class; Gear eight main wheels in tandem with single outrigger wheels near wing tips.

#### PERFORMANCE

Can be described only as "a very-high-speed, long-range heavy bomber with a service ceiling over 50,000 feet and speed more than 650 mph."



Boeing B-52D Bomber

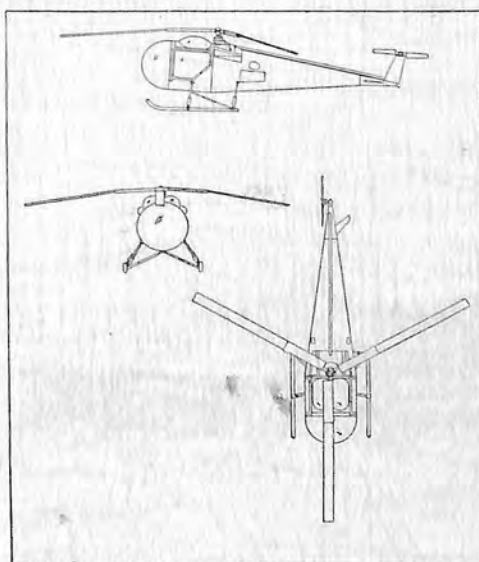


# BRANTLY HELICOPTER CORP.

FREDERICK, OKLAHOMA



Brantly B-2



### REMARKS

Production on the Brantly B-2 helicopter will be set up in the near future at Brantly's new production facilities at Frederick, Oklahoma.

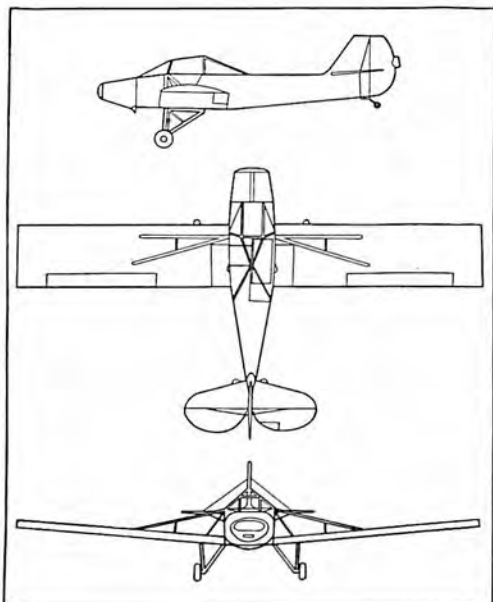
### SPECIFICATIONS

Main Rotor Diameter 23 ft. 8.89 in.; Anti-torque Rotor Diameter 4 ft. 3 in.; Length 21 ft. 9.1 in.; Height 6 ft. 11.75 in.; Empty Weight 970 lb.; Useful Load 450 lb.

### PERFORMANCE

Cruising Speed 90 mph; Maximum Speed 100 mph; Rate of Climb at Sea Level 1200 fpm; Rate of Descent in autorotation at Sea Level 1400 fpm; Range 270 mi.

**CALLAIR**  
AFTON, WYOMING



**REMARKS**

This low wing land monoplane is built exclusively for agricultural dusting and spraying operations. Cabin canopy is optional equipment. Rear seat for flagman or loader is standard. It is available with or without dispersal equipment.

**SPECIFICATIONS**

Span 35 ft. 5¼ in.; Length 23 ft. 5⅜ in.; Height 7 ft.; Empty Weight 975 lb.; Wing Loading 11.8 lb. per sq. ft.; Power Loading 14.3 lb. per bhp; Engine Lycoming, 150 hp normal rates, or 150 hp at 2700 rpm takeoff; Fuel Capacity 25 gal.; Propeller Sensenich all-metal M74DM; Wing Area 180 sq. ft.; Aileron Area 10.7 sq. ft.; Fin Area 8.6 sq. ft.; Rudder Area 8.8 sq. ft.; Stabilizer Area 15.8 sq. ft.; Elevator Area 14 sq. ft.

**PERFORMANCE**

Maximum Speed 110 mph at 150 hp at 2700 rpm at 7000 ft.; Cruise Speed 100 mph at 112 hp at 2400 rpm at 7000 ft.; Landing Speed 43 mph; Rate of Climb 1000 fpm at 6000 ft.; Service Ceiling 17,500 ft.; Range with Maximum Payload 235 mi.

**CallAir Model A-4**



## CESSNA AIRCRAFT CO.

WICHITA 14, KANSAS



Cessna L-19E

### REMARKS

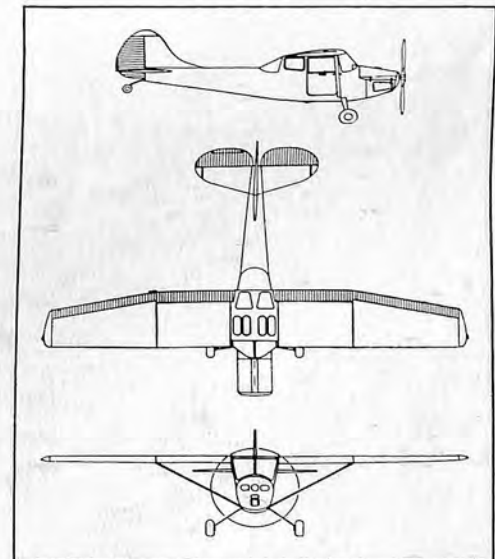
The L-19 went back into production in June, 1956, with initial deliveries in July. The L-19, nicknamed "The Bird Dog," was used during the Korean campaign as a liaison airplane by Army Field Forces for observation, wire laying, communications, and as an instrument trainer. Current production is being delivered to the Army where airplane will serve as instrument trainer. Foreign orders have included both France and Canada. Japanese have been licensed to build the L-19 in Japan. First Japanese production models came off the line in November, 1957.

### SPECIFICATIONS

Span 36 ft.; Length 25 ft. 9 in.; Height 7 ft. 6 in.; Empty Weight 1614 lb.; Gross Weight 2165 lb.; Wing Loading 12.4 lb. per sq. ft.; Power Loading 10.1 lb. per bhp; Engine Continental O-470-15, 190 hp normal rated, or 213 hp at 2600 rpm takeoff; Fuel Capacity 40 gal.; Propeller all-metal constant speed; Wing Area 174 sq. ft.; Aileron Area 18.3 sq. ft.; Flap Area 21.24 sq. ft.; Fin Area 9 sq. ft.; Rudder Area 9.42 (with tab) sq. ft.; Stabilizer Area 19.23 sq. ft.; Elevator Area 15.95 (with tab) sq. ft.

### PERFORMANCE

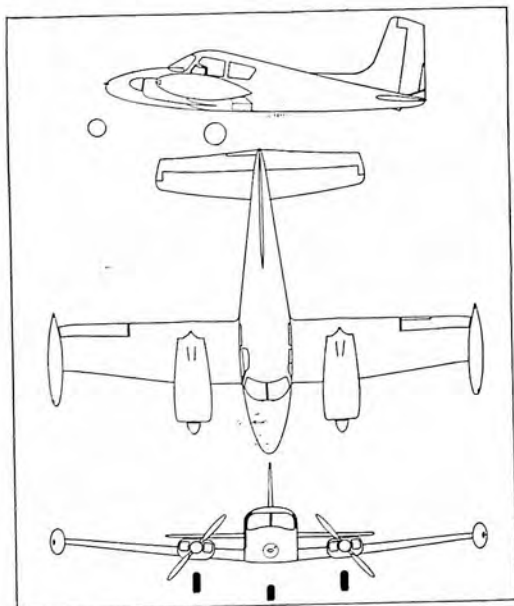
Maximum Speed 116 mph at 80 percent hp at 2300 rpm at 5000 ft.; Cruise Speed 91.7 knots at 29 hp at 1900 rpm at 5000 ft.; Landing Speed 49 mph; Rate of Climb 1150 fpm at Sea Level; Service Ceiling 20,000 ft.; Range at Cruising Speed with 40 gal. fuel 590 mi.







Cessna L-27A



**REMARKS**

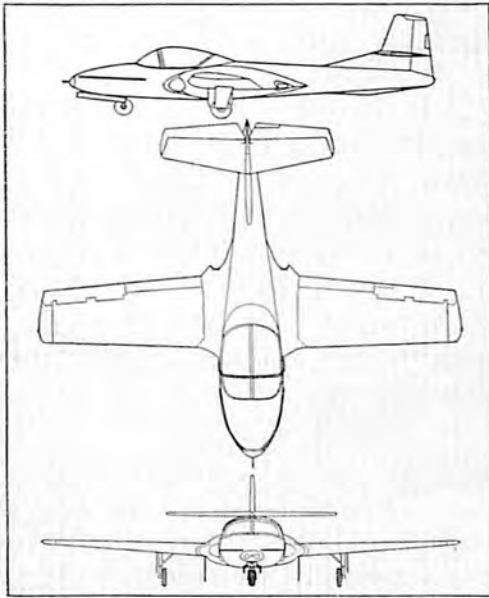
The L-27A is an off-the-shelf version of the Cessna Model 310 and was purchased by the Air Force to meet the need for low-cost and low-maintenance administrative and light cargo transportation. Air Force purchased 80 of the light twins during 1957.

**SPECIFICATIONS**

Span 36 ft.; Length 26 ft.; Height 10 ft 6 in.; Empty Weight 3146 lb.; Gross Weight 4830 lb.; Wing Loading 27.6 lb. per sq. ft.; Power Loading 10.05 lb. per bhp; Engines Two Continental O-470-M, 240 hp at 2600 rpm takeoff; Fuel Capacity 130 gal.; Propeller Two-bladed Hartzell full feathering, constant speed; Wing Area 175 sq. ft.; Aileron Area 13.4 sq. ft.; Flap Area 22.9 sq. ft.; Fin Area 14.08 sq. ft.; Rudder Area 11.78 sq. ft.; Stabilizer Area 32.15 sq. ft.; Elevator Area 22.1 sq. ft.

**PERFORMANCE**

Maximum Speed 230 mph at 240 hp at 2600 rpm at Sea Level; Cruise Speed 210 mph at 70 percent hp at 2300 rpm at 8000 ft.; Landing Speed 95 mph (single-engine go around); Rate of Climb 1590 fpm at Sea Level; Service Ceiling 20,000 ft.; Absolute Ceiling 21,300 ft.; Range with Maximum Fuel Load 1125 st. mi.



#### REMARKS

The Cessna T-37A twin-jet trainer was developed to fit the needs of the Air Force for a primary trainer to be used in the USAF pilot training program. The T-37A has side-by-side seating, permitting the seating of instructor next to student instead of tandem seating. Now in production for the USAF and undergoing final evaluation by a using command at Bainbridge Air Base, Georgia, Southern Airways' Civilian Contract Primary Flight School. Airplane will gradually be phased into other civilian contract schools.

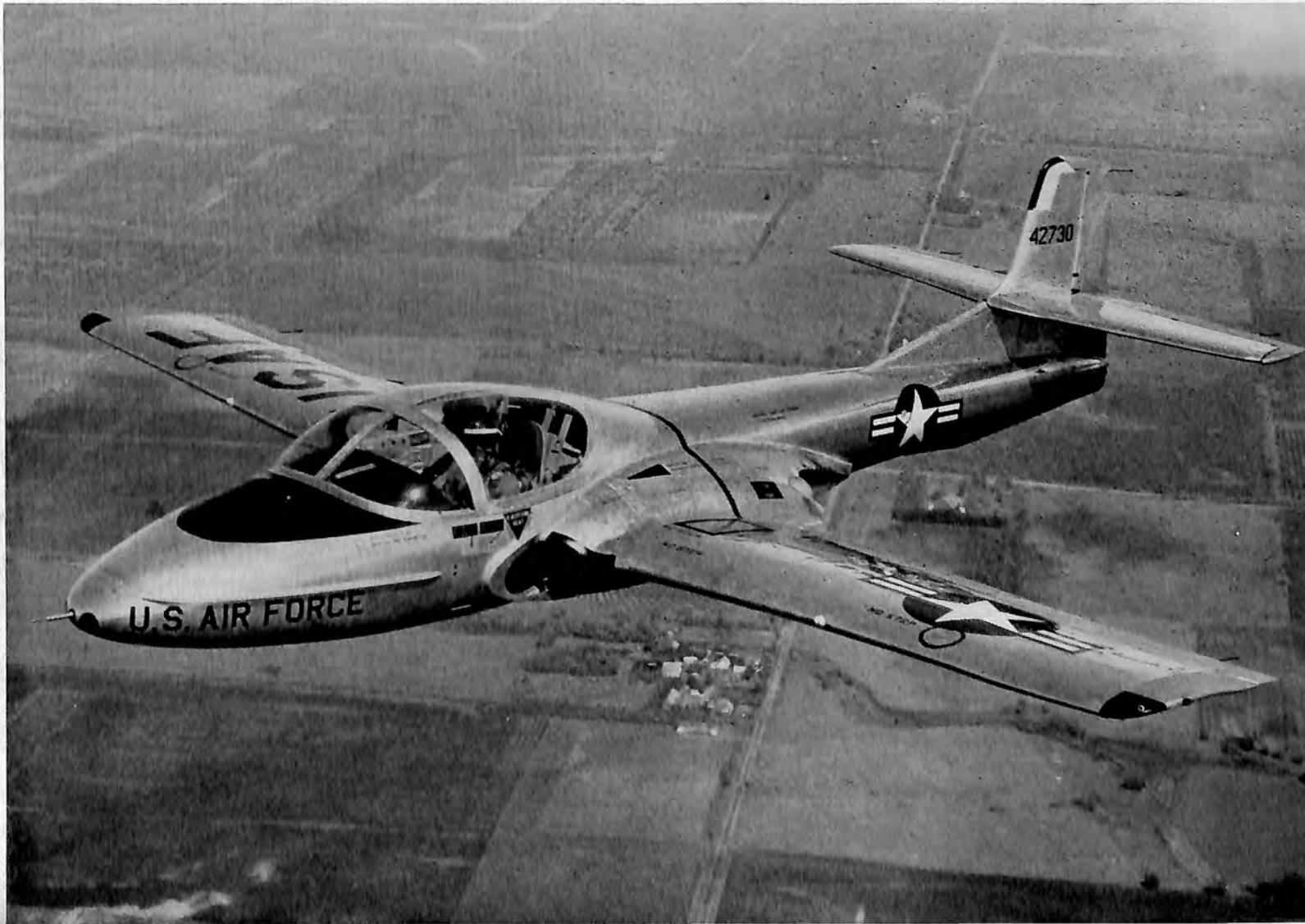
#### SPECIFICATIONS

Span 33 ft. 10 in.; Length 29 ft. 3 in.; Height 9 ft. 4 in.; Empty Weight 3890.7 lb.; Gross Weight 6403.3 lb.; Engines Two J69-T9 Continental, 920 lb. thrust maximum at 22,700 rpm; Fuel Capacity 309 U. S. gal.; Wing Area 183.9 sq. ft.; Aileron Area 10.74 sq. ft.; Flap Area 15.10 sq. ft.; Fin Area 11.54 sq. ft.; Rudder Area 6.24 sq. ft.; Stabilizer Area 34.93 sq. ft.; Elevator Area 11.64 sq. ft.; Vertical Tail Area 17.78 sq. ft.

#### PERFORMANCE

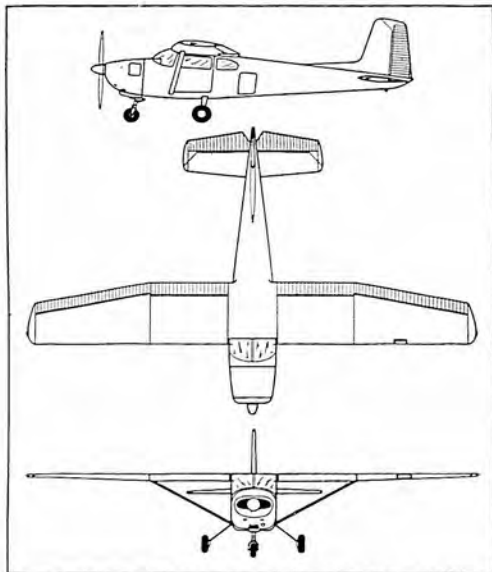
High Speed Level Flight at 30,000 ft. (military power  $\frac{1}{2}$  fuel) 366 knots; Cruise Speed normal rated power  $\frac{1}{2}$  fuel 35,000 ft. 294 knots; Cruise Ceiling  $\frac{1}{2}$  fuel 33,400 ft.; Service Ceiling  $\frac{1}{2}$  fuel normal rated power 36,600 ft.; Range Cruise at 35,000 ft. at 268 knots (with MIL-C-5011A reserves) 700 nautical mi.; Stall Speed Landing Configuration (design gross weight) 72 knots; Time to Climb to 35,000 ft. (takeoff at design gross weight) 31 minutes.

#### Cessna T-37A Trainer



#### REMARKS

The all-metal four-place model 182 with "Land-O-Matic" gear was first introduced to the U. S. market in March, 1956. The airplane is designed primarily for businessmen pilots learning to fly. New features include a wider landing gear by five inches. The cabin has been lowered six inches without sacrificing prop clearance. Other new features include spring-loaded windows, new door latch design, new exterior luggage door lock, redesigned panel and inside fuel drain. Equipped with Cessna "Para-Lift" flaps with 10-20-30-40 degrees. Rear seat can be removed for cargo weighing more than a quarter of a ton. Airplane has excellent ground handling characteristics.



#### SPECIFICATIONS

Span 36 ft.; Length 26 ft.; Height 8 ft. 6 in.; Empty Weight 1560 lb.; Gross Weight 2650 lb.; Wing Loading 15.1 lb. per sq. ft.; Power Loading 11.5 lb. per bhp; Engine Continental O-470-L, 230 hp at 2600 rpm; Fuel Capacity 65 U. S. gal.; Propeller all-metal constant speed; Wing Area 175 sq. ft.

#### PERFORMANCE

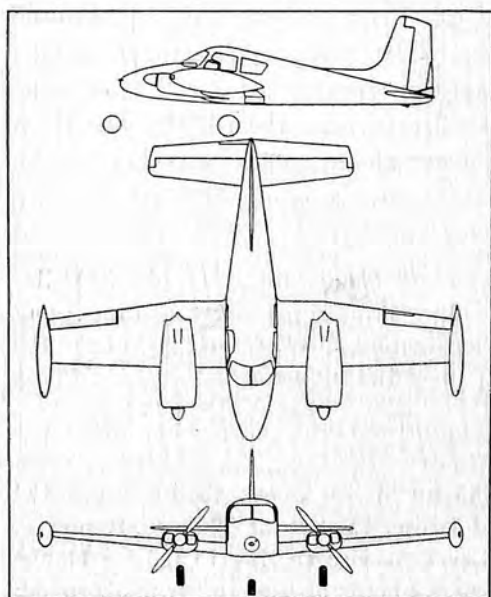
Maximum Speed at Sea Level 165 mph; Cruise Speed 155 mph; Rate of Climb 1030 fpm at Sea Level; Service Ceiling 19,800 ft.; Range at Maximum Recommended Cruise Speed 655 mi.

Cessna 182





Cessna 310B



**REMARKS**

Outstanding performance and 213 miles per hour cruise is standard on this five-place model. Oxygen and 30-gallon auxiliary fuel system available as optional equipment. New features include complete new interior with individual reclining seats as optional, redesigned functional panel, larger luggage space, and double retractable step. Wing-tip tanks have 100-gallon capacity.

**SPECIFICATIONS**

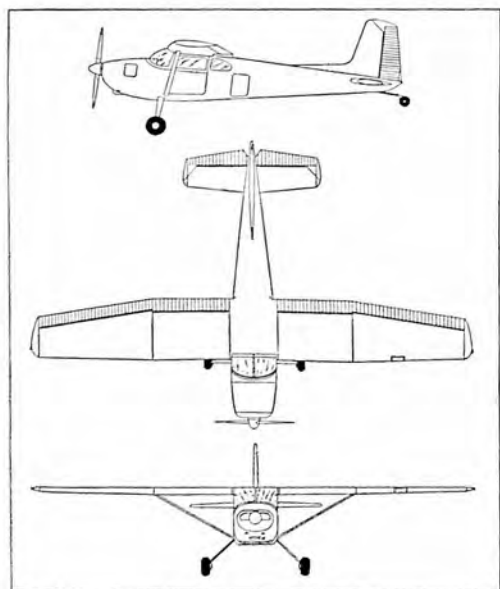
Span 36 ft.; Length 27 ft.; Height 10.5 ft.; Empty Weight 2965 lb.; Gross Weight 4700 lb.; Wing Loading 26.9 lb. per sq. ft.; Power Loading 9.8 lb. per bhp; Engines Two Continental O-470-M, 240 hp normal rated at 2600 rpm; Fuel Capacity 100 gal. carried in wing tip tanks, no inboard fuel as standard; Propeller constant speed full feathering; Gear tricycle; Wing Area 175 sq. ft.

**PERFORMANCE**

Maximum Speed at Sea Level 232 mph; Cruise Speed 213 mph; Rate of Climb 1660 fpm; Service Ceiling 20,000 ft.; Range with Maximum Payload 850 mi.



Cessna 172



#### REMARKS

The four-place all-metal model 172 was introduced in 1956 with new "Land-O-Matic" gear to make flying easier primarily for businessmen learning to fly. The low center of gravity allowed by the new type gear provides excellent maneuverability, ease of landing, and ground handling. The all-metal airplane is also equipped with "Para-Lift" flaps for greater lift on takeoff runs and slow, easy descent when landing. More than 2500 have been manufactured and delivered since the airplane was first introduced.

#### SPECIFICATIONS

Span 36 ft.; Length 25 ft.; Height 8 ft. 6 in.; Empty Weight 1260 lb.; Gross Weight 2200 lb.; Wing Loading 12.6 lb. per sq. ft.; Power Loading 15.2 lb. per bhp. Engine Continental O-300-A (six-cylinder), 145 hp; Fuel Capacity 42 U. S. gal.; Propeller all-metal fixed pitch; Wing Area 175 sq. ft.

#### PERFORMANCE

Maximum Speed 135 mph at 145 hp at Sea Level; Cruise Speed 124 mph at maximum recommended cruise, 7500 ft. at 70 percent power; Rate of Climb 660 fpm at Sea Level; Service Ceiling 13,300 ft.; Range with Maximum Payload 519 mi. or 4.2 hours at 124 mph true air speed; Range with Maximum Fuel Load 620 mi. or 6.4 hours with true air speed of 97 mph.



Cessna Model 180

#### REMARKS

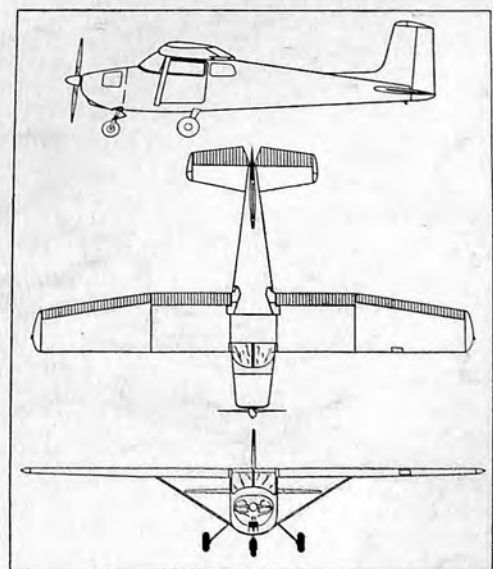
Design improvements and new features include external luggage compartment door, hand-operated parking brake, inside fuel drain, redesigned instrument panel, and spring-loaded windows. Castering wheels are standard equipment on this model. Trim operates full horizontal stabilizer. Equipped with Cessna "Para-Lift" flaps with 10-20-30-40 degrees. This four-place model is available on floats and skis, and is all metal.

#### SPECIFICATIONS

Span 36 ft.; Length 26 ft.; Height 7 ft. 6 in.; Empty Weight 1555 lb.; Gross Weight 2650 lb.; Wing Loading 15.1 lb. per sq. ft.; Power Loading 11.5 lb. per bhp; Engine Continental O-470-K, 230 hp at 2600 rpm; Fuel Capacity 65 gal.; Propeller All-Metal constant speed; Wing Area 175 sq. ft.

#### PERFORMANCE

Maximum Speed at Sea Level 170 mph; Cruise Speed 160 mph; Rate of Climb 1130 fpm at Sea Level; Cruising Range 675 mi.; Service Ceiling 21,500 ft.



## CHAMPION AIRCRAFT CORP.

OSCEOLA, WISCONSIN

### REMARKS

The Traveler is a full-size fully equipped plane, with the same basic airframe as the Traveler Deluxe including the Sky-Vu wraparound windshield, Clear-Vu tinted greenhouse and extra-big side windows. Operating costs less than \$3.00 per hour, including maintenance and allowance for engine overhaul.

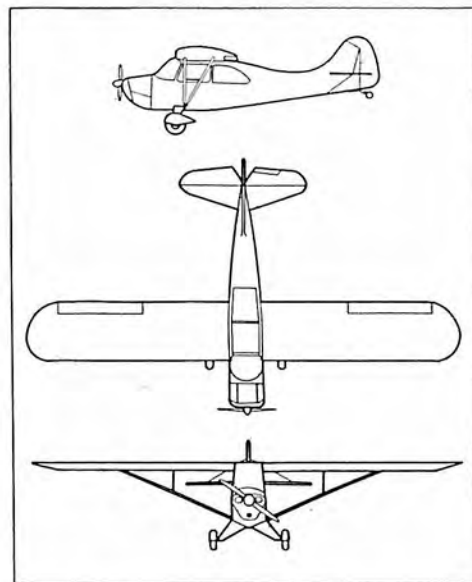
### SPECIFICATIONS

Span 35 ft. 2 in.; Length 21 ft. 8 in.; Height 7 ft.; Empty Weight 929 lb.; Wing Loading 8.5 lb. per sq. ft.; Power Loading 16.1 lb. per bhp; Engine Continental C90-12F, 90 hp normal rate, or 95 hp at 2625 rpm takeoff; Fuel Capacity 26 gal.; Propeller McCauley Metal; Wing Area 170.22 sq. ft.; Aileron Area 16.54 sq. ft.; Fin Area 7.41 sq. ft.; Rudder Area 6.80 sq. ft.; Stabilizer Area 14.08 sq. ft.; Elevator Area 11.92 sq. ft.

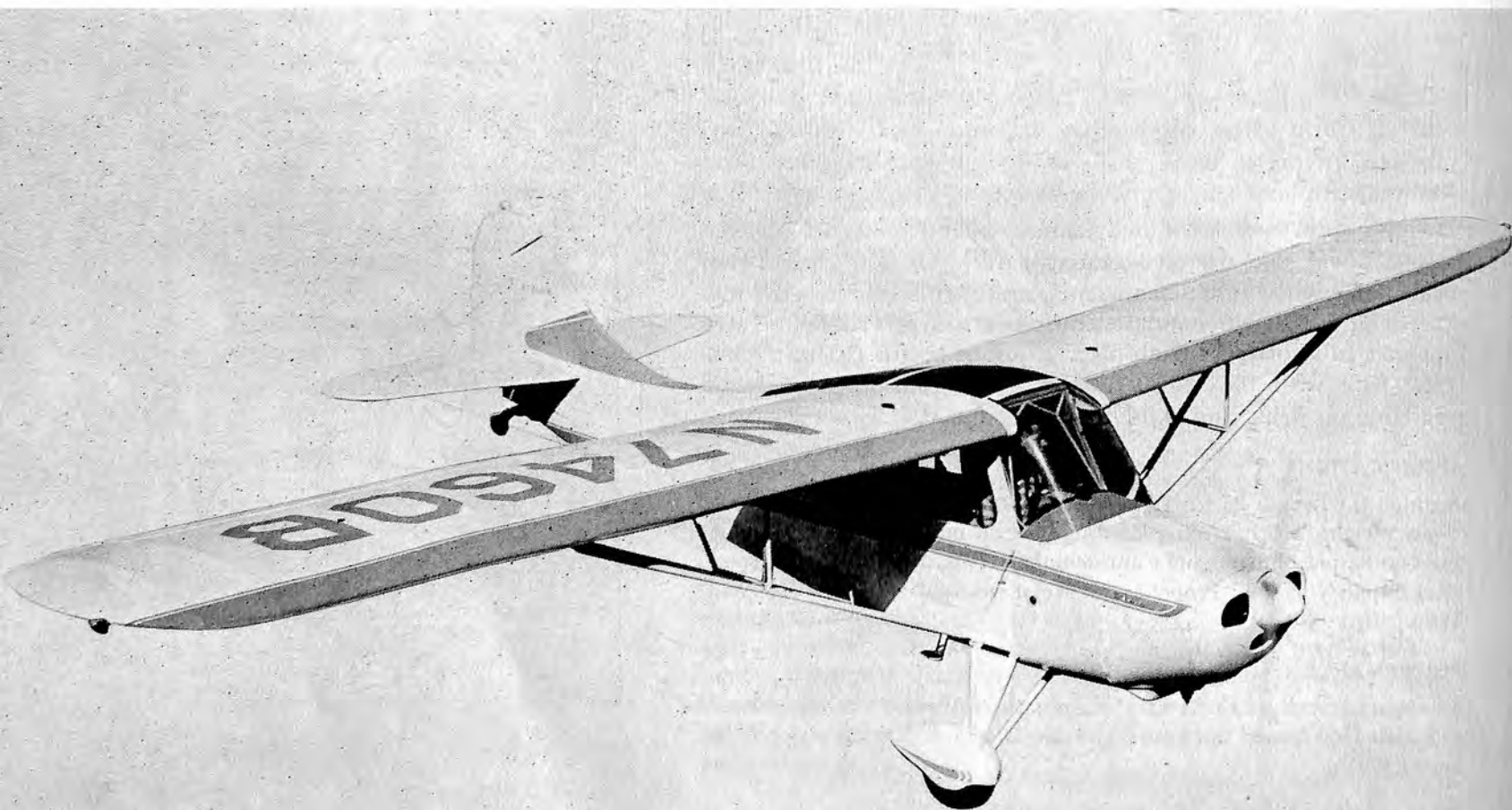
### PERFORMANCE

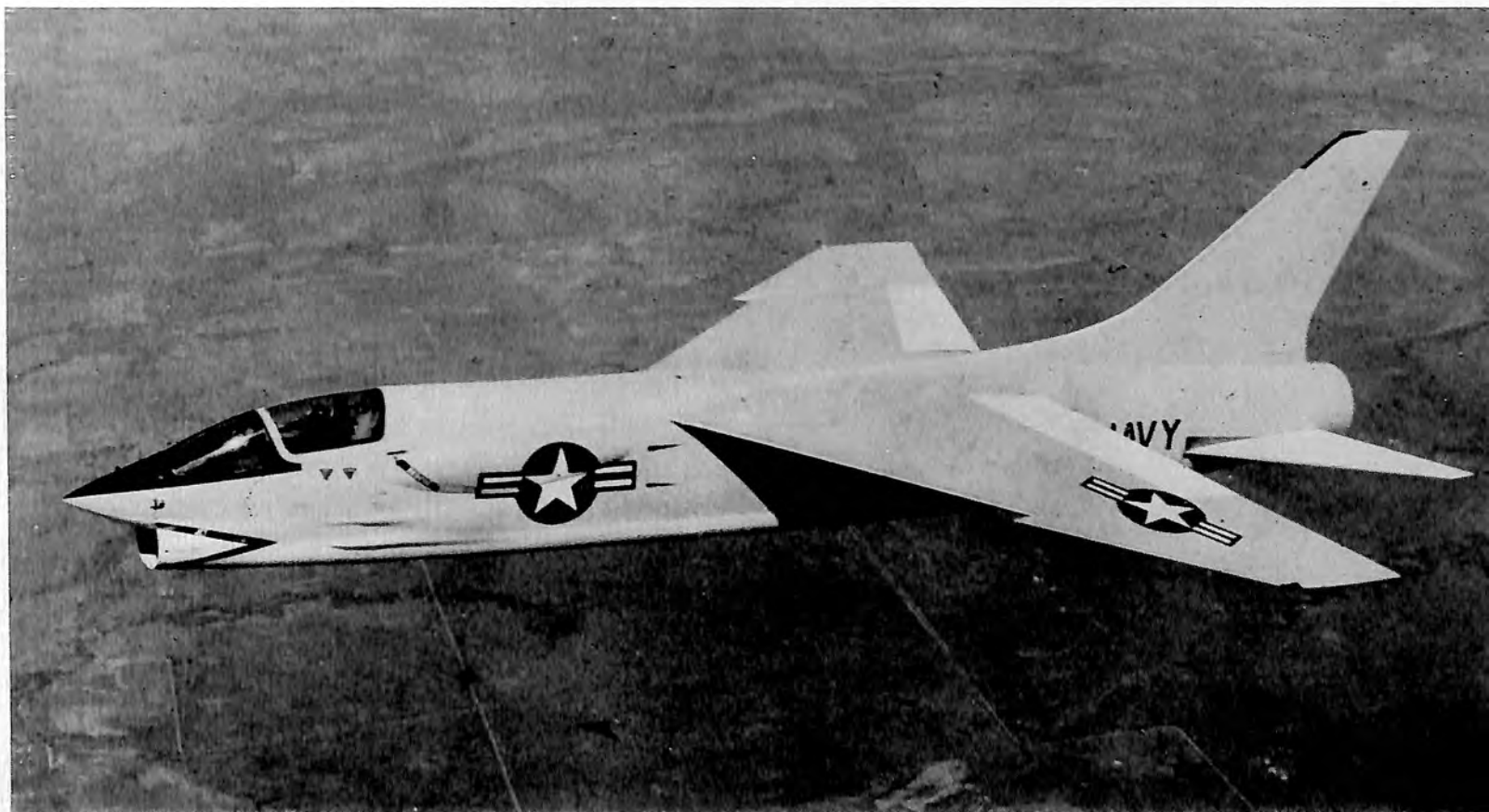
Maximum speed 135 mph at 95 hp at 2625 rpm at Sea Level; Cruise Speed 112 mph at 80 percent hp at 2350 rpm at Sea Level; Landing Speed 40 mph; Rate of Climb 900 fpm at Sea Level; Service Ceiling 15,500 ft.; Absolute Ceiling 19,000 ft.; Range with Maximum Payload 500 mi.; Range with Maximum Fuel Load 500 mi.

The tricycle gear, Tri-Traveler, differs from the Traveler specifications, listed below, with a Height 8 ft. 8 in.; Empty Weight 968 lb.; Gross Weight 1500 lb.; Useful Load 532 lb. Cruise Speed for the Tri-Traveler is 108 mph.



Champion Traveler Deluxe





**Chance Vought F8U-1 Crusader Navy Fighter**

**REMARKS**

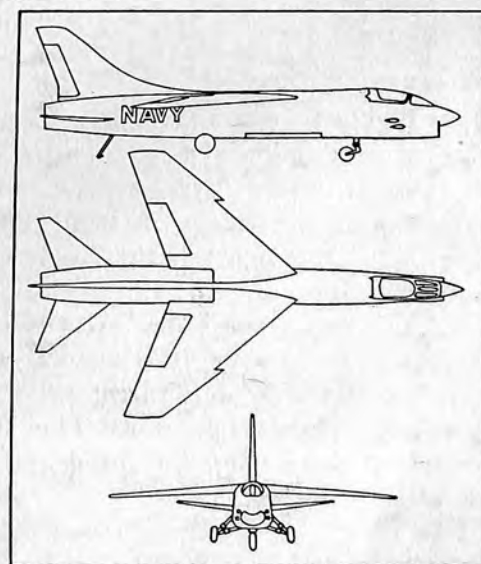
The F8U-1 Crusader is in production at Chance Vought Aircraft at Dallas and is serving with fleet squadrons on both coasts. The F8U-1P, photographic version of the Crusader, set the first supersonic (at-altitude) transcontinental speed record in history July 16, 1957, when it flew from Los Alamitos, California, to New York (2445.9 miles) in 202 minutes, 50 seconds, refueling three times en route. The high wing fighter completed the Fleet Introduction Program in January and February, 1957, and the first Crusader was delivered to a fighter squadron (VF-32 at Cecil Field, Florida) in March, 1957, exactly two years from the day the first XF8U-1 experimental model made its first flight on March 25, 1955. Designed for carrier operations, the F8U-1 has a two-position wing. It carries 20 mm. firing cannon and other armament. Other specifications and performance data have not been released.

**SPECIFICATIONS**

Span 35 ft. 8 in.; Length 54 ft. 2.75 in.; Height 15 ft. 9.1 in.; Engine Pratt & Whitney J57.

**PERFORMANCE**

Maximum Speed above 1000 mph.





## CONVAIR, A DIVISION OF GENERAL DYNAMICS CORP.

SAN DIEGO 12, CALIFORNIA



Convair B-58 Hustler Supersonic Bomber

### REMARKS

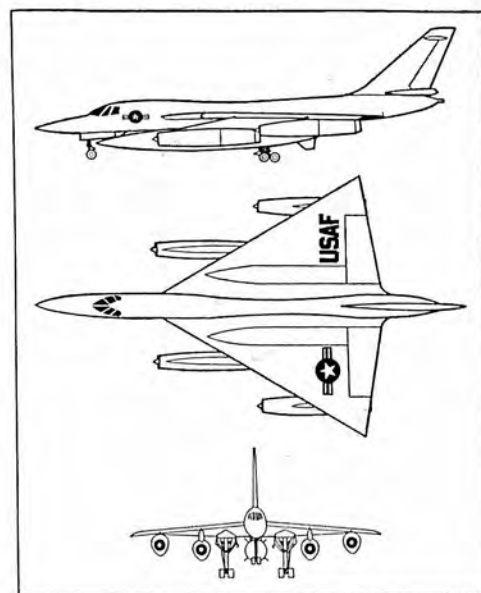
First flight of the B-58 was December 11, 1956 and it is now in limited production. Faster than sound, the B-58 was developed by Convair for the Air Force as a complete weapon system. The versatile Hustler carries its strategic striking power in a bullet-like pod slung beneath the fuselage. By simply changing the pod, the same airframe can perform a variety of missions: the pod can carry a bomb, powerful cameras, or electronic countermeasures equipment. It is virtually an automatic airplane and requires a crew of but three: pilot, navigator-bombardier, and defensive systems operator. The B-58 employs the Convair-pioneered delta wing for speed and stability, even in the thin air of the stratosphere.

### SPECIFICATIONS

Span 55 ft.; Length 95 ft.; Height 30 ft.; Engines Four General Electric J79 turbojets with afterburner.

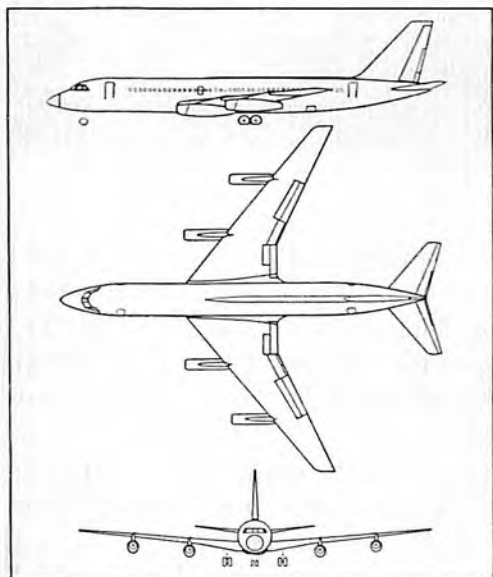
### PERFORMANCE

Maximum Speed Supersonic; Service Ceiling above 50,000 ft.



#### REMARKS

Convair 880 is scheduled for its initial flight in January, 1959 and delivery to the airlines starting in 1960. In a first-class arrangement, up to 88 passengers will cruise in comfortable "two-on-the-aisle" seats at a near-sonic 615 miles per hour. In a coach arrangement, 109 passengers can be accommodated. Despite its great speed, the Convair 880 will be able to operate safely and economically from existing airports in more than 150 American cities. The 880 will fly at altitudes from 36,000-40,000 feet, high above turbulent weather. Its four powerful engines will be commercial versions of the same General Electric J79 turbojets that drive Convair's B-58 Hustler supersonic bomber. Early customers for the 880 include Trans World Airlines (30); Delta Air Lines (10); Transcontinental (Argentina) (4); and REAL Aerovias (Brazil) (4).



#### SPECIFICATIONS

Span 120 ft.; Length 129 ft. 4 in.; Height 36 ft.; Empty Weight 82,100 lb.; Wing Loading 89 lb. per sq. ft.; Engines Four General Electric CJ805-3; Fuel Capacity 10,800 gal.; Wing Area 2,000 sq. ft.; Combined Vertical Area (Fin and Rudder) 295 sq. ft.; Combined Horizontal Area (Stabilizer and Elevator) 395 sq. ft.

#### PERFORMANCE

Maximum Speed 615 mph at 95 percent rpm at 22,000 ft.; Cruise Speed 575 mph at 92 percent rpm at 30,000 ft.; Landing Speed 150 mph; Rate of Climb 3800 fpm at Sea Level; Service Ceiling 36,000 ft.; Range with Maximum Payload 3250 mi.; Range with Maximum Fuel Load 3250 mi.

Convair 880 Commercial Jet Transport





Convair F-106A Delta Dart

#### REMARKS

Convair's F-106A Delta Dart evolved from the Convair F-102A Delta Dagger all-weather, supersonic, jet interceptor design. Both employ the Convair-pioneered delta or triangular wing platform. The F-106A has a more powerful engine—the Pratt & Whitney J75 turbojet—and is designed to fight at even greater speeds and altitudes than the F-102A.

The F-106A's package of guided missile armament—carried in a bay beneath the fuselage—and electronic fire control system give this newest interceptor great "kill probability." On command from the ground controller or pilot, the Hughes MA-1 integrated electronic guidance system directs the F-106A to target through any kind of weather, day or night. At the proper instant, the missiles are fired automatically, and the flight control system breaks off contact with the target and navigates the plane's return to any of dozens of destinations selected by the pilot or ground controller. In emergencies, the pilot can override the automatic flight control system through manual controls.

A two-place version of the F-106A, designated F-106B, is under development by Convair-San Diego. It will carry the same armament and fire control system and will be capable of performing the same missions as the F-106A. It differs externally from the F-106A only in forward section of the fuselage, which will provide two tandem cockpits. F-106B forward fuselage sections are fabricated at Convair-Fort Worth. After assembly at San Diego, F-106A's are flown to Convair's production flight facility at Palmdale, California, for painting and electronic gear installation. More than \$263-million worth of contracts for F-106A's and F-106B's have been placed with Convair to date. (November 1, 1957) by the Air Force. First flight of prototype F-106A: December 26, 1956; first flight of production model: August 31, 1957.

#### SPECIFICATIONS

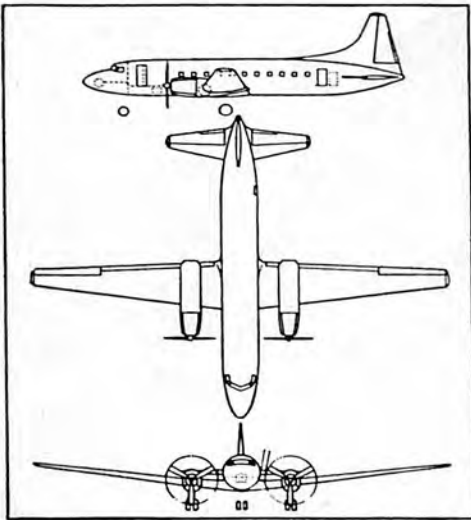
Span 38 ft. 1.6 in.; Length 70 ft. 8.78 in.; Height 20 ft. 3.32 in.; Engine Pratt & Whitney J75 turbojet.

#### PERFORMANCE

All data are classified.

#### REMARKS

Latest in the series of twin-engine Convair transports is the Model 440 Metropolitan. Tailored to give quiet, safe, and economical service over medium and short-range routes, the new Metropolitan has been purchased by major European scheduled airlines, as well as air carriers in the United States. Sound suppression improvements, including new Convair-designed engine exhaust mufflers, make the Metropolitan passenger cabin exceptionally comfortable. They may be equipped with weather mapping nose radar that permits the pilot to "see" bad weather and prominent terrain features as far as 150 miles ahead.



#### SPECIFICATIONS

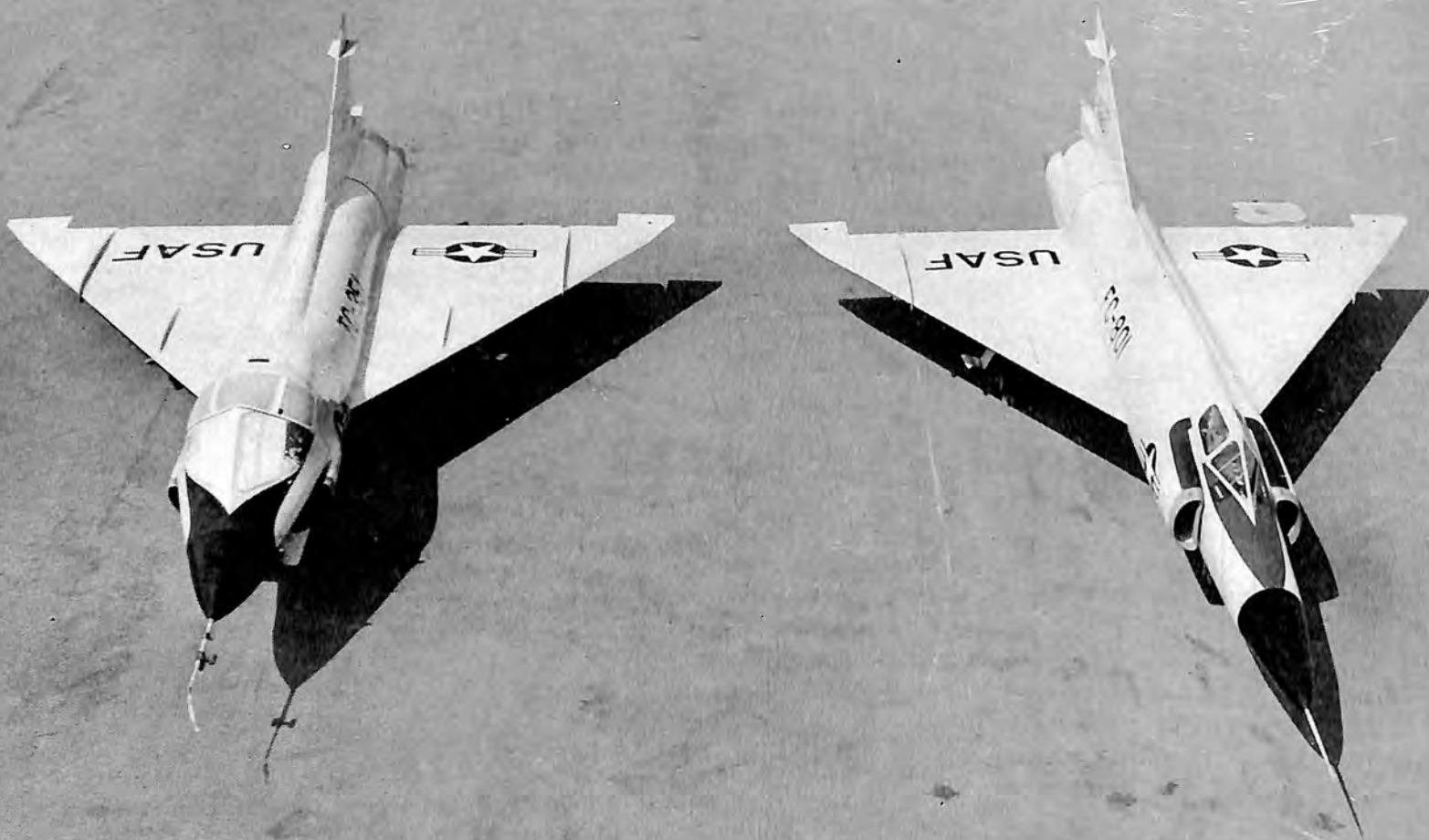
Span 105 ft. 4 in.; Length 79 ft. 2 in.; Height 28 ft. 1 in.; Empty Weight 31,305 lb.; Gross Weight 49,100 lb.; Wing Loading 53.3 lb. per sq. ft.; Power Loading 9.82 lb. per bhp; Engines Two Pratt & Whitney R-2800-CB-17, 2500 hp normal rated; Fuel Capacity 1730 gal.; Propeller Hamilton Standard, hydromatic; Wing Area 920 sq. ft.; Aileron Area 43.8 sq. ft.; Flap Area 182.5 sq. ft.; Fin Area 86.2 sq. ft.; Rudder Area 41 sq. ft.; Stabilizer Area 175.4 sq. ft.; Elevator Area 58.6 sq. ft.

#### PERFORMANCE

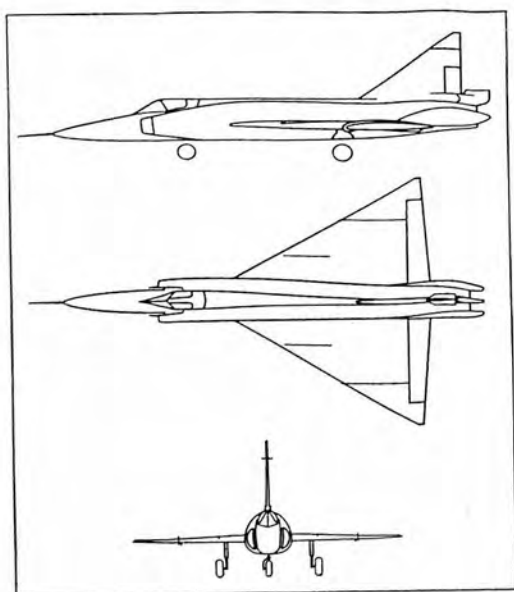
Cruise Speed 289 mph; Stalling Speed 86 mph; Rate of Climb 1230 fpm at Sea Level; Service Ceiling 25,000 ft.; Range with Maximum Payload 400 mi.; Range with Maximum Fuel Load 2450 mi.

Convair 440 Metropolitan





Convair TF-102A and F-102A Delta Dagger



#### REMARKS

Supersonic F-102A Delta Dagger jet interceptors and TF-102A trainers, now in volume production at Convair-San Diego, are in operational service with more than 20 Air Defense Command fighter-interceptor squadrons from California to New York, initial deliveries to ADC having begun in May, 1956. First production version was completed in March, 1954. The F-102A electronic and armament improvements make it a lethal weapon in any kind of weather. After a very short takeoff and rapid climb to more than 50,000 feet, the F-102A locks onto its target. At proper instant, the F-102A's electronic system fires a salvo of Falcon guided missiles or air-to-air rockets. All fuel and armament are carried inside to preserve its clean aerodynamic, delta-wing shape in combat.

#### SPECIFICATIONS

Span 38 ft. 1 in.; Length 68 ft. 3.3 in.; Height 21 ft. 2.53 in.; Engine Pratt & Whitney J57-P-23 in 10,000-lb. thrust class.

#### PERFORMANCE

Maximum Speed Supersonic; Service Ceiling above 50,000 ft.

**DOMAN HELICOPTERS, INC.**  
DANBURY, CONNECTICUT

**REMARKS**

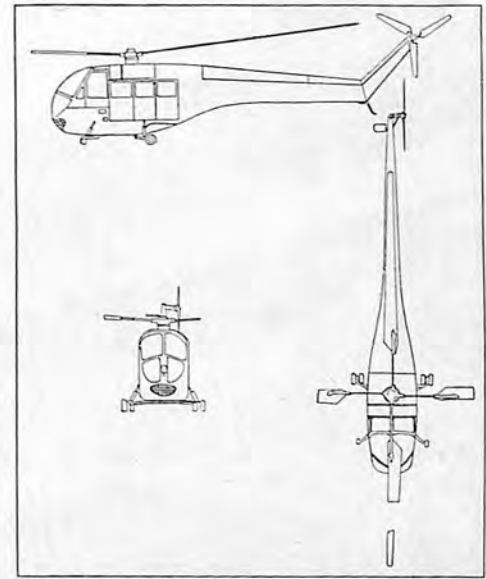
The Doman LZ-5 features a simplified rotor system that is completely enclosed, self-lubricated, and simple in appearance, fabrication, and operation. Blade flapping and drag hinges, dampers, and grease fittings, long employed in conventional rotors, are completely eliminated on the Doman. All moving parts, including controls, are located within the rotor head and protected from the elements. No post-flight maintenance is required. Equipped with an eight-cylinder 400 horsepower Lycoming engine, the LZ-5 has a CAA certified gross weight of 5200 pounds and will carry a payload of one ton—a payload gross weight ratio unmatched by any other helicopter up to 12,000 pounds gross weight.

**SPECIFICATIONS**

Length 38 ft.; Height 10 ft. 5 in.; Empty Weight 3250 lb.; Main Rotor Diameter 48 ft.; Tail Rotor Diameter 10 ft.; Engine Lycoming SO-580-A1B, 400 hp at 3300 rpm takeoff; Fuel Capacity 119 gal.

**PERFORMANCE**

Maximum Speed 100 mph; Cruise Speed 81 mph; Range with Standard Fuel Load 486 mi.



Doman LZ-5



**DOUGLAS AIRCRAFT CO., INC.**  
SANTA MONICA, CALIFORNIA



**Douglas DC-6B Transport**

**REMARKS**

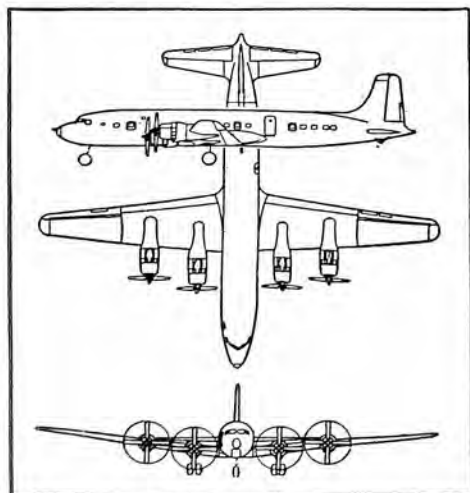
The DC-6A and DC-6B transports are enlarged versions of the DC-6's which first flew February 15, 1946. First step in the evolution was the DC-6A Liftmaster first flown on September 29, 1949. This was followed by the DC-6B, first flown February 10, 1951. Twenty-seven of the world's leading airlines have purchased 270 airplanes of the DC-6B configuration and 12 commercial airlines have ordered more than 44 of the DC-6A cargo carriers. Commercial sales of the DC-6 are past the 500 mark. The military has ordered the DC-6A series, designated C-118 by the Air Force and R6D-1 by the Navy. These can be converted to troop transports or hospital planes. 54 to 89 passengers.

**SPECIFICATIONS**

Span 117 ft. 6 in.; Length 106 ft. 6 in.; Height 28 ft. 8 in.; Empty Weight 58,340 lb.; Gross Weight 107,000 lb.; Wing Loading 73.1 lb. per sq. ft.; Power Loading 10.7 lb. per bhp; Engines Four Pratt & Whitney R-2800-CB-17, 2500 hp normal rated; Fuel Capacity 5512 gal.; Propeller Hamilton Standard full feathering reversible pitch; Gear tricycle, two sets of dual-type main wheels; Wing Area 1463 sq. ft.; Aileron Area 89 sq. ft.; Flap Area 229.4 sq. ft.; Fin Area 93.4 sq. ft.; Rudder Area 49 sq. ft.; Stabilizer Area 210.9 sq. ft.; Elevator Area 108.9 sq. ft.

**PERFORMANCE**

Maximum Speed 360 mph at 1,750 hp at 2300 rpm at 18,700 ft.; Cruise Speed 315 mph at 1200 hp at 2300 rpm at 22,400 ft.; Landing Speed 106 mph; Rate of Climb 1100 fpm at Sea Level; Service Ceiling 21,900 ft.; Range with Maximum Payload 3393 mi.; Range with Maximum Fuel Load 4968 mi.

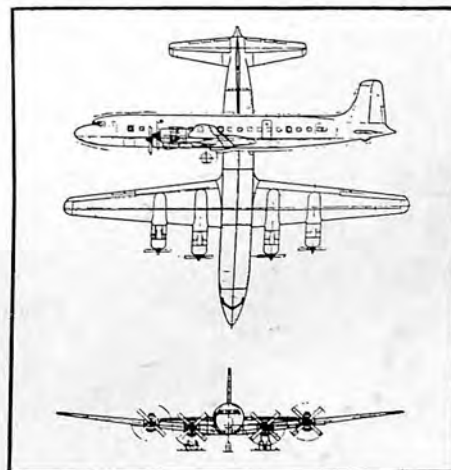




**Douglas DC-7 Transport**

**REMARKS**

The DC-7 is a development of the DC-6 series. The DC-7 is eight feet longer and has several technical improvements. First DC-7 flight was on May 18, 1953. It entered airline service six months later and made possible nonstop transcontinental flights. The DC-7B is equipped with saddle tanks for greater range. Third model is the DC-7C with a ten-foot greater wing span, 40-inch longer fuselage. Added fuel carried in the extended wing root increases operating range to 5000 miles with reserves. Engine modifications provide a total of 400 greater climb horsepower. Carries 64 to 95 passengers.



**SPECIFICATIONS**

Span 117 ft. 6 in.; Length 108 ft. 11 in.; Height 28 ft. 7 in.; Gross Weight 126,000 lb.; Wing Loading 86.2 lb. per sq. ft.; Power Loading 9.7 lb. per bhp; Engines Four Wright R-3350 turbo compound, 3250 hp at takeoff; Fuel Capacity 6478 gal.; Propeller Hamilton Standard, four-blade; Gear tricycle, two sets of dual main wheels; Wing Area 1463 sq. ft.; Aileron Area 85 sq. ft.; Flap Area 229 sq. ft.; Fin Area 101 sq. ft.; Rudder Area 67 sq. ft.; Stabilizer Area 156 sq. ft.; Elevator Area 155 sq. ft.

**PERFORMANCE**

Maximum Speed 412 mph at 2450 hp at 2600 rpm at 22,200 ft.; Cruise Speed 358 mph at 1,800 hp at 2,400 rpm at 23,000 ft.; Landing Speed 122 mph; Rate of Climb 1673 fpm at Sea Level; Service Ceiling 23,300 ft.; Absolute Ceiling 24,400 ft.; Range with Maximum Payload 3565 mi.; Range with Maximum Fuel Load 5155 st. mi.



#### REMARKS

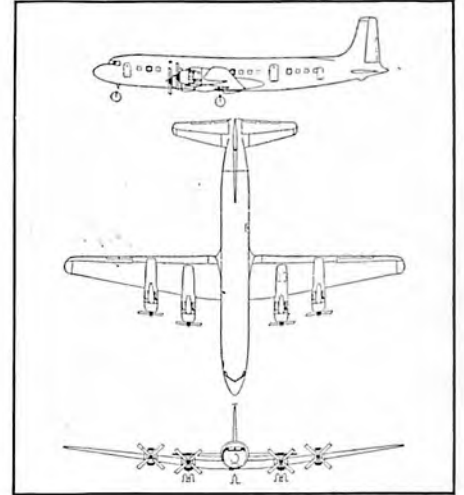
Success of earlier DC-7 models in domestic U. S. operations led to development of a larger (10-foot greater wing span, 40-inch longer fuselage) version especially designed for long-range, intercontinental airline service. This version is capable of flying nonstop between most cities of Europe and the U. S. Production of the newest Douglas commercial transport is concurrent with preceding DC-7 models and airliners of the DC-6 series.

#### SPECIFICATIONS

Span 127 ft. 6 in.; Length 112 ft. 3 in.; Height 31 ft. 8 in.; Wing Area including aileron 1637 sq. ft.; Empty Weight 72,150 lb.; Gross Weight 143,000 lb.; Wheel Base 39 ft. 6 in.; Powerplant Wright R-3350 compound-type EA1; takeoff 3400 bhp each; Propeller Hamilton Standard four-bladed.

#### PERFORMANCE

Maximum Speed 405 mph with rated power; Cruise Speed 357 mph; Landing Speed 116 mph at Sea Level; Rate of Climb 1050 fpm at Sea Level; Service Ceiling 21,600 ft.



Douglas DC-7C Seven Seas Transport





**Douglas DC-8 Jet Transport**

**REMARKS**

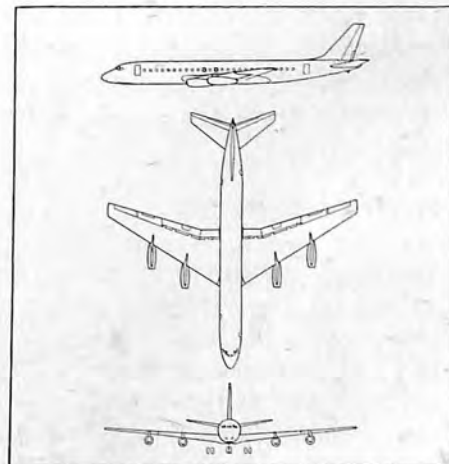
All models of the DC-8 have identical dimensions, differing only in weight, resulting from more fuel capacity and structural accommodations for the added fuel on intercontinental models. Three power plants may be selected: Pratt & Whitney JT3C and JT4A for domestic models, and JT4A and Rolls Royce Conway for the intercontinental versions. First flight is scheduled for March, 1958; first delivery in November, 1959.

**SPECIFICATIONS**

Span 139 ft. 9 in.; Length 150 ft. 6 in.; Height 42 ft. 4 in.; Empty Weight 118,265 lb.; T. O. Gross Weight 265,000 lb.; Wing Loading 96.2 lb. per sq. ft.; Engines Four Pratt & Whitney JT-3C-6 Turbojet; Fuel Capacity 17,600 gal.; Wing Area 2758 sq. ft.; Aileron Area 158.3 sq. ft.; Flap Area 453.7 sq. ft.; Fin Area 224.6 sq. ft.; Rudder Area 127.1 sq. ft.; Stabilizer Area 392 sq. ft.; Elevator Area 167.1 sq. ft.

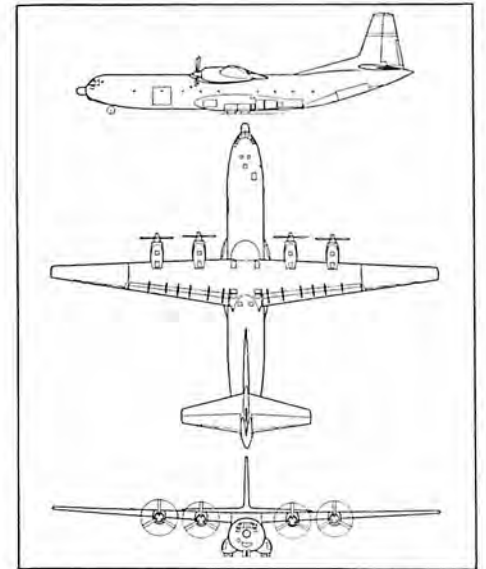
**PERFORMANCE**

Maximum Speed 586 mph at maximum continuous thrust at 25,000 ft.; Cruise Speed 566 mph at maximum cruise thrust at 30,000 ft.; Landing Stall Speed 116 mph; Rate of Climb at maximum gross weight 1670 fpm at Sea Level; Service Ceiling at maximum gross weight 35,500 ft.; Range with Maximum Payload 4660 mi.; Absolute Range with Maximum Fuel Load 6050 mi.





**Douglas C-133A Heavy Cargo Transport**



**REMARKS**

The C-133A turboprop cargo transport has the ability to haul a 41,700-pound payload 3500 nautical miles, or a 95,000-pound load for distances up to 1500 nautical miles. Ninety-six percent of all ground force military vehicles can be hauled fully assembled by the giant plane. Two cargo entrances permit simultaneous front-and-rear loading into the 13,000-cubic-foot capacity cabin which is pressurized to provide a 10,000-foot cabin altitude maintainable at an altitude of 35,000 feet. First flight was made April 23, 1956. The C-133A, developed for the Military Air Transport Service, is produced at the Douglas Long Beach Division.

**SPECIFICATIONS**

Span 179 ft. 8 in.; Length 157 ft. 6 in.; Height 48 ft. 3 in.; Empty Weight 114,690 lb.; Design Weight 275,000 lb.; Wing Loading 103 lb. per sq. ft.; Power Loading 11.45 lb. per ESHP Dry Power; Engines Four Pratt & Whitney T34-P7W, 6000 ESHP Sea Level; Static dry at 11,000 rpm takeoff; Fuel Capacity 18,112 gal.; Propeller Curtiss-Wright CT735S-B100; Aileron Area 142 sq. ft.; Fin Area (including rudder balance) 399.5 sq. ft.; Stabilizer Area (including elevator balance) 556.7 sq. ft.; Wing Area 2673 sq. ft.; Flap Area (without vane) 411.5 sq. ft.; Rudder Area 137.2 sq. ft.; Elevator Area 244 sq. ft.

**PERFORMANCE**

Maximum Speed 308 knots at mrp at 200,000 lb. at 7900 ft.; Cruise Speed 272 knots at 99 percent maximum range at 200,000 lb. at 24,000 ft.; Landing Speed 93 knots at 175,000; Rate of Climb 1300 fpm at Sea Level with mrp at 275,000 lbs.; Service Ceiling 27,600 ft. at 200,000 lb. with mrp; Absolute Ceiling 28,700 ft. at 200,000 lb. with mrp; Range at Design Weight with Maximum Payload 1500 nautical mi.; Range at Design Weight with Maximum Fuel Load 3700 nautical mi.

#### REMARKS

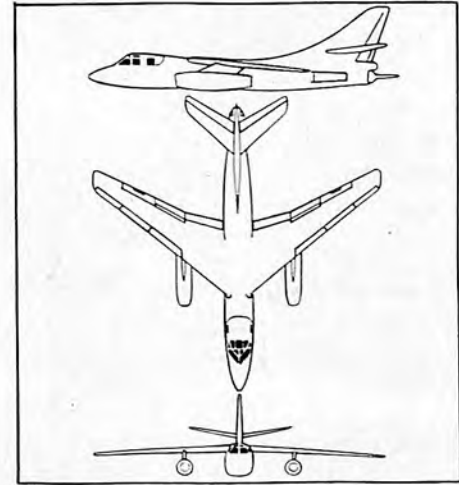
The B-66B, a companion model of the RB-66, was built expressly for tactical bombing missions. It is specially designed to permit a wide selection of bomb combinations. Even with full bomb load, the B-66B's efficient power-to-weight ratio gives ample range for travel far over enemy territory and return. Equipped for probe-and-drogue method of inflight refueling, range of the aircraft is extended indefinitely. First flight made January 4, 1955; first aircraft delivered to Air Force on March 16, 1956. The B-66B is produced at the Douglas Long Beach Division.

#### SPECIFICATIONS

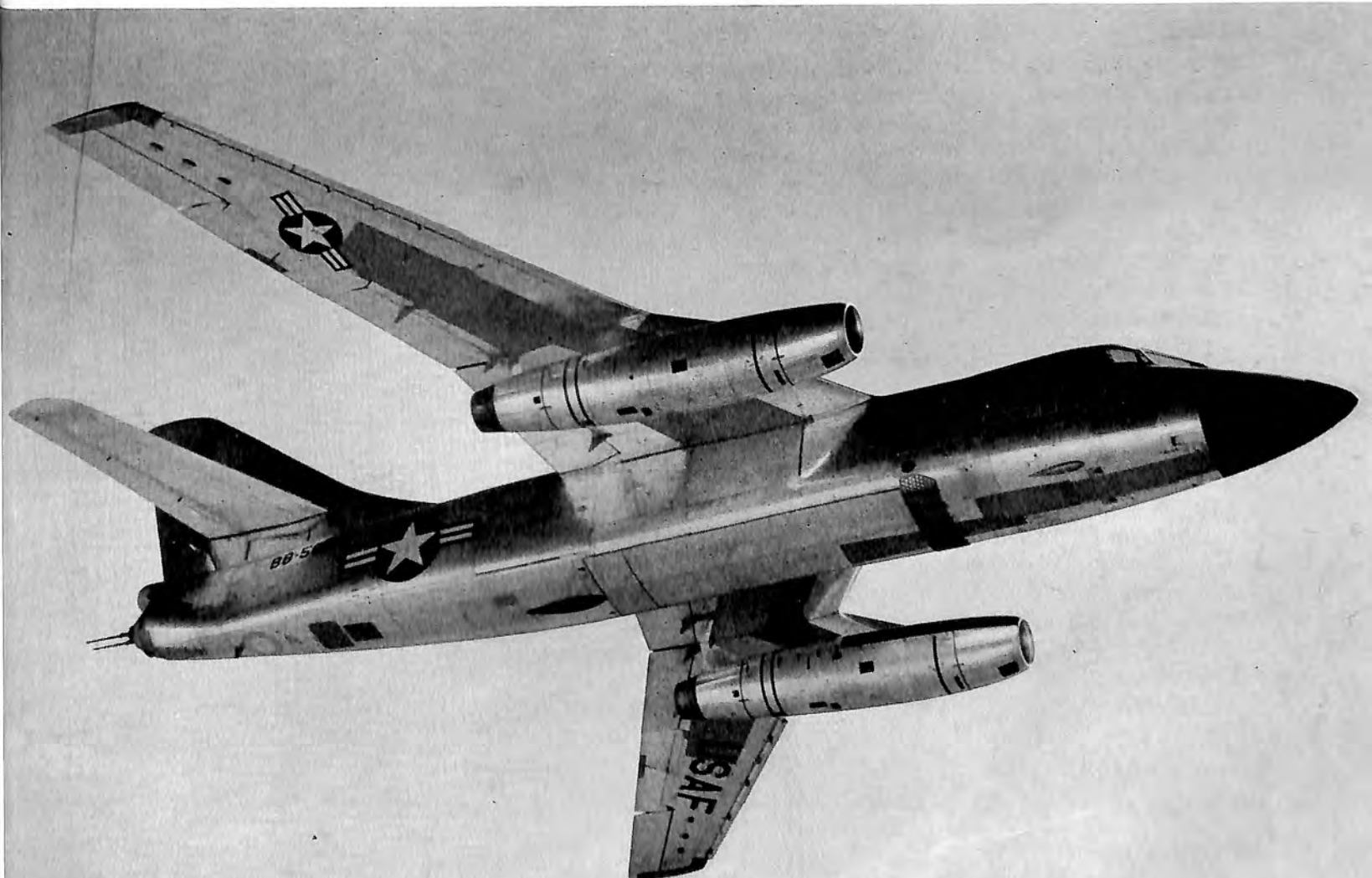
Span 72 ft. 6 in.; Length 75 ft. 2 in.; Height 23 ft. 7 in.; Empty Weight 42,549 lb.; Design Gross Weight 78,000 lb.; Overload Gross Weight 83,000 lb.; Wing Loading 100 lb. per sq. ft.; Power Loading 3.73 lb. per lb. thrust (takeoff); Engines Two Allison J71-A-13, 9700 lb. thrust at 6100 rpm military rated, or 10,200 lb. thrust at 6175 rpm takeoff; Fuel Capacity 4483 gal.; Gear tricycle; Wing Area 780 sq. ft.; Aileron Area 32.6 sq. ft.; Flap Area 108.8 sq. ft.; Fin Area 129.9 sq. ft.; Rudder Area 32.5 sq. ft.; Stabilizer Area 114.8 sq. ft.; Elevator Area 52.2 sq. ft.

#### PERFORMANCE

All data are classified.



Douglas B-66B Destroyer





**Douglas WB-66 Weather Reconnaissance Destroyer**

#### REMARKS

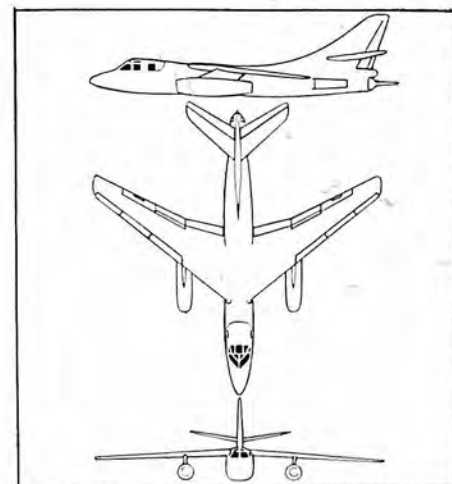
The swept-wing, twin-jet RB-66 is designed in various versions to perform numerous specialized reconnaissance missions. Powered by two Allison J71 engines slung in pods beneath its wings, the RB-66 is in the 600-700 mile-per-hour class and can perform well at all altitudes up to 45,000 feet. It was re-engineered from the basic design of the Douglas A3D. Like the B-66, it is equipped for inflight refueling. The RB-66B is manufactured at Douglas Long Beach Division; first flight made June 28, 1954; first aircraft delivered to Air Force on February 1, 1956. The RB-66C is produced at the Douglas Tulsa Division; first flight made October 29, 1955; first aircraft delivered to Air Force on May 11, 1956. The WB-66D, a weather reconnaissance aircraft, is produced at the Douglas Tulsa Division. It carries a five man crew—pilot, navigator, gunner and two weather equipment operators.

#### SPECIFICATIONS

Span 72 ft. 6 in.; Length 75 ft. 2 in.; Height 23 ft. 7 in.; Empty Weight 43,476 lb.; Design Gross Weight 70,000 lb.; Overload Gross Weight 83,000 lb.; Wing Loading 90 lb. per sq. ft.; Power Loading 3.43 lb. per lb. thrust (takeoff); Engines Two Allison J71-A-13, 9700 lb. thrust at 6100 rpm military rated, or 10,200 lb. thrust at 6175 rpm takeoff; Fuel Capacity 4489 gal.; Gear tricycle; Wing Area 780 sq. ft.; Aileron Area 32.6 sq. ft.; Flap Area 108.8 sq. ft.; Fin Area 129.9 sq. ft.; Rudder Area 32.5 sq. ft.; Stabilizer Area 114.8 sq. ft.; Elevator Area 52.2 sq. ft.

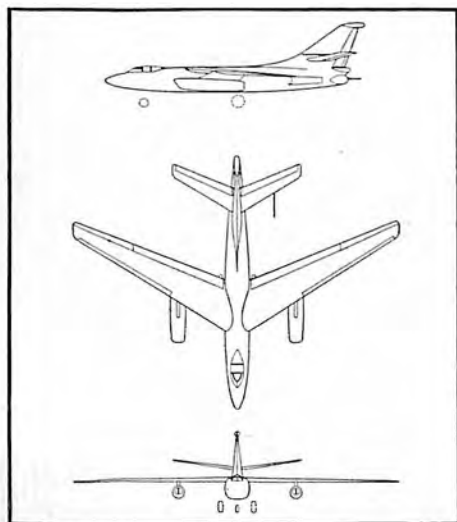
#### PERFORMANCE

All data are classified.



#### REMARKS

Continuing in accelerated production at Douglas El Segundo Division, A3D-2 Skywarriors are now flying in carrier squadrons as the Navy's most potent single striking force. The twin-jet bomber, mightiest ever to operate from an aircraft carrier, first flew October 28, 1952. Rated in the 600-700 mile-per-hour class, the A3D flies long-range missions above 40,000 feet. Primarily designed to deliver nuclear weapons, it can also carry a huge variety of other armament on twelve bomb bay racks. As recently announced by the Navy, two new configurations of the Skywarrior are under development. They are the A3D-2P, first jet airplane designed exclusively for photographic missions, and the A3D-2T, first Navy jet bomber trainer. The latter will carry a pilot, an instructor, and six students. Wing racks will carry practice bombs. Both of these versions will have the bomb bay removed to accommodate the special equipment, but will retain the twin-gun installation in the tail. On March 21, 1957, a transcontinental speed record was broken when an A3D-1 completed a round trip from Los Angeles to New York and return in 9 hours 31 minutes 35.4 seconds (1 hour 46 minutes under the old record). Simultaneously, the east-to-west record was bettered. This was 5 hours 12 minutes 39.24 seconds, more than 11 minutes faster than the previous mark. (Both records were later topped.)



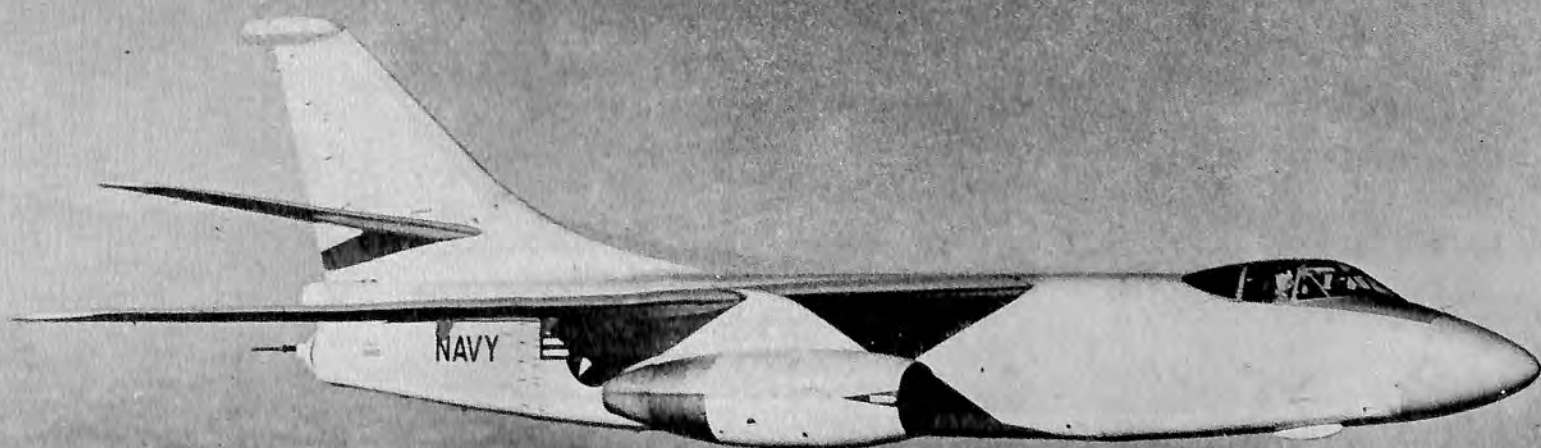
#### SPECIFICATIONS

Span 72 ft. 6 in.; Length 74 ft. 5 in.; Height 22 ft. 9 in.; Engine Pratt & Whitney J57. All other data are classified.

#### PERFORMANCE

All data are classified.

#### Douglas A3D-2 Skywarrior Attack Bomber



#### REMARKS

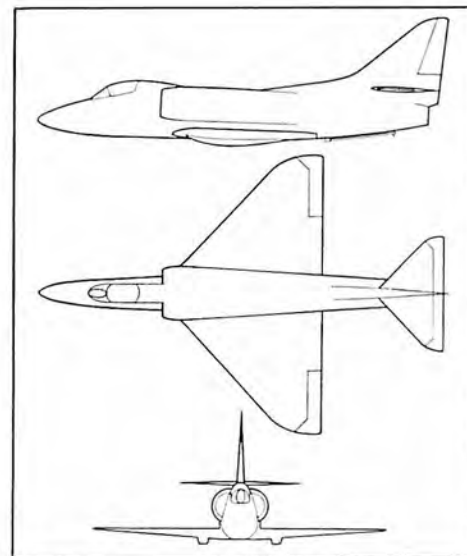
The A4D Skyhawk was designed and built at the Douglas El Segundo Division. The first flight was made June 22, 1954, and fleet deliveries began in mid-1956, following carrier qualifications. The size of the A4D allowed it to operate from carriers without folding wings, yet it is capable of carrying out long-range missions with atom bombs, missiles, bombs, rockets, guns, and other weapons. Skyhawks can be refueled from tanker aircraft and can also be converted into tankers themselves by carrying external fuel tanks on the wing and the Douglas In-Flight Fueling Store on the centerline rack. On October 15, 1955, the A4D set a new F.A.I. world speed record for the 500-kilometer closed course with an average speed of 695.163 miles per hour at Edwards Air Force Base, California, bettering the old record by more than 45 miles per hour. Skyhawks are continuing in production for both the Navy and the Marine Corps.

#### SPECIFICATIONS

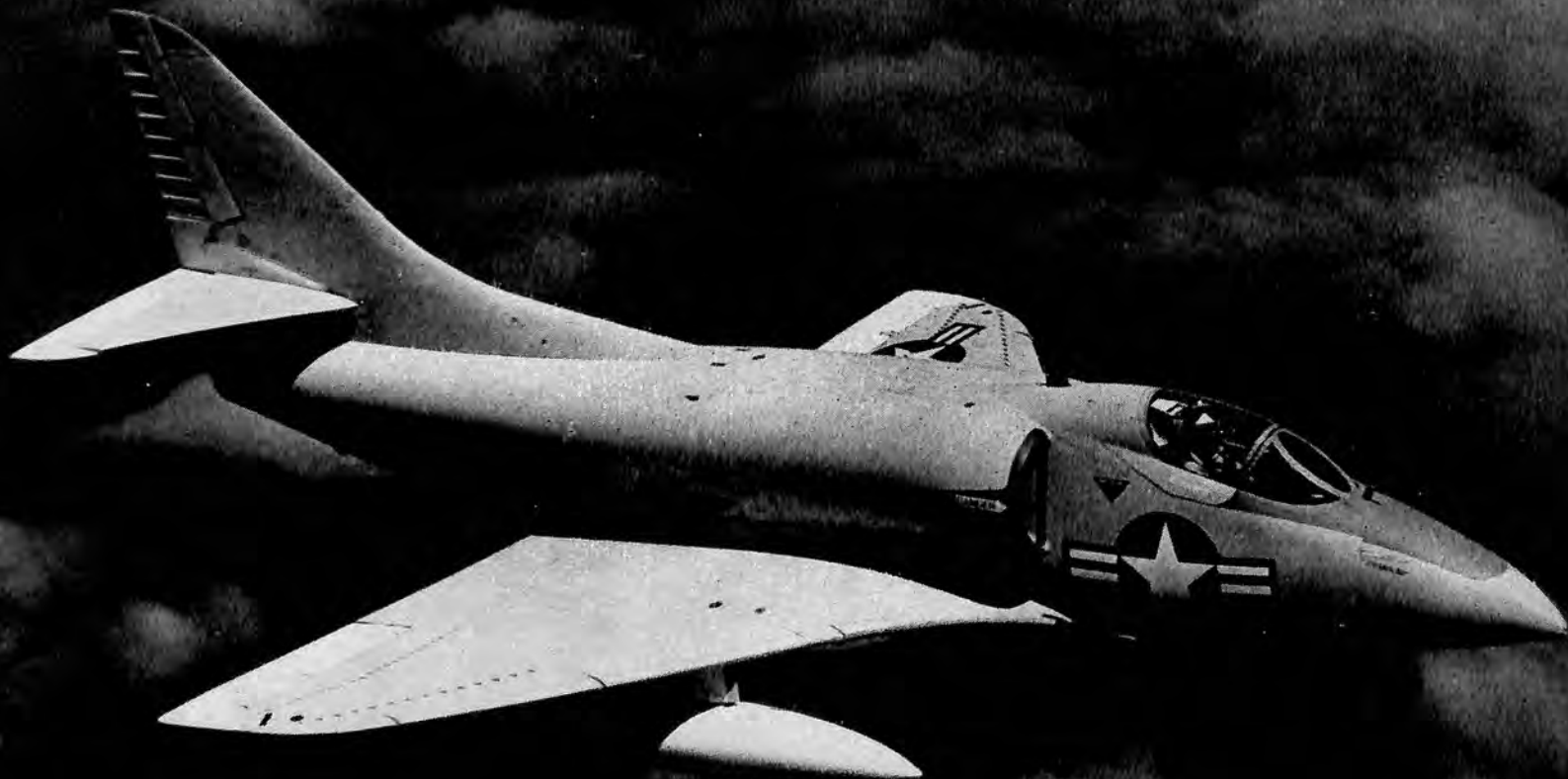
Span 27 ft. 6 in.; Length 39 ft. 5 in.; Gross Weight 15,000 lb.; Engine Wright J65. All other specifications classified.

#### PERFORMANCE

All data are classified.



Douglas A4D-2 Skyhawk Attack Bomber





Douglas AD-7 Skyraider

#### REMARKS

In March, 1957, the final AD-7 was delivered to the Navy. It was the 3180th Skyraider, culminating a twelve-year production span at the Douglas El Segundo Division that included fifty different configurations. The AD was originally designed to carry a 1000-pound bomb load, but improved models eventually carried a 10,000-pound bomb load on fifteen bomb racks, a record for single-engine airplanes.

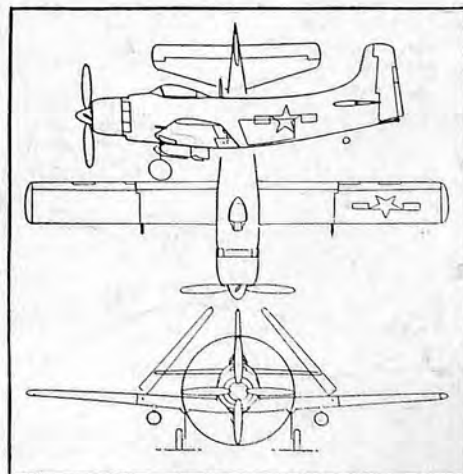
Skyraiders were available in quantity at the outbreak of the Korean War, and during this conflict the AD's carried the brunt of the aerial attack on enemy positions from land bases and aircraft carriers. Configurations built in production quantities include day attack, night attack, and airborne early warning. Since 1952 aircraft carriers have had Skyraiders equipped to carry atomic bombs. Recently, AD-6 and AD-7 models have been equipped to be quickly converted into tankers with two 400-gallon droppable tanks on wing racks and the Douglas In-Flight Fueling Store, containing 300 additional gallons plus transfer equipment, on the centerline rack.

#### SPECIFICATIONS

Span 50 ft.; Length 39 ft.; Height 15 ft. 8 in.; Empty Weight 12,094 lb.; Gross Weight 18,000 lb.; Powerplant Wright R-3350, 2700 hp at takeoff and 2900 rpm; Fuel Capacity 380 gal. with provisions for two 300-gal. drop wing-tip tanks; Propeller AeroProducts, four blades; Gear conventional retractable.

#### PERFORMANCE

All data are classified.





#### REMARKS

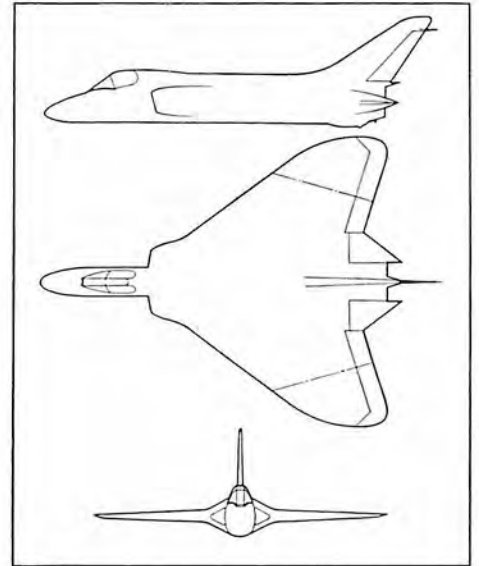
The F4D-1 Skyray is a carrier-based interceptor designed and built by the El Segundo Division of Douglas and is now in operation on carriers and land bases with both the Navy and Marines. The all-weather Skyray can intercept with missiles, rockets, and guns, and can also carry the additional fuel required for general-purpose fighter and ground support missions. On October 3, 1953, the F4D set a world's official speed record over a three-kilometer (1.863-mile) course averaging 752.9 miles per hour in four passes. On October 16, 1953, the same plane averaged 728.110 miles per hour for a 100-kilometer (62.1-mile) course record. The Skyray also set a record for a time to climb to 10,000 feet from a standing start at 56 seconds.

#### SPECIFICATIONS

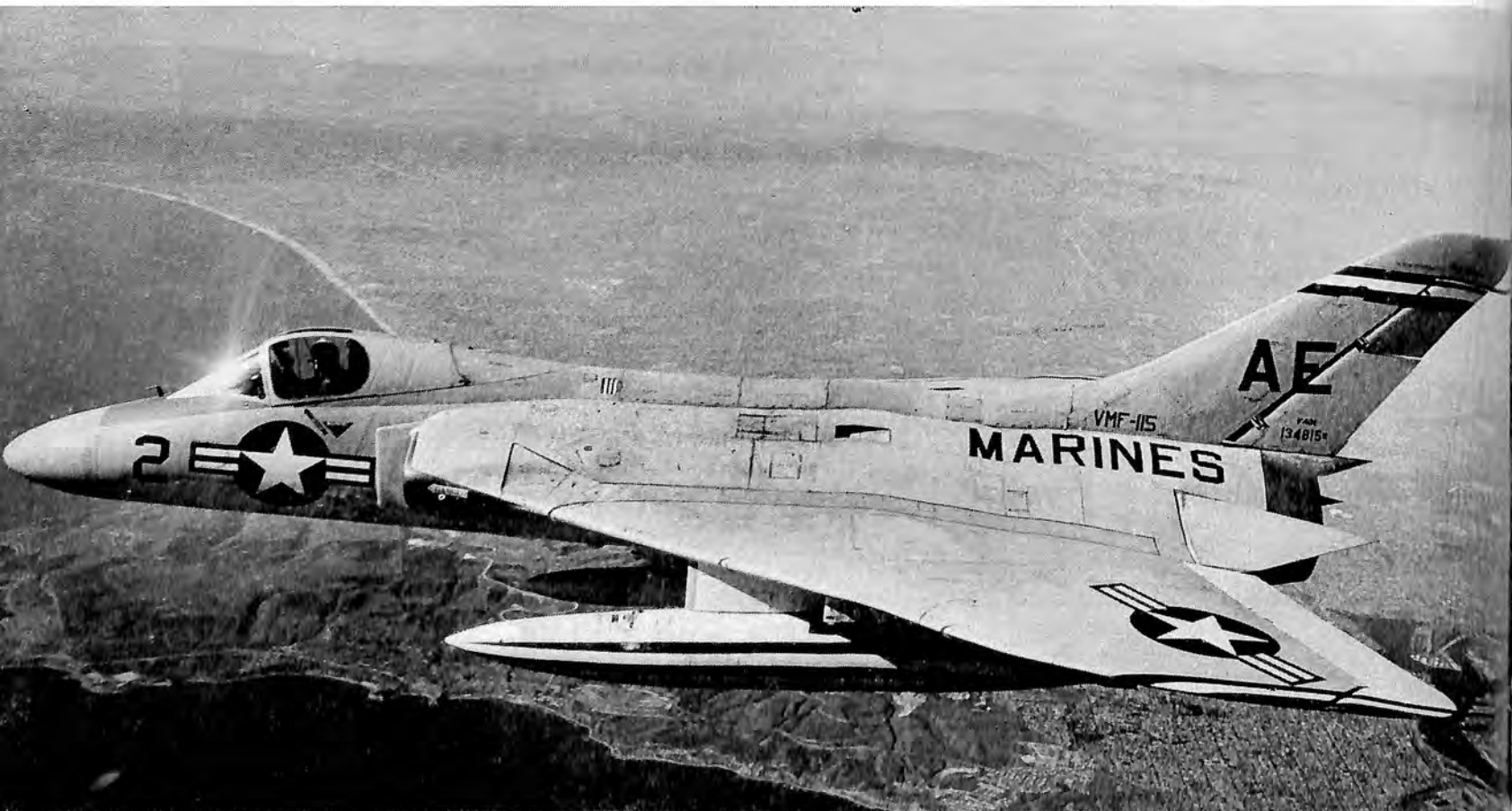
Span 33 ft. 6 in.; Length 45 ft. 5 in.; Height 13 ft.; Gross Weight about 20,000 lb.; Engine Pratt & Whitney J57 with afterburner.

#### PERFORMANCE

All data are classified.



Douglas F4D-1 Skyray Interceptor



#### REMARKS

First flown April 21, 1956, by Douglas test pilot Bob Rahn. Designed for catapult takeoff from all types of aircraft carriers, the F5D is a multi-purpose airplane and can be utilized as a general day fighter, all-weather interceptor, or as a fixed point interceptor. The F5D closely resembles the F4D-1 Skyray, Douglas fighter interceptor which holds three world speed records and is now in fleet service. However, the F5D has a thinner wing, finer and longer fuselage, and increased fuel capacity which give it more speed, longer range, and higher performance than the F4D. Another distinguishing feature of the Skylancer is its V-shaped cockpit enclosure. This improved design results in a substantial increase in speed over the more conventional flat faced windshield. Extensive use of integrally stiffened wing skins milled from aluminum alloy plate permits the wings to double as self-contained fuel tanks, while the craft's sliver-like fuselage also contains a fuel cell. The Skylancer is currently undergoing development.



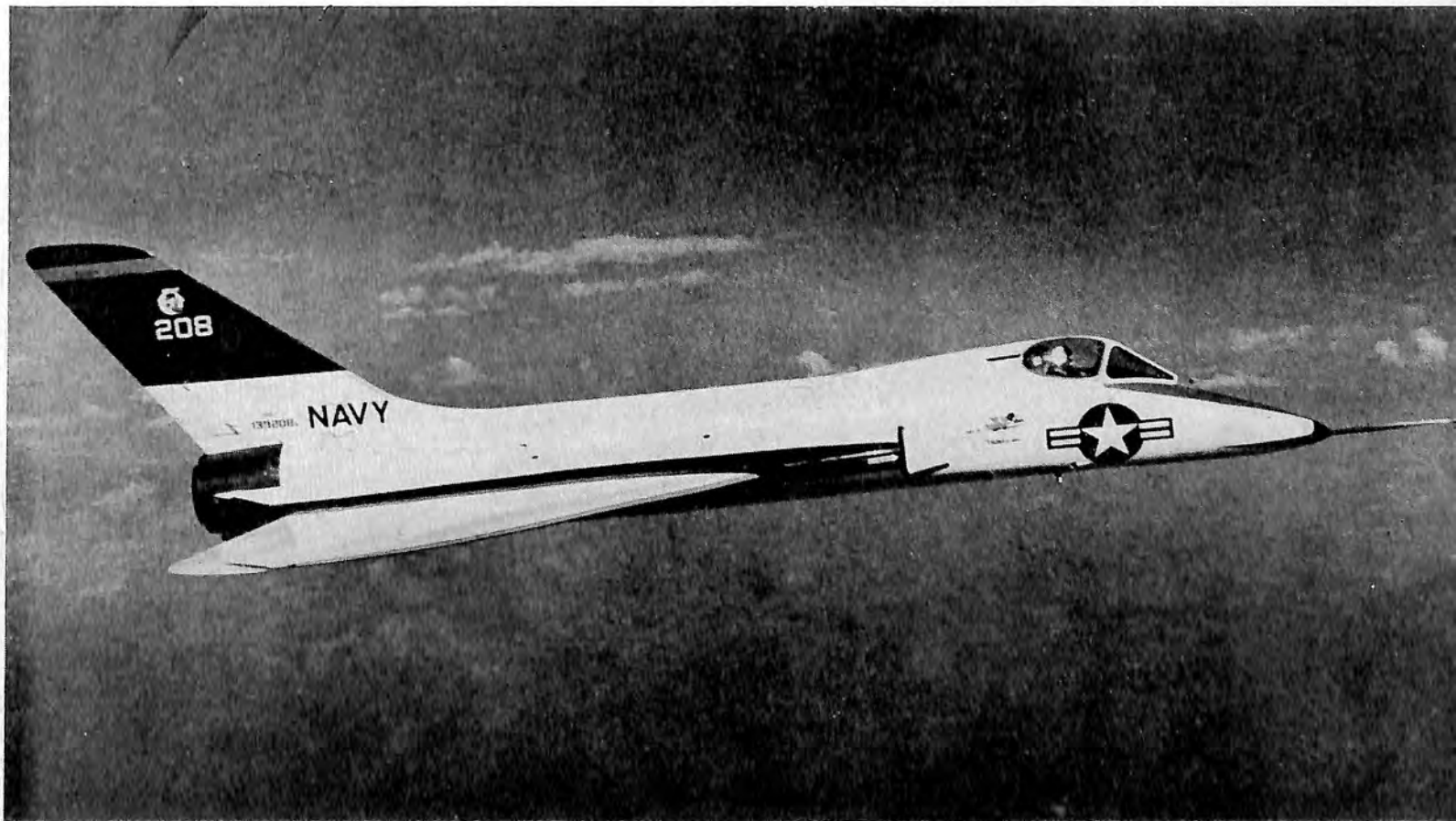
#### SPECIFICATIONS

Engine Pratt & Whitney J57 with afterburner. All other data classified.

#### PERFORMANCE

All data are classified.

Douglas F5D-1 Skylancer Fighter



**FAIRCHILD AIRCRAFT DIV.**  
**FAIRCHILD ENGINE & AIRPLANE CORP.**  
HAGERSTOWN, MARYLAND

**REMARKS**

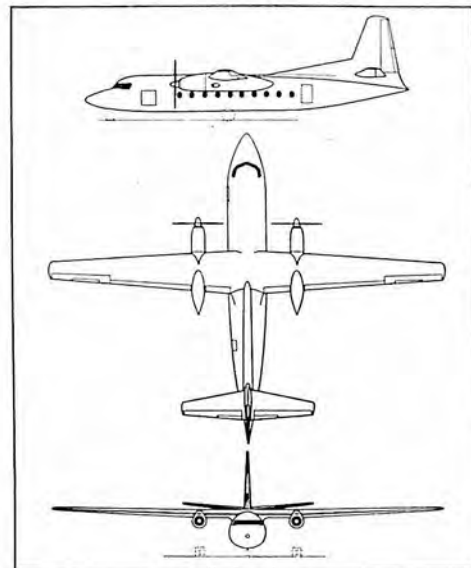
The first F-27 will be delivered in the Spring of 1958. Designed for the medium and short-range requirements of the regional airlines, the 40-seat F-27 introduces a number of passenger comfort firsts in addition to vibrationless propjet power and speed. The pressurized F-27 is completely air conditioned on the ground as well as in flight. Cabin and cockpit temperatures are controlled independently. The high-wing configuration, which provides inherent stability, makes possible faster ground loading and off loading. The 90" x 70" cargo door is only 43 inches from the ground—at truck bed height—eliminating the need for special loading equipment. "Route time" studies show the F-27's operating costs will be lower than those of comparable twin-engine aircraft. As a 10 to 16-passenger executive transport, the F-27 offers 300 miles-per-hour speeds, cross-country range, and the same short takeoff and landing capability as the airline version.

**SPECIFICATIONS**

Span 95 ft. 2 in.; Length 77 ft. 1.5 in.; Height 27 ft. 6 in.; Empty Weight 22,237 lb.; Gross Weight 35,700 lb.; Wing Loading 47.3 lb. per sq. ft.; Power Loading 11.2 lb. per shp; Engine Rolls Royce Dart—RDa 6/MK511, 1600 shp at 14,500 rpm takeoff, or RDa 7/MK528, 1800 shp at 15,000 rpm takeoff; Fuel Capacity 1320 gal.; Propeller Rotor, four-blade, constant speed; Wing Area 754 sq. ft.; Aileron Area 37.6 sq. ft.; Total Flap Area 590 sq. ft.; Vertical Tail including dorsal 153 sq. ft.; Rudder Area (aft of hinge line) 33 sq. ft.; Horizontal Tail Surfaces 172 sq. ft.; Elevator Area (aft of hinge line) 34 sq. ft.

**PERFORMANCE**

(RDa 6/MK511 engine) Cruise Speed 280 mph at 13,600 rpm at 20,000 ft.; Rate of Climb 1500 fpm at Sea Level; Service Ceiling 32,000 ft.; Range with Maximum Fuel Load 2250 mi.



**Fairchild F-27 Passenger Transport**





**Fairchild C-123B Transport**

**REMARKS**

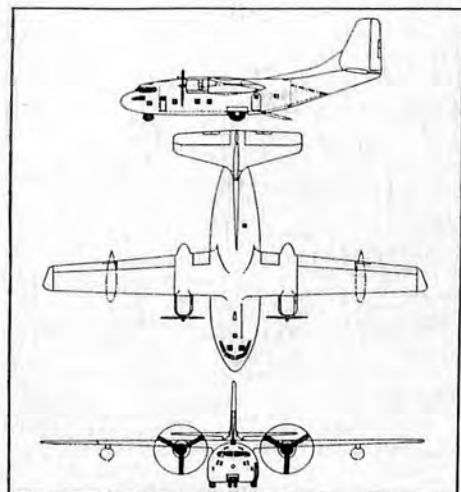
Normal cargo load of the C-123B is 16,000 pounds. It is equipped with integral hydraulically operated ramp and cargo door. Tie down fittings are stressed for 10,000 pounds in any direction and are spaced on the cargo compartment floor on a 20-inch grid pattern. The C-123B was designed specifically as a cargo plane and can carry 60 fully-equipped troops, and 50 litter patients.

**SPECIFICATIONS**

Span 110 ft.; Length 76 ft. 3 in.; Height 34 ft. 1 in.; Empty Weight 31,620 lb.; Wing Loading 44 lb. per sq. ft.; Power Loading 10.8 lb. per bhp; Engine R-2800-99W (Pratt & Whitney) 1900 hp normal rates, or 2500 hp at t/o rpm takeoff; Fuel Capacity 2362 gal.; Propeller Hamilton Standard three-blade; Wing Area 1223.2 sq. ft.; Aileron Area 83.2 sq. ft. each; Flap Area 135.2 sq. ft.; Fin Area 186.7 sq. ft.; Rudder Area 59.2 sq. ft.; Stabilizer Area 217.7 sq. ft.; Elevator Area 127.9 sq. ft.

**PERFORMANCE**

Maximum Speed 208 mph at 1800 hp at 2600 rpm at 13,000 ft.; Cruise Speed 186 mph at 1150 hp at 2150 rpm at Sea Level; Landing Speed 85 mph; Rate of Climb 1105 fpm at Sea Level; Service Ceiling 29,000 ft.; Absolute Ceiling 30,000 ft.; Range with 18,000 lb. payload 1000 mi.; Range with Maximum Fuel Load 2400 mi.



## FLETCHER AVIATION CORP.

ROSEMEAD, CALIFORNIA



Fletcher FU-24 Utility

### REMARKS

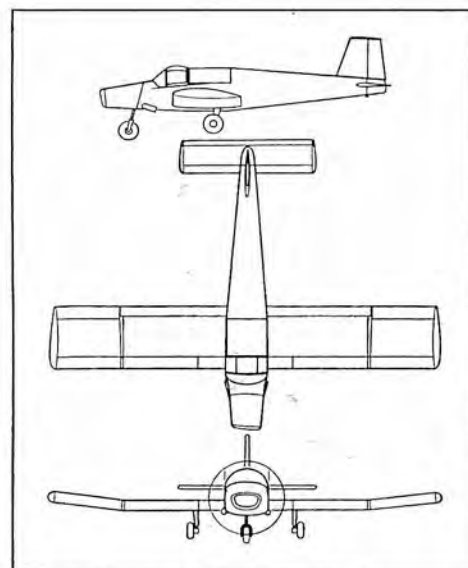
The Fletcher Utility is designed to accommodate a hopper, spreader, and other equipment required in dusting or fertilizing. The construction of this plane permits simple installation of special equipment to meet individual needs. Provisions have been made to install a spray pump that can be belt driven off of the engine. Also used for hauling machinery and equipment, search and rescue work, transporting work crews and materials, or as a flying fire watcher. To date 67 have been put in operation in the New Zealand aerial agricultural program.

### SPECIFICATIONS

Span 42 ft.; Length 31 ft. 10 in.; Height 9 ft. 4 in.; Empty Weight 1870 lb.; Wing Loading 11.9 lb. per sq. ft.; Power Loading 15.5 lb. per bhp; Engine Continental O-470-N, 240 hp normal rates; Wing Area 294 sq. ft.

### PERFORMANCE

Maximum Speed 130 mph; Cruise Speed 110 mph at 75 percent normal rated power at Sea Level; Rate of Climb 745 fpm at Sea Level; Service Ceiling 17,000 ft.; Range with Maximum Payload 410 mi.



## GOODYEAR AIRCRAFT CORP.

AKRON 15, OHIO

### REMARKS

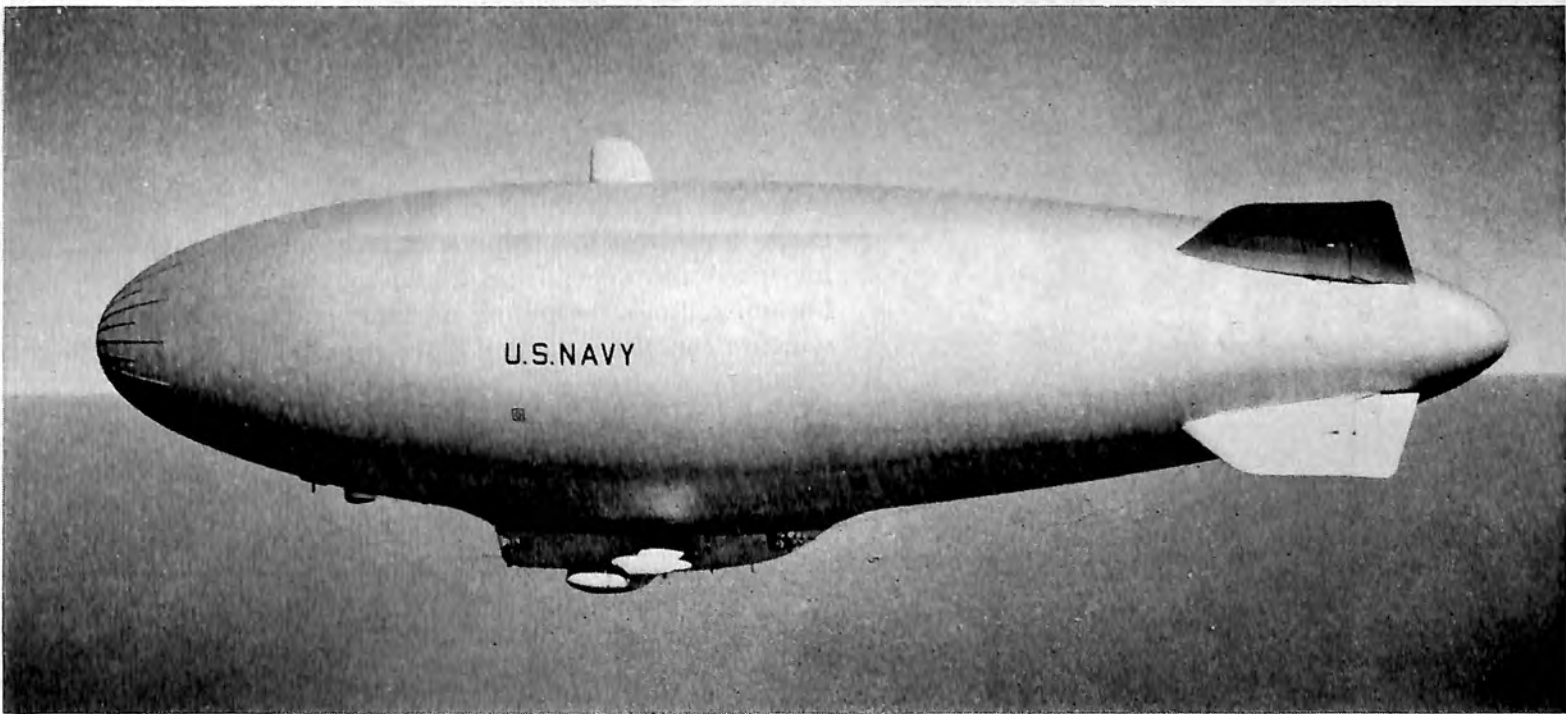
In March, the Navy ZPG-2 set a new world record for continuous flight (more than 300 hours).

### SPECIFICATIONS

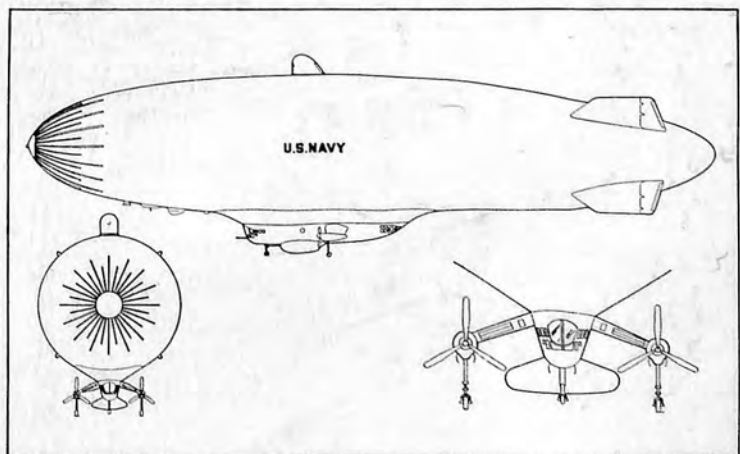
Width 75 ft.; Length 343 ft.; Height 108 ft.; Empty Weight 48,000 lb.; Engines Two Wright R-1300, 700 hp normal rates, or 800 hp at 2600 rpm takeoff; Fuel Capacity 3220 gal. without auxiliary tanks; Propeller Curtiss Electric; Envelop Volume 1,000,000 cu. ft.; Fin Area (Four) 2070 total sq. ft.; Rudder Area (Four) 988 total sq. ft.

### PERFORMANCE

Maximum Speed 70 knots; Cruise Speed 50 knots; Rate of Climb 2200 fpm at Sea Level.



Goodyear ZPG-2W





Goodyear ZS2G-1

#### REMARKS

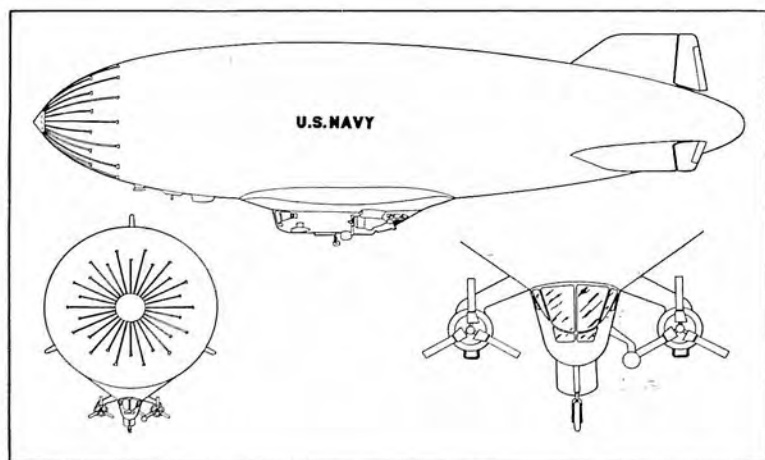
Power loading of this ship varies according to heaviness. Landing speed also depends on heaviness; it could be zero at equilibrium ceilings, depending on atmospheric conditions. Under standard conditions, ceiling is about 9000 feet. It can be higher if helium is valved.

#### SPECIFICATIONS

Width 68 ft.; Length 285 ft.; Height 92 ft.; Empty Weight 29,000 lb.; Engines Two Wright R-1300-4, 700 hp normal rates, or 800 hp at 2600 rpm takeoff; Fuel Capacity 2300 gal.; Propeller Curtiss Electric; Envelope Volume 650,000 cu. ft.; Fin Area 653 sq. ft.; Rudder Area 235 sq. ft.; Stabilizer Area 653 sq. ft. each; Elevator Area 235 sq. ft. each.

#### PERFORMANCE

Maximum Speed 73 knots; Cruise Speed 50 knots; Rate of Climb 2400 fpm at Sea Level.



## GRUMMAN AIRCRAFT ENGINEERING CORP.

BETHPAGE, LONG ISLAND, NEW YORK



### REMARKS

The F11F-1 Tiger Fighter (Navy) was the nation's first aircraft to use the "area rule" or indented fuselage concept. Originally designated F9F-9. Simplicity of design is evident throughout. Wings, swept to same degree as Cougars, are extremely thin. Entire upper and lower wing skins are machined from single sheets of aluminum alloy. Small portion of wing near the tip folds down manually for carrier storage. First flight was made July 30, 1954. Capable of carrying the most modern external stores, including air-to-air and air-to-ground missiles. A faster version, the F11F-1F, powered by a General Electric J79 engine and afterburner, was developed and flown successfully at Edwards Air Force Base, California, in May, 1956.

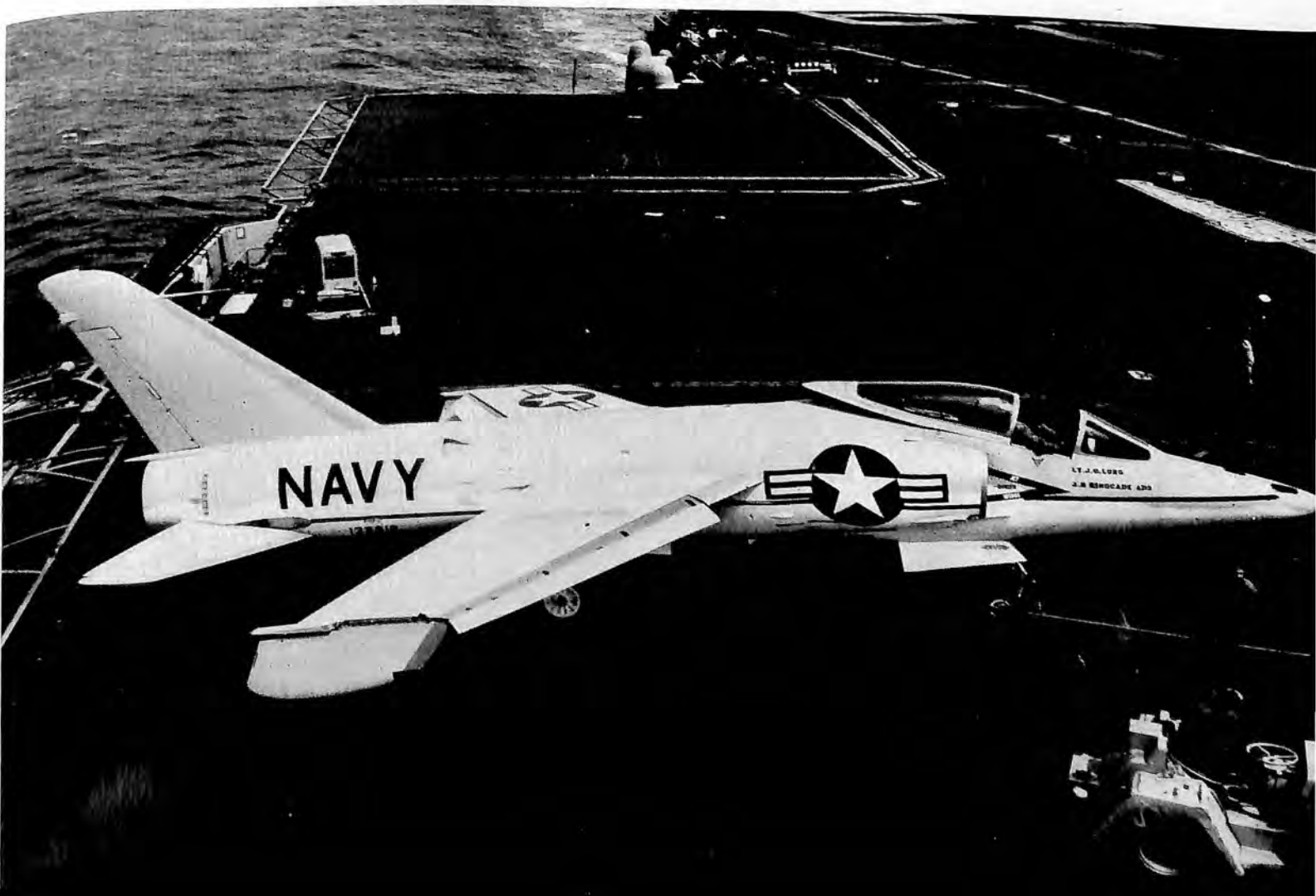
### SPECIFICATIONS

Span 31 ft. 7 in.; Length 40 ft. 10 in.; Height 12 ft. 8 in.; Engine Wright J65-W-6 with afterburner.

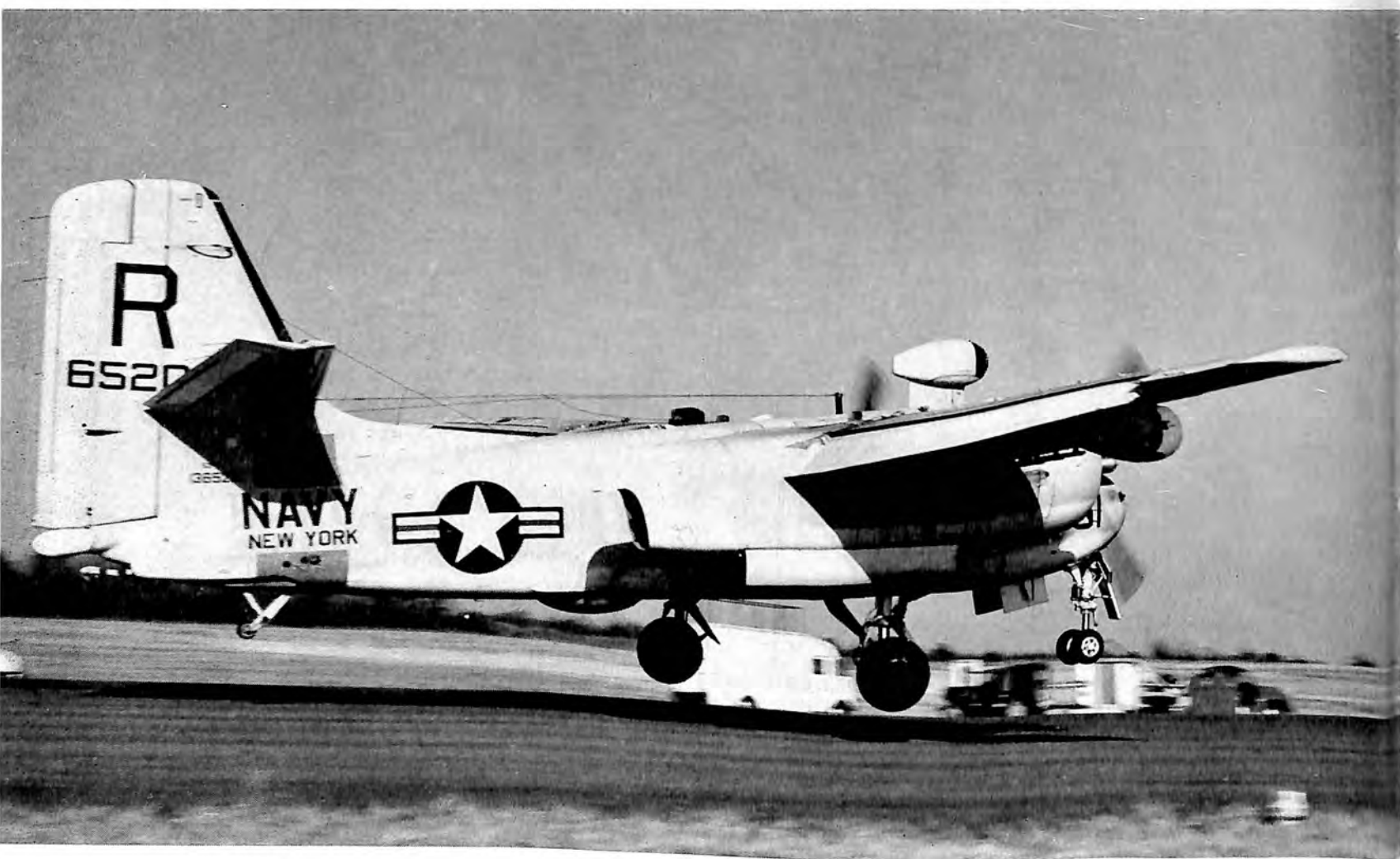
### PERFORMANCE

All data are classified.

Grumman F11F-1 Tiger Fighter







Grumman S2F-1 Tracker

#### REMARKS

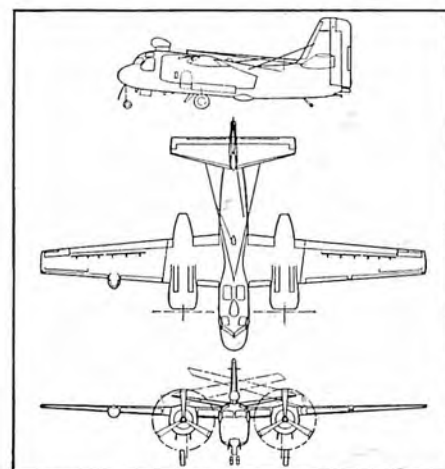
First anti-submarine carrier aircraft combining search and attack elements in one plane. Carries crew of four. Exceptional single-engine performance. Can land and take off from smallest carriers. Three modifications of S2F-1 also in production: S2F-2 features enlarged torpedo bay, while TF-1 is a passenger-cargo trainer-utility version, and WF-2 is early-warning version.

#### SPECIFICATIONS

Span 69 ft. 8 in.; Length 42 ft. 3 in.; Height 16 ft. 3 in.; Engines Two Wright R-1820-82, 1525 hp takeoff.

#### PERFORMANCE

All data are classified.



#### REMARKS

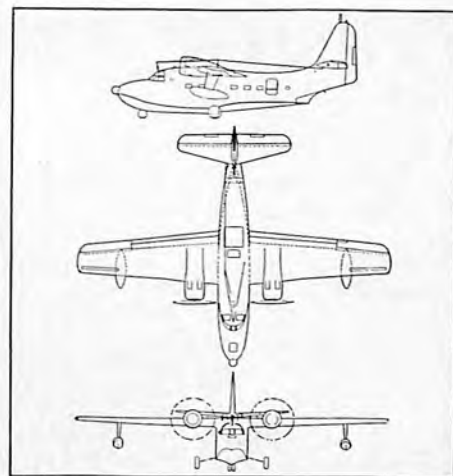
The Albatross, Grumman's largest amphibian, is used by the Air Force, Navy, and Coast Guard as a general utility aircraft capable of performing as a hospital plane or for air-sea rescue, cargo, transport or photographic duty. On active service with every Air Force Rescue Squadron throughout the world. Crew: 6. The SA-16B, a longer-range, faster version (pictured), has a greater wingspan and larger horizontal and vertical surfaces than the SA-16A, and is being integrated into Air Force service.

#### SPECIFICATIONS

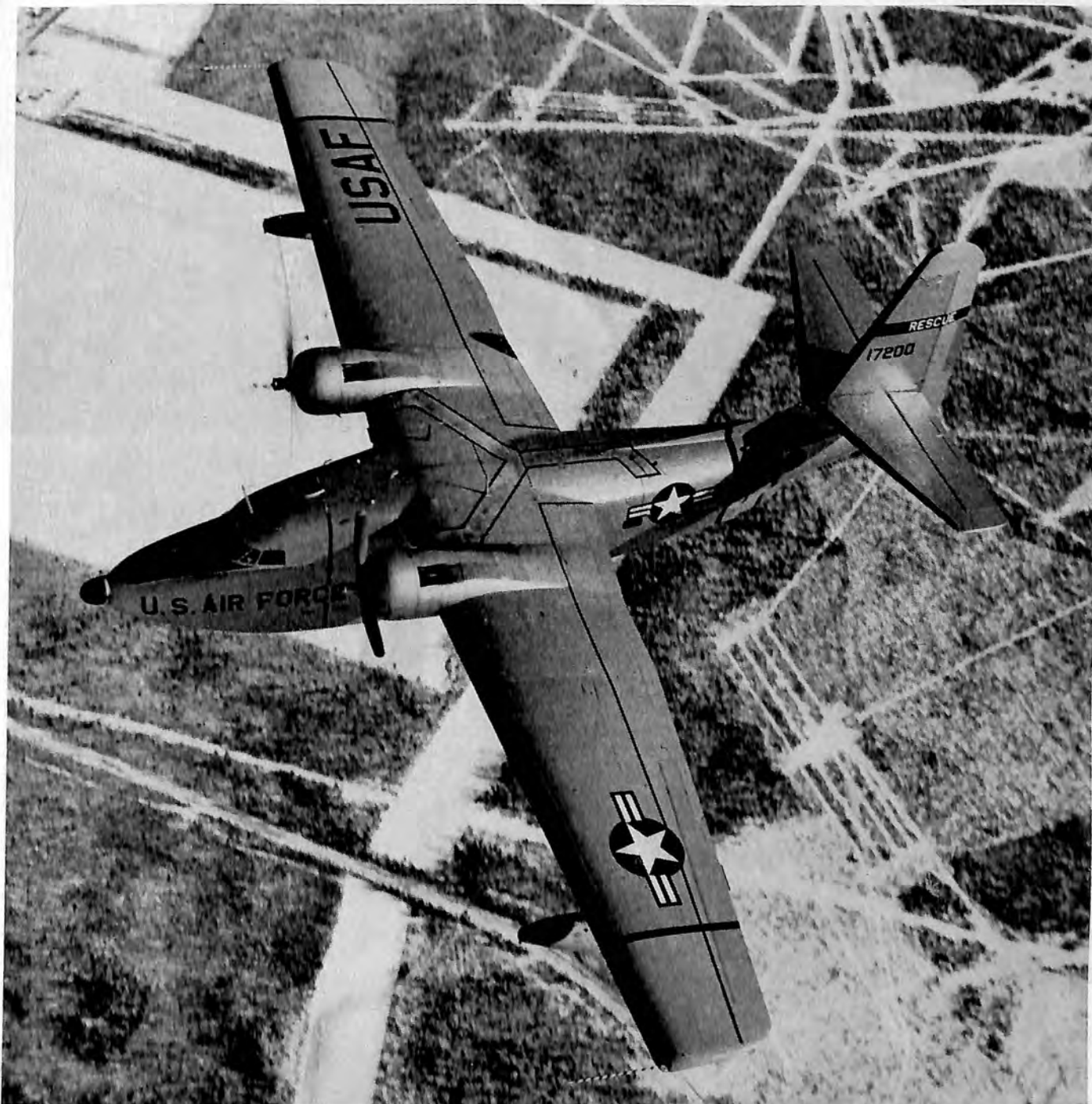
Span 80 ft.; Length 61 ft. 4 in.; Height 24 ft. 5 in.; Engines Two Wright R-1820-76, 1425 hp takeoff.

#### PERFORMANCE

Maximum Speed 277 mph; Cruise Speed 230 mph.



Grumman SA-16B Albatross





Grumman F9F-8T Cougar

**REMARKS**

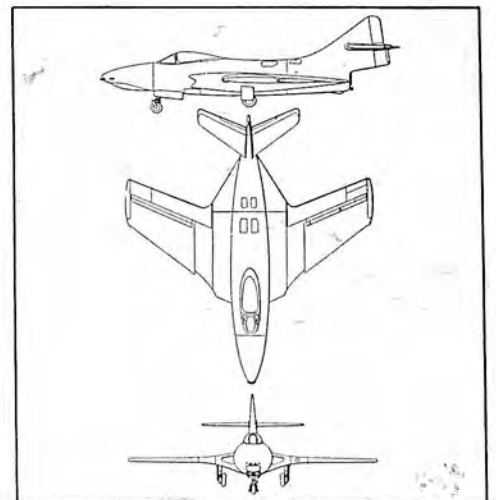
The F9F-8T Cougar is a two-seat version of the F9F-8 fighter. The "8T" is the Navy's only transonic fighter-trainer. In addition to being ready for service as an operational fighter, the two-seater permits Navy fliers to make a rapid transition to high performance fighter aircraft. A photo version of the Cougar, the F9F-8P, is also in service with the Navy.

**SPECIFICATIONS**

Span 34 ft. 6 in.; Length 48 ft. 6.5 in.; Height 12 ft. 1.2 in.; Engine Pratt & Whitney J48-P-8A.

**PERFORMANCE**

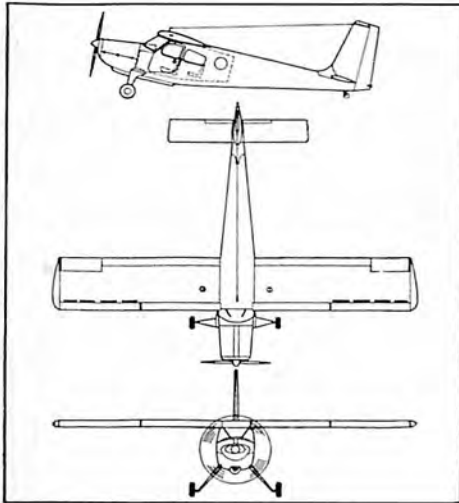
All data are classified.



**HELIO AIRCRAFT CORP.**  
PITTSBURG, KANSAS

**REMARKS**

This all-metal "heliplane" combines high speed and long range economy with stall-proof, slow flight and ultra short field utility. Takeoff and landing distance over 50-foot obstacle, no wind, at sea level, at gross weight, is 165 yards. Sea-level takeoff run, no wind is under 75 yards. The plane has full controllability down to speeds of 30 miles per hour. Eleven new features of the Courier are: full span leading-edge slats, high-lift slotted flap, low drag cantilever wing, geared engine and over-size propeller, an advanced control system, large landing gear, Goodyear castering wheels, special over-strength cabin and seat structure, new Griswold single-strap seat and chest belt, large baggage compartment and two large doors, left front and right rear. Airplane is also certificated on Edo floats and Federal wheel-ski gear.



**SPECIFICATIONS**

Span 39 ft.; Length 30 ft.; Height 8 ft. 10 in.; Empty Weight 1880 lb.; Gross Weight 3000 lb.; Overload Gross Weight 3500 lb. (per CAR 08); Engine Lycoming GO-435-C2B, 240 hp normal rated, or 260 hp at 3400 rpm takeoff; Fuel Capacity 60 gal.; Propeller constant speed; Wing Area 231 sq. ft.; Flap Area 74 percent span.

**PERFORMANCE**

Maximum Speed 169 mph at 100 percent hp at Sea Level; Cruise Speed 160 mph at 69 percent hp at 8500 ft.; Landing Speed 30 mph; Rate of Climb 1300 fpm; Service Ceiling 23,000 ft.; Range with Maximum Fuel Load 800 mi. at average true airspeed 150 mph.

**Helio Courier**



**HILLER HELICOPTERS**  
PALO ALTO, CALIFORNIA



Hiller H-23D (Army)

**REMARKS**

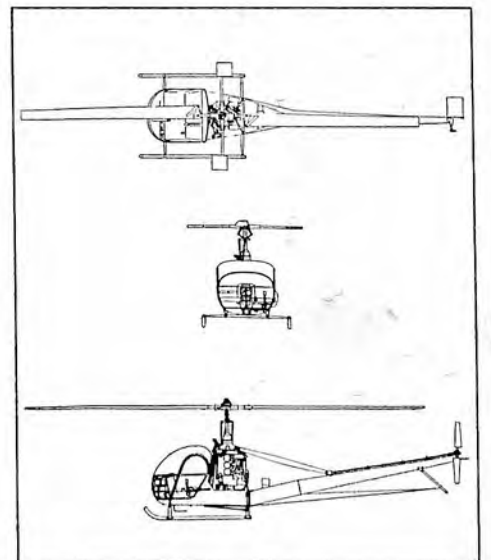
Major improvements of the H-23D over previous models include 1000 hour overhaul life drive system and a 50 horsepower increase (250 horsepower Lycoming VO-435). The advanced commercial UH-12D-1 further improves performance by installation of the 300 horsepower Lycoming VO-540 engine.

**SPECIFICATIONS**

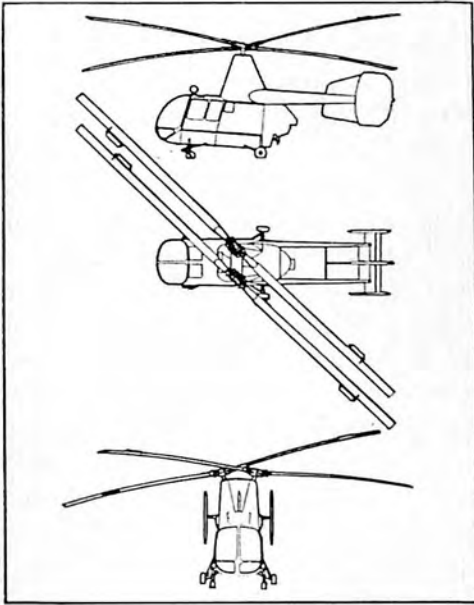
Main Rotor Diameter 35 ft.; Anti-torque Rotor Diameter 5 ft. 5 in.; Height 9 ft. 8 in.; Empty Weight 1789 lb.; Fuselage Length 27 ft. 8 in.; Useful Load 639 lb.

**PERFORMANCE**

Maximum Speed 92 mph at Sea Level; Cruise Speed 66 mph at Sea Level; Rate of Climb 1030 fpm at Sea Level; Service Ceiling 12,600 ft.; Range with Maximum Payload 173 mi.



**KAMAN AIRCRAFT CORP.**  
BLOOMFIELD, CONNECTICUT



**REMARKS**

General utility design can be readily converted to ambulance version carrying two litter patients and one medical attendant or an additional ambulatory patient, in addition to the pilot. The HOK-1 uses the patented Kaman servo-flap for blade control. The triple vertical fins provide directional stability in high speed flight. Stabilizer controllable from collective pitch control.

**SPECIFICATIONS**

Rotor Diameter 47 ft.; Length 25 ft.; Height 11 ft. 10 in.; Engine Pratt & Whitney R-1340, 600 hp at 2700 rpm.

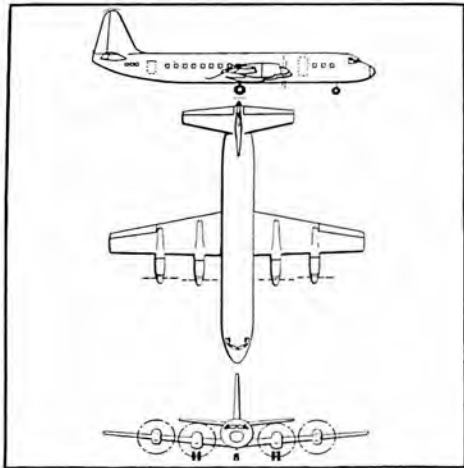
**PERFORMANCE**

Maximum Speed 95 knots at 8000 ft.; Cruise Speed 65 knots; Maximum Rate of Climb 1300 fpm; Service Ceiling 18,000 ft.; Range with Maximum Payload 220 mi.

**Kaman HOK-1 (Air Force H-43A)**



**LOCKHEED AIRCRAFT CORP.**  
BURBANK, CALIFORNIA



**REMARKS**

The Electra's first flight was scheduled for January 31, 1958. But production and flight test crews teamed to beat this goal by a wide margin, and the first Electra was airborne in 1957. Designed primarily for heavily traveled short-to-medium-range routes, the Electra is capable of transcontinental nonstop flight. However, it specializes in economical operation on shorter stages, rapid turnaround time at intermediate stops, altitude flexibility, fast block speeds on short and medium range flights. It carries from 66 to 91 passengers. It is powered by four Allison 501 prop-jet engines developing 3750 horsepower each and Aero-products 606 four-bladed propellers. Its power plants are half the weight of comparable piston engines and fit into nacelles only half as wide as for reciprocating units. Both cockpit and cabin feature excellent visibility, independent climate controls. Test flight program began well before flight of the first article, with both Lockheed and Allison flying the Electra's power plants on other test vehicles. Eastern Air Lines will put the Electra in service late in 1958. Other airlines ordering the Electra include American Airlines, National Air Lines, Braniff International Airways, Western Air Lines, KLM Royal Dutch Airlines, Cathay Pacific, PSA—Pacific Southwest Airlines, Garuda Indonesian Airways, Ansett/ANA, and Aeronaves de Mexico.

**SPECIFICATIONS**

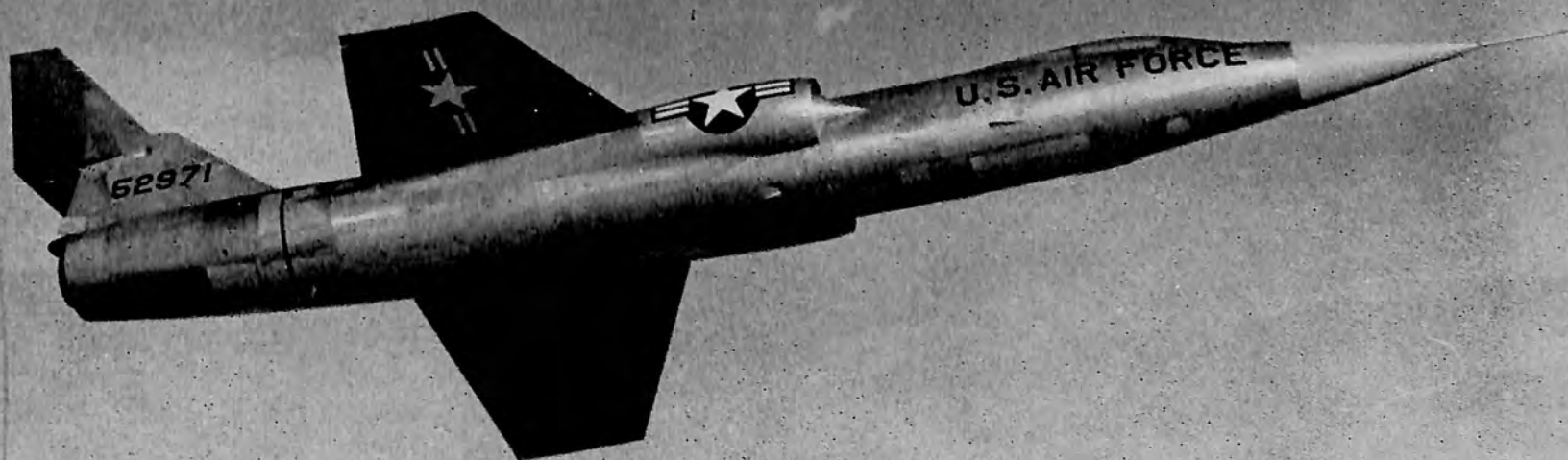
Span 99 ft.; Length 104 ft. 6.5 in.; Height 32 ft. 11 in.; Empty Weight 56,000 lb.; Gross Weight 113,000 lb.; Engines Four Allison 501-D-13 prop-jet, 3750 hp normal rated; Fuel Capacity 5360 gal.; Wing Area 1300 sq. ft.

**PERFORMANCE**

Maximum Speed 448 mph; Cruise Speed 405 mph; Rate of Climb 2400 fpm; Service Ceiling 30,000 ft.; Range with Maximum Payload 2360 mi.; Range with Maximum Fuel Load 2830 mi. with reserves.

**Lockheed Electra**





**Lockheed F-104A Starfighter**

**REMARKS**

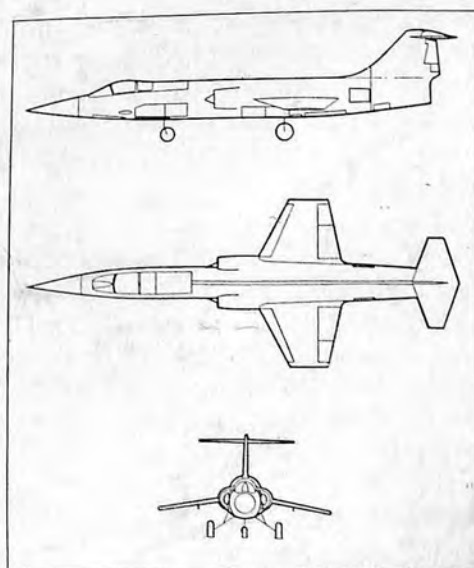
Can climb as fast as it flies straight and level. First downward ejection seat for a production jet fighter. First production fighter to incorporate boundary layer control. With BLC Starfighter can land in less distance than any present-day jet fighter. Razor-thin wings of Starfighter are thinner even than those on rocket research planes. A felt covering over the wing's leading edge protects ground crewmen when the plane is not flying. Starfighter is designed to carry missiles, rockets or even atomic bombs. F-104 design described as "the ultimate configuration for a manned fighter." Two-seat fighter (F-104B) also in production.

**SPECIFICATIONS**

Span 21 ft. 11 in.; Length 54 ft. 9 in.; Height 13 ft. 6 in.; Weighs less than any operational jet combat plane; Engine General Electric J79.

**PERFORMANCE**

Maximum Speed Ultrasonic; Service Ceiling upper stratosphere.







**Lockheed C-130A Hercules Troop/Cargo Transport**

**REMARKS**

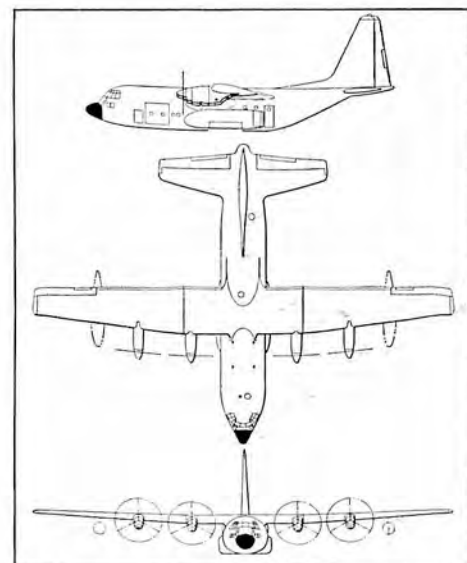
First production aircraft were delivered to the Tactical Air Command in 1956. The first prototype flew at Burbank, California, in 1954 and the first C-130A, the production version, flew at Marietta, Georgia, in April, 1955. The C-130A's military missions for the Tactical Air Forces include transport of personnel and material for delivery by parachute or landing as required. It can airlift up to 18 tons gross in a cargo compartment which has a clear cubage 41 feet by 10 feet by 9 feet. Up to 92 troops can be accommodated. As an aerial ambulance, it has provisions for quick installation of 74 litters. Normal crew is four: pilot, copilot, systems manager, and navigator.

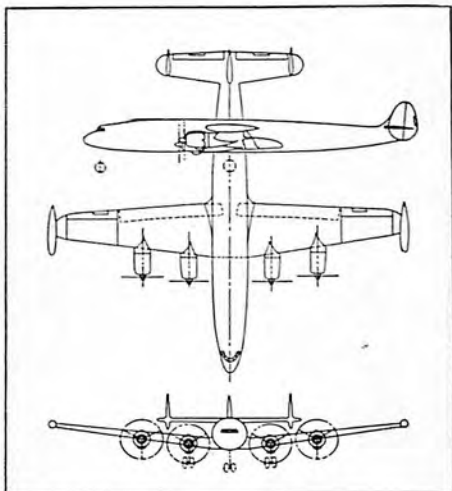
**SPECIFICATIONS**

Span 132 ft. 6.9 in.; Length 97 ft. 9 in.; Height 38 ft. 9 in.; Empty Weight 58,700 lb.; Wing Loading 71.3 lb. per sq. ft.; Power Loading 8.3 lb. per eshp; Engines Four Allison T56-A-1A, 3375 eshp normal power, or 3750 eshp at takeoff; Fuel Capacity 5080 gal.; Propeller Aero products three blades, 15 ft. diameter; Wing Area 1745 sq. ft.; Aileron Area 110 sq. ft.; Flap Area 342 sq. ft.; Fin Area 225 sq. ft.; Rudder Area 75 sq. ft.; Stabilizer Area 381 sq. ft.; Elevator Area 155 sq. ft.

**PERFORMANCE**

Maximum Speed 360 mph at normal hp at 18,000 ft.; Cruise Speed 350 mph at normal hp at 25,000 ft.; Stall Speed 95 mph; Rate of Climb 2300 fpm at Sea Level; Service Ceiling 32,000 ft.; Range with 36,900 lb. Payload 1730 mi.; Range with Maximum Fuel Load 2800 mi.





#### REMARKS

Model 1049H is a cargo-convertible-to-passenger version of the 1049G Super Constellation, with a fuselage specially stressed and designed for cargo loads upwards of 20 tons. Easily convertible to 94 passenger (crew of 9) configuration, with removable cabin racks, sidewall linings, lavatories, buffet, and other facilities such as reading lights and passenger service equipment.

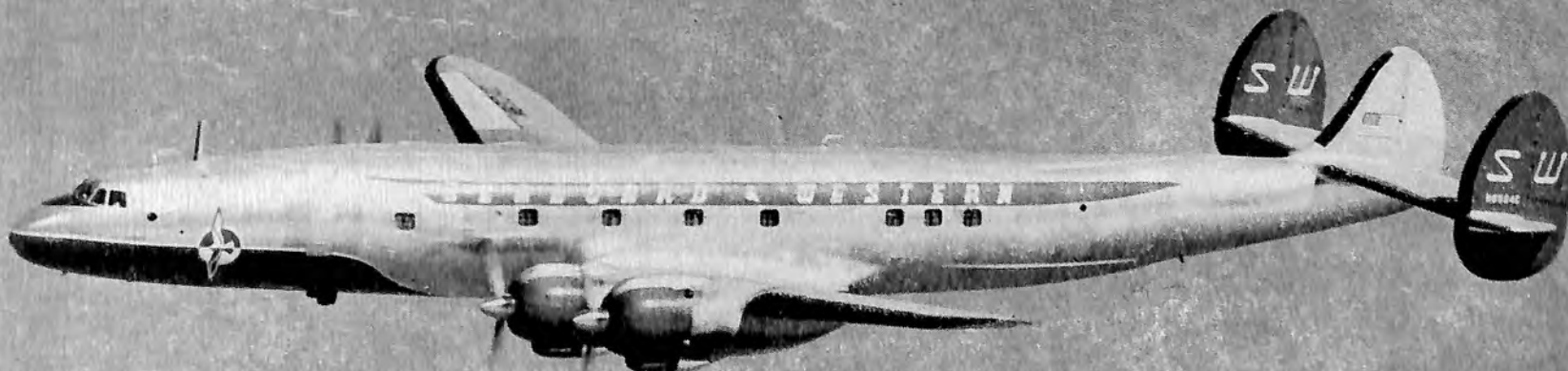
#### SPECIFICATIONS

Span 123 ft.; Length 113 ft. 7 in.; Height 24 ft. 9 in.; Empty Weight 70,686 lb.; Maximum Gross Takeoff Weight 140,000 lb.; Wing Loading 84.8 lb. per sq. ft.; Power Loading 10.6 lb. per bhp; Engines Four Wright 988TC18EA6, 2860 bhp normal rated at Sea Level, or 3400 hp at 2900 rpm takeoff at Sea Level; Fuel Capacity 6550 gal.; Propeller Hamilton Standard 43H60-331; Wing Area 1650 sq. ft.; Aileron Area 99.6 sq. ft.; Flap Area 295.4 sq. ft.; Fin Area 216.8 sq. ft.; Rudder Area 91.2 sq. ft.; Stabilizer Area 356.8 sq. ft.; Elevator Area 106.8 sq. ft.

#### PERFORMANCE

Maximum Speed 346 mph at 2390 hp at 2600 rpm at 19,400 ft.; Cruise Speed 327 mph at 1810 hp at 22,600 ft.; Landing Speed 99 mph; Rate of Climb normal rated power 1685 fpm at Sea Level; Service Ceiling 28,100 ft. at 113,000 lb.; Range with Maximum Payload 2837 mi.; Range with Maximum Fuel Load 4447 mi.

#### Lockheed 1049H



#### REMARKS

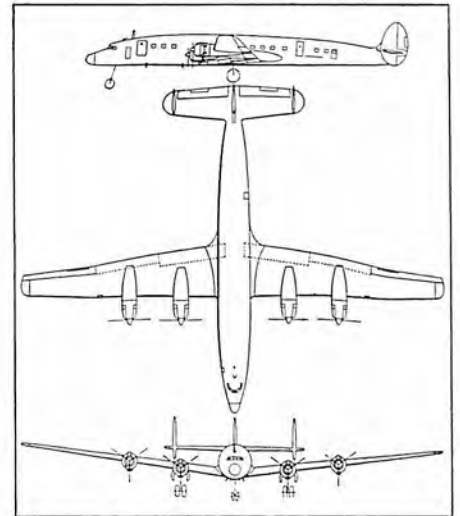
The 1649A Starliner's new wing, designed for maximum speed/range characteristics, resulted in several long-distance flight records: Burbank-Paris, Burbank-Hamburg, Los Angeles-London, New York-Athens, and London-San Francisco. Fastest California-Europe time was 16 hours 21 minutes between Burbank and Paris. Carrying 58 to 62 passengers in luxury configuration, or up to 92 tourist style, the 1649A features extremely low cabin sound levels because engines are placed farther out on long wing and propeller tip travel slowed. Provisions are made for weather surveillance/navigational radar to permit avoidance of turbulent air.

#### SPECIFICATIONS

Span 150 ft.; Length 116 ft. 2 in.; Height 23 ft. 5 in.; Gross Weight 156,000 lb.; Engines Four Wright EA-2 R-3350 turbo-compound, 3400 hp; Fuel Capacity 9600 gal.; Wing Area 1850 sq. ft.

#### PERFORMANCE

Maximum Speed 372 mph at 18,600 ft.; Cruise Speed 342 mph at 22,600 ft.; Landing Speed 101 mph; Rate of Climb 1660 fpm at Sea Level; Service Ceiling 29,700 ft.; Range with Space Limit 5000 mi.; Range with Maximum Fuel Load 6320 mi. plus reserves.



Lockheed 1649A Starliner

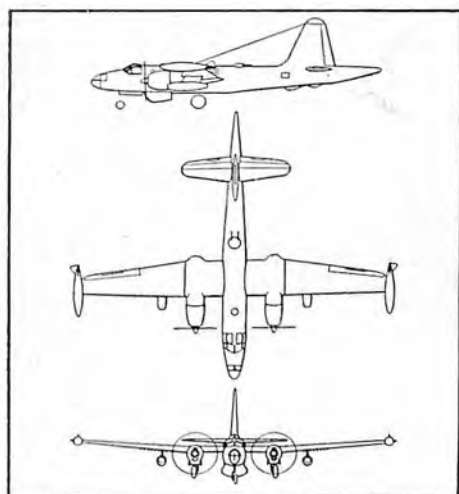




Lockheed P2V-7 Neptune

#### REMARKS

The P2V-7 is the latest in the Neptune anti-submarine series. Identifying features are the double-bubble canopy, jet pod engines supplementing its turbo-compound powerplants, and an elongated tail housing MAD (magnetic anomaly detector) gear for locating underwater craft. A versatile plane, the Neptune can be converted for patrol, mine laying or torpedo bomber duty. The jet engines, included now on all production planes, can be used whenever desired: for extra power on takeoffs and extra speed at any time during mission. Lockheed modified earlier P2V-5 and P2V-6 airplanes with jet pods. Four ski-equipped Neptunes were flown by Navy in Operation Deep-freeze III at South Pole.

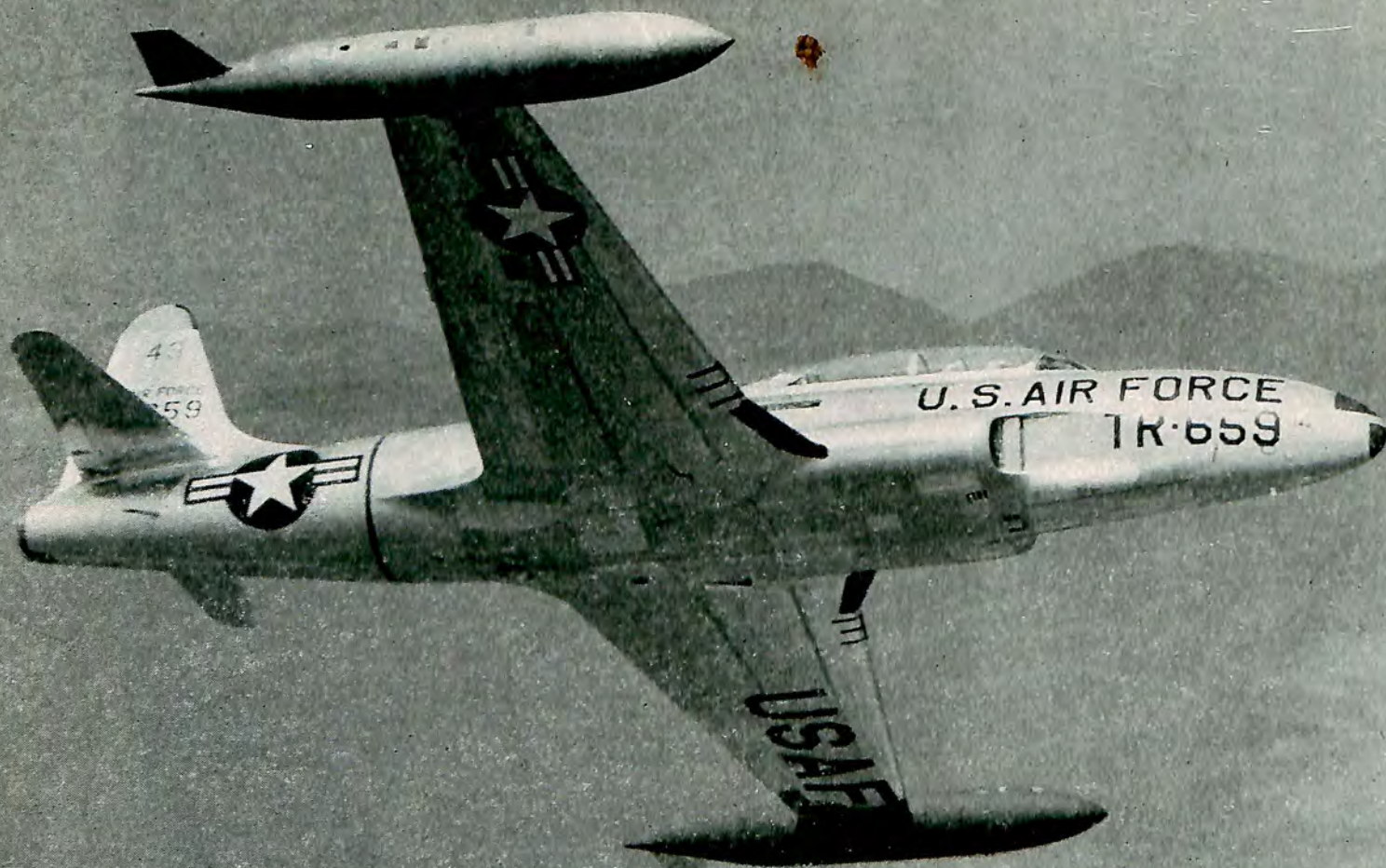


#### SPECIFICATIONS

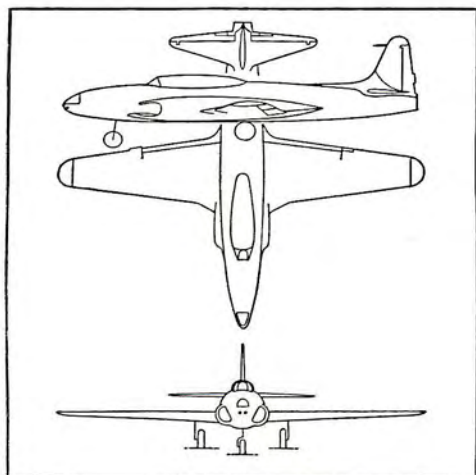
Span 101 ft. 6 in. with tip tanks; Length 91 ft. 5 in.; Height 29 ft. 4 in.; Empty Weight 46,046 lb., with jet pod engines 49,456 lb.; Gross Weight 75,310 lb., with jet pods 78,760 lb.; Engines Two Wright R-3350-32W turbo-compound, 3250 hp, and Two Westinghouse J34 engines in pods, 3400 lb. thrust; Propeller Hamilton Standard four-blade; Wing Area 1000 sq. ft.

#### PERFORMANCE

Maximum Speed without pods 345 mph; Service Ceiling 23,000 ft. without pods.



**Lockheed T-33A Shooting Star**



**REMARKS**

The T-33 is a development of the F-80 Shooting Star, first standard jet plane in the military services. It has been in service since 1948 and is now being built for both the Air Force and Navy and also several foreign powers through the Mutual Defense Assistance Pact. T-33's are also being produced by Canadair Ltd., Montreal, for the Royal Canadian Air Force and Kawasaki Aircraft, GIFU, for the Japanese Air Self Defense Force. In addition to being the standard jet trainer in this country, T-33's have been used to train pilots from Holland, France, Belgium, Turkey, Greece, Denmark, Norway, Italy, Portugal, Spain, Yugoslavia, Nationalist China, Japan, Thailand, Cuba, Colombia, Venezuela, Peru, Chile, and the Philippines. Crew: 2.

**SPECIFICATIONS**

Span 38 ft. 10.5 in.; Length 37 ft. 8 in.; Height 11 ft. 8 in.; Empty Weight 8400 lb.; Gross Weight 15,000 lb.; Wing Loading 60.8 lb. per sq. ft.; Engine Allison J33-35, 5400 lb. thrust at 11,750 rpm at Sea Level; Fuel Capacity 683 gal. including tip tanks.

**PERFORMANCE**

Maximum Speed 580 mph; Rate of Climb 5525 fpm; Service Ceiling 45,000 ft.; Range 1345 mi.

**REMARKS**

The T2V-1 is the first U. S. production airplane with boundary layer control as standard equipment, and the first two-place jet trainer for pilot training on seagoing aircraft carriers. The seagoing T2V-1, which flies its student-instructor crew at a 600 mile-per-hour clip but lands at only 97 miles per hour, can perform all the maneuvers of a standard Navy fighter. Its boundary layer control system by which compressed air from the engine is channeled into the wing and squirted through tiny holes directed at the flaps causes normal airflow to hug the control surfaces and provide greater lift as well as improved anti-stall performance. Other new features are a raised rear seat to give the "back-seat driver" fuller vision; movable slats on the wings' leading edge, for better low-speed stability; an arresting hook for carrier landings; a higher and larger horizontal stabilizer than on previous Lockheed jet trainers; and a simplified cockpit with instruments which give two readings from one dial. T2V-1's are now in production at Lockheed's California Division, Burbank, California.

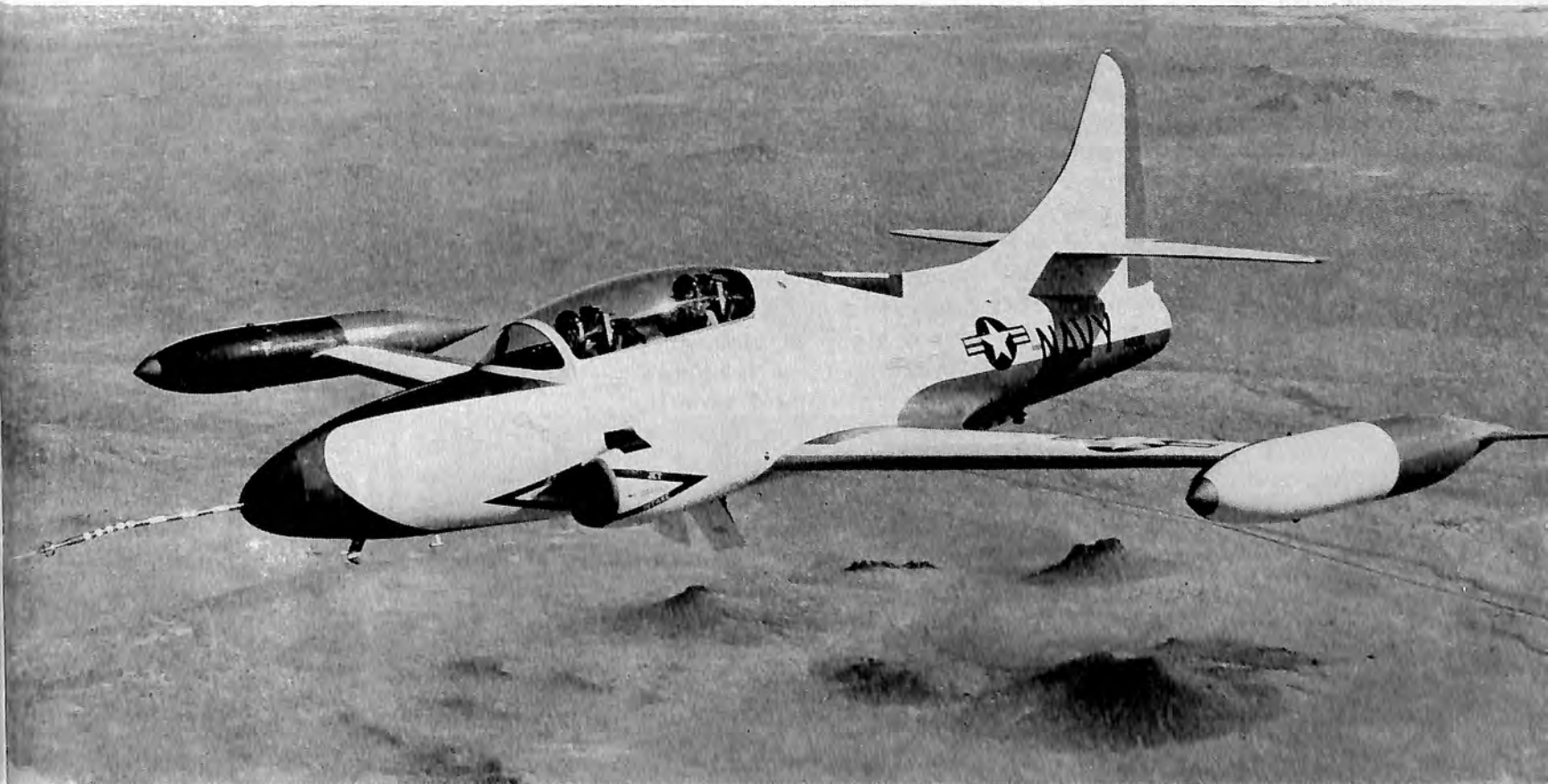
**SPECIFICATIONS**

Span 42 ft. including 203-gal. tip tanks; Length 38 ft.; Height 13 ft.; Approximate Gross Takeoff Weight 16,400 lb.; Engine Allison J33; Fuel Capacity 760 gal.

**PERFORMANCE**

Maximum Speed 600 mph; Landing Speed 97 mph; Approximate Range 900 mi.

Lockheed T2V-1 SeaStar





**Lockheed RC-121D Super Constellation**

#### REMARKS

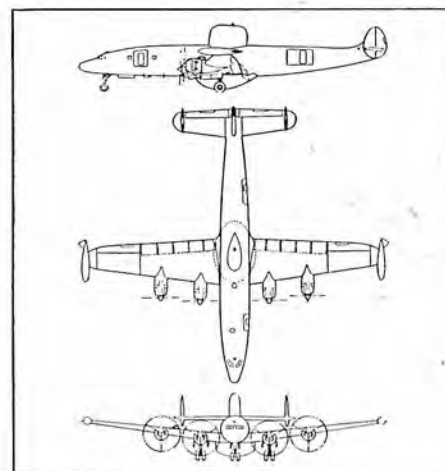
The RC-121D, newest version, has added two 600-gallon wingtip fuel tanks and a 1000-gallon fuselage tank for extra hours aloft. Fuel capacity on the RC-121D totals 8750 gallons, 2200 gallons more than previous models. These high-altitude reconnaissance aircraft bulge with more than six tons of electronic detection apparatus. The craft are designed to carry the military services' most powerful search radar to high altitudes where radar beams (which cannot bend over the horizon) attain their maximum effectiveness in spotting either surface or air targets. Exact effective range of the radar was not revealed. RC-121's are special versions of Lockheed's Super Constellation. The Air Force version is being used to give air-defense forces extra-early warning of approaching targets. The WV-2's are used by the Navy to screen U. S. fleets and provide seaward extensions of the Dewline. Two complete flight crews plus a group of electronics specialists, a total of 31 men in all, make up the flying ship's complement. WV-3 (weather reconnaissance version) now in operation with U. S. Navy.

#### SPECIFICATIONS

Span 123 ft.; Length 116 ft.; Height 26 ft.; Empty Weight 81,000 lb.; Gross Weight 145,000 lb. (based on claim with two wing tip tanks); Wing Loading 87 lb. per sq. ft.; Engines Four Wright R-3350-34, 3250 hp takeoff, 2600 hp cruise; Fuel Capacity 8000 plus gal.; Propeller Hamilton Standard 6903A three-bladed 15 ft.; Wing Area 1650 sq. ft.

#### PERFORMANCE

Maximum Speed approximately 300 mph; Cruising Speed 200 plus mph; Landing Speed 105 mph; Rate of Climb 800 fpm; Service Ceiling 20,000 plus ft.; Range with Maximum Fuel Load 3500 plus nautical mi.



## McDONNELL AIRCRAFT CORP.

ST. LOUIS 3, MISSOURI

### REMARKS

The F-101A currently holds the official world's speed record of 1207.6 miles per hour. (See Aviation Events.)

Designed to meet Air Force requirements for a high-performance, strategic fighter, the F-101A (pictured here) has been in squadron service with the Tactical Air Command since May, 1957. With its all-weather radar and versatile heavy armament, the F-101A can perform the role of a fighter and is designed to deliver the atomic bomb at extreme ranges, utilizing its unique inflight refueling capabilities. It utilizes the "flying boom," "probe-drogue," and buddy tank systems of inflight refueling. Most of the unusually large fuel load which gives the Voodoo such extreme range is contained in the fuselage. Provisions have also been made for carrying extra fuel externally. On missions of shorter range, this large capacity can be utilized to carry a huge payload of bombs and rockets. Both wings and stabilizer are swept back at an angle of 35 degrees. The wing skin consists of heavy, tapered, pre-formed sections. Like the other two versions of the Voodoo, the F-101A employs a tricycle landing gear and hydraulically-operated retractable speed brakes in the aft fuselage section.

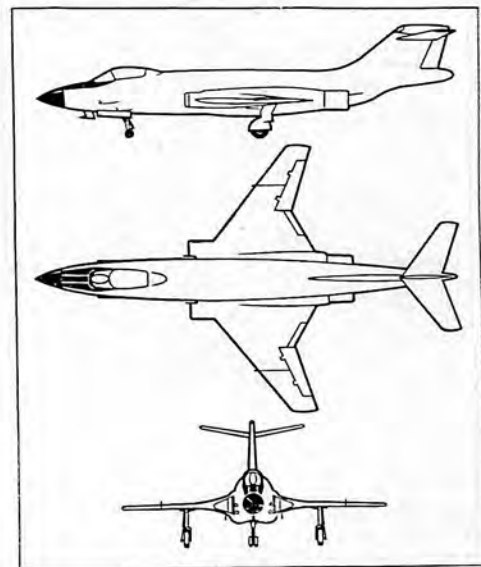
The F-101B, newest version of the fighter, successfully completed its first test flight on March 27, 1957. It is a two-seat interceptor designed for duty with the USAF's Air Defense Command. Similar in appearance to the F-101A, it will carry a radar observer and have additional armament and electronic equipment. The F-101B will operate under all-weather conditions to execute two primary missions—the identification of unknown aircraft, and their destruction if they are hostile. In addition to being a long-range interceptor, the F-101B is designed to achieve exceptional "climb" performance and to operate at extremely high altitudes. The Voodoo interceptor is capable of inflight refueling by the "probe-drogue" system.

### SPECIFICATIONS

Span 40 ft.; Length 67 ft. 5 in.; Height 18 ft.; Engines Two Pratt & Whitney J57.

### PERFORMANCE

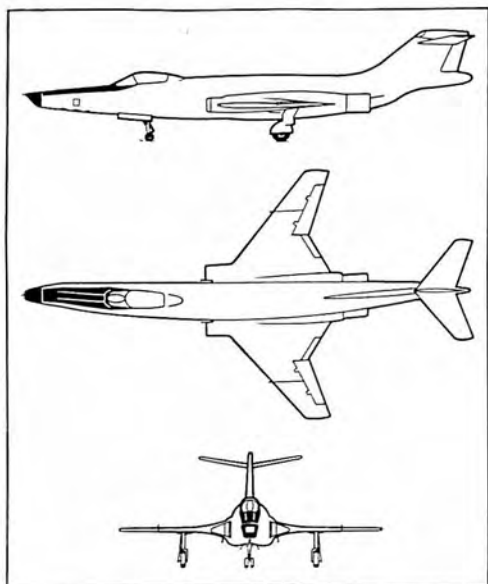
Speed over 1200 mph. All other data classified.



McDonnell F-101A Voodoo







#### REMARKS

The RF-101 Voodoo photo-reconnaissance plane is a supersonic photo-recon aircraft and currently holds three transcontinental speed records. (See Aviation Events.) First squadron deliveries were made to the Tactical Air Command on May 6, 1957. The RF-101 closely resembles its fighter counterpart. Slightly lighter in weight, the RF-101 has the same high performance characteristics as the fighter version of the Voodoo. Its two Pratt & Whitney J57 engines give the Voodoo 20,000 pounds of thrust class, without afterburning. The RF-101 employs a tricycle landing gear and hydraulically-operated retractable speed brakes in the aft fuselage section. The photo reconnaissance Voodoo was developed through the joint efforts of the Air Force Reconnaissance Laboratory at Wright Air Development Center and McDonnell Aircraft.

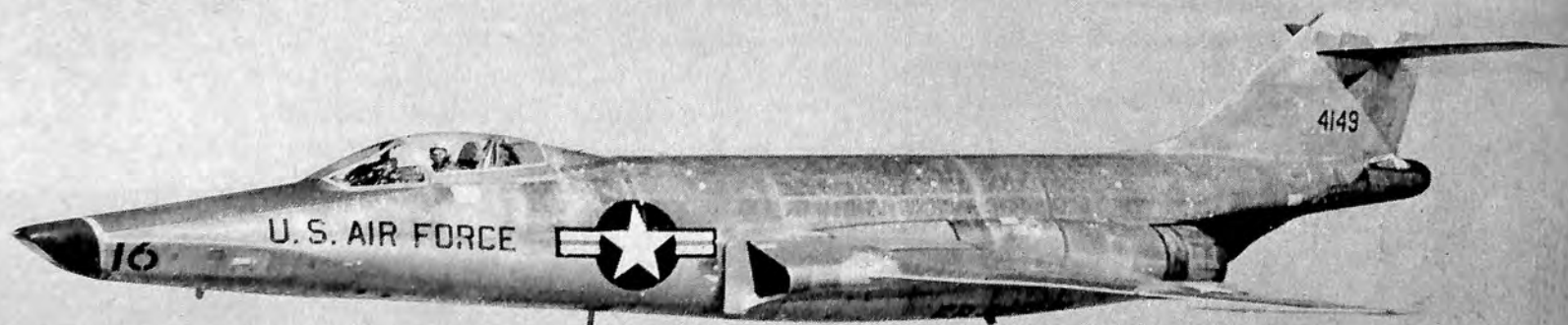
#### SPECIFICATIONS

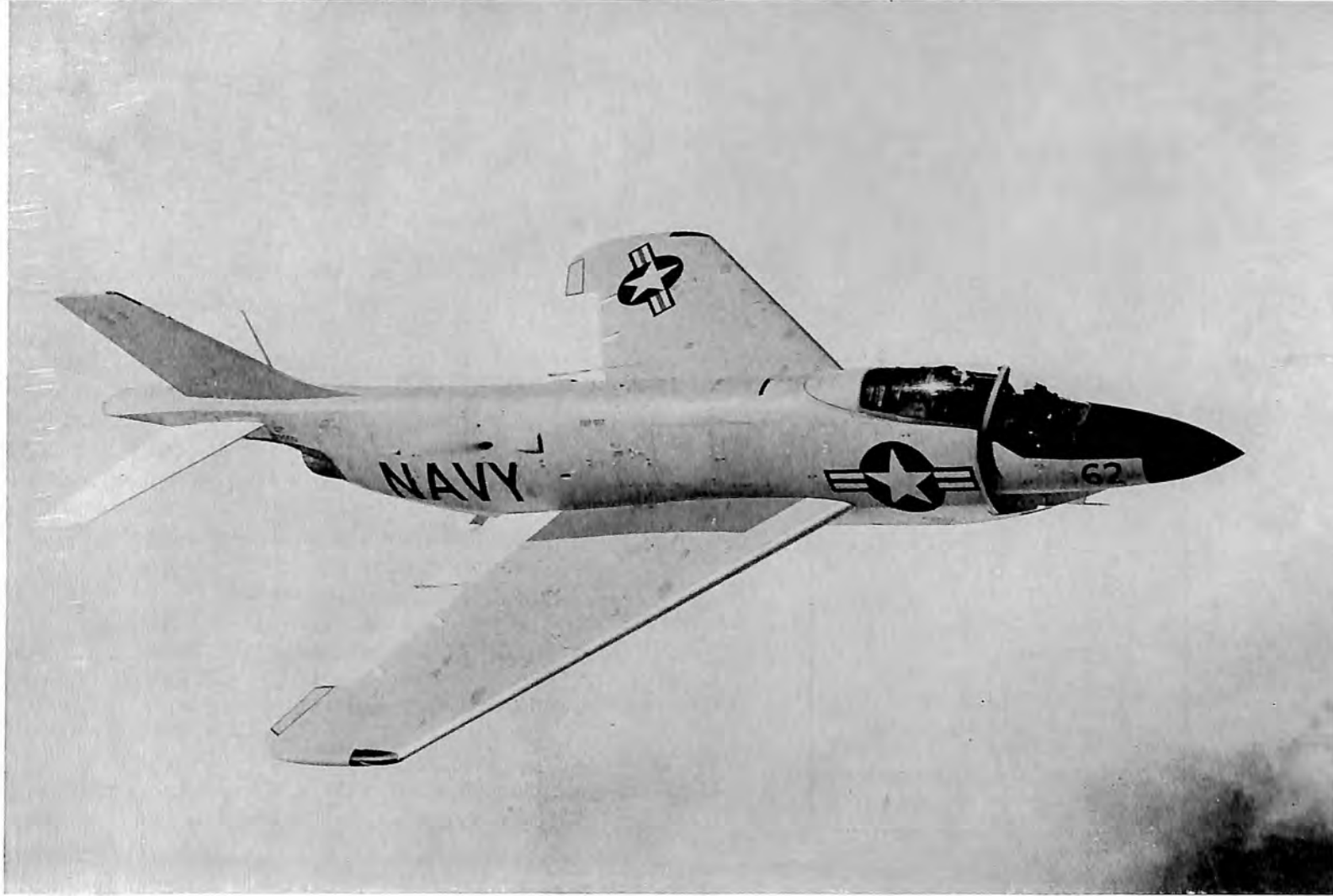
Span 40 ft.; Length 69 ft. 3 in.; Height 18 ft.; Engines Two Pratt & Whitney J57.

#### PERFORMANCE

Speed over 1000 mph. All other data classified.

#### McDonnell RF-101 Voodoo

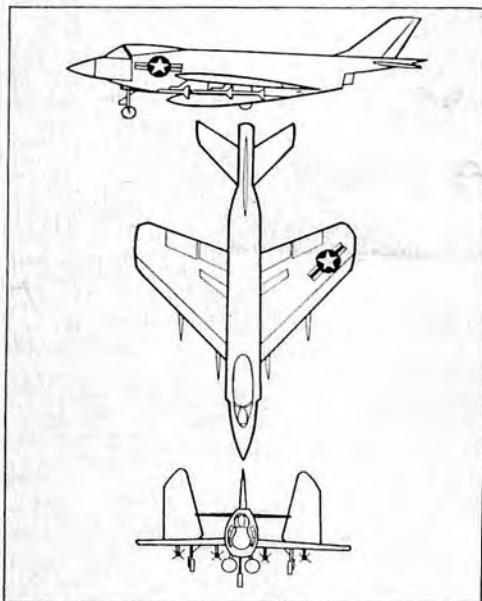




**McDonnell F3H-2 Demon**

**REMARKS**

The McDonnell F3H Demon is a single place, high performance, general purpose jet fighter for the Navy. It is one of the fastest, all-weather fighters in fleet operation. The Demon is produced in three versions—the F3H-2N, F3H-2M, and the F3H-2. In addition to four 20 mm rapid-firing cannon, this extremely versatile airplane carries unusually heavy loads of various external combinations of missiles, including the Sparrow III and Sidewinder, rockets, bombs, fuel tanks, and miscellaneous stores depending on the nature of the mission. The Demon, which combines interceptor speeds and fighter maneuverability with the payload of an attack bomber, has a 45-degree swept wing, designed for supersonic speeds, and its radar assures all-weather and night operational ability. The Allison J71 engine which powers the F3H provides in excess of 10,000 pounds of thrust without afterburner. The F3H now has been in operational service for nearly two years, and the plane has been enthusiastically received by pilots of both Atlantic and Pacific fleet squadrons.



**SPECIFICATIONS**

Span 35 ft. 4 in.; Length 58 ft. 11 in.; Height 14 ft. 7 in.; Empty Weight 22,133 lb.; Engine J71-A-2, 10,000 lb. thrust class; Fuel Capacity 1506 gal.; Wing Area 519 sq. ft.

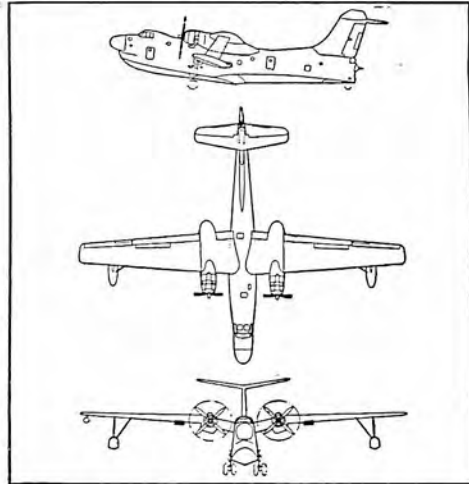
**PERFORMANCE**

All data are classified.

**THE MARTIN CO.**  
BALTIMORE 3, MARYLAND

**REMARKS**

The Marlin is an advanced anti-submarine warfare seaplane in service with Navy patrol squadrons in both Atlantic and Pacific fleets. Plane carries electronic search and detection gear, including a radar scanner in its bow radome and a Magnetic Airborne Detector unit on its tail assembly. Marlin is the first seaplane with the "New Look" in hull design, featuring an extended hull afterbody. Hydroflaps installed on both sides of this afterbody near the tall T-shaped tail serve as a brake when opened together, or as a rudder when opened separately. Plane carries a crew of seven, and a substantial load of depth charges, bombs, torpedoes, rockets, and/or mines.



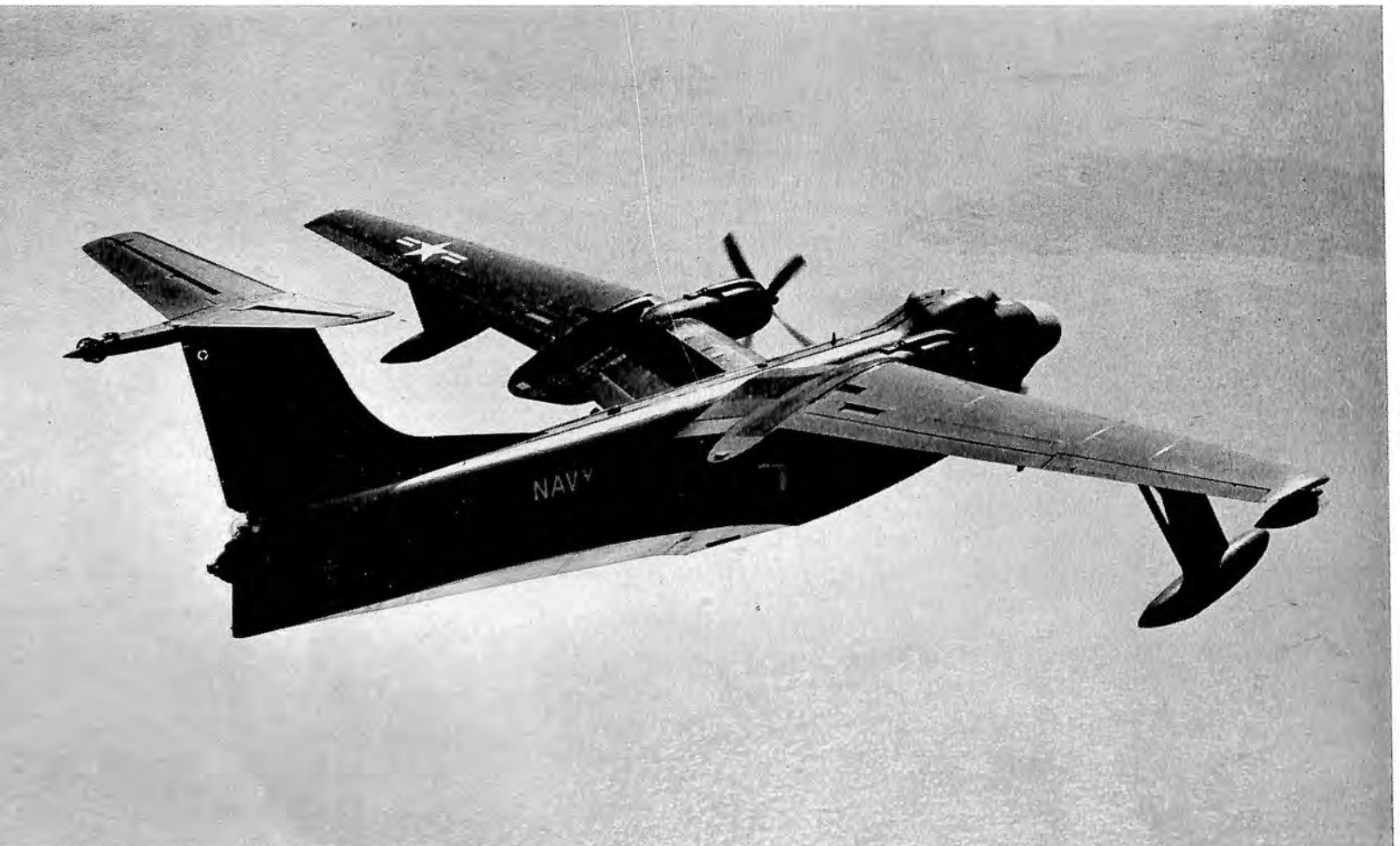
**SPECIFICATIONS**

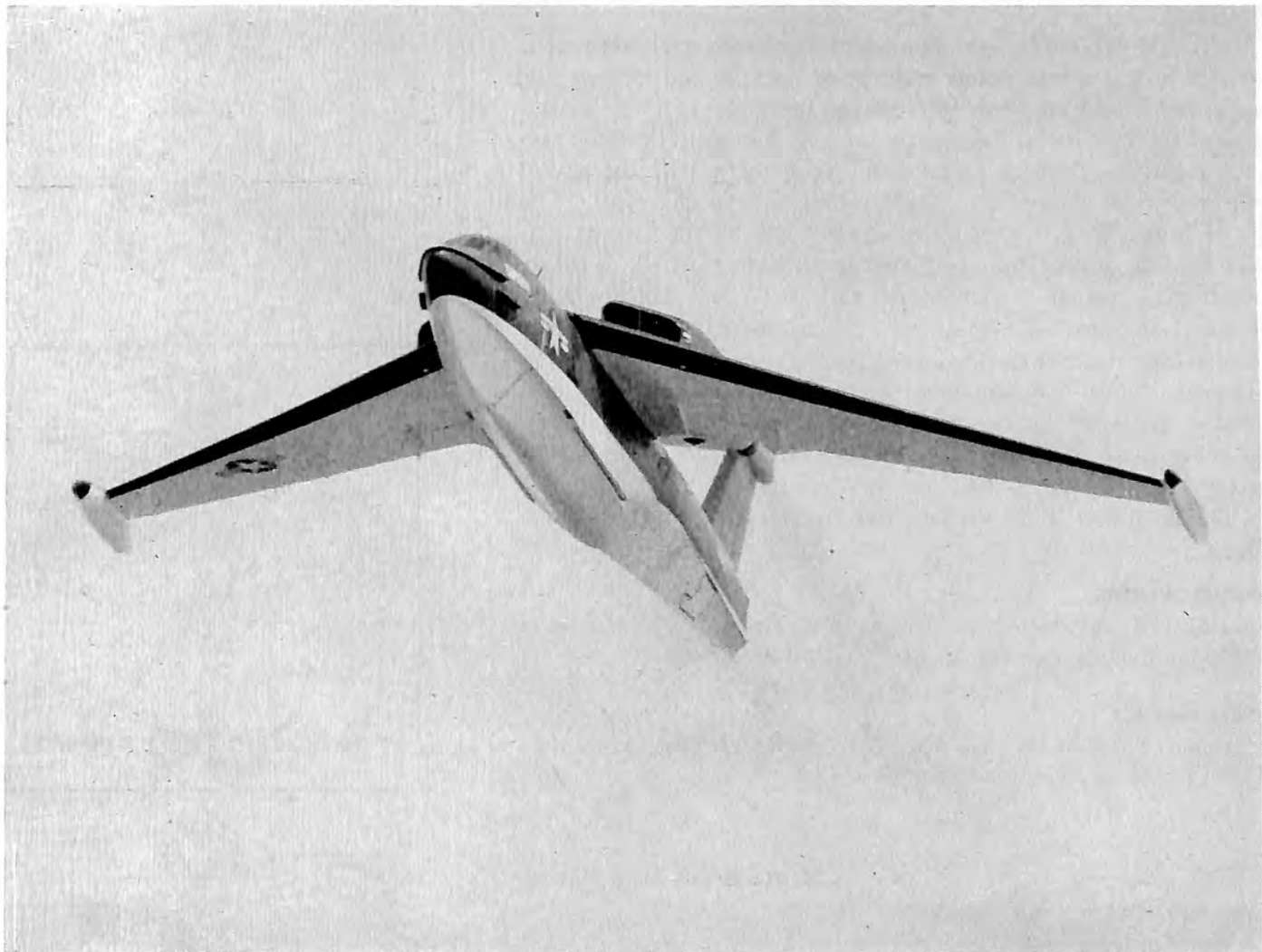
Span 118 ft.; Length 98.9 ft.; Height 33 ft.; Hull Width 10 ft.; Gross Weight over 73,000 lb.; Engines Two Wright R-3350-32W; Propeller Hamilton Standard four-blade reversible.

**PERFORMANCE**

Maximum Speed 250 mph; Landing Speed 97 mph; Range 2500 nautical mi.; Fuel Capacity 3635 gal.; Takeoff Power 3400 bhp.

**Martin P5M-2 Marlin**





**Martin P6M-1 SeaMaster**

**REMARKS**

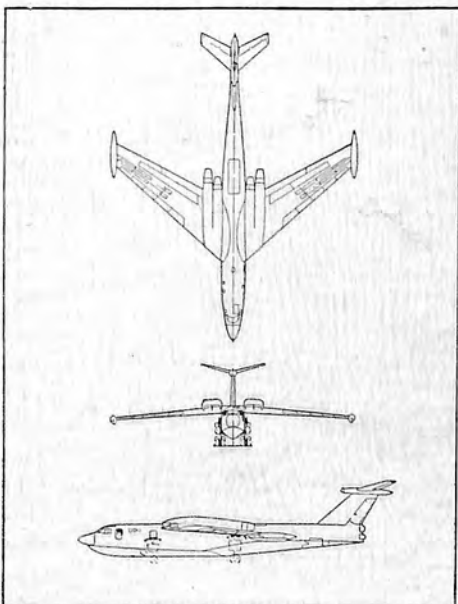
This Navy attack seaplane features long slender hull with a high T-shaped tail and twin sets of streamlined engine nacelles atop swept-back wings. Has water-tight rotary mine door on which a variety of weapons, including mines or camera pod, can be installed interchangeably while the plane is afloat or on its beaching gear. Fixed wing-tip floats provide buoyancy while the plane is at rest in the water. Hydroflaps on both sides of the hull afterbody act as a brake when opened together, or as a rudder to permit short turns when opened separately. Hinged panels extending the full length and width of engine nacelles permit engine changes while afloat.

**SPECIFICATIONS**

Span 100 ft.; Length 134 ft.; Height 31 ft.; Payload 30,000 lb.; Engines Four Allison J71 turbojets; Wing Area 1900 sq. ft.; Vertical Tail Area 213 sq. ft.

**PERFORMANCE**

Maximum Speed over 600 mph; Normal Cruise Altitude 40,000 ft.; Unrefueled Combat Radius 1500 mi.; Gross Weight 160,000 lb.



#### REMARKS

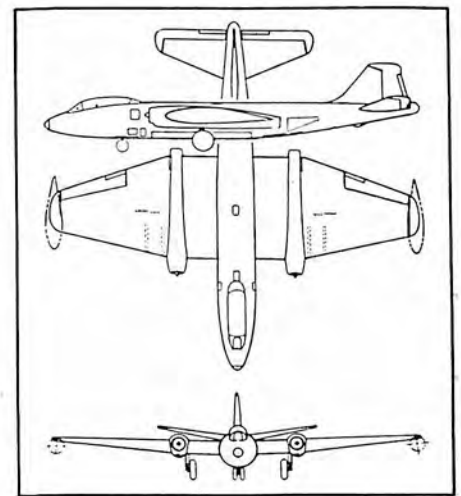
The B-57B Air Force light bomber differs from earlier versions in that it has a completely redesigned cockpit and canopy and has speed brakes on both sides of the fuselage. Primary advantage of the new cockpit is greatly improved visibility for the two crew members. Seating is a tandem arrangement, with the second officer directly behind and slightly higher than the pilot. The speed brakes give more control during low altitude operations and landing approaches. Included in the armament is a rotary bomb door which is removable and preloaded before being replaced in position. Bomb or rockets are carried internally until release time when the door is turned over making the stores external. Additional armament includes four 20 mm wing cannons or eight .50 caliber machine guns, and rockets or bombs on wing pylons. Other versions: B-57A, test vehicles; RB-57, reconnaissance type; B-57C, has dual controls, otherwise similar to B-57B; B-57D, high-altitude test bed; B-57E, tow-target airplane.

#### SPECIFICATIONS

Span 64 ft.; Length 65 ft. 5 in.; Height 16 ft.; Gross Weight more than 50,000 lb.; Engines Two Wright J65-W-5, 7220 lb. thrust.

#### PERFORMANCE

Maximum Speed more than 600 mph; Service Ceiling more than 45,000 ft.; Range more than 2000 mi.



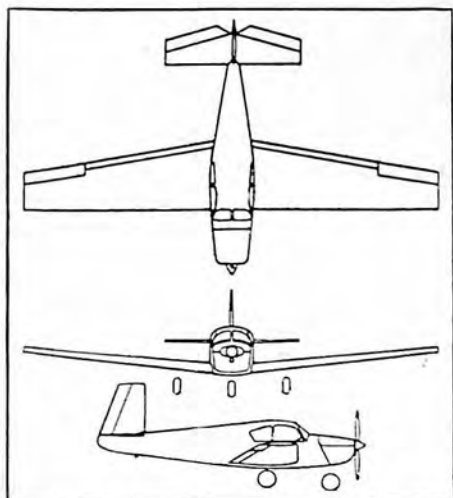
Martin B-57B Light Bomber



**MOONEY AIRCRAFT, INC.**  
KERRVILLE, TEXAS

**REMARKS**

This new four-placer attains its high speed and economy of operation through the utilization of an NACA laminar-flow wing design and the 150 horsepower Lycoming engine, which is noted for its low operating cost and low fuel consumption. It has the advantages of speed, comfort, and economy. The Mark 20A has a 180 horsepower Lycoming engine which gives an increase in performance.



**SPECIFICATIONS**

Span 35 ft.; Length 23 ft. 2 in.; Height 8 ft. 4.5 in.; Empty Weight 1415 lb.; Wing Loading 14.7 lb. per sq. ft.; Power Loading 16.3 lb. per bhp; Engine Lycoming O-320, 150 hp normal rates, or 150 hp at 2700 rpm takeoff; Fuel Capacity 50 gal., Propeller Hartzell, constant speed; Wing Area 167 sq. ft.; Aileron Area 11.1 sq. ft.; Flap Area 17.2 sq. ft.; Fin Area 5 sq. ft.; Rudder Area 7.9 sq. ft.; Stabilizer Area 21.5 sq. ft.; Elevator Area 12 sq. ft.

**PERFORMANCE**

Maximum Speed 171 mph at 150 hp at 2700 rpm at Sea Level; Cruise Speed 165 mph at 112.5 hp at 2450 rpm at 4900 ft.; Landing Speed 57 mph; Rate of Climb 900 fpm at Sea Level; Service Ceiling 17,200 ft.; Absolute Ceiling 20,000 ft.; Range with Maximum Payload 900 mi.; Range with Maximum Fuel Load 900 mi.

**Mooney Mark 20**



**NORTH AMERICAN AVIATION, INC.**  
LOS ANGELES 45, CALIFORNIA

North American FJ-4B Fury



**REMARKS**

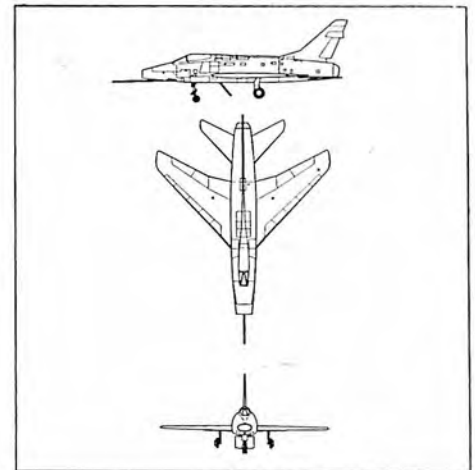
The F-100D is a fighter-bomber designed for maximum climb, maneuverability, altitude and speed. Like F-100A, which was first put into production in mid-1953, it has 45-degree swept-wing, uses tail braking parachute, has "solid" stabilizer and large ventral air brake. -C model differs from -A in that it contains inflight refueling system, has provision for carrying extra fuel drop tanks and bombs. -D model has addition of autopilot. F-100D is in production at the Los Angeles plant.

**SPECIFICATIONS**

Span 38 ft.; Length 47 ft.; Height 16 ft.; Engine Pratt & Whitney J57-P21.

**PERFORMANCE**

Maximum Speed Supersonic, in level flight; Service Ceiling 50,000 ft.; Range with Maximum Fuel Load 1000 st. mi.



North American Super Sabre F-100F



#### REMARKS

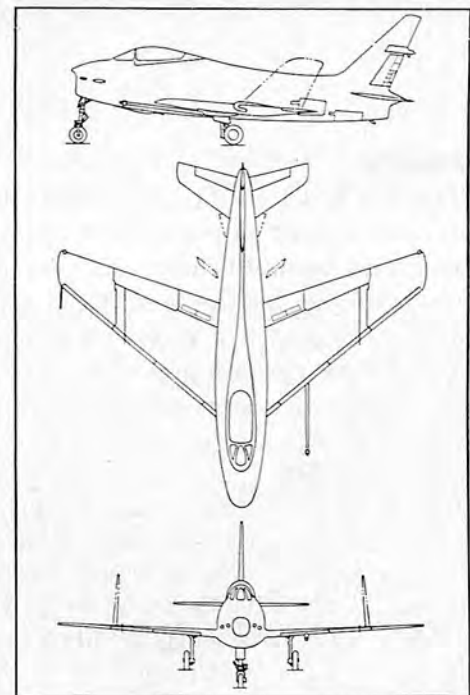
While maintaining the general configuration of the FJ-4A, the "B" features longitudinal, lateral, and directional improvements for low altitude operations. It retains the 35-degree swept back wings, hydraulically operated irreversible controls, and artificial feel for the ailerons and tail section. Outstanding recognition features are the thin wings and tail, and the dorsal fin fairing aft of the canopy. First flight December 3, 1956.

#### SPECIFICATIONS

Span 39 ft. 1 in.; Length 37 ft. 6 in.; Height 12 ft. 8 in.; Maximum Gross Takeoff Weight over 26,000 lb.; Engine Wright J65-16A approximately 7800 lb. thrust.

#### PERFORMANCE

Maximum Speed over 600 knots; Service Ceiling over 45,000 ft.



North American F-100D Super Sabre



#### REMARKS

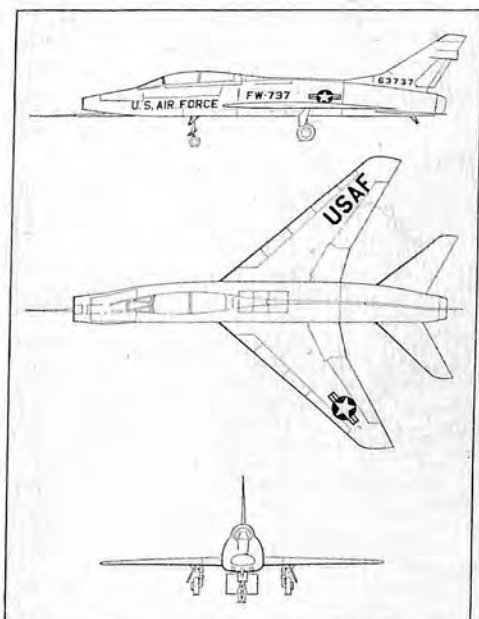
The latest operational model of the Super Sabre series is the supersonic two-place F-100F fighter-bomber. At speeds in excess of 1000 miles per hour and capable of delivering a bomb tonnage greater than that carried by a World War II B-17, the "F" has the same maximum climb, maneuverability, altitude and speed of the single-seat F-100D. All four models of the Super Sabre are featured with 45 degrees swept-back wings, a solid horizontal stabilizer which is slightly below wing level, and leading edge automatic slats. The "D" and "F" are currently in production at the Los Angeles Division.

#### SPECIFICATIONS

Span 39 ft.; Length 50 ft.; Height 16 ft.; Engine Pratt & Whitney J57-P-21 axial flow turbo-jet, excess of 10,000 lb. thrust with after-burner.

#### PERFORMANCE

Maximum Speed in excess of 1000 mph; Service Ceiling over 50,000 ft.; Range with Maximum Payload over 1000 mi.





#### REMARKS

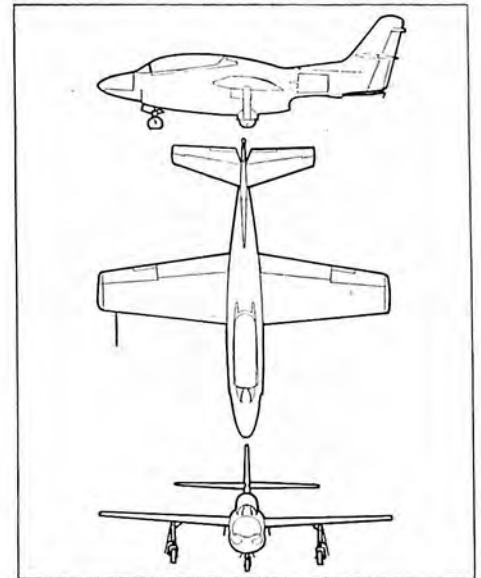
The T2J is designed to provide the fleet with a tandem seat land or carrier-based jet trainer with appropriately increased performance and versatility over the primary trainer. It is a straight wing, tricycle landing gear jet trainer. It features stepped tandem seating with a clamshell canopy for better visibility and low altitude ejection provisions. Special attention has been paid to maintenance ease and reliability.

#### SPECIFICATIONS

Span 36 ft.; Length 38 ft. 4 in.; Height 14 ft.; Empty Weight 6500 lb. (approximately); Wing Loading 35 lb. per sq. ft.; Engine Westinghouse J34-WE-36, 3400 lb. thrust; Fuel Capacity 381 gal. without tip tanks, 581 gal. with tip tanks; Wing Area 255 sq. ft.; Aileron Area 190 sq. ft.; Flap Area 50 sq. ft.; Fin Area 38 sq. ft.; Total Rudder Area 10.71 sq. ft.; Stabilizer Area 68 sq. ft.; Elevator Area 17.66 sq. ft.

#### PERFORMANCE

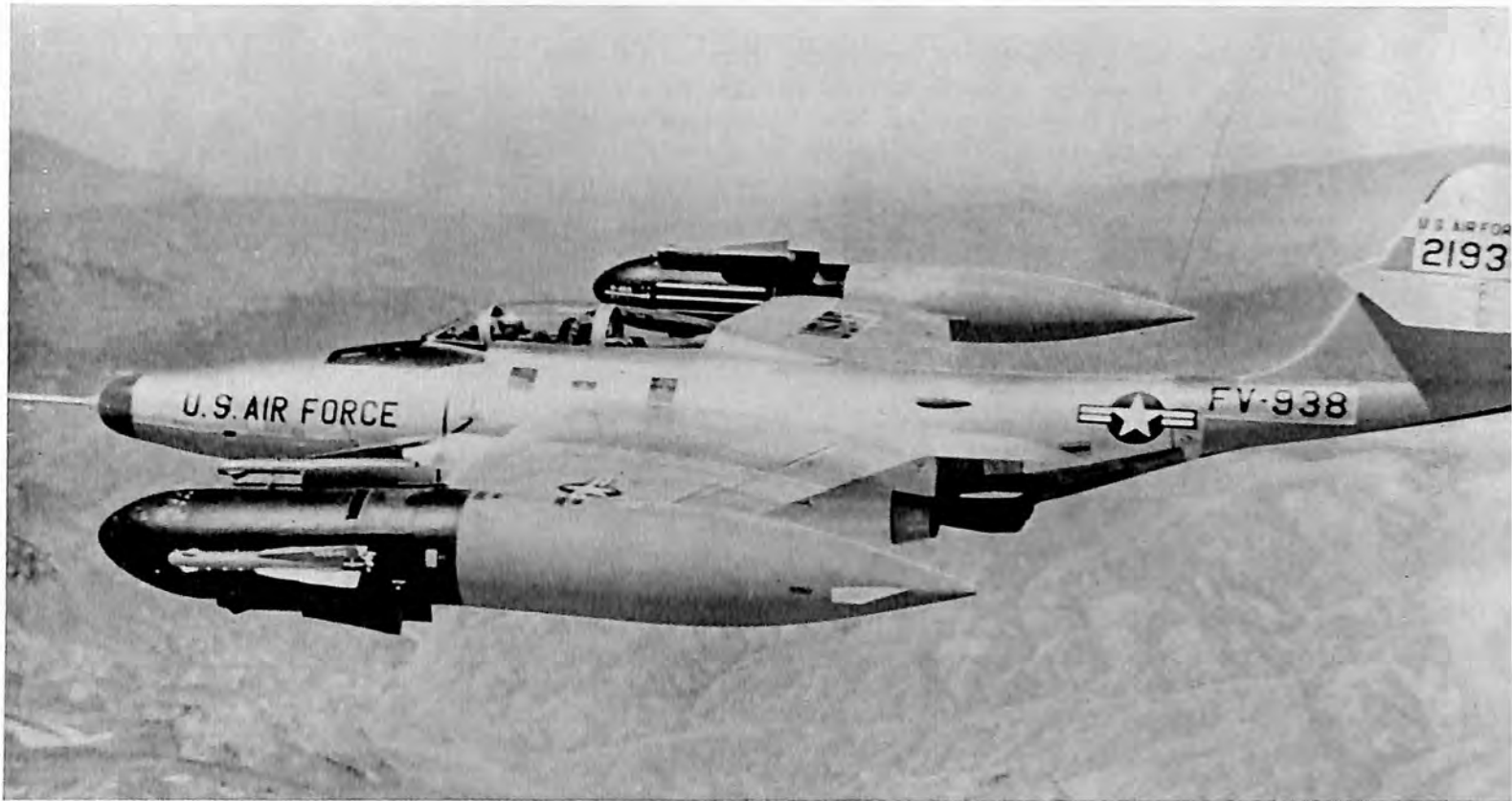
Maximum Speed 429 knots at 25,000 ft.; Cruise Speed 362 knots at 34,700 ft.; Landing Speed 67 knots; Rate of Climb 5000 fpm at Sea Level; Service Ceiling 42,500 ft.; Absolute Ceiling 45,000 ft.; Range with Maximum Payload 840 nautical mi.; Range with Maximum Fuel Load 840 nautical mi.



North American T2J



**NORTHROP AIRCRAFT, INC.**  
HAWTHORNE, CALIFORNIA



**Northrop F-89H Interceptor**

**REMARKS**

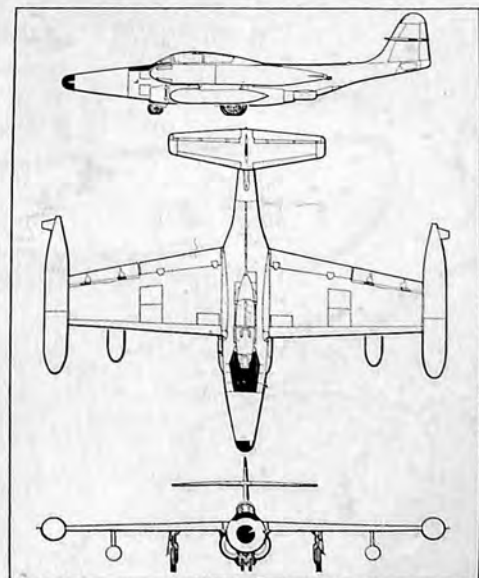
High altitude, mid-wing, twin-engine, jet propelled, all-weather interceptor, manned by crew of two, pilot and radar observer, seated in tandem in pressurized cockpits enclosed by single jet-tisonable canopy. Ejection seats are provided for both crew members. The plane's characteristic "Scorpion" silhouette is created by its up-swept tail assembly. The horizontal stabilizer is above the engine exhaust and airflow of wing. Both the Falcon-carrying F-89H and the rocket-armed F-89D airplanes are being flown around-the-clock by fighter interceptor squadrons of the Air Defense Command. The F-89H was the first operational fighter plane to be armed with the Hughes Falcon missiles. It has been operational at the squadron level since January, 1956. The new models, F-89J, carry MB-1 atomic rockets. First firings of atomic rockets were accomplished by the F-89 during the summer of 1957.

**SPECIFICATIONS**

Span Approximately 56 ft.; Length Approximately 53 ft.; Height Approximately 17 ft.; Weight over 40,000 lb.; Engines Two Allison J35-A-35 turbojet with thrust-augmenting afterburners; Landing Gear tricycle, with steerable dual-nose wheel.

**PERFORMANCE**

Speed 600 mph class; Altitude over 45,000 ft.; Range over 1000 mi.



## NORTHERN AIRCRAFT, INC.

ALEXANDRIA, MINNESOTA

### REMARKS

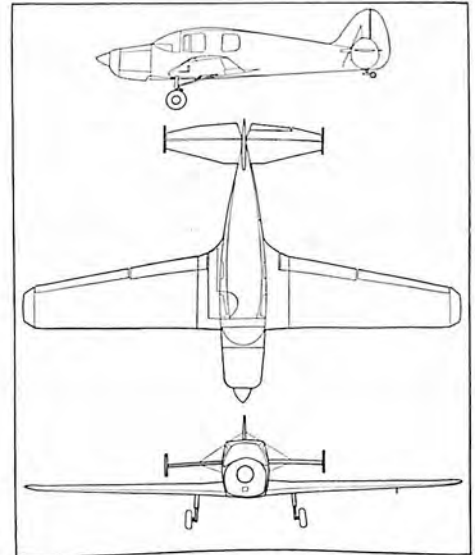
The Cruisemaster is capable of remarkably short takeoffs and landings. The fuselage frame is stressed particularly high, regardless of type of fuselage covering. This bridge-type construction of the tubular fuselage is another Bellanca safety feature. The spacious luggage compartment is easily accessible and accommodates more than 186 pounds of luggage.

### SPECIFICATIONS

Span 34 ft. 2 in.; Length 22 ft. 10 $\frac{3}{4}$  in.; Height 6 ft. 2.4 in.; Empty Weight 1680 lb.; Wing Loading 16.7 lb. per sq. ft.; Power Loading 11.7 lb. per bhp; Engine Continental O-470-K, 230 hp normal rates, or 230 hp at 2600 rpm takeoff; Fuel Capacity 54 gal.; Propeller Hartzell constant speed, McCauley constant speed; Wing Area 161.5 sq. ft.; Aileron Area 11.77 sq. ft.; Flap Area 16.16 sq. ft.; Fin Area 5.67 sq. ft.; Rudder Area 6.28 sq. ft.; Stabilizer Area 17.21 sq. ft.; Elevator Area 12.2 sq. ft.

### PERFORMANCE

Maximum Speed 205 mph at 80 percent hp at 2450 rpm at 6700 ft.; Cruise Speed 196 mph at 75 percent hp at 2450 rpm at 7500 ft.; Landing Speed 48 mph; Rate of Climb 1,550 fpm at 1500 ft.; Service Ceiling 22,500 ft.; Absolute Ceiling 25,000 ft.; Range with Maximum Payload 954.5 mi.; Range with Maximum Fuel Load 994 mi. (50 gal.).



Northern Aircraft's Bellanca Cruisemaster



## PIPER AIRCRAFT CORP.

LOCK HAVEN, PENNSYLVANIA

### REMARKS

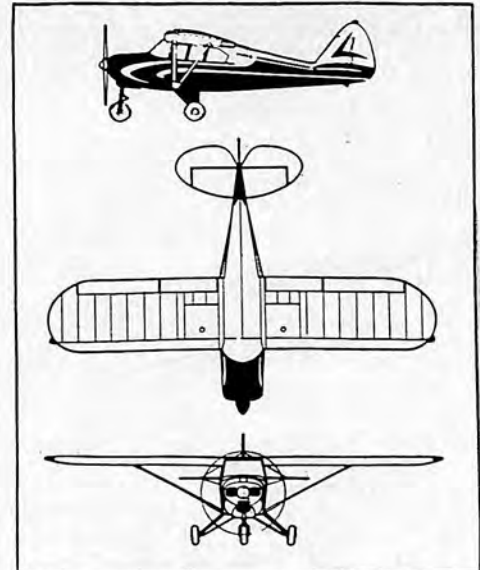
Production continued heavy on the four-place Tri-Pacer during 1957. More than 6000 Tri-Pacers are now being flown in all parts of the world.

### SPECIFICATIONS

Span 29.3 ft.; Length 20.6 ft.; Height 8.3 ft.; Empty Weight 1100 lb.; Gross Weight 2000 lb.; Wing Loading 13.5 lb. per sq. ft.; Power Loading 12.5 lb. per bhp; Engine Lycoming O-320-B, 160 hp at 2700 rpm takeoff; Fuel Capacity 36 gal., extra 8 gal. optional; Propeller Sensenich metal; Gear tricycle.

### PERFORMANCE

Maximum Speed 141 mph; Cruise Speed 134 mph at 75 percent power at 7000 ft.; Landing Speed 49 mph; Rate of Climb 800 fpm at Sea Level; Service Ceiling 16,500 ft.



Piper PA-22 Tri-Pacer



### REMARKS

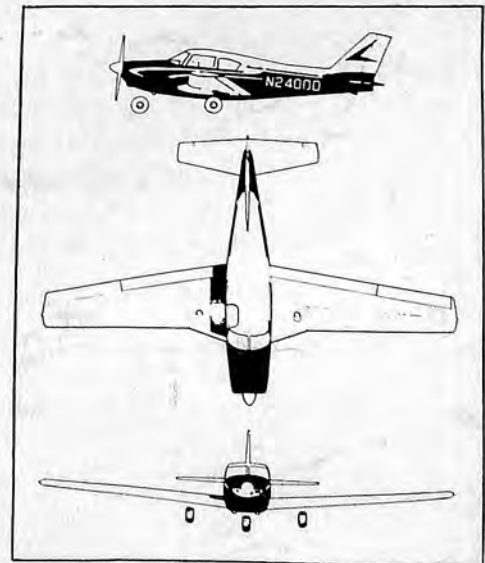
The Comanche is Piper's new high performance, all-metal plane with retractable tricycle landing gear. Advanced design features include swept rudder, stabilator, and laminar flow wing section. Roomy cabin, ample luggage and cargo space, and component systems designed for ease of maintenance characterize the Comanche, which went into volume production late in 1957.

### SPECIFICATIONS

Span 36 ft.; Length 24 ft. 8 in.; Height 7 ft. 4 in.; Empty Weight 1475 lb.; Wing Loading 14.3 lb. per sq. ft.; Power Loading 14.2 lb. per bhp; Engine Lycoming O-360 AIA, 180 hp at 2700 rpm takeoff; Fuel Capacity 60 gal.; Propeller constant speed, controllable; Wing Area 178 sq. ft.

### PERFORMANCE

Maximum Speed 167 mph; Cruise Speed 160 mph at 75 percent power at 8000 ft.; Landing Speed 58 mph; Rate of Climb 910 fpm; Service Ceiling 18,500 ft.; Absolute Ceiling 21,000 ft.; Range with Maximum Payload 920 mi.; Range with Maximum Fuel Load 1100 mi.



Piper Comanche — PA-24





Piper PA-18 Super Cub

#### REMARKS

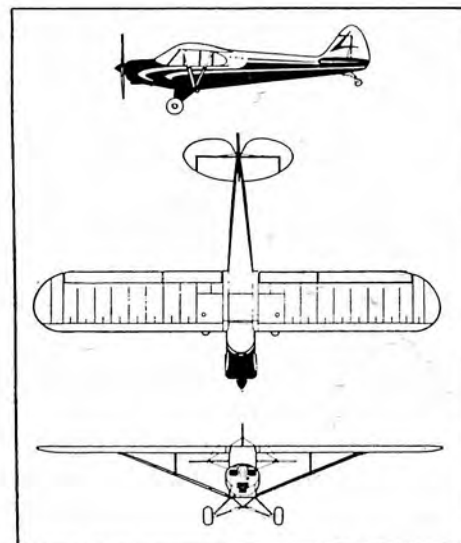
This series includes the 150 horsepower PA-18 "150," the 90 horsepower PA-18 "95," and also includes the PA-18-A agricultural model, available as sprayer, duster or combination. With gross of 2070 pounds, PA-18-A is equipped with hopper with capacity of 110 gallons of liquid or 18 cubic feet of dust.

#### SPECIFICATIONS

Span 35 ft. 4 in.; Length 22 ft. 6 in.; Height 6 ft. 8 in.; Empty Weight 930 lb.; Gross Weight 1750 lb.; Overload Gross Weight 2070 lb.; Wing Loading 10 lb. per sq. ft.; Power Loading 11.6 lb. per bhp; Engine PA-18 "150" Lycoming O-320 (PA-18 "95" Continental C90), 150 (90) hp at 2700 (2475) rpm takeoff; Fuel Capacity 36 (18) gal.; Propeller Sensenich; Wing Area 178.5 sq. ft.

#### PERFORMANCE

Maximum Speed 130 mph; Cruise Speed 115 mph at 75 percent power at 7000 ft.; Landing Speed 43 mph with flaps; Rate of Climb 960 fpm at Sea Level; Service Ceiling 19,000 ft.; Absolute Ceiling 21,300 ft.; Range with Maximum Payload 460 mi.



#### REMARKS

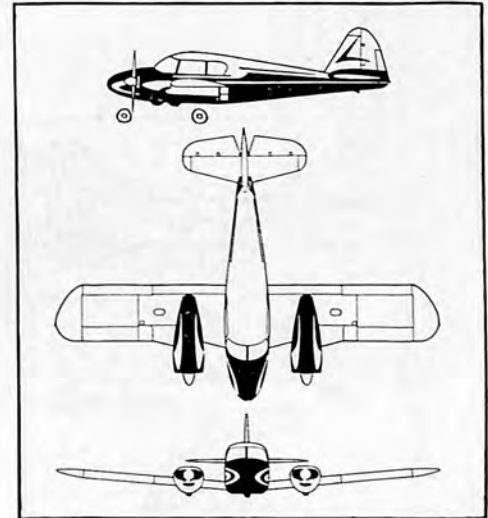
The Piper Twin Apache is all-metal design with short takeoff characteristics and slow landing speed for short field operations. It is capable of maintaining altitude at full gross weight on one engine. The rear seat can be removed in less than two minutes to provide 80 cubic feet of unobstructed stowage space. The model can be converted into an ambulance plane with room for one stretcher and attendant in the rear seat. The cabin has been built so that a hatch can be cut in the floor for camera installation. Flap and landing gear controls are shaped as an air-foil and wheel respectively for positive identification. Optional Apache configurations include a five-passenger version or installation of two reclining airline-type seats in the rear.

#### SPECIFICATIONS

Span 37 ft.; Length 27.1 ft.; Height 9.5 ft.; Engines Two Lycoming O-320 B. 160 hp at 2700 rpm; Gross Weight 3800 lb.; Empty Weight 2230 lb.; Useful Load 1570 lb.; Wing Loading 18.6 lb. per sq. ft.; Power Loading 11.9 lb. per hp; Wing Area 204 sq. ft.; Baggage 200 lb.; Fuel Capacity 108 gal. with auxiliary tanks.

#### PERFORMANCE

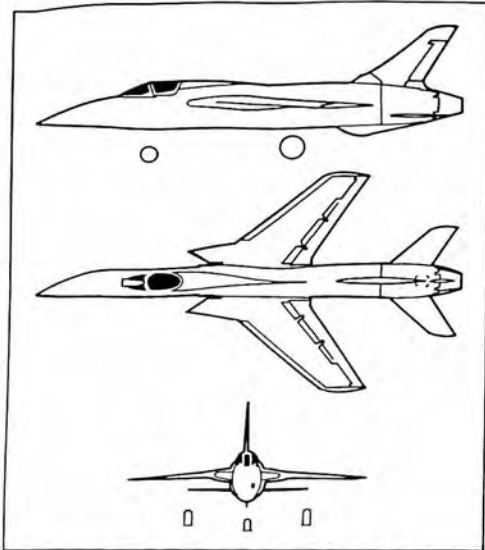
Cruise Speed 171 mph at 7000 ft.; Range up to 1260 mi.



Piper PA-23 Twin Apache



**REPUBLIC AVIATION CORP.**  
FARMINGDALE, LONG ISLAND, NEW YORK



Republic F-105 Thunderchief

**REMARKS**

The Thunderchief, scheduled for service with the Air Force's Tactical Air Command, was developed to deliver nuclear weapons and heavier loads of conventional bombs and rockets at extremely high speeds over long ranges. The Thunderchief has an area rule "coke bottle" fuselage and specially designed swept-forward air-intake ducts at the wing roots. A ram-air intake at the base of the vertical fin cools the after-end of the plane. Radically different "clover leaf" speed brakes form the last 36 inches of the fuselage. During braking, these surfaces unfold, forming a 360-degree wind-brake. A Republic-designed ventral fin installed on the bottom of the fuselage aft section provides greater stability at very high speeds. The Thunderchief carries its weapon load either internally or externally.

**SPECIFICATIONS**

Span 34 ft. 11 in.; Length 63 ft. 1 in.; Height 19 ft. 8 in.; Engine J75 with afterburner.

**PERFORMANCE**

Maximum Speed Supersonic.





Republic F-84F Thunderstreak refueling RF-84F Thunderflash

**REMARKS**

The F-84F has a primary mission as fighter-bomber, but its performance and versatility make it adaptable for interception and escort missions. It is armed with six .50 caliber machine guns and can carry more than 6000 pounds of bombs, rockets, and napalm. In addition, it is listed as capable of carrying the atomic bomb. It is in service with USAF commands and the air forces of NATO nations. The F-84F, the Air Force's first swept-wing fighter-bomber, far exceeds performance of previous F-84 models. It has a one-piece stabilator for greater maneuverability and is equipped for inflight refueling.

**SPECIFICATIONS**

Span 33 ft. 6 in.; Length 43 ft. 4 in.; Height 14 ft. 4 in.; Gross Weight 25,000 lb.; Engine Wright J65-W-3, 7200 lb. thrust.

**PERFORMANCE**

Maximum Speed more than 650 mph; Service Ceiling 45,000 ft.; Range with Maximum Payload over 2000 mi.

**REMARKS**

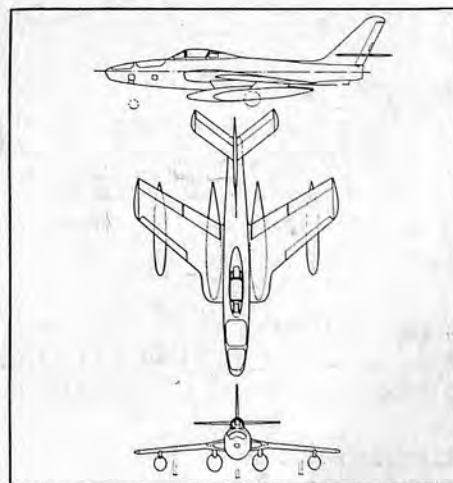
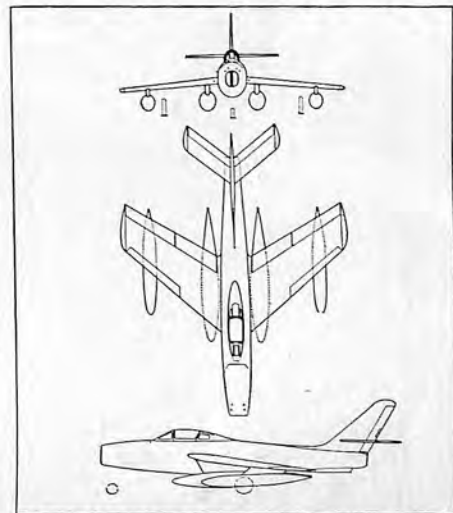
The RF-84F Thunderflash is the first reconnaissance aircraft equipped with the whole combination of standard aerial cameras plus the dicing camera. It is also the first fighter-type aircraft equipped with the Tri-Metrogon camera. The RF-84F was designed to meet requirements for a high speed, high or low altitude, day or night photo plane capable of getting vital intelligence photos. It mounts four .50 caliber machine guns to fight its way to and from the target—if necessary. Wing root air intakes enable installation of a sweeping variety of cameras from among 15 day and night types. The Thunderflash serves in the U. S. Air Force and the air forces of NATO nations.

**SPECIFICATIONS**

Span 33 ft. 6 in.; Length 47 ft. 6 in.; Height 15 ft.; Engine Wright J65, 7200 lb. thrust.

**PERFORMANCE**

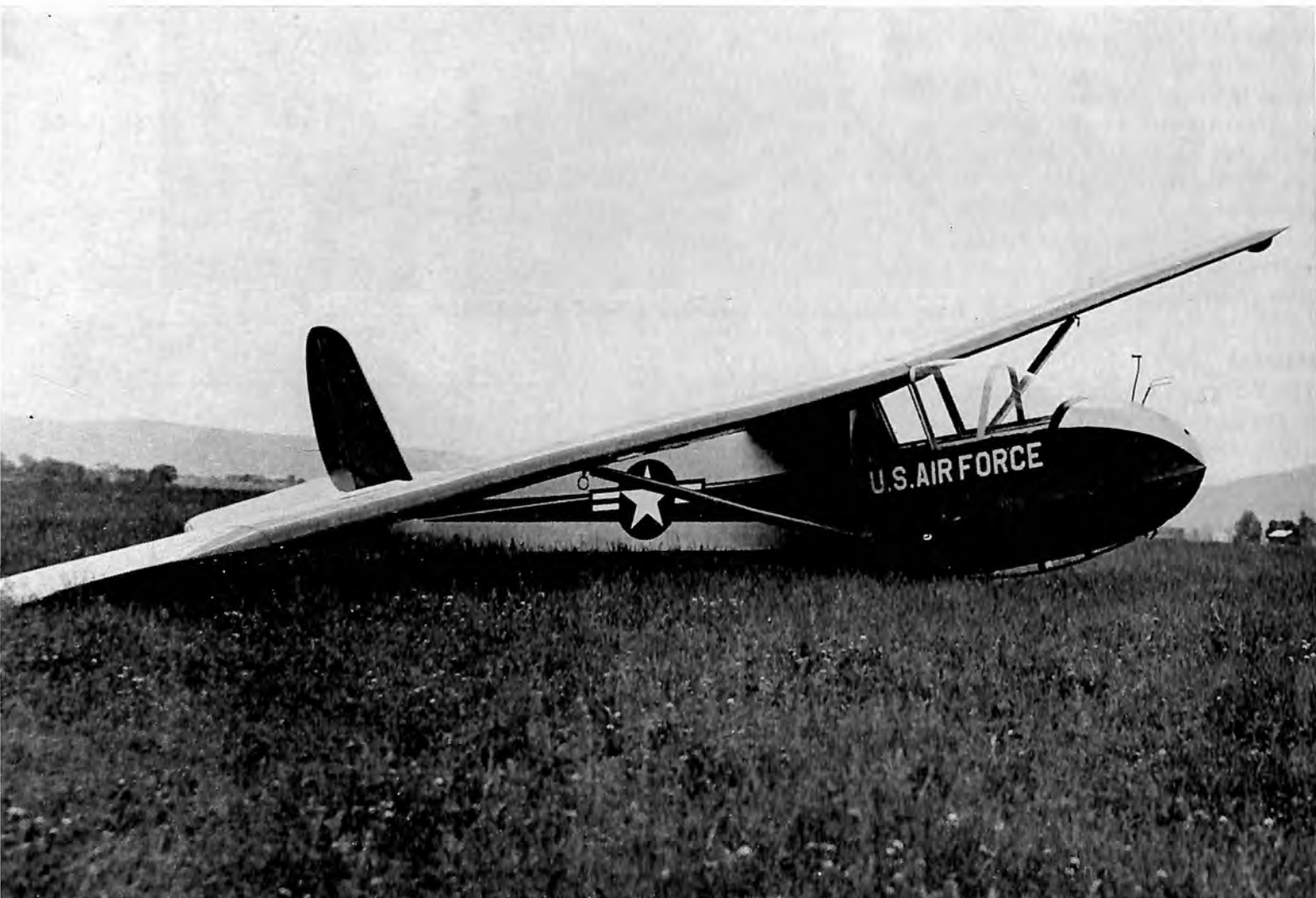
Maximum Speed more than 650 mph; Service Ceiling over 45,000 ft.; Range with Maximum Fuel Load over 2000 mi.





# SCHWEIZER AIRCRAFT CORP.

ELMIRA, NEW YORK



Schweizer SGS 1-26 Sailplane

## REMARKS

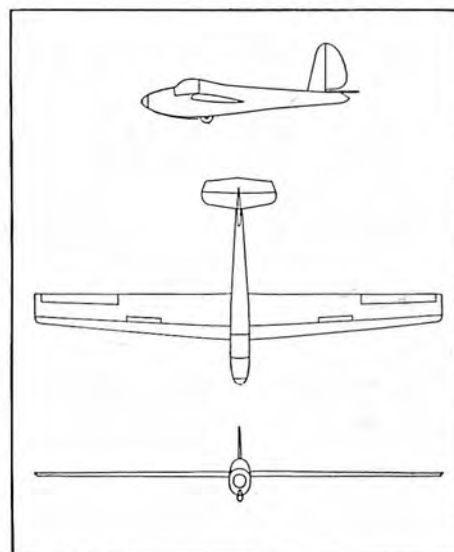
The 1-26 sailplane is sold in kit form or as a complete unit. It is a simple-to-fly, stable sailplane that permits soaring even under light thermal conditions. Has excellent quick-turning ability. The 1-26 can be operated from auto or winch tow and is easy to tow with a light plane.

## SPECIFICATIONS

Span 40 ft.; Length 21 ft. 3 in.; Height 7 ft. 2.5 in.; Empty Weight 348 lb.; Gross Weight 575 lb.; Wing Loading 3.59 lb. per sq. ft.

## PERFORMANCE

Minimum Sinking Speed 2.60 ft./sec.; Cruise Speed 77 mph; Placard Speed 104 mph.



**SIKORSKY AIRCRAFT DIVISION**  
**UNITED AIRCRAFT CORP.**  
BRIDGEPORT, CONNECTICUT

**REMARKS**

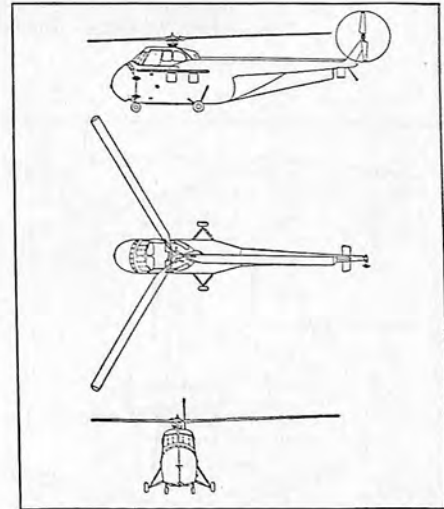
The S-55 has a seating capacity of crew (pilot and copilot), passengers (commercial—7) (military—10), with alternate cargo capacity of 340 cubic feet. Military models have Wright R-1300 engine, which is now being offered commercially.

**SPECIFICATIONS**

Main Rotor Diameter 53 ft.; Tail Rotor Diameter 8 ft. 9 in.; Length 42 ft. 3 in.; Height 13 ft. 4 in.; Empty Weight 4888 lb.; Gross Weight 7200 lb.; Engine Pratt & Whitney S3H2 with 600 bhp; Fuel Capacity 185 gal.

**PERFORMANCE**

Maximum Speed 112 mph.; Cruise Speed 85 mph; Maximum Rate of Climb at Sea Level 700 fpm; Range 405 st. mi.; Service Ceiling 9800 ft.

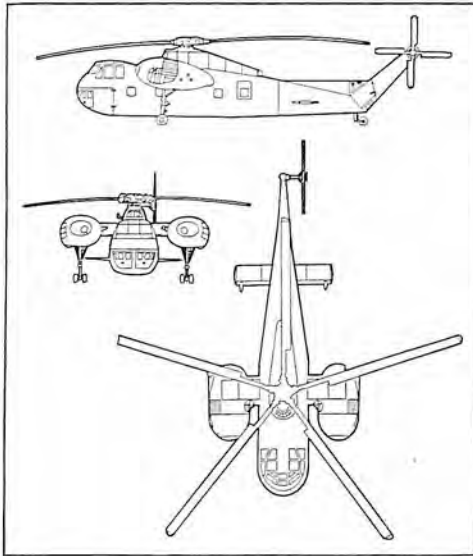


Sikorsky S-55C (Commercial); H-19 (Air Force, Army); HRS (Marines); HO4S (Navy, Coast Guard)





Sikorsky S-56: H-37A (Army); HR2S-1 (Navy)



**REMARKS**

In production since 1955, the aircraft has been delivered to both Army and Marine units and carries 36 fully-equipped troops or equivalent payload in cargo. Loading and unloading may be achieved through clamshell doors in the nose, a cabin floor hatch or cargo door located on the right side of the fuselage. A traversing electric hoist with 2000-pound capacity permits easy cargo shifting in the cabin. Auto-pilot, de-icing and semi-automatic blade folding equipment are featured, as is retractable landing gear. Five-bladed main and four-bladed tail rotors are all metal.

**SPECIFICATIONS**

Rotor Diameter 72 ft.; Length 60 ft.; Gross Weight 28,500 lb.; Engines Two Pratt & Whitney R-2800, derated to 2100 hp.

**PERFORMANCE**

Maximum Speed 140 mph; Cruise Speed 115 mph; Best Rate of Climb at Sea Level 1140 fpm.

**REMARKS**

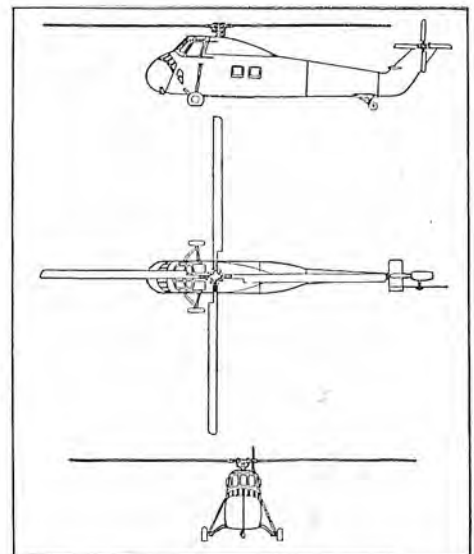
Specifications and performance data of the HSS-1, Navy version using a Wright R-1820 engine, are classified.

**SPECIFICATIONS**

Length 46 ft. 9 in. (Tail Pylon Not Folded); Height 15 ft. 10 in.; Empty Weight 7560 lb. (With Standard Equipment); Gross Weight 12,700 lb.; Useful Load 5140 lb.; Engine Wright Cyclone C9, 1275 hp normal rated at 2500 rpm or 1525 hp at 2800 rpm takeoff; Fuel Capacity 290 gal.; Main Rotor Diameter 56 ft.; Tail Wheel 6.00 x 6.

**PERFORMANCE**

Maximum Speed 130 mph at 1275 hp at 2500 rpm at Sea Level; Cruise Speed 88 mph at 2500 rpm; Maximum Rate of Climb 1175 fpm at Sea Level.



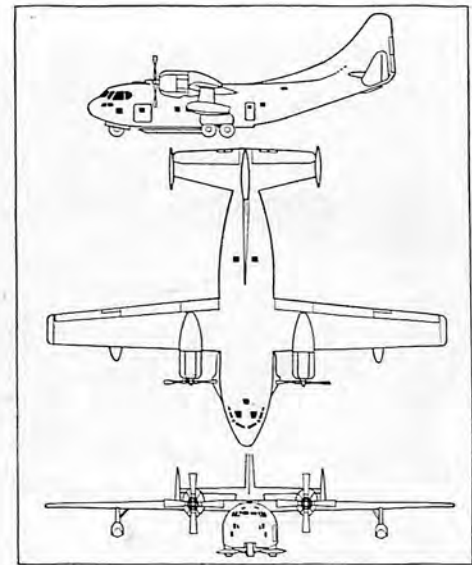
Sikorsky S-58 (Commercial); HSS-1 (Navy); H-34 (Army); HUS (Marines)

## STROUKOFF AIRCRAFT CORP.

WEST TRENTON, NEW JERSEY

### REMARKS

The Stroukoff MS-8-1 (USAF YC-134A) is nearing completion and is expected to fly in January, 1958. This airplane is known as a BLC-PANTOBASE Assault Transport. The Boundary Layer Control System permits this 70,000-pound aircraft to achieve remarkably short takeoffs and landings. The Pantobase Landing System permits operation off any unprepared surface as well as ice, snow, water, sand, swamp or tundra. Air freight or military loads can be loaded into the spacious cargo compartment either through the high, wide tail gate ramp and door system or through a large forward cargo door. The cargo floor is at truck-bed height. The airplane will transport over 30,000 pounds of cargo on a specially constructed floor that needs no special reinforcing for heavy concentrated loads. The new Stroukoff-developed four-wheel tandem main landing gear gives the airplane excellent flotation characteristics on soft ground. The forerunner of this airplane, the YC-134, is now flying and has exhibited excellent performance. Takeoffs and landings under 400 feet have been achieved.



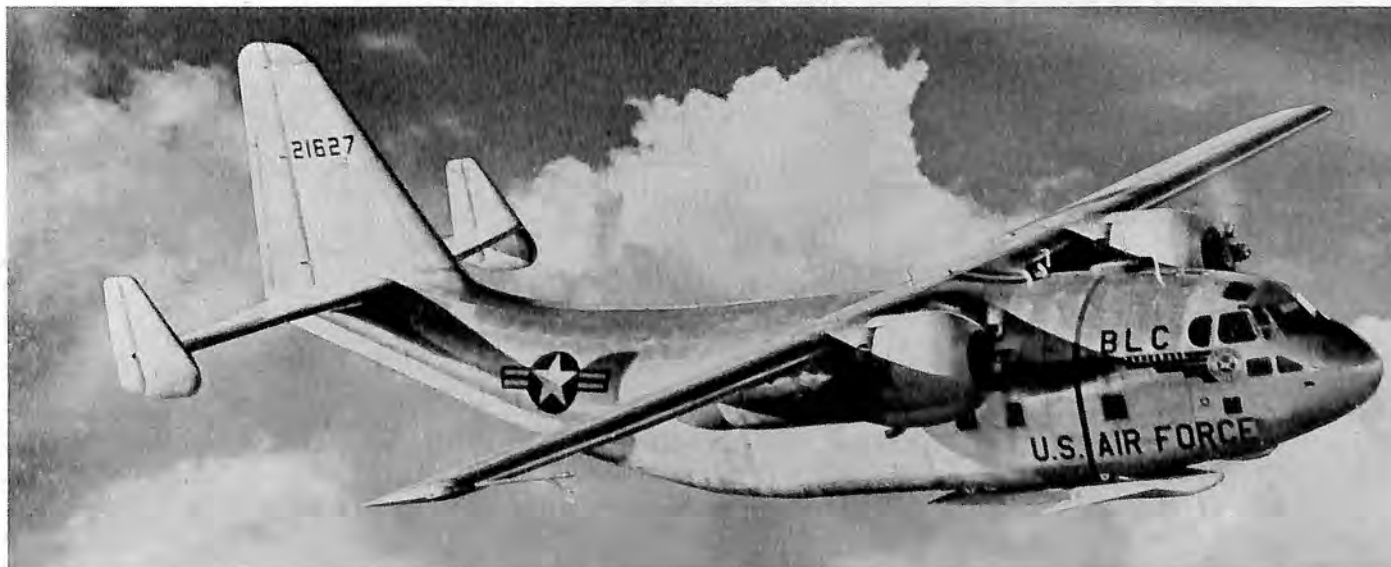
### SPECIFICATIONS

Span 110 ft.; Length 82 ft. 1 in.; Height 34 ft. 8.5 in.; Empty Weight 37,380 lb.; Wing Loading 56.4 lb. per sq. ft.; Power Loading 9.95 lb. per bhp; Engines Two Wright R-3350-89A, 2600 hp normal rates, or 3500 hp at 2900 rpm takeoff; Fuel Capacity 2016 gal.; Propeller Aero-products A644FN-C2; Wing Area 1234.89 sq. ft.; Aileron Area 113.58 sq. ft.; Flap Area 217.6 sq. ft.; Fin Area 267.5 sq. ft.; Rudder Area 96.6 sq. ft.; Stabilizer Area 217.66 sq. ft.; Elevator Area 127.88 sq. ft.

### PERFORMANCE

Maximum Speed 285 mph at 16,600 ft.; Cruise Speed 250 mph at 10,000 ft.; Landing Speed under 75 mph; Rate of Climb 1100 fpm at Sea Level; Service Ceiling 26,000 ft.; Absolute Ceiling 30,000 ft.; Range with Maximum Payload 600 mi.; Range with Maximum Fuel Load 4750 mi.

Stroukoff YC-134



## TAYLORCRAFT, INC.

CONWAY, PENNSYLVANIA



Taylorcraft Zephyr 400

### REMARKS

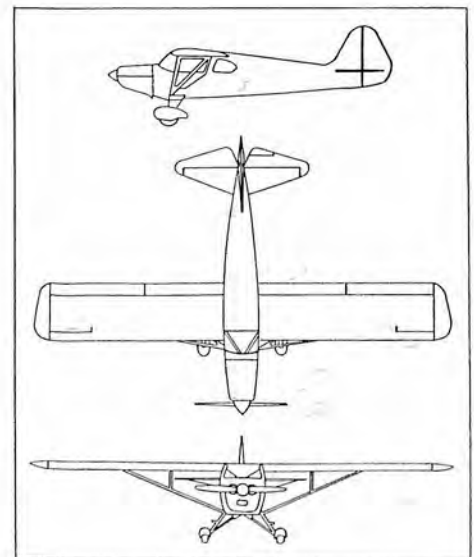
This advanced structural design in aircraft manufacturing has been made possible through the development of molded fiberglass, the first all-new aircraft structural material to be perfected in over 30 years. Wings, fuselage, cowl, doors, seats, gas tanks, and other structures of the new Taylorcraft models are made of molded fiberglass. A bridge-type frame of welded steel tubing together with the fiberglass structure forms a rugged fuselage of unequalled safety. This same regard for safety has been engineered in the wing and tail structures.

### SPECIFICATIONS

Span 34 ft. 8 in.; Length 24 ft. 4 in.; Height 7 ft. 2 in.; Empty Weight 1750 lb.; Wing Loading 15.4 lb. per sq. ft.; Power Loading 12.2 lb. per bhp; Engine Continental O-470-J, 225 hp normal rates; Fuel Capacity 66 gal.; Propeller Hartzell constant speed; Wing Area 178.5 sq. ft.; Aileron Area 14.38 sq. ft.; Flap Area 14.3 sq. ft.; Fin Area 9.35 sq. ft.; Rudder Area 9.36 sq. ft.; Stabilizer Area 15.84 sq. ft.; Elevator Area 13.98 sq. ft.

### PERFORMANCE

Maximum Speed 160 mph at 100 percent hp at 2550 rpm at 7500 ft.; Cruise Speed 150 mph at 70 percent hp at 2450 rpm at 7500 ft.; Landing Speed 60 mph; Rate of Climb 1000 fpm at Sea Level; Service Ceiling 15,000 ft.; Absolute Ceiling 16,000 ft.; Range with Maximum Payload 675 mi.; Range with Maximum Fuel Load 675 mi.



## TEMCO AIRCRAFT CORP.

DALLAS, TEXAS

### REMARKS

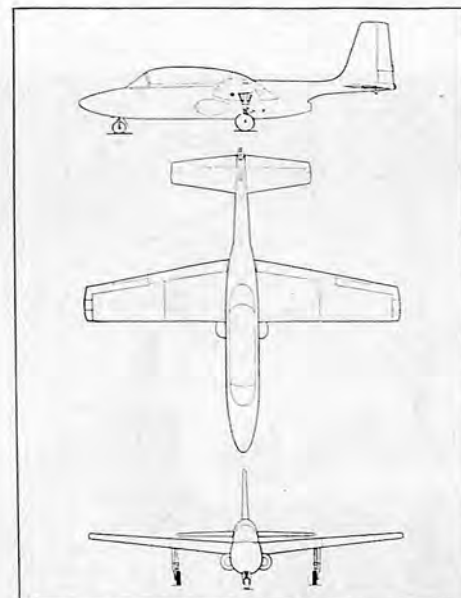
The first production model of the TT-1 primary jet trainer came off Temco's assembly lines at Dallas early in September. Continuous testing of the prototype after it won the Navy's competitive evaluation tests resulted in several engineering changes. From the outside, the most apparent of these is the closed position of main nose gear doors except when the wheel is actually being raised or lowered, resulting in cleaner configuration for takeoffs and landings. The new TT-1 also has UHF radio and automatic direction finding equipment. More than 35 access panels are provided for easy maintenance. The TT-1 was designed specifically to make a jet pilot out of a student in one aircraft—the first one he flies—and gives true jet "feel." It is being considered by representatives of several foreign governments for use in their jet pilot training programs.

### SPECIFICATIONS

Span 29 ft. 10 in.; Length 30 ft.; Height 10 ft. 10 in.; Empty Weight 3139 lb.; Gross Weight 4400 lb.; Overload Gross Weight 4440 lb.; Wing Loading 29.4 lb. per sq. ft.; Power Loading 4.78 lb. per bhp; Engine Continental J69-T-2, 920 lb. thrust; Fuel Capacity 124 gal.; Wing Area 150 sq. ft.; Aileron Area 10.4 sq. ft.; Flap Area 15.65 sq. ft.; Fin Area 23.5 sq. ft.; Rudder Area 5.32 sq. ft.; Stabilizer Area 39 sq. ft.; Elevator Area 11.6 sq. ft.

### PERFORMANCE

Maximum Speed 286 knots at 100 percent rpm at 15,000 ft.; Average Cruise Speed 234 knots at 100 percent rpm at 22,350 ft.; Landing Speed 70 to 75 knots; Rate of Climb 1900 fpm at Sea Level; Service Ceiling 30,000 ft.; Absolute Ceiling 32,800 ft.; Range with Maximum Fuel Load 239 nautical mi.



Temco TT-1 Pinto Trainer



## TRECKER AIRCRAFT CORP.

MILWAUKEE, WISCONSIN



Trecker Gull P-136-L2 Amphibian

### REMARKS

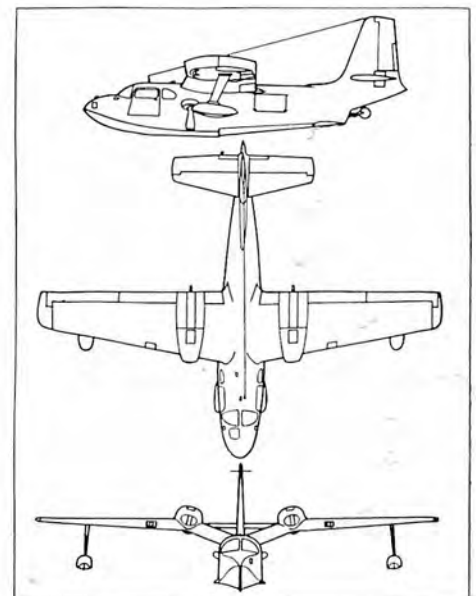
Although the present Trecker Corp. has been in full operation only several months, it has in production the supercharged Trecker Gull, twin-engine amphibian successor to the Royal Gull.

### SPECIFICATIONS

Span 44 ft. 5 in.; Length 35 ft. 7 in.; Height 12 ft. 7 in.; Empty Weight 4630 lb.; Wing Loading 24.5 lb. per sq. ft.; Power Loading 10.3 lb. per bhp; Engines Two Lycoming GSO-480-A1A6, 320 hp normal rates, or 340 hp at 3400 rpm takeoff; Fuel Capacity 190 gal.; Propeller Two Hartzell full-feathering, 3-blade; Wing Area 270.2 sq. ft.; Aileron Area 21.3 sq. ft.; Flap Area 28.6 sq. ft.; Fin Area 17.85 sq. ft.; Rudder Area 12.16 sq. ft.; Stabilizer Area 29.1 sq. ft.; Elevator Area 27 sq. ft.

### PERFORMANCE

Maximum Speed 208 mph at 320 hp at 3200 rpm at 11,000 ft.; Cruise Speed 184 mph at 240 hp at 2750 rpm at 12,500 ft.; Landing Speed 82 mph; Rate of Climb 1279 fpm at Sea Level; Service Ceiling 25,400 ft.; Absolute Ceiling 26,600 ft.; Range with Maximum Payload 55 percent power 800 mi.; Range with Maximum Fuel Load 994 mi.



## VERTOL AIRCRAFT CORP.

MORTON, PENNSYLVANIA

### REMARKS

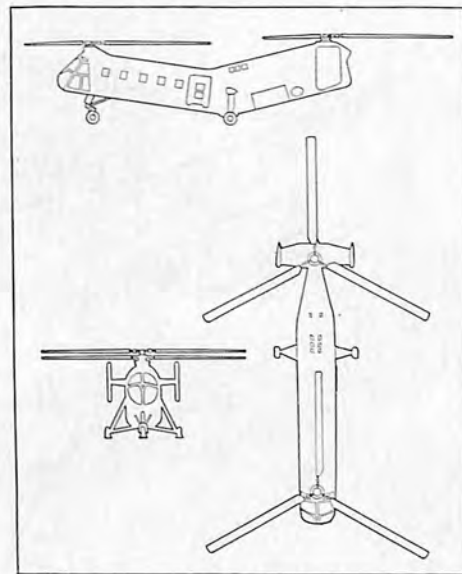
A prototype for the Vertol 44 was jointly certified by the U. S. Civil Aeronautics Administration and the Canadian Department of Transport in April, 1957. The Vertol Model 44 transport helicopter is being offered to industry in three different versions: the Model 44A, cargo utility version which permits transport of 19 passengers; the Model 44B, a luxurious airliner capable of carrying 15 passengers; and the Model 44C, for deluxe executive transport in business and industry. It has a useful load of 5420 pounds, a cruising speed of 101 miles per hour. The tandem configuration eliminates balance problems in the placement of cargo and allows passengers to sit anywhere in the cabin.

### SPECIFICATIONS

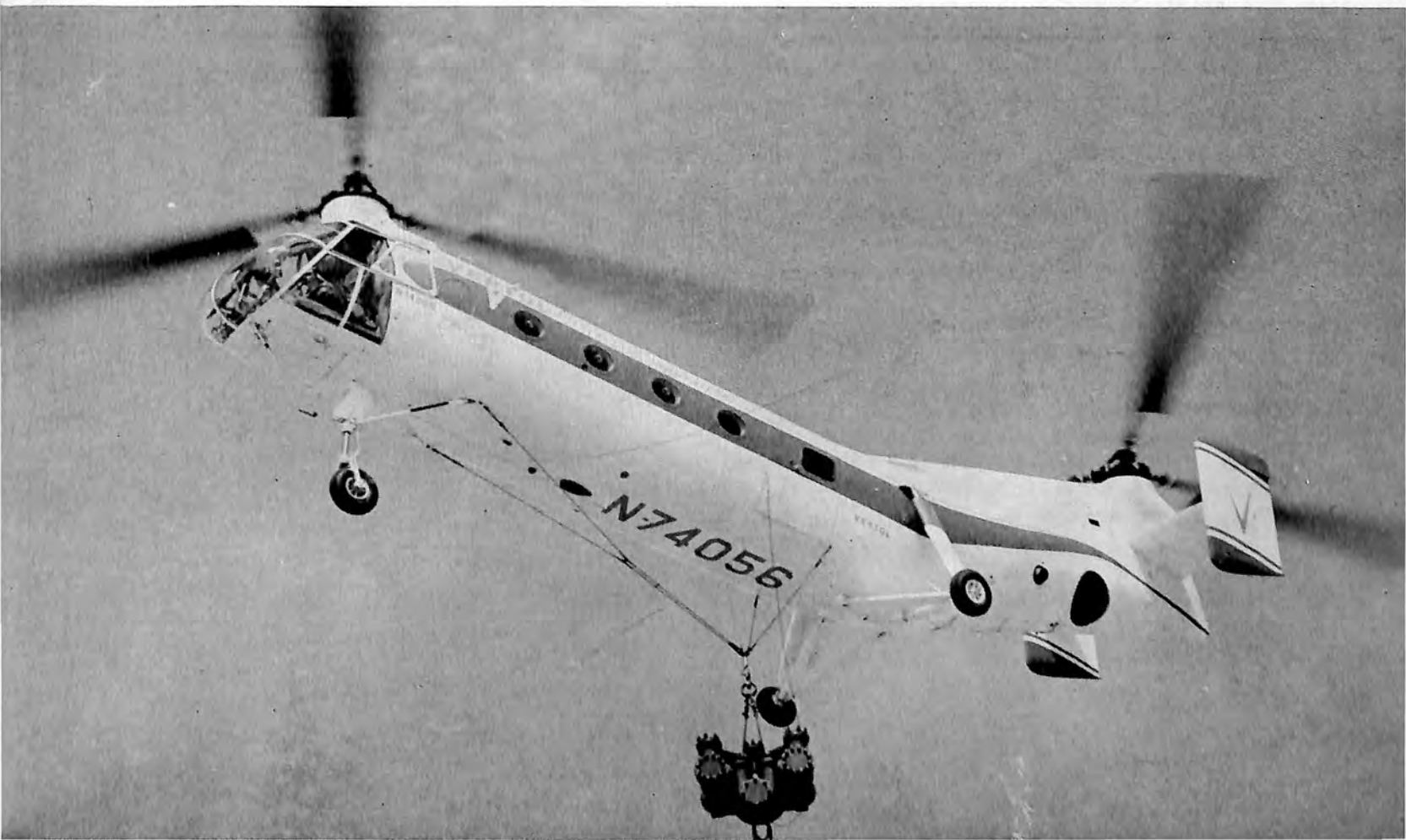
Main Rotor Diameter 44 ft.; Length 52 ft. 6 in.; Height 15 ft. 5 in.; Empty Weight 8980 lb.; Useful Load 5420 lb.; Engine Wright 1820-103, 1275 hp normal rates, or 1425 hp at 2700 rpm takeoff; Fuel Capacity 300 gal.

### PERFORMANCE

Maximum Speed 127 mph; Cruise Speed 101 mph; Service Ceiling 10,600 ft.; Range with Maximum Fuel Load 360 statute mi.



Vertol Model 44







**Vertol H-21 Workhorse Transport**

**REMARKS**

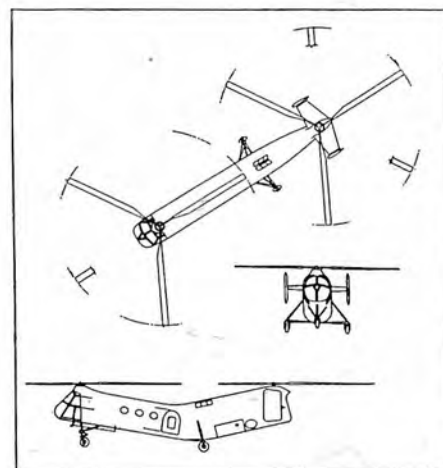
The H-21B is the Air Force and RCAF model in this series, and is similar to the Army H-21C. The fuselage is of all metal stressed skin, semi-monocoque construction. The cockpit has side-by-side seating with the pilot on the right and complete hydraulic controls. The main entrance door is located on the left side at the rear of the cabin. H-21D version powered by two General Electric T58 gas turbines was flown in September, 1957, and is currently in an extensive flight test program.

**SPECIFICATIONS**

Rotor Diameter 44 ft.; Length 52 ft. 6 in.; Height 16 ft.; Empty Weight 8500 lb.; Gross Weight 13,300 lb.; Overload Gross Weight 15,200 lb.; Engine Wright R-1820-103, 1425 hp, military; Fuel Capacity 300 gal.; Gear fixed tricycle.

**PERFORMANCE**

Maximum Speed 135 mph at Sea Level; Cruise Speed 98 mph at Sea Level; Rate of Climb 1100 fpm; Service Ceiling 10,000 ft.; Range over 450 mi.



# ENGINES IN PRODUCTION



## AEROJET-GENERAL CORPORATION AZUSA, CALIFORNIA

### • MODEL: 15KS-1000 AIRCRAFT ROCKET ENGINE

#### Data

Type: Solid-propellant rocket.

#### Specs

Diameter: 10.30 in. Length: 33.45 in. Empty Weight: 72 lb. Loaded Weight: 144 lb.

#### Performance

Rating: 1000 lb. thrust, or 400 horsepower, for 15 secs.

#### Equipment

The engine consists of a steel cylinder closed on the fore end. The igniter is on the fore end, and the exhaust nozzle and pressure release diaphragm are on the aft end. Thrust is transmitted to the aircraft attachment fittings through two mounting lugs welded on the cylinder.

#### Remarks

The 15KS-1000 aircraft rocket engine was originally developed as a smokeless JATO (jet-assisted takeoff unit) for the United States Navy, Bureau of Aeronautics. It is currently the only rocket engine certified by the CAA.

### • MODEL: 5KS-4500 JET-ASSISTED TAKEOFF (JATO) UNIT MOTOR

#### Data

Type: Solid-propellant rocket.

#### Specs

Diameter: 9.38 in. Length: 54.57 in. Empty Weight: 123 lb. Loaded Weight: 236 lb.

#### Performance

Rating: 4500 lb. thrust for 5 secs.

#### Equipment

The engine consists of a steel cylinder closed on the fore end. The igniter is on the fore end, and the canted exhaust nozzle and the pressure release diaphragm are on the aft end. Thrust is transmitted to the aircraft attachment fittings by two mounting lugs welded on the cylinder.

#### Remarks

5KS-4500 units are used for the assisted takeoff of carrier-based aircraft, or whenever high thrust is required for short duration. These engines are also employed to propel high-velocity deceleration sleds.

• **MODEL: AJ10-24 BOOSTER ROCKET ENGINE**

**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 powerplant is used to propel the Aerobee high-altitude sounding rocket in investigations of the upper atmosphere.

• **MODEL: 15NS-250 JET-ASSISTED TAKEOFF (JATO) UNIT**

**Data**

Type: Solid-propellant rocket.

**Specs**

Diameter: 6 in. Length: 26.6 in overall. Empty Weight: 21 lb. Loaded Weight: 42 lb.

**Performance**

Rating: 250 lb. thrust for duration of 15 secs. Nominal at 60°F.

**Equipment**

The engine consists of a steel cylinder closed on the fore ends. The igniter is on the fore end, while the exhaust nozzle and two pressure release diaphragms are on the aft end. Thrust is transmitted to the attachment fittings by two mounting lugs welded on the cylinder.

**Remarks**

The 15NS-250 "Junior JATO" aircraft rocket engine is currently under development specifically for use as standby rocket power on light aircraft. CAA certification tests are scheduled to be completed early in November 1957. AGC photo No. 957-003 shows the unit.

• **MODEL: 2.2KS-11,000 ROCKET ENGINE**

**Data**

Type: Solid-propellant rocket.

**Specs**

Diameter: 11.38 in. Length: 52.0 in. overall. Empty Weight: 113 lb. Loaded Weight: 256 lb.

**Performance**

Rating: 11,000 lb. thrust for a duration of 2.2 secs.

**Equipment**

The engine consists of a steel cylinder closed on the fore end. The igniter and the pressure release diaphragm are on the fore end, while the exhaust nozzle is on the aft end. Thrust is transmitted to the attachment fittings by two mounting bands installed around the cylinder.

**Remarks**

2.2KS-11,000 units are employed to propel high-velocity test sleds and may be employed as zero launch missile boosters.

• **MODEL: 2.2KS-33,000 ROCKET ENGINE**

**Data**

Type: Solid-propellant rocket.

**Specs**

Diameter: 13.42 in. Length: 109.50 in. overall. Empty Weight: 426 lb. Loaded Weight: 838 lb.

**Performance**

Rating: 33,000 lb. thrust for a duration of 2.2 secs.

**Equipment**

The engine consists of a steel cylinder closed on the fore end. The igniter and the pressure release diaphragm are on the fore end and the adjustable nozzle is on the aft end. The nozzle may be canted 1° above the chamber center line to 22° below and 4° to either side of the principal plane of adjustment. Thrust is transmitted to the attachment fittings by two mounting bands installed around the cylinder.

**Remarks**

2.2KS-33,000 units may be employed as zero launch missile boosters or to propel high-velocity test sleds.

• **MODEL: 40NS-4500 ROCKET ENGINE**

**Data**

Type: Solid-propellant rocket.

**Specs**

Diameter: 16.03 in. Length: 152.5 in. overall. Empty Weight: 1382 lb. Loaded Weight: 2380 lb.

**Performance**

Rating: 4500 lb. thrust for a duration of 40 secs.

**Equipment**

The engine consists of a steel cylinder closed on the fore end. The igniter and the pressure release diaphragm are on the fore end while the exhaust nozzle is on the aft end. Thrust is transmitted to the aircraft attachment fittings by mounting bands installed around the cylinder.

**Remarks**

40NS-4500 units may be employed for assist takeoff of large aircraft.

• **MODEL: AJ10-33 BOOSTER ROCKET ENGINE**

**Remarks**

This triple thrust chamber, liquid propellant, rocket sled powerplant is the most powerful such unit ever developed. It was designed and built for use at the Supersonic Military Air Research Track (SMART) at Hurricane Mesa, Utah, to test airplane cockpit ejection systems for supersonic aircraft. This engine develops the equivalent of one-half million horsepower during the run, driving the sled at a maximum velocity of 1600 mph with an acceleration of 8-10 g's. The use of multiple thrust chambers makes possible the high velocities noted above as well as better control of the thrust level and consequent wide applications in the rocket-sled field.

• **MODEL: AJ10-37 BOOSTER ROCKET ENGINE**

**Remarks**

The engine is used as the powerplant for the second stage of the Vanguard, satellite-launching vehicle. Performance data are classified on this bi-propellant liquid rocket engine. The second stage engine drives the satellite and its third stage from the 40-mile first stage burnout altitude to the second stage burnout altitude of 130 miles. The vehicle then coasts to its orbital altitude where a small amount of residual propellant is burned to tip the vehicle over to a horizontal position. The third stage engine then fires to complete the satellite launching mission.

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**AIRCOOLED MOTORS, INC.**

SYRACUSE, NEW YORK

• **MODEL: FRANKLIN 6AG4-185-B12**

**Data**

Type: 6 cylinder, air-cooled, horizontally opposed. CAA Type Certificate: 238.

### Specs

Length: 40 $\frac{1}{2}$  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 lb. with hub and accessories. Weight per hp: 1.86 lb.

### Performance

Takeoff Power: 185 hp at 3100 rpm. Cruise: 135 hp. Fuel Consumption: .51 lb. per hp hr. Oil Consumption: .002 lb.

### Equipment

Carburetor: Marvel-Schebler MA4-5 or Bendix PS5-C. Ignition: Dual Scintilla. Starter: Delco-Remy. Generator: Delco-Remy. Fuel Pump: AC.

## • MODEL: FRANKLIN 6A4-165-B3

### Data

Type: 6 cylinder, air-cooled, horizontally opposed. CAA Type Certificate: 238.

### Specs

Length: 27 $\frac{1}{2}$  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

Takeoff Power: 165 hp at 2800 rpm. Cruise: 124 hp at 2200 rpm. Fuel Consumption: .5 lb. per hp hr. Oil Consumption: .002 lb. per hp hr.

### Equipment

Carburetor: Marvel-Schebler MA4-5 or Bendix PS5-C. Ignition: Dual Scintilla S6N21. Starter: Delco-Remy. Generator: Delco-Remy. Fuel Pump: AC.

## • MODEL: FRANKLIN 6V4-200-C32, C33

### Data

Type: 6 cylinder, air-cooled, horizontally opposed. CAA Type Certificate: 244.

### Specs

Length: 29 $\frac{1}{2}$  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 accessories. Weight per hp: 1.66 lb.

### Performance

Takeoff 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 S6RN21. Starter: Delco-Remy. Generator: Delco-Remy. Fuel Pump: Weldon.

### Remarks

This model was designed for helicopter installations.

## • MODEL: FRANKLIN 6V-335-A, B

### Data

Type: 6 cylinder, air-cooled, horizontally opposed; 210 hp. CAA Type Certificate: 244.

### Specs

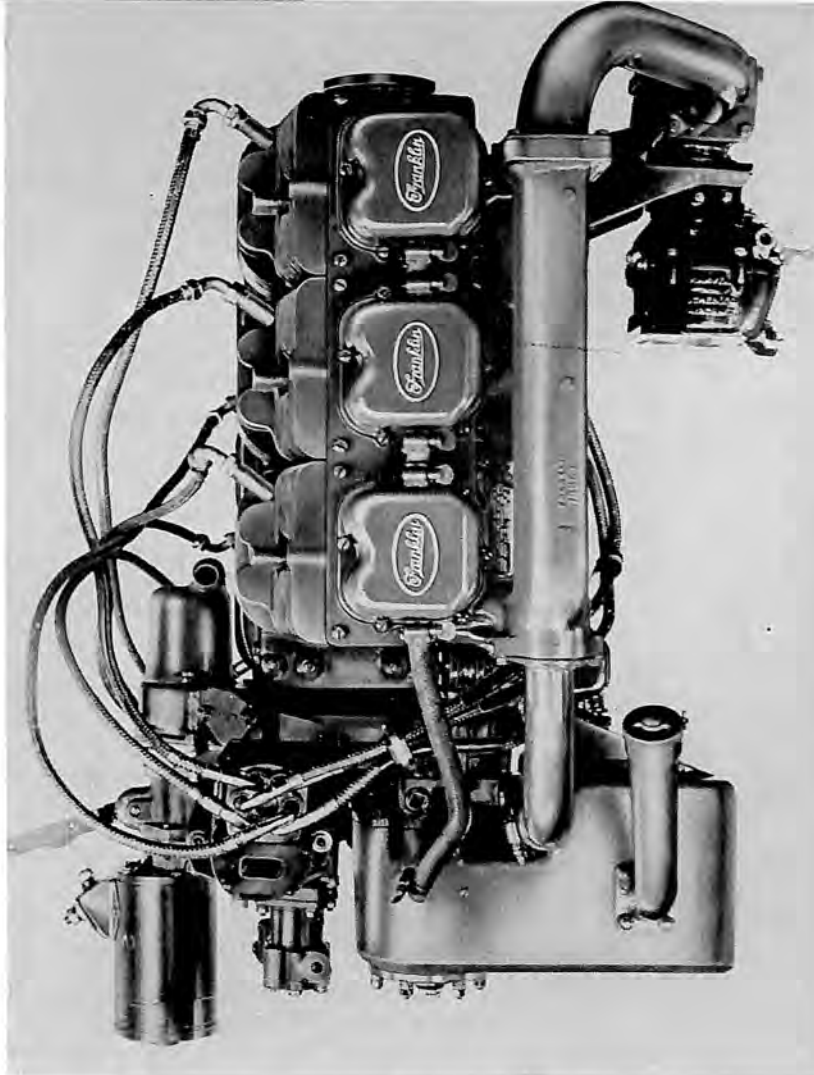
Length: 34 $\frac{3}{4}$  in. Fuel Grade: 91 octane. Bore: 4.5 in. Stroke: 3.5 in. Displacement: 335 cu. in. Compression Ratio: 8.5:1. Dry Weight: 308 lb. Weight per hp: 1.46 lb.

### Performance

Takeoff Power: 210 hp. Fuel Consumption: .52 lb. per hp hr. Oil Consumption: .002 lb. per hp hr.

### Equipment

Carburetor: Marvel-Schebler MA4-5. Ignition: Dual Scintilla S6RN21. Starter: Delco-Remy. Generator: Delco-Remy. Fuel Pump: Weldon. Designed for helicopter installation.



*Aircooled Franklin 6V4-200-C32, C33.*

## • MODEL: FRANKLIN 6A4-150-B3

### Data

Type: 6 cylinder, air-cooled, horizontally opposed. CAA Type Certificate: 238.

### Specs

Length: 37 $\frac{3}{4}$  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

Takeoff Power: 150 hp at 2600 rpm. Cruise: 113 hp at 2350 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: AC.

## • MODEL: FRANKLIN 6A-335-A

### Data

Type: 6 cylinder, air-cooled, horizontally opposed; 210 hp.

### Specs

Length: 36 $\frac{3}{4}$  in. Width: 31 $\frac{1}{2}$  in. Displacement: 335 cu. in. Bore: 4 $\frac{1}{2}$  in. Stroke 3 $\frac{1}{2}$  in. Compression Ratio: 8.5:1. Fuel Grade: 91 octane. Dry Weight: 308 lb.

### Equipment

Carburetor: Marvel-Schebler MA4-5. Magnetos: Scintilla S6RN21. Starter: Delco-Remy 24 volt. Generator: Pierson 24 volt, 20 amp.

**ALLISON DIVISION**  
**GENERAL MOTORS CORPORATION**  
INDIANAPOLIS, INDIANA

• **MODEL: 501-D13 PROP-JET ENGINE**

**Data**

Type: Axial-flow propjet.

**Specs**

Length: 145 in. Width: 27 in. Weight: 1750 lb. Compressor Stages: 14. Turbine Stages: 4.

**Equipment**

Starter: Airframe-furnished.

**Remarks**

Current production installation in Lockheed Electra commercial transport; ESHP 3750 at 13,820 rpm, sea level conditions.

• **MODEL: T56-A-1A**

**Data**

Type: Axial-flow propjet.

**Specs**

Length: 145 in. Width: 27 in. Total Weight: 1645 lb. Compressor Stages: 14. Turbine Stages: 4.

**Equipment**

Starter: Govt. furn. equip.

**Remarks**

Current production installation is in Lockheed C-130A Hercules; ESHP 3750 at 13,820 rpm, sea level conditions.

*Pilot inspects Aeroproducts Turbo-propeller on Allison T56 prop-jet engine.*



• **MODEL: J33-A-20**

**Data**

Type: Centrifugal-flow turbojet.

**Specs**

Length: 105 in. Width: 48 in. Total Weight: 1800 lb. Compressor Stages: dual inlet single. Turbine Stages: 1.

**Equipment**

Starter: Govt. furn. equip.

**Remarks**

Current production installation is in Lockheed TV-2 trainer; Thrust 4600 lb. max. at sea level conditions.

• **MODEL: J33-A-37**

**Data**

Type: Centrifugal-flow turbojet.

**Specs**

Length: 156 in. Width: 48 in. Total Weight: 1800 lb. Compressor Stages: dual inlet single. Turbine Stages: 1.

**Equipment**

Starter: Govt. furn. equip.

**Remarks**

Current production installation is in Martin TM-61A & C Matador. Thrust 4600 lb. max. at sea level conditions.

• **MODEL: J33-A-18A**

**Data**

Type: Centrifugal-flow turbojet.

**Specs**

Length: 94 in. Width: 49 in. Total Weight: 1790 lb. Compressor Stages: dual inlet single. Turbine Stages: 1.

**Equipment**

Starter: Govt. furn. equip.

**Remarks**

Current production installation is in Chance Vought Regulus; Thrust 5100 lb. max. at sea level conditions.

• **MODEL: J33-A-41**

**Data**

Type: Centrifugal-flow turbojet.

**Specs**

Length: 156 in. Width: 48 in. Weight: 1800 lbs. Compressor Stages: dual inlet single. Turbine Stages: 1.

**Equipment**

Starter: Govt. furn. equip.

**Remarks**

Current production installation is in Martin TM-61A and TM-61C Matador missile. Thrust 5200 lb. max. at sea level conditions.

• **MODEL: J71-A-2**

**Data**

Type: Axial-flow turbojet.

**Specs**

Length: 285 in. Width: 42 in.

**Remarks**

Current production installation is in McDonnell F3H-2N Demon.

• **MODEL: J71-A-6**

**Data**

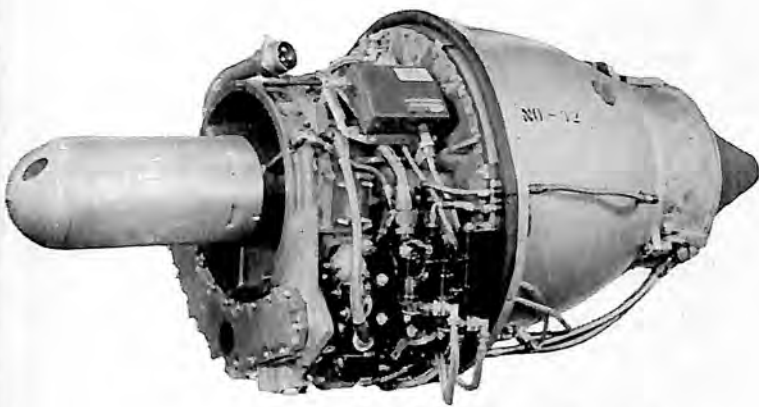
Type: Axial-flow turbojet.

**Specs**

Length: 210 in. Width: 42 in.

**Remarks**

Current installation is in Martin YP-6M Seamaster.



*Continental J69-T-9 turbojet engine.*

• **MODEL: J71-A-13**

**Data**

Type: Axial-flow turbojet.

**Specs**

Length: 191 in. Width: 40 in.

**Remarks**

Current production installation is in Douglas B-66 bomber, RB-66 photo reconnaissance and WB-66 all-weather reconnaissance aircraft.

**CONTINENTAL AVIATION & ENGINEERING CORPORATION**  
DETROIT, MICHIGAN

• **MODEL: 352-2 (J69-T-9)**

**Data**

Type: Turbojet.

**Specs**

Length: 49.94 in. Width: 22.32 in. Total Weight: 364 lb. Compressor Stages: 1. Turbine Stages: 1.

**Performance**

Takeoff: Thrust (lb.) 920, rpm 22,700, SFC 1.13; Normal: Thrust (lb.) 725, rpm 21,000, SFC 1.06.

**Equipment**

Starter: Electric.

**Remarks**

Current production installation: Cessna T-37 USAF Intermediate Trainer, Temco TT-1 Navy Trainer, Beech Model 73 Jet Mentor.

• **MODEL: 354-10 (J69-T-19B)**

**Data**

Type: Turbojet.

**Specs**

Length: 61.53 in. Width: 22.32 in. Total Weight: 317 lb. Compressor Stages: 1. Turbine Stages: 1.

**Performance**

Takeoff: Thrust: 1060, SFC: 1.27, rpm: 21,700. Normal: Thrust: 860, SFC: 1.25, rpm: 20,500.

**Equipment**

Starter: Electric.

**Remarks**

Current production installation: Ryan Q-2 "Firebee" Target Drone.

• **MODEL: 141**

**Data**

Type: Gas Turbine Air Compressor.

**Specs**

Length: 44.6 in. Width: 15.94 in. Total Weight: 197 lb. Compressor Stages: 1. Turbine Stages: 2.

**Performance**

Rated Air hp: St'd day 191, 130°F 182. Air Delivery: St'd day 2.2 lb./sec. Delivery Pressure: St'd day, PSIA 52.5. RPM: 35,000.

**Equipment**

Starter: Electric.

**Remarks**

Current production installation: Used in TC-106 (USAF type MA-1A) trailer mounted turbine air compressor. Also suitable as power plant for pressure-jet helicopters.

**CONTINENTAL MOTORS CORPORATION**  
MUSKEGON, MICHIGAN

• **MODEL: O-470-G**

**Data**

Type: 6 cylinder, air-cooled, horizontally opposed, CAA Type Certificate: 273.

**Specs**

Length: 37.56 in. Width: 33.58 in. Displacement: 471 in. Bore: 5.00 in. Stroke: 4.00. Compression Ratio: 8.0:1. Fuel Grade: 91/96. Dry Weight: 466.5 lb.

**Performance**

Rating: 240 bhp at 2600 rpm, sea level.

**Equipment**

Carburetor: Bendix. Magneto: Scintilla. Starter: Delco-Remy (12 volt). Generator: Delco-Remy (50 amp 12 volt).

• **MODEL: O-470-J**

**Data**

Type: 6 cylinder, air-cooled, horizontally opposed, CAA Type Certificate: 273.

**Specs**

Length: 36.03 in. Width: 33.32 in. Displacement: 471 in. Bore: 5.00 in. Stroke: 4.00 in. Compression Ratio: 7.0:1. Fuel Grade: 80/87 octane. Dry Weight: 415 lb.

**Performance**

Rating: 225 hp at 2550 rpm at sea level.

**Equipment**

Carburetor: Marvel. Magneto: Scintilla. Starter: Delco-Remy. Generator: Delco-Remy.

**Remarks**

Current installation: Taylorcraft.

• **MODEL: O-470-M**

**Data**

Type: 6 cylinder, air-cooled, horizontally opposed, CAA Type Certificate: 273.

**Specs**

Length: 43.31 in. Width: 33.56 in. Displacement: 471 in. Bore: 5.00 in. Stroke: 4.00 in. Compression Ratio: 8.0:1. Fuel Grade: 91/96. Dry Weight: 450 lb.

**Performance**

Rating: 240 hp at 2600 rpm at sea level.

**Equipment**

Carburetor: Bendix. Magneto: Scintilla. Starter: Delco-Remy. Generator: Delco-Remy.

**Remarks**

Current installation: Cessna Aircraft Model 310.

● **MODEL: O-300-A & B**

**Data**

Type: 6 cylinder, air-cooled, horizontally opposed, CAA Type Certificate: 253.

**Specs**

Length: 36.38 in. Width: 31.50 in. Displacement: 301.37 in. Bore: 4.0625 in. Stroke: 3.875 in. Compression Ratio: 7.0:1. Fuel Grade: 80/87. Dry Weight: 310.88 lb.

**Performance**

Rating: 145 hp at 2700 rpm at sea level.

**Equipment**

Carburetor: Marvel. Magneto: Scintilla.

**Remarks**

Current installation: Cessna Aircraft Model 170 for "A" Series, Model 172 for "B" Series. Both engine series are identical except provisions for controllable prop.

● **MODEL: O-470-K & L**

**Data**

Type: 6 cylinder, air-cooled, horizontally opposed, CAA Type Certificate: 273.

**Specs**

Length: 36.03 in. Width: 33.56 in. Displacement: 471 in. Bore: 5.00 in. Stroke: 4.00 in. Compression Ratio: 7.0:1. Fuel Grade: 80/87. Dry Weight: 438 lb.

**Performance**

Rating: 230 hp at 2600 rpm at sea level.

**Equipment**

Carburetor: Marvel. Magneto: Scintilla. Starter: Delco-Remy. Generator: Delco-Remy.

**Remarks**

Current installation: Cessna Aircraft Model 180 for "K" Series and Model 182 for "L" Series. Both engines are identical except for carburetor location.

● **MODEL: A65-8F**

**Data**

Type: 4 cylinder, air-cooled, horizontally opposed, CAA Type Certificate: 205.

**Specs**

Length: 30.41 in. Fuel Grade: 80/87 octane. Bore: 3.875 in. Stroke: 3.625 in. Displacement: 171 cu. in. Compression Ratio: 6.3:1. Dry Weight: 176 lb.

**Performance**

65 hp at 2300 rpm at sea level.

**Equipment**

Carburetor: Stromberg. Ignition: Eisemann or J. I. Case.

● **MODEL: C85-12F**

**Data**

Type: 4 cylinder, air-cooled, horizontally opposed, CAA Type Certificate: 233.

**Specs**

Length: 32 in. Fuel Grade: 80/87 octane. Bore: 4.062 in. Stroke: 3.625 in. Displacement: 188 cu. in. Compression Ratio: 6.3:1. Dry Weight: 186 lb.

**Performance**

85 hp at 2575 rpm.

**Equipment**

Carburetor: Bendix-Stromberg. Ignition: Scintilla. Starter: Delco-Remy. Generator: Delco-Remy.

● **MODEL: C90-12F**

**Data**

Type: 4 cylinder, air-cooled, horizontally opposed, CAA Type Certificate: 252.

**Specs**

Length: 31.25 in. Fuel Grade: 80/87 octane. Bore: 4.062 in. Stroke: 3.875 in. Displacement: 200.91 cu. in. Compression Ratio: 7:1. Dry Weight: 186 lb.

**Performance**

90 hp at 2475 rpm at sea level.

**Equipment**

Carburetor: Bendix-Stromberg. Ignition: Scintilla. Starter: Delco-Remy. Generator: Delco-Remy.

● **MODEL: E-185**

**Data**

Type: 6 cylinder, air-cooled, horizontally opposed, CAA Type Certificate: 246.

**Specs**

Length: 46.66 in. Fuel Grade: 80/87 octane. Bore: 5 in. Stroke: 4 in. Displacement: 471 cu. in. Compression Ratio: 7:1. Dry Weight: 350 lb.

**Performance**

205 hp at 2600 rpm at sea level.

**Equipment**

Carburetor: Bendix-Stromberg. Ignition: Scintilla. Starter: Provisions for direct cranking starter. Generator: Delco-Remy. 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 octane. Bore: 5 in. Stroke: 4 in.

**Performance**

225 hp at 2650 rpm at sea level.

**Equipment**

Carburetor: Bendix-Stromberg. Ignition: Scintilla. Starter: Eclipse. Generator: Delco-Remy. This engine also available with full AN accessory section.

● **MODEL: O-470-2**

**Data**

Type: 6 cylinder, air-cooled, horizontally opposed, CAA Type Certificate: 281.

**Specs**

Length: 37.73 in. Width: 33.62 in. Displacement: 471 in. Bore: 5.00 in. Stroke: 4.00 in. Compression Ratio: 7.0:1. Fuel Grade: 100/130. Dry Weight: 474 lb.

**Performance**

Rating: 265 bhp at 2600 rpm at sea level.

**Equipment**

Carburetor: Bendix. Magneto: Scintilla.

● **MODEL: O-470-13A**

**Data**

Type: 6 cylinder, air-cooled, horizontally opposed, CAA Type Certificate: 269.

**Specs**

Length: 40.90 in. Width: 33.62 in. Displacement: 471 in. Bore 5.00 in. Stroke: 4.00 in. Compression Ratio: 7.0:1. Fuel Grade: 80/100. Dry Weight: 415 lb.

**Performance**

Rating: 225 bhp at 2600 rpm at sea level.

**Equipment**

Carburetor: Bendix. Magneto: Scintilla.

● **MODEL: O-470-15**

**Data**

Type: 6 cylinder, air-cooled, horizontally opposed, CAA Type Certificate: 269.

**Specs**

Length: 45.20 in. Width: 33.41 in. Displacement: 471 in. Bore 5.00 in. Stroke: 4.00 in. Compression Ratio: 7.0:1. Fuel Grade: 80/87. Dry Weight: 405 lb.

**Performance**

Rating: 213 bhp at 2600 rpm at sea level.

**Equipment**

Carburetor: Stromberg. Magneto: Scintilla.

- **MODEL: O-526**

**Data**

Type: 6 cylinder, air-cooled, horizontally opposed, CAA Type Certificate: Pending.

**Specs**

Length: 36.03 in. Width: 34.64 in. Displacement: 526 in. Bore: 5.125 in. Stroke: 4.25 in. Compression Ratio: 7.0:1. Fuel Grade: 80/87. Dry Weight: 428 lb.

**Performance**

Rating: 225 bhp at 2300 rpm at sea level.

**Equipment**

Carburetor: Marvel. Magneto: Scintilla.

- **MODEL: GO-526**

**Data**

Type: 6 cylinder, air-cooled, horizontally opposed, CAA Type Certificate: Pending.

**Specs**

Length: 49.12 in. Width: 34.68 in. Displacement: 526 in. Bore: 5.125 in. Stroke: 4.25 in. Compression Ratio: 7.0:1. Fuel Grade: 80/87. Dry Weight: 408 lb.

**Performance**

Rating: 290 bhp at 3200 rpm at sea level.

**Equipment**

Carburetor: Bendix. Magneto: Scintilla.

- **MODEL: IO-470-C**

**Data**

Type: 6 cylinder, air-cooled, horizontally opposed, CAA Type Certificate: 273.

**Specs**

Length: 37.56 in. Width: 33.58 in. Displacement: 470 in. Bore: 5.00 in. Stroke: 4.00 in. Compression Ratio: 8.0:1. Fuel Grade: 91/96. Dry Weight: 432 lb.

**Performance**

Rating: 250 bhp at 2600 rpm at sea level.

**Equipment**

Carburetor: CMC Injector. Magneto: Scintilla.

- **MODEL: FSO-546**

**Data**

Type: 6 cylinder, air-cooled, horizontally opposed, CAA Type Certificate: 292.

**Specs**

Length: 47.69 in. Width: 33.64 in. Displacement: 526 in. Bore: 5.125 in. Stroke: 4.25 in. Compression Ratio: 7.0:1. Fuel Grade 91/96. Dry Weight: 568 lb.

**Performance**

Rating: 270 bhp at 3200 rpm at sea level.

**Equipment**

Carburetor: Bendix. Magneto: Scintilla.

- **MODEL: GSO-526**

**Data**

Type: 6 cylinder, air-cooled, horizontally opposed, CAA Type Certificate: Pending.

**Specs**

Length: 52.28 in. Width: 34.68 in. Displacement: 526 in. Bore: 5.125 in. Stroke: 4.25 in. Compression Ratio: 7.0:1. Fuel Grade: 91/96. Dry Weight: 523 lb.

**Performance**

Rating: 320 hp at 3000 rpm at sea level.

**Equipment**

Carburetor: Bendix. Magneto: Scintilla.

- **MODEL: GO-300**

**Data**

Type: 6 cylinder, air-cooled, horizontally opposed, CAA Type Certificate: Pending.

**Specs**

Length: 39.12 in. Width: 31.50 in. Displacement: 301 in. Bore: 4.0625 in. Stroke: 4.25 in. Compression Ratio: 7.31:1. Fuel Grade: 80/87. Dry Weight: 312 lb.

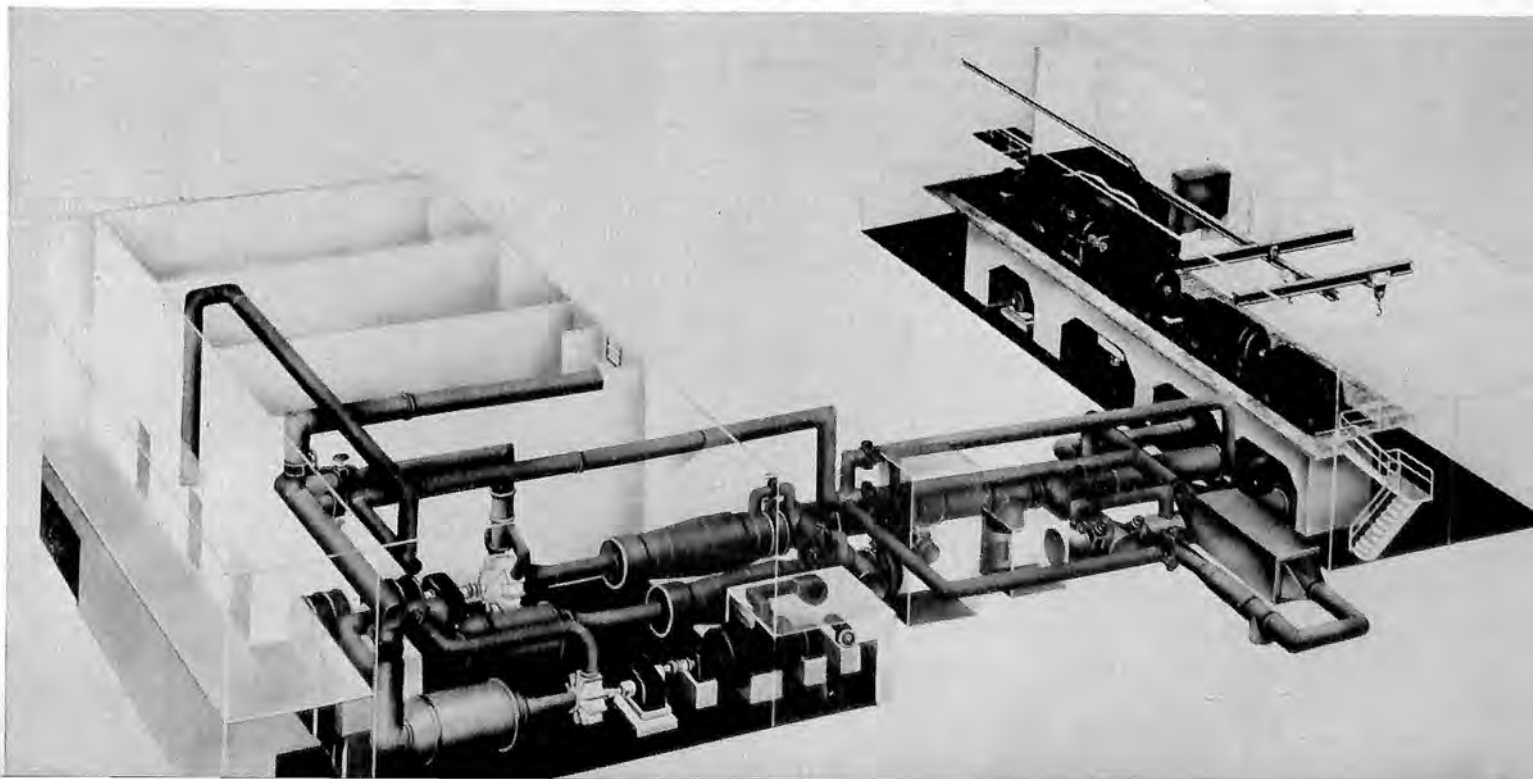
**Performance**

Rating: 175 bhp at 3200 rpm at sea level.

**Equipment**

Carburetor: Marvel. Magneto: Scintilla.

*Cut-away view of Fairchild's supersonic combustion laboratory.*





**FAIRCHILD ENGINE DIVISION**  
**FAIRCHILD ENGINE & AIRPLANE CORPORATION**  
 DEER PARK, LONG ISLAND, NEW YORK

• **MODEL: J-44-R-3 (FT-101E)**

**Data**

Type: Military inhabited aircraft turbojet (Commercial inhabited aircraft turbojet).

**Specs**

Length: 90 in. Diameter: 22 in. Weight 370 lb. Compressor Stages: 1 mixed flow. Turbine Stages: 1.

**Performance**

Static Thrust: 1000 lb. Rated rpm: 15,780. Starter: Compressed air or electric.

• **MODEL: J-44-R-20B**

**Data**

Type: Pilotless aircraft turbojet.

**Specs**

Length: 92 in. Diameter: 22 in. Weight: 339 lb. Compressor Stages: 1 mixed flow. Turbine Stages: 1.

**Performance**

Static Thrust: 1000 lb. Rated rpm: 15,780. Starter: Compressed air or electric.

• **MODEL: J-44-R-26**

**Data**

Type: Pilotless aircraft turbojet.

**Specs**

Length: 92 in. Width: 22 in. Total Weight: 365 lb. Compressor Stages: 1. Turbine Stages: 1.

**Equipment**

Starter: Compressed air or electric SFC 1.35.

**Remarks**

Thrust 1100 lb. Rated rpm 16,570.

• **MODEL: XJ83**

**Data**

Type: 2000 lb. thrust class.

**Remarks**

A family of J83 type, extremely lightweight, high performance engines, is now under design and development for piloted and pilotless aircraft.

**GENERAL ELECTRIC COMPANY**  
**AIRCRAFT GAS TURBINE DIVISION**  
 CINCINNATI, OHIO

• **MODEL: CJ-805-3**

**Data**

Type: Commercial turbojet engine: continuous flow, single rotor, variable stators, fixed area jet nozzle.

**Specs**

Length: 112 in. Width: 37 in. Total Weight: Classified. Compressor Stages: 17. Turbine Stages: 3.

**Remarks**

Current production installation: Lockheed F-104A & B; patible reverser and suppressor have been developed for the engine. Inlet guide vanes, plus first six stator stages variable.

• **MODEL: J79-GE-1, -3, -3A, -5, -7, -2**

**Data**

Type: Turbojet.

**Specs**

Length: 17 ft. approx. Width: 3 ft. approx. Total Weight: less than 3200 lb. Compressor Stages: 17. Turbine Stages: 3.

**Remarks**

Current production installation: Lockheed F-104A & B; Convair B-58; Chance Vought Regulus II.

**LYCOMING DIVISION**  
**AVCO MFG. CORPORATION**  
 STRATFORD, CONNECTICUT

• **MODEL: O-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**

Takeoff Power: 115 hp 2800 rpm. Cruise: 86 hp at 2350 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: O-290-D2B**

**Data**

Type: 4 cylinder, air-cooled, horizontally opposed, direct drive, 140 hp. CAA Type Certificate: 229.

**Specs**

Length: 29.56. Width: 32.24. Height: 22.81. Bore: 4.875. Stroke: 3.875. Compression Ratio: 7.0:1. Displacement: 289.0 cu. in. Weight: 264 lbs. Fuel Grade: 80/87.

**Performance**

Takeoff Power: 140 hp at 2800. Rated Power: 135 hp at 2600 rpm. Fuel Consumption: 6.5 gal. per hr. at 2250 rpm, economy cruise.

**Equipment**

Carburetor: Marvel-Schebler MA-3FPA. Magnetos: Scintilla S4LN-20 and S4LN-21. Generator: Delco-Remy 12 volt. Starter: Delco-Remy.

*General Electric T58.*



• **MODEL: O-320-A1A**

**Data**

Type: 4 cylinder, air-cooled, horizontally opposed, direct drive, 150 hp. CAA Type Certificate: 274.

**Specs**

Length: 29.56. Height: 23.12. Width: 32.24. Bore: 5.125. Stroke: 3.875. Displacement: 319 cu. in. Compression Ratio: 7.00:1. Weight: 272 lb. Fuel Grade: 80/87.

**Performance**

Takeoff and Rated Power: 150 hp at 2700 rpm. Fuel Consumption: 8.2 gal. per hr. at 2350 rpm, economy cruise.

**Equipment**

Carburetor: Marvel-Schebler MA4SPA. Magnetos: Scintilla S4LN-20 and S4LN-21. Generator: Delco-Remy, 12 and 24 volt. Starter: Delco-Remy.

• **MODEL: O-320-B1A**

**Data**

Type: 4 cylinder, air-cooled, horizontally opposed, direct drive, 160 hp. CAA Type Certificate: 274.

**Specs**

Length: 29.56. Width: 32.24. Height: 23.12. Bore: 5.125. Stroke: 3.875. Displacement 319 cu. in. Compression Ratio: 8.5:1. Fuel Grade: 91/96.

**Performance**

Takeoff and Rated Power: 160 hp at 2700 rpm. Fuel Consumption: 8.2 gal. per hr. at 2350 rpm, economy cruise.

**Equipment**

Carburetor: Marvel-Schebler MA4SPA. Magnetos: Scintilla S4LN-20 and S4LN-21. Generator: Delco-Remy, 12 or 24 volt. Starter: Delco-Remy, 12 or 24 volt.

• **MODEL: O-340-A1A**

**Data**

Type: 4 cylinder, air-cooled, horizontally opposed, direct drive, 170 hp. CAA Type Certificate: 277.

**Specs**

Length: 30.09. Width: 32.55. Height: 24.68. Bore: 5.125. Stroke: 4.125. Compression Ratio: 8.5:1. Displacement: 340.4 cu. in. Weight: (with starter and generator) 278 lb. Fuel Grade: 91/96.

**Performance**

Takeoff and Rated Power: 170 hp. at 2700 rpm. Fuel Consumption: 8.5 gal. per hr. at 2350 rpm and 65 percent rated power.

**Equipment**

Carburetor: Marvel-Schebler MA4-5. Magnetos: Scintilla S4LN-20 and S4LN-21. Generator: Delco-Remy 12 volt. Starter: Delco-Remy.

• **MODEL: O-340-B1A**

**Data**

Type: 4 cylinder, air-cooled, horizontally opposed, direct drive, 170 hp. CAA Type Certificate: 277.

**Specs**

Length: 30.09. Width: 32.55. Height: 24.68. Bore: 5.125. Stroke: 4.125. Compression Ratio: 7.20:1. Displacement: 340.4 cu. in. Weight: (with starter and generator) 278 lbs. Fuel Grade: 80/87.

**Performance**

Takeoff and Rated Power: 168 hp at 2700 rpm. Fuel Consumption: 8.5 gal. per hp. at 2350 rpm and 65 percent rated power.

**Equipment**

Carburetor: Marvel-Schebler MA4-5. Magnetos: Scintilla S4LN-20 and S4LN-21. Generator: Delco-Remy 12 volt. Starter: Delco-Remy.

• **MODEL: O-360-A1A**

**Data**

Type: 4 cylinder, horizontally opposed, air-cooled, 180 hp. CAA Type Certificate: 286.

**Specs**

Length: 29.56 in. Width: 33.37 in. Height: 24.68 in. Displacement: 361 cu. in. Bore: 5.125 in. Stroke: 4.375. Compression Ratio: 8.50:1. Fuel Grade: 91/96. Dry Weight: 282 lb.

**Equipment**

Carburetor: Marvel-Schebler MA4-5. Magnetos: Scintilla S4LN-20, S4LN-21. Starter: Delco-Remy. Generator: Delco-Remy.

• **MODEL: O-360-A1B**

**Data**

Type: 4 cylinder, horizontally opposed, air-cooled, 180 hp. CAA Type Certificate: 286.

**Specs**

Length: 29.56 in. Width: 33.37 in. Height: 23.30 in. Displacement: 361 cu. in. Bore: 5.125 in. Stroke: 4.375. Compression Ratio: 8.50:1. Fuel Grade: 91/96. Dry Weight: 285 lb.

**Equipment**

Carburetor: Bendix-Stromberg PS-5BD. Magnetos: Scintilla S4LN-20, S4LN-21. Starter: Delco-Remy. Generator: Delco-Remy.

• **MODEL: O-360-B1A**

**Data**

Type: 4 cylinder, horizontally opposed, air-cooled, 180 hp. CAA Type Certificate: 286.

**Specs**

Length: 29.56 in. Width: 33.37 in. Height: 24.68 in. Displacement: 361 cu. in. Bore: 5.125 in. Stroke: 4.375. Compression Ratio: 7.20:1. Fuel Grade: 80/87.

**Performance**

Takeoff and Rated Power: 168 hp at 2700 rpm.

**Equipment**

Carburetor: Marvel-Schebler MA4-5. Magnetos: Scintilla S4LN-20, S4LN-21. Starter: Delco-Remy. Generator: Delco-Remy.

• **MODEL: O-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**

Takeoff Power: 190 hp at 2550 rpm. Cruise: 145 hp at 2300 rpm. Fuel Consumption: .52 lb. per hr. Oil Consumption: .0012 lb. per hp hr.

**Equipment**

Carburetor: Marvel-Schebler MA4-5. Ignition: Dual Scintilla S6LN-50. Starter: Delco-Remy. Generator: Delco-Remy.

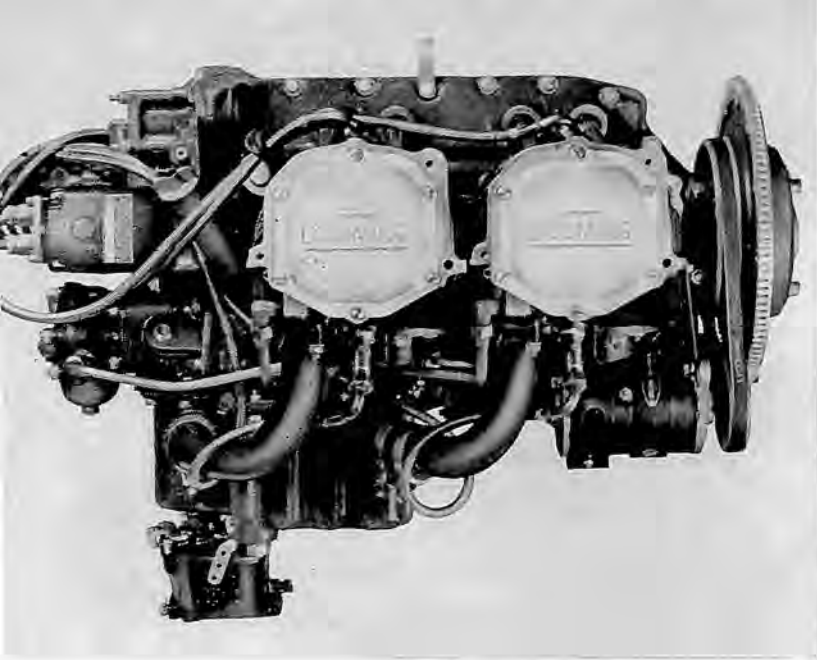
• **MODEL: VO-435-A1C (O-435-23B)**

**Data**

Type: 6 cylinder, air-cooled, horizontally opposed, for vertical helicopter installation 260 hp. CAA Type Certificate: 279.

**Specs**

Height: 34.73. Width: 33.32. Depth: 25.19. Fuel Grade: 80/87. Bore: 4.875. Stroke: 3.875. Displacement: 434 cu. in. Compression Ratio: 7.3:1. Weight: 396 lb.



Lycoming O-320-B.

**Performance**

Takeoff: 260 hp at 3400 rpm. Rated Power: 250 hp at 3200 rpm. Fuel Consumption: 20.0 gal. per hr. at 80 percent rated power.

**Equipment**

Carburetor: Marvel-Schebler MA4-5 AA. Magnetos: Scintilla S6LN-20 and S6RN-21. Hand cranking provisions optional. New design crankcase and oil pump, hydraulic and fuel pump drives.

• **MODEL: VO-435-A1D (O-435-6A)**

**Data**

Type: 6 cylinder, air-cooled, horizontally opposed, for vertical helicopter installation 260 hp. CAA Type Certificate: 279.

**Specs**

Height: 34.73. Width: 33.32. Depth: 25.19. Fuel Grade: 80/87. Bore: 4.875. Stroke: 3.875. Displacement: 434 cu. in. Compression Ratio: 7.3:1. Weight: 396 lb.

**Performance**

Takeoff: 270 hp at 3400 rpm. Rated Power: 250 hp at 3200 rpm. Fuel Consumption: 20.0 gal. per hr. at 80 percent rated power.

**Equipment**

Carburetor: Marvel-Schebler MA4-5 AA. Magnetos: Scintilla S6LN-20 and S6RN-21. Hand cranking provisions optional. New design crankcase and oil pump.

• **MODEL: GO-435-C2B2**

**Data**

Type: 6 cylinder, horizontally opposed, geared, air-cooled. CAA Type Certificate: 228, 240 hp.

**Specs**

Length: 38.64. Width: 33.12 in. Displacement: 430.0 in. Bore: 4.875 in. Stroke: 3.875. Compression Ratio: 7.3:1. Fuel Grade: 80/87. Dry Weight: 430 lb.

**Equipment**

Carburetor: Marvel-Schebler MA4-5. Magnetos: Scintilla S6LN-20, and S6LN-21.

• **MODEL: GO-480-B1A6, -B1D**

**Data**

Type: 6 cylinder, horizontally opposed, air-cooled, gear drive, 270 hp. CAA Type Certificate: 275.

**Specs**

Length: 38.64 in. Width: 33.12 in. Height: 28.02 in. Bore: 5.125 in. Stroke: 3.875 in. Displacement: 479.7. Compression Ratio: 7.3:1. Weight: 432 lb. Fuel Grade: 80/87.

**Performance**

Takeoff Power: 270 hp at 3400 rpm (2180 prop

rpm). Rated Power: 260 at 3000 rpm. Fuel Consumption: 14.1 gal. per hr. at 2600 rpm, economy cruise.

**Equipment**

Carburetor: Bendix-Stromberg PS-5BD. Magnetos: Scintilla S6LN-20, S6LN-21.

• **MODEL: GO-480-D1A**

**Data**

Type: 6 cylinder, reduction gear drive, horizontally opposed, air-cooled, 295 hp. CAA Type Certificate: 275.

**Specs**

Length: 40.59 in. Fuel Grade: 80/87. Bore: 5.125 in. Stroke: 3.875. Compression Ratio: 7.30:1. Displacement: 479.7 cu. in. Weight: 454 lb. Fuel Grade: 80/87.

**Performance**

Takeoff Power: 275 hp at 3400 rpm (218 prop. rpm). hp at 3000 rpm. Fuel Consumption: 13.0 gal. per hr. at rated speed and 60 percent rated power.

**Equipment**

Carburetor: Bendix-Stromberg PS-5BD. Magnetos: Scintilla S6LN-20 and S6LN-21.

• **MODEL: GO-480-F1A6**

**Data**

Type: 6 cylinder, gear drive, horizontally opposed, air-cooled, 275 hp. CAA Type Certificate: 275.

**Specs**

Length: 40.59 in. Fuel Grade: 80/87. Bore: 5.125 in. Stroke: 3.875. Displacement: 479.7. Compression Ratio: 7.30:1. Weight: 436 lb.

**Performance**

Takeoff Power: 275 hp at 3400 rpm (218 prop. rpm). Rated Power: 265 hp at 3100 rpm. Fuel Consumption: 14.0 gal. per hr. at 2600 rpm and 60 percent rated power.

**Equipment**

Carburetor: Bendix-Stromberg PS-5BD. Magnetos: Scintilla S6LN-20 and S6LN-21.

• **MODEL: GO-480-G1B6**

**Data**

Type: 6 cylinder, reduction gear drive, horizontally opposed, air-cooled, 295 hp. CAA Type Certificate: 275.

**Specs**

Length: 40.04. Width: 33.12. Height: 27.46 in. Bore: 5.125 in. Stroke: 3.875 in. Compression Ratio: 8.70:1. Displacement: 479.7 cu. in. Weight: 464 lb. Fuel Grade: 100/130.

**Performance**

Takeoff Power: 295 hp at 3400 rpm. Rated Power: 280 hp at 3000 rpm. Fuel Consumption: 13.0 gal. per hr. at rated speed and 60 percent rated power.

**Equipment**

Carburetor: Bendix-Stromberg PS-5BD. Magnetos: Scintilla, S6LN-20 and S6RN-21.

• **MODEL: GO-480-G2D6**

**Data**

Type: 6 cylinder, gear drive, horizontally opposed, air-cooled, 295 hp. CAA Type Certificate: 275.

**Specs**

Length: 40.59. Width: 33.12. Bore: 5.125 in. Stroke: 3.875 in. Compression Ratio: 8.70:1. Displacement: 479.7 cu. in. Weight: 442 lb. Fuel Grade: 100/130.

**Performance**

Takeoff Power: 295 hp at 3400 rpm. Rated Power: 285 hp at 3100 rpm. Fuel Consumption: 13.5 gal. per hr. at rated speed and 60 percent rated power.

#### Equipment

Carburetor: Bendix-Stromberg PS-5BD. Magnetos: Scintilla S6LN-20, S6LN-21.

#### • MODEL: GSO-480-B1A6

##### Data

Type: 6 cylinder, horizontally opposed, geared, supercharged, 340 hp. CAA Type Certificate: 284.

##### Specs

Length: 44.43. Height: 29.40. Width: 33.12. Bore: 5.125. Stroke: 3.875. Displacement: 479.7. Compression Ratio: 7.3:1. Weight: 498 lb. Fuel Grade: 100/130.

##### Performance

Takeoff Power: 340 hp at 3400 rpm (2180 prop. rpm). Rated Power: 320 hp at 3200 rpm. Fuel Consumption: 16.0 gal. per hr. at 60 percent rated power at 2600 rpm.

##### Equipment

Carburetor: Bendix PS-7BD. Magnetos: Scintilla S6LN-20 and S6RN-21.

#### • MODEL: GSO-480-B1B6 (O-480-1)

##### Data

Type: 6 cylinder, horizontally opposed, geared, supercharged, 340 hp. CAA Type Certificate: 284.

##### Specs

Length: 46.22. Height: 33.26. Width: 33.12. Bore: 5.125. Stroke: 3.875. Displacement: 479.7 cu. in. Compression Ratio: 7.3:1. Weight: 500 lb. Fuel Grade: 100/130.

##### Performance

Takeoff Power: 340 hp at 3400 rpm (2180 prop. rpm). Rated Power: 320 hp at 3200 rpm. Fuel Consumption: 16.0 gal. per hr. at 60 percent rated hp and 2600 rpm.

##### Equipment

Carburetor: Bendix PSH-7BD. Magnetos: Scintilla S6LN-20, S6RN-21.

#### • MODEL: GSO-480-B1C6

##### Data

Type: 6 cylinder, horizontally opposed, geared, supercharged, 340 hp. CAA Type Certificate: 284.

##### Specs

Length: 52.18. Height: 22.56. Weight: 33.12. Bore: 5.125. Stroke: 3.875. Displacement: 479.7 cu. in. Compression Ratio: 7.3:1. Weight 497 lb. Grade 100/130.

##### Performance

Takeoff Power: 340 hp at 3400 rpm (2180 prop. rpm). Rated Power: 320 hp at 3200 rpm. Fuel Consumption: 16.0 gal. per hr. at 60 percent rated hp and 2600 rpm.

##### Equipment

Carburetor: Bendix PSH-7BD. Magnetos: Scintilla S6LN-20, S6LN-21.

#### • MODEL: O-540-A1A

##### Data

Type: 6 cylinder, air-cooled, horizontally opposed, direct drive, 265 hp. CAA Type Certificate: 295.

##### Specs

Length: 37.22. Height: 25.81. Width: 33.37. Bore: 5.125. Stroke: 4.375. Displacement: 541.5 cu. in. Compression Ratio: 8.5:1. Weight: 396. Fuel Grade: 91/96.

##### Performance

Takeoff Power: 265 hp at 2800 rpm. Rated Power: 260 hp at 2700 rpm. Fuel Consumption: 12 gal. per hr. at economy cruise.

##### Equipment

Carburetor: Marvel-Schebler MA4-5. Magnetos: Scintilla S6LN-20, S6LN-21. Generator: Delco-Remy 12 or 24 volt. Starter: Delco-Remy.

#### • MODEL: SO-580-A1B (O-580-3)

##### Data

Type: 8 cylinder, air-cooled, opposed, supercharged, for horizontal or vertical helicopter installation, 400 hp. CAA Type Certificate: 285.

##### Specs

Length: 46.67. Width: 33.12. Height: 24.58. Bore: 4.875. Stroke: 3.875. Compression Ratio: 7.3:1. Displacement: 578 cu. in. Weight: 578 lb. Fuel Grade: 100/130.

##### Performance

Takeoff Power: 400 hp at 3300 rpm. Rated Power: 350 hp at 3000 rpm. Fuel Consumption: 16.5 gal. per hr. at rated speed and 80 percent rated power.

##### Equipment

Carburetor: Bendix PS-9BDE. Magnetos: Scintilla (2) S4LN-20 and (2) S4RN-21.

#### • MODEL: GSO-580-D

##### Data

Type: 8 cylinder, air-cooled, horizontally opposed, geared, supercharged. CAA Type Certificate: 256.

##### Specs

Length: 57.08 in. Fuel Grade, 100/130 octane. Bore: 4.875 in. Stroke: 3.875 in. Displacement: 578 cu. in. Compression Ratio: 7.30:1. Weight: 610 lb.

##### Performance

Takeoff Power: 400 hp. Fuel Consumption: .57 lb. per bhp per hr.

#### • MODEL: -76A & -76B

##### Data

Type: R-1820, 9 (radial) cylinder, air-cooled, 1275 rated hp.

##### Specs

Length: 48.50 in. Height: 54.95 in. dia. Bore: 6.125 in. Stroke: 6.875 in. Displacement: 1820. Compression Ratio: 6.80:1. Fuel Grade: 100/130. Weight: 1380 lb.

##### Performance

Takeoff Power and Speed: 1425 at 2700 rpm. Rated Power and Speed: 1275 at 2500 rpm. Fuel Consumption: .700 lb. per bhp per hr.

##### Equipment

Carburetor: PD12K18. Magneto: Bosch S9LU-3.

#### • MODEL: -80

##### Data

Type: R-1820, 9 (radial) cylinder, air-cooled, 1275 rated hp. CAA Type Certificate: 259.

##### Specs

Length: 48.50 in. Height: 54.95 in. dia. Bore: 6.125 in. Stroke: 6.875 in. Displacement: 1820. Compression Ratio: 6.80:1. Fuel Grade: 100/130. Weight: 1404 lb.

##### Performance

Takeoff Power and Speed: 1475 bhp at 2800 rpm. Rated Power and Speed: 1275 bhp at 2500. Fuel Consumption: .700 lb. per bhp per hr.

##### Equipment

Carburetor: PD12K18. Magneto: Bosch S9LU-3.

#### • MODEL: -82

##### Data

Type: R-1820, 9 (radial) cylinder, air-cooled, 1275 rated hp. CAA Type Certificate: 259.

##### Specs

Length: 50.10 in. Height: 55.74 in. dia. Bore: 6.125 in. Stroke: 6.875 in. Displacement: 1820. Compression Ratio: 6.80:1. Fuel Grade: 115/145. Weight: 1469 lb.

**Performance**

Takeoff Power and Speed: 1525 at 2800 rpm. Rated Power and Speed: 1275 at 2500 rpm. Fuel Consumption: .677 lb. per bhp per hr.

**Equipment**

Carburetor: PD12K18. Magneto: Scintilla Model D9LN-2.

- **MODEL: -84**

**Data**

Type: R-1820, 9 (radial) cylinder, air-cooled, direct drive, 1275 rated hp. CAA Type Certificate: 259.

**Specs**

Length: 52.00 in. Height: 55.74 in. dia. Bore: 6.125 in. Stroke: 6.875 in. Displacement: 1820. Compression Ratio: 6.80:1. Fuel Grade: 115/145. Weight: 1405 lb.

**Performance**

Takeoff Power and Speed: 1525 at 2800 rpm. Rated Power and Speed: 1275 at 2500 rpm. Fuel Consumption: .677 lb. per bhp per hr.

**Equipment**

Carburetor: PD12R1. Magneto: Scintilla D9LN-2. 39° from horizontal nose up.

- **MODEL: -86**

**Data**

Type: R-1820, 9 (radial) cylinder, air-cooled, direct drive, 1275 rated hp. CAA Type Certificate: 243.

**Specs**

Length: 48.50 in. Height: 54.95 in. dia. Bore: 6.125 in. Stroke: 6.875 in. Displacement: 1820. Compression Ratio: 6.80:1. Fuel Grade: 100/130. Weight: 1385 lb.

**Performance**

Takeoff Power and Speed: 1425 at 2700 rpm. Rated Power and Speed: 1275 at 2500 rpm. Fuel Consumption: .695 lb. per bhp per hr.

**Equipment**

Carburetor: PD12K18. Magneto: Bosch S9LU-3.

- **MODEL: -103**

**Data**

Type: R-1820, 9 (radial) cylinder, air-cooled, 1275 rated hp. CAA Type Certificate: 243.

**Specs**

Length: 48.50 in. Height: 54.95 in. dia. Bore: 6.125 in. Stroke: 6.875 in. Displacement: 1820. Compression Ratio: 6.80:1. Fuel Grade: 100/130. Weight: 1350 lb.

**Performance**

Takeoff Power and Speed: 1425 at 2700 rpm. Rated Power and Speed: 1275 at 2500 rpm. Fuel Consumption: .700 lb. per bhp per hr.

**Equipment**

Carburetor: PD12K19. Magneto: Bosch S9LU-3.

- **MODEL: -3**

**Data**

Type: R-1300, 7 (radial) cylinder, air-cooled, direct drive, 700 bhp rated hp.

**Specs**

Length: 49.68 in. Height: 50.45 in. dia. Bore: 6.125 in. Stroke: 6.312 in. Displacement: 1300. Compression Ratio: 6.20:1. Fuel Grade: 91/96. Weight: 1080 lb.

**Performance**

Takeoff Power and Speed: 800 bhp at 2600 rpm. Rated Power and Speed: 700 bhp at 2400 rpm. Fuel Consumption: .700 lb. per bhp per hr.

**Equipment**

Carburetor: Bendix PD9G1. Magneto: Bosch S7LU-3.

- **MODEL: -4**

**Data**

Type: R-1300, 7 (radial) cylinder, air-cooled, 700 bhp rated hp.

**Specs**

Length: 48.12 in. Height: 50.45 in. dia. Bore: 6.125 in. Stroke: 6.312 in. Displacement: 1300. Compression Ratio: 6.20:1. Fuel Grade: 91/96. Weight: 1092 lb.

**Performance**

Takeoff Power and Speed: 800 bhp at 2600 rpm. Rated Power and Speed: 700 bhp at 2400 rpm. Fuel Consumption: .720 lb. per bhp per hr.

**Equipment**

Carburetor: Bendix PD9F1. Magneto: Bosch S7LU-3.

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**PRATT & WHITNEY AIRCRAFT DIVISION  
UNITED AIRCRAFT CORPORATION  
EAST HARTFORD, CONNECTICUT**

- **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: 2004 cu. in. Compression Ratio: 6.5:1. Dry Weight: Single speed, 1585 lb.; two speed, 1605 lb.

**Performance**

Takeoff: 1450 at 2700 rpm and 1000 ft. Normal Rated Power: 1200 hp at 2550 rpm and 5000 ft.

**Equipment**

Carburetor: Stromberg PD-12F13. Ignition: two Scintilla SF-14LN-8.

**Remarks**

Powers Douglas C-54 military transport and the commercial version, the DC-4.

- **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: 2804 cu. in. Compression Ratio: 6.75:1. Dry Weight: Two speed, 2390 lb.; single speed, 2357 lb.

**Performance (CB3)**

Takeoff Power: 2400 hp at 2800 rpm at 4000 ft. with water injection; 2050 hp at 2700 rpm at 6000 ft. dry. Normal Rated Power: 1800 hp at 2600 rpm at 8500 ft.

**Equipment**

Carburetor: Stromberg PR-58E5. Ignition: Scintilla DLN-10 low tension. CB16, same in low, but has maximum continuous rating in high of 1700 hp.

**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: Bell XHSL-1 helicopter, Fairchild 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. Commercial versions power the Convair 240, 340 and 440 transports, Douglas DC-6, -6A, and -6B transports and Martin 2-0-2A and 4-0-4 transports.

• **MODEL: TURBO-WASP J48 (JT-7)**

**Data**

Type: Centrifugal-flow turbojet.

**Specs**

Diameter: 50.50 in. Length: 109.75 in. Compressor: double-entry, single-stage, centrifugal-flow. Weight: 2080 lb. Fuel: Kerosene, gasoline or special jet fuel.

**Performance**

Takeoff Power: 7250 lb. thrust. Military Rating: 7250 lb. thrust. Normal Rating: 5600 lb. thrust. Cruise Rating 3750 lb. or 3100 lb. thrust.

**Remarks**

The J48 powers the Navy's Grumman F9F-5 Panther and the swept-wing F9F-6 and F9F-8 and the Lockheed F-94C all-weather interceptor for the Air Force; Marcel-Dassault MD452-08 and MD-453.

• **MODEL: TURBO-WASP PT2G-4**

**Data**

Type: Axial-flow turboprop.

**Specs**

Diameter: 35.75 in. Length: 156.8 in. Compressor: Multi-stage, axial-flow. Turbine: three-stage, axial-flow. Weight: 2670 lb. Fuel: JP-4.

**Performance**

Takeoff Power: 6000 hp. Fuel Consumption: 0.63 lb. per hp hr.; SFC 0.630 lb. per ESHP per hr.

**Remarks**

This engine powers the Douglas YC-133A and C-133A, Lockheed C-121F, Boeing C-97J.

• **MODEL: TURBO-WASP J57 (JT-3)**

**Data**

Type: Twin-spool, axial-flow turbojet.

**Remarks**

Specifications and performance are still classified other than that the engine is in the 10,000 lb. thrust class. It powers the Air Force's Boeing B-52 long-range bomber, the KC-135, the Northrop SM-62, the North American F-100, McDonnell F-101, Convair F-102 and the Navy's Douglas F4D fighter, the F5D and A3D bomber, and Chance Vought F8U-1 fighter. The J57 also powers the Boeing 707 and Douglas DC-8. The fighter aircraft are powered by afterburner versions of the J57 engine.

• **MODEL: TURBO-WASP J75 (JT-4)**

**Data**

Type: Twin-spool, axial-flow turbojet.

**Remarks**

Specifications and performance remain classified. The J75 is in the 15,000 lb. thrust class, greatly augmented by afterburner operation. The engine powers the Air Force's Convair F-106, Republic F-105; it will power the Navy's Martin P6M and Chance Vought F8U-3. The JT-4 will power models of the Boeing 707 and Douglas DC-8 commercial airliners. The J75 with afterburner for fighter aircraft is designed for speeds up to Mach 2.

• **MODEL: TURBO-WASP J52**

**Data**

Type: Twin-spool, axial-flow turbojet.

**Remarks**

Specifications and performance are classified other than that the engine is in the medium range of 7500 lb. of dry thrust and incorporates many new advances in the turbine art.

**WESTINGHOUSE ELECTRIC CORPORATION**  
**AVIATION GAS TURBINE DIVISION**  
KANSAS CITY, MISSOURI

• **MODEL: J34-WE-36**

**Data**

Type: Axial-flow turbojet.

**Specs**

Diameter: 27 in. Length: 111.4 in. Height: 34.7 in. Weight: 1207 lb. Compression Ratio: 4.35.

**Performance**

Takeoff Thrust: 3400 lb. at 12,500 rpm. Operating Altitude: 45,000 ft.

**Remarks**

Currently used in pods as auxiliary power for Lockheed P2V-7 Neptune. An advanced version, the J34-WE-46 will power the North American Aviation T2J basic trainer.

• **MODEL: YJ81-WE-3**

**Data**

Type: Axial-flow turbojet.

**Specs**

Length: 58.9 in. Diameter: 15.8 in.

**Performance**

Thrust: 1740 lb. (S.L.S.). SFC: 1.26. Annular Combustion Chamber—Burning JP4.

**Remarks**

Engine initially designed for use in missiles and drones. The J81 is an Americanized version of the Rolls Royce RSr/2 Soar.

• **MODEL: J54-WE-2**

**Data**

Type: Axial-flow turbojet.

**Specs**

Length: 120 in. Diameter: 35 in.

**Performance**

6000 lb. thrust class.

**Remarks**

Developed as a Westinghouse-financed program, J54 has completed: 150 hour endurance run; NATTC Trenton altitude chamber tests; and initial flight tests.

**WRIGHT AERONAUTICAL DIVISION**  
**CURTISS WRIGHT CORPORATION**  
WOOD-RIDGE, NEW JERSEY

• **MODEL: R-1300-2A & 2B**

**Data**

Type: 7 cylinder, air-cooled, radial.

**Specs**

Length: 48.10 in. Width: 50.45 in. Weight: 1067 lb. Displacement: 1300 cu. in. Bore: 6.125 in. Stroke: 6.312 in. Compression Ratio: 6.2:1. Fuel Grade: 91/98.

**Performance**

Takeoff hp: 800 at 2600 rpm. Normal Rated hp: 700 at 2400 rpm up to 5000 ft. Military Rating: 800 at 2600 rpm at 3500 ft. Fuel Consumption: .72 lb. per bhp per hr. Oil Consumption: .025 lb. per bhp per hr. at normal rated power.

**Equipment**

Carburetor: Stromberg PD9F1. Magneto: Bosch SF-7LU-2.

**Remarks**

This engine designed for blimp and helicopter installations; also the R-1300-3.

• **MODEL: R-1300-3**

**Data**

Type: 7 cylinder, air-cooled, radial.

**Specs**

Length: 49.68 in. Width: 50.45 in. Weight: 1080 lb. Displacement: 1300 cu. in. Bore: 6.125 in. Stroke: 6.312 in. Compression Ratio: 6.2:1. Fuel Grade: 91/96.

**Performance**

Takeoff hp: 800 at 2600 rpm. Normal Rated hp: 700 at 2400 rpm. Military Rating: 800 at 2600 rpm at 3500 ft. Fuel Consumption: .720 lb. per bhp per hr. at normal rated power. Oil Consumption: .020 lb. per bhp per hr. at normal rated power.

**Equipment**

Carburetor: Bendix PD9G1. Magneto: Amer. Bosch S7LU-3.

**Remarks**

Current production installation is Sikorsky H-19 helicopter. Designed for operation at 39° angle nose-up. Direct drive. Commercial version 99OC7BA1 installed in Sikorsky S-55.

• **MODEL: R-1300-4**

**Data**

Type: 7 cylinder, air-cooled, radial.

**Specs**

Length: 48.10 in. Width: 50.70 in. Displacement: 1300 cu. in. Bore: 6.125 in. Stroke: 6.312. Compression Ratio: 6.20:1. Fuel Grade: 91/96. Dry Weight: 1092 lb.

**Performance**

Takeoff hp: 800 at 2600 rpm. Military Rating: 800 at 2600 rpm at 3500 ft. Normal Rating: 700 at 2400 rpm up to 5000 ft. Specific Fuel Consumption: .720 lb. per bhp per hr. at normal rated power. Oil Consumption: .025 lb. per bhp per hr. at normal rated power.

**Equipment**

Carburetor: Bendix PD9F1. Magnetos: Bosch S7LU-3.

**Remarks**

Installation — Goodyear Blimp ZS2B-1. Increased strength gears in rear section.

• **MODEL: R-1820-86**

**Data**

Type: 9 cylinder, air-cooled, radial.

**Specs**

Length: 48.34 in. Width: 55.27 in. Displacement: 1820 cu. in. Bore: 6.125 in. Stroke: 6.875. Compression Ratio: 6.80:1. Fuel Grade: 100/130. Dry Weight: 1385 lb.

**Performance**

Takeoff hp: 1425 at 2700 rpm. Military Rating: 1425 at 2700 rpm at 2000 ft. Normal Rating: 1275 at 2500 rpm up to 3100 ft. Specific Fuel Consumption: .693 lb. per bhp per hr. at normal rated power. Oil Consumption: .025 lb. per bhp per hr. at normal rated power.

**Equipment**

Carburetor: Bendix PD-12K18. Magnetos: Bosch S9LU-2.

**Remarks**

Installation: North American T-28B. Commercial version 987C9HDI installed in Learstar Mark 1.

• **MODEL: R-1820-82**

**Data**

Type: 9 cylinder, air-cooled, radial.

**Specs**

Length: 50.07 in. Width: 55.74 in. Displacement: 1820

cu. in. Bore: 6.125 in. Stroke: 6.875. Compression Ratio: 6.80:1. Fuel Grade: 115/145. Dry Weight: 1469 lb.

**Performance**

Takeoff hp: 1525 at 2800 rpm. Military Rating: 1425 at 2700 rpm at 2400 ft. Normal Rating: 1275 at 2500 rpm up to 3500 ft. Specific Fuel Consumption: .677 lb. per bhp per hr. at normal rated power. Oil Consumption: .025 lb. per bhp per hr. at normal rated power.

**Equipment**

Carburetor: Bendix PD-12K18. Magnetos: Bendix Scintilla D9LN-2.

**Remarks**

Installation: Grumman S2F. Similar to Commercial 982C9HE1 which is installed in Hurel-Dubois HD-321 and HD-323.

• **MODEL: R-1820-84**

**Data**

Type: 9 cylinder, air-cooled, radial.

**Specs**

Length: 50.07 in. Width: 55.74 in. Displacement: 1820 cu. in. Bore: 6.125 in. Stroke: 6.875. Compression Ratio: 6.80:1. Fuel Grade: 115/145. Dry Weight: 1405 lb.

**Performance**

Takeoff hp: 1525 at 2800 rpm. Military Rating: 1425 at 2700 rpm at 2400 ft. Normal Rating: 1275 at 2500 rpm up to 3500 ft. Specific Fuel Consumption: .677 lb. per bhp per hr. at normal rated power. Oil Consumption: .025 lb. per bhp per hr. at normal rated power.

**Equipment**

Carburetor: Bendix PD-12R1. Magnetos: Bendix Scintilla D9LN-2.

**Remarks**

Installation: Sikorsky Helicopter H-34. Commercial version 989C9HE1, 2 installed in Sikorsky S-58 Helicopter.

• **MODEL: R-1820-88**

**Data**

Type: 9 cylinder, air-cooled, radial.

**Specs**

Length: 58.89 in. Width: 55.74 in. Displacement: 1820 cu. in. Bore: 6.125 in. Stroke: 6.875. Compression Ratio: 6.80:1. Fuel Grade: 100/130. Dry Weight: 1560 lb.

**Performance**

Takeoff hp: 1525 at 2800 rpm. Military Rating: 1425 at 2700 rpm at 2400 ft. Normal Rating: 1275 at 2500 rpm up to 3500 ft. Specific Fuel Consumption: .677 lb. per bhp per hr. at normal rated power. Oil Consumption: .025 lb. per bhp per hr. at normal rated power.

**Equipment**

Carburetor: Bendix PD-12K18. Magnetos: Bendix Scintilla D9LN-2.

**Remarks**

Installation: Goodyear ZPG-3W Blimp. This engine has strengthened two-piece nose section with 60A prop shaft spline size.

• **MODEL: R-1820-103**

**Data**

Type: 9 cylinder, air-cooled, radial.

**Specs**

Length: 48.35 in. Width: 55.25 in. Displacement: 1820

cu. in. Bore: 6.125 in. Stroke: 6.875. Compression Ratio: 6.80:1. Fuel Grade: 100/130. Dry Weight: 1362 lb.

**Performance**

Takeoff hp: 1425 at 2700 rpm. Military Rating: 1425 at 2700 rpm at 1000 ft. Normal Rating: 1275 at 2500 rpm up to 3000 ft. Specific Fuel Consumption: .700 lb. per bhp per hr. at normal rated power. Oil Consumption: .025 lb. per bhp per hr. at normal rated power.

**Equipment**

Carburetor: Bendix PD-12K19. Magnetos: Bosch S9LU-3.

**Remarks**

Installation: Vertol Helicopter H-21. Commercial version 977C9HD1 installed in Vertol Helicopter PH-42.

• **MODEL: R-3350-26WB**

**Data**

Type: 18 cylinder, air-cooled, radial.

**Specs**

Length: 80.81 in. Width: 55.62 in. Weight: 2953 lb. Displacement: 3350 cu. in. Bore: 6.125 in. Stroke: 6.312 in. Compression Ratio: 6.7:1. Fuel Grade: 115/145.

**Performance**

Takeoff hp: 2700 at 2900 rpm. Military Rating: 2700 at 2900 rpm at 3700 ft. Normal Rated hp: 2300 at 2600 rpm up to 6200 ft. Fuel Consumption: .720 lb. per bhp per hr. Oil consumption: .030 lb. per bhp per hr. at normal rated power.

**Equipment**

Carburetor: PR58U1. Magneto: Scintilla DLN-9.

**Remarks**

Installation: Douglas AD7.

• **MODEL: R-3350-32W (TURBO COMPOUND)**

**Data**

Type: 18 cylinder, air-cooled, radial.

**Specs**

Length: 91.80 in. Width: 56.59 in. Displacement: 3350 cu. in. Bore: 6.125 in. Stroke: 6.312. Compression Ratio: 6.70:1. Fuel Grade: 115/145. Dry Weight: 3521 lb.

**Performance**

Takeoff hp: 3700 at 2900 rpm. Military Rating: 3420 at 2900 rpm at 2400 ft. Normal Rating: 2850 at 2600 rpm up to 4100 ft. Specific Fuel Consumption: .660 lb. per bhp per hr. at normal rated power. Oil Consumption: .022 lb. per bhp per hr. at normal rated power.

**Equipment**

Carburetor: Bendix PR58S2. Magnetos: Bendix Scintilla DLN-9.

**Remarks**

Installation: Lockheed P2V-5-7, Martin P5M-2. Military version of the earlier models Turbo Compound are installed in R7U1, C-119, C and RC-121, WV1, 2 and 3.

• **MODEL: 981TC18EA1 (TURBO COMPOUND)**

**Data**

Type: 18 cylinder, air-cooled, radial.

**Specs**

Length: 89.53 in. Width: 56.59 in. Displacement: 3350 cu. in. Bore: 6.125 in. Stroke: 6.312. Compression Ratio: 6.70:1. Fuel Grade: 115/145. Dry Weight: 3651 lb.

**Performance**

Takeoff hp: 3700 at 2900 rpm. Normal Rated hp: 2850 at 2600 rpm. Cruise Rated hp: 1910 at 2400 rpm. Fuel Consumption: .645 lb. per bhp per hr. Oil Consumption: .022 lb. per bhp per hr.

**Equipment**

Carburetor: Bendix PR58S2. Magnetos: Bendix Scintilla DLN-9.

**Remarks**

Installation CP-107 Bristol Britannia for RCAF.

• **MODEL: 988TC18EA1-2 and 3 (TURBO COMPOUND)**

**Data**

Type: 18 cylinder, air-cooled, radial.

**Specs**

Length: 89.53 in. Width: 56.59 in. Weight: 3645 lb. Displacement: 3350 cu. in. Bore: 6.125 in. Stroke: 6.312 in. Compression Ratio: 6.7:1. Fuel Grade: 115/145.

**Performance**

Takeoff hp: 3400 at 2900 rpm. Normal Rated hp: 2850 at 2600 rpm. Cruise Rated hp: 1910 at 2400 rpm. Fuel Consumption: .645 lb. per bhp per hr. at 2800 rpm. Oil Consumption: .022 lb. per bhp per hr.

**Equipment**

Carburetor: Bendix PR58S2. Magnetos: Bendix Scintilla DLN-9.

**Remarks**

Reduction gear ratio of EA-1 and 3 is 0.4375:1; EA-2 reduction gear ratio is 0.355:1. Installation: EA-1 in Douglas DC-7C, EA-2 Lockheed 1649, EA-3 Lockheed 1049 G and H.

• **MODEL: J65-W-16**

**Data**

Type: Axial-flow turbojet.

**Specs**

Length: 112.80 in. Width: 37.5 in. Total Weight: 2742 max. lb. Compressor Stages: 13 of 29.375. Turbine Stages: 2 of 30.5 in.

**Performance**

Maximum Thrust: 7700 at 8300 rpm. Normal Rated Thrust: 6780 at 8070 rpm. 75 percent Normal Thrust: 5080 at 7510 rpm.

**Remarks**

Current production installation of various J65 models include Republic F84-F and RF84-F; North American FJ-3 and 4; Douglas A4D; and Martin B-57.

• **MODEL: J65-W-18**

**Data**

Type: Axial-flow turbojet.

**Specs**

Length: 182 in. Width: 36.25 in. Total Weight: 3425 lb. Compressor Stages: 13 of 29.375. Turbine Stages: 2 of 30.5 in.

**Remarks**

Current production installation: Grumman F11F-1. This engine is equipped with afterburner.

• **MODEL: 988TC18EA4-5 & 6 (TURBO COMPOUND)**

**Data**

Type: 18 cylinder, air-cooled, radial.

**Specs**

Length: 89.53 in. Width: 56.59 in. Displacement: 3350 cu. in. Bore: 6.125 in. Stroke: 6.312. Compression Ratio: 6.7:1. Fuel Grade: 115/145. Dry Weight: 3675 lb.

**Equipment**

Carburetor: Bendix PR58S2. Magnetos: Bendix Scintilla DLN-9.

**Remarks**

Reduction gear ratio of EA-5 is 0.355:1; EA-4 and 6 reduction gear ratio is 0.4375:1. Installation: EA-4 in Douglas DC-7C, EA-6 in Lockheed 1049G and H.

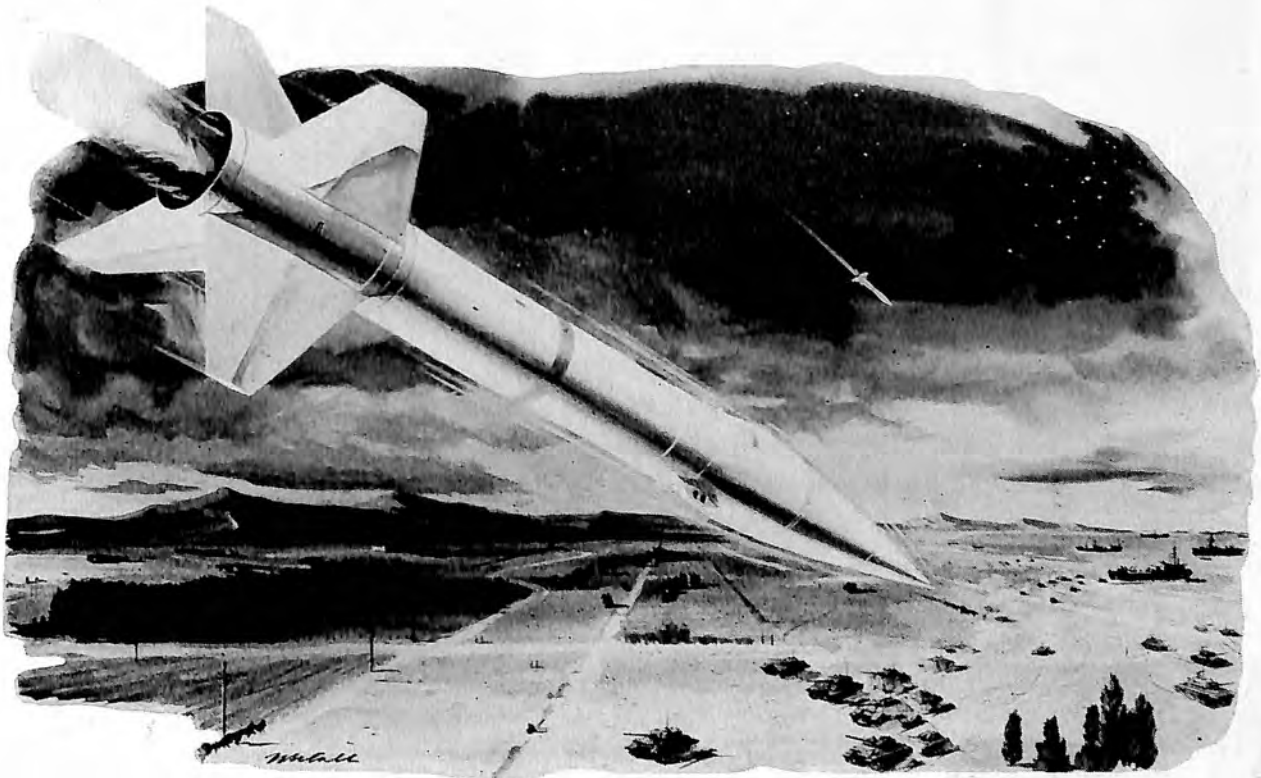




# MISSILES

In the short space of six years, the guided missile grew from a \$21-million research program to a massive \$2-billion budget item. In 1957, the missile blossomed into full maturity as some new types reached operational status, newer ones started their test programs and orders went out for development of even more modern weaponry. In a number of cases, the cloak of secrecy was lifted for the first time. This section of the Aircraft Year Book is an explanatory display of all the missiles, drones and test vehicles whose external configurations were cleared for release by the Department of Defense.

## SURFACE TO SURFACE



### HONEST JOHN

Built by Douglas Aircraft Company, Honest John is designed for Army tactical use in providing close fire support for ground operations. A free-flight rocket having no electronic controls, the missile has a range equivalent to that of medium-to-long-range artillery. It is fired from a highly mobile self-propelled launcher and can carry either a standard high-explosive or an atomic warhead. Status: operational.



### **LITTLE JOHN**

Designed and developed by Redstone Arsenal, the Army's Little John is an artillery-type rocket, to be used for short-range troop support. About 12 feet long and 12 and one-half inches in diameter, it is of smaller caliber than its teammate Honest John. Transportable by helicopter it is intended for use by Army airborne divisions. Status: operational.



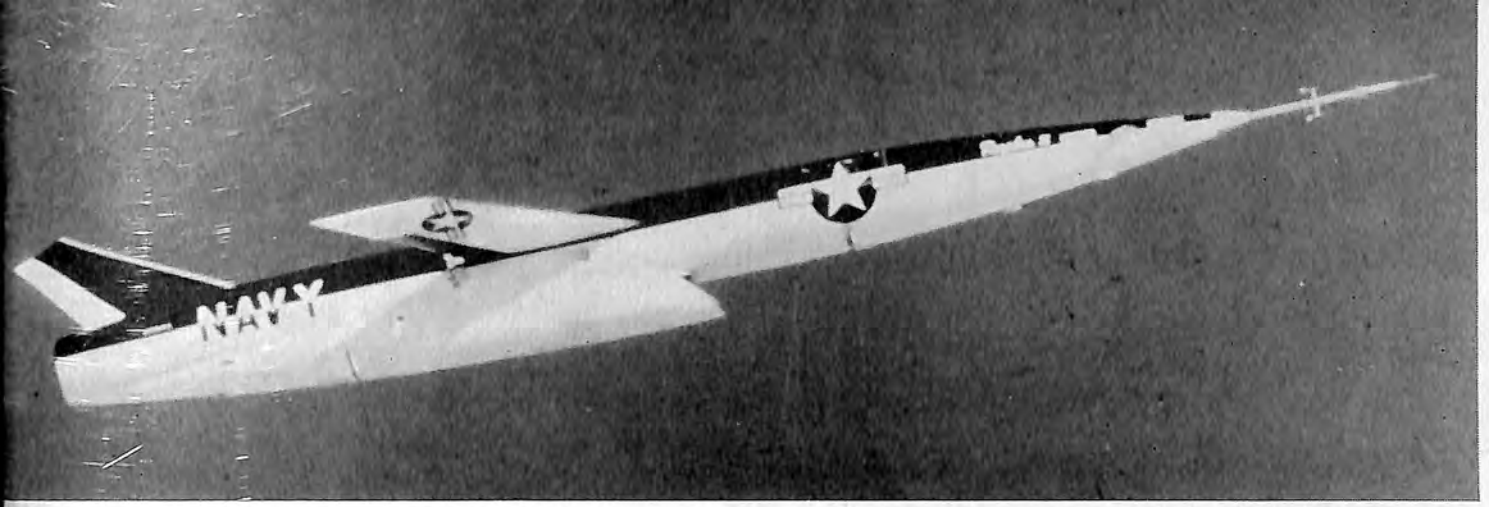
### **REGULUS 1**

Launchable from submarines, surface ships or shore bases, the Chance Vought Regulus is 34 feet 4 inches long. With a speed in the transonic area, it has a range of about 500 miles. Training and target drone versions are equipped with landing gear which has permitted hundreds of recoveries. Power plant is Allison J33 turbojet. Status: operational.



### **CORPORAL**

Powered by liquid propellant, Corporal is a short range Army artillery rocket 46 feet long and 30 inches in diameter. It weighs 11,000 pounds. Radio-guided, Corporal follows a ballistic trajectory to its target. Missile and its takeoff pedestal are built by Firestone Tire and Rubber Company. Status: operational.



### **REGULUS II**

With a range more than double that of its predecessor, Regulus I, the Navy Regulus II has a speed capability of more than twice the speed of sound. About 57 feet long, it has a wing span of 20 feet. Powered by a General Electric J79 turbojet engine, it has a ceiling of better than 50,000 feet. A nuclear-powered submarine designed to launch Regulus II—USS Halibut—is under construction. Missile manufacturer is Chance Vought Aircraft. Status: in production.

### **MATADOR**

An Air Force missile of the pilotless bomber variety, the Martin Matador is controlled electronically in flight by ground personnel. Designed for medium range operations, it is powered by a single Allison J33 with rocket boost. Speed is over 650 miles per hour. Early model, the TM-61, is 39.6 feet long and has a 28.7 wing span. A more advanced model, TM-76, is longer (44 feet) but has shorter (22.9 feet) wing span. One of the earliest missiles to join tactical units, TM-61 has been in operational service since 1951. TM-76 went into production in the fall of 1957.





### **DART (left)**

Jointly developed by the Army's Redstone Arsenal and Aerophysics Development Corporation, Dart is a simple but effective anti-tank weapon capable of smashing the heaviest known armor. As compared with recoilless rifles and tank guns, Dart offers increased effective range, greater accuracy and a greater probability of a first round hit. It is launched from a light-weight launcher. Power is supplied by a smokeless rocket. Status: operational.

### **LACROSSE (right)**

Built by The Martin Company, Lacrosse fits into the Army spectrum of artillery missiles in a range category between Little John and Honest John. Highly mobile, it can penetrate even very thick concrete and is designed to replace heavy artillery in strikes against strong points delaying ground advances. Power is supplied by a Thiokol solid fuel rocket motor and guidance system is manufactured by Federal Telecommunications Laboratory. Lacrosse is about 20 feet in length. Production is handled by Martin's Orlando, Florida, facility. Status: operational.

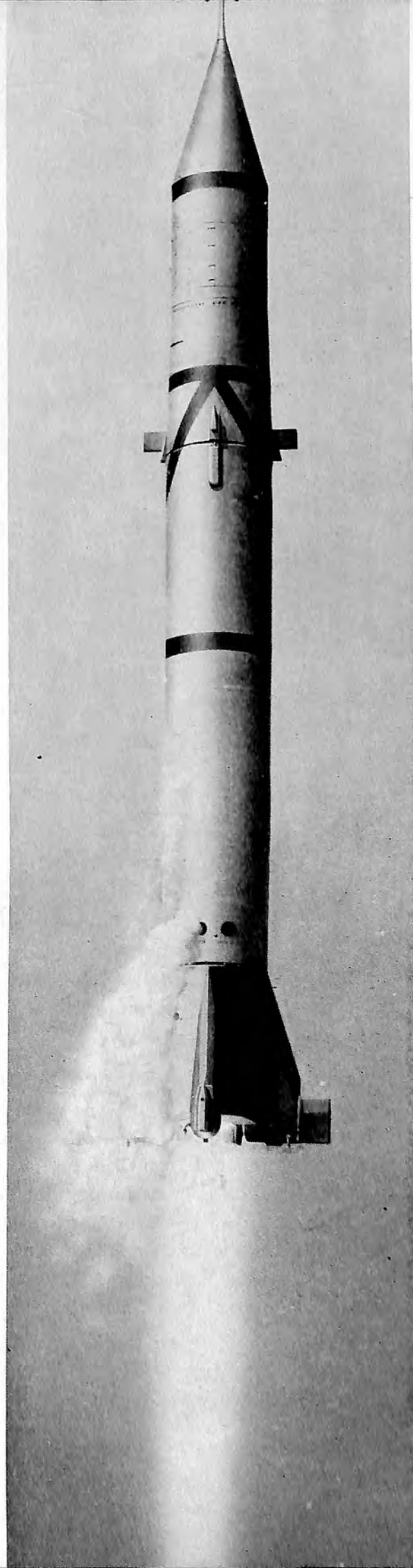


**REDSTONE (right)**

Providing firepower for the field Army and the Heavy Missile Commands, a Redstone can deliver a nuclear warhead at a range of 200 miles. About 69 feet tall and five feet in diameter, the weapon is powered by a 75,000 pound thrust rocket engine built by North American Aviation's Rocketdyne Division. Developed by Army Ordnance and Redstone Arsenal, Redstone is produced by Chrysler Corporation. Ford Instrument Company provides the inertial guidance system. Status: operational.

**SNARK (left)**

The Air Force's first missile with an intercontinental capability, the Northrop Snark successfully completed a flight of more than 5000 miles during its 1957 test program and during the same year joined units of Strategic Air Command. A Pratt & Whitney J57 turbojet engine powers it at supersonic speeds. Snark measures 69 feet in length and 15 feet in height, and its sweptback wings span 42 feet. Status: operational.



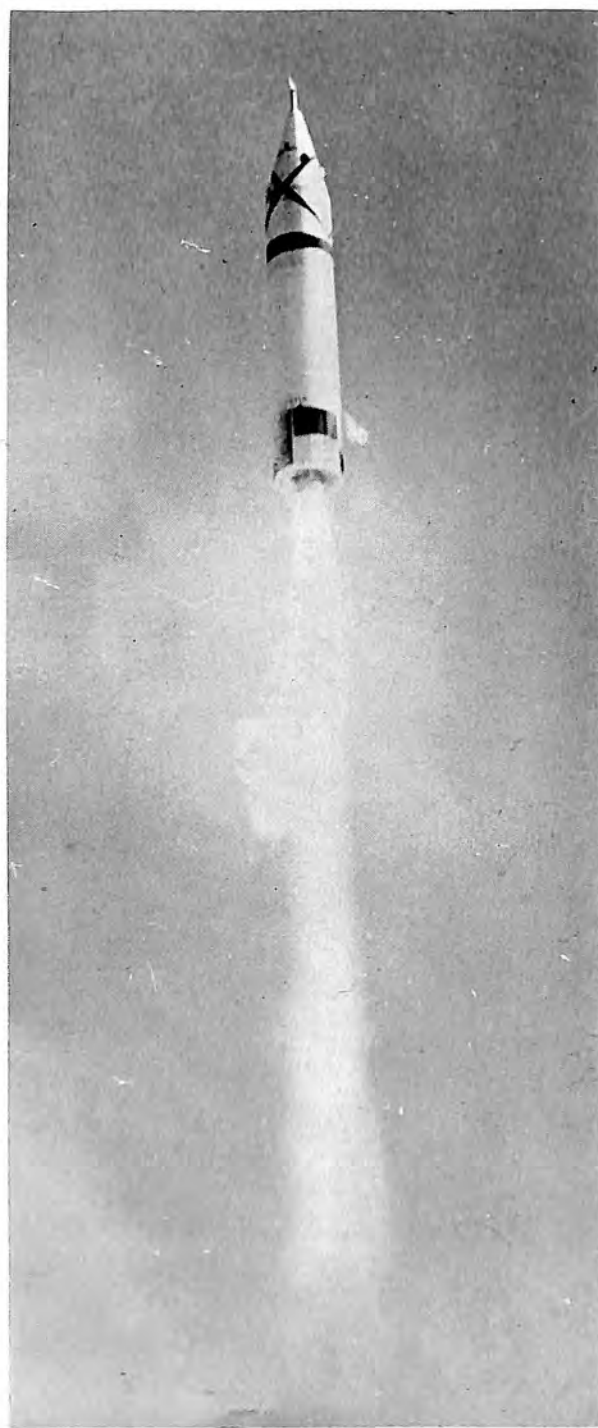


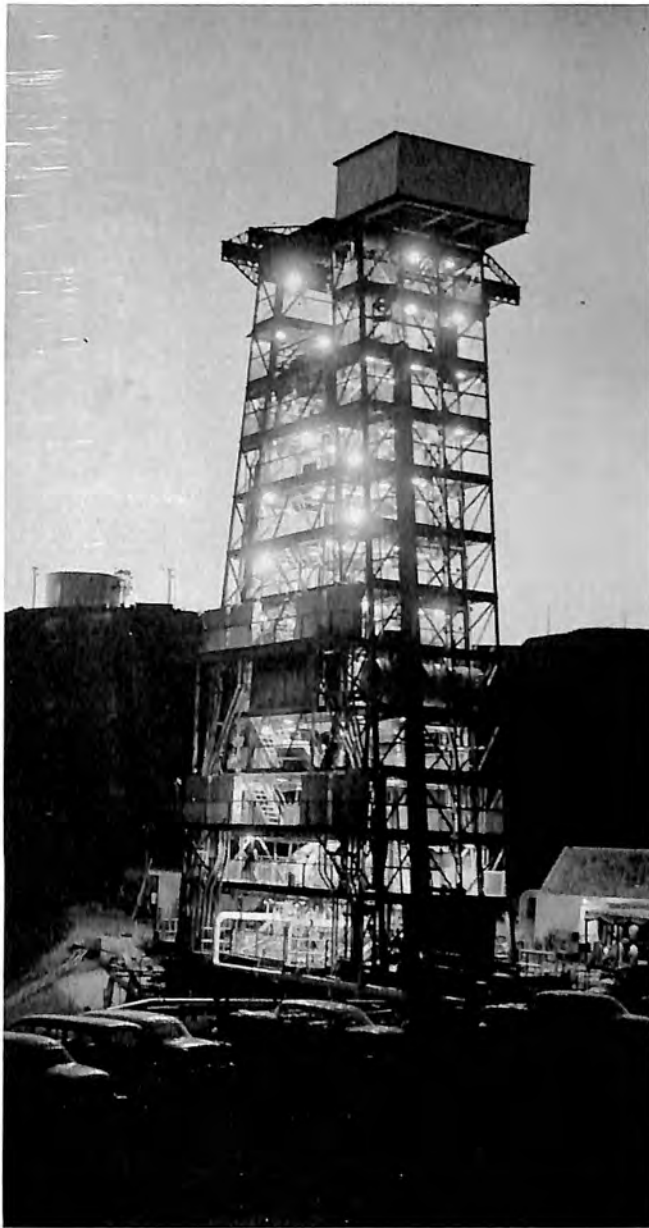
**THOR (above)**

Developed by Douglas Aircraft Company and a number of affiliated contractors under Air Force sponsorship, Thor is one of two American intermediate range ballistic missiles which reached firing status during 1957. Power plant is supplied by North American Aviation's Rocketdyne Division. Scheduled for use by American and other NATO forces, Thor was ordered into production late in 1957, although its test firing program was in an early stage. Status: advanced development and initial production.

**JUPITER (below)**

A companion weapon to Thor, Jupiter was developed by Redstone Arsenal, with production handled by Chrysler Corporation. Its Rocketdyne power plant is almost identical to that of Thor and range and performance are roughly the same. Like Thor, Jupiter was fired successfully several times in 1957 and late in the year was ordered into production. Status: advanced development and initial production.





## ATLAS

The big brother of the surface-to-surface missile family, Atlas is America's first intercontinental ballistic missile. Its three-unit rocket propulsion system, built by Rocketdyne, blasts it to a point in space with the help of an inertial guidance system and the missile continues without power in a ballistic trajectory to its target, which could be as much as 5500 miles distant. Atlas represents the combined effort of a great number of contractors, under the general supervision of the Air Force and the prime contractor, Convair Division of General Dynamics Corporation. Initial test firings were conducted at Cape Canaveral in the latter months of 1957. Status: pilot production and advanced development.





## SURFACE TO AIR



### NIKE-AJAX

One of the first missiles to see operational service, Nike-Ajax is now guarding a great number of cities and target complexes throughout the continental United States, and is gradually being deployed overseas. Developed for the Army by Douglas Aircraft Company, Nike-Ajax is about 20 feet long and one foot in diameter. Launched at an 85 degree angle, Nike-Ajax gets its initial propulsion from a booster rocket which falls off on burn-out. Two sets of fins provide guidance of individual missiles and the Martin Missile Master coordinates the tracking and firing operations of several batteries in the same area. Nike, named after the Greek goddess of victory, was initiated as long ago as 1945 as a study project and prototype development. First firings were made in 1946. Status: operational.





### **TERRIER**

A supersonic anti-aircraft missile weighing 1100 pounds, Terrier is built for the Navy and Marine Corps by Convair Division of General Dynamics Corporation. Allegany Ballistics Laboratories provides a solid propellant rocket for power. Guided missile cruisers like the USS Boston and USS Canberra carry the Terrier on twin two-missile launchers installed on the after deck. For Marine Corps use, it is fired from a mobile launcher. Terrier is 15 feet long and 14 inches in diameter. It has the radar beam-rider type of guidance. Status: operational.

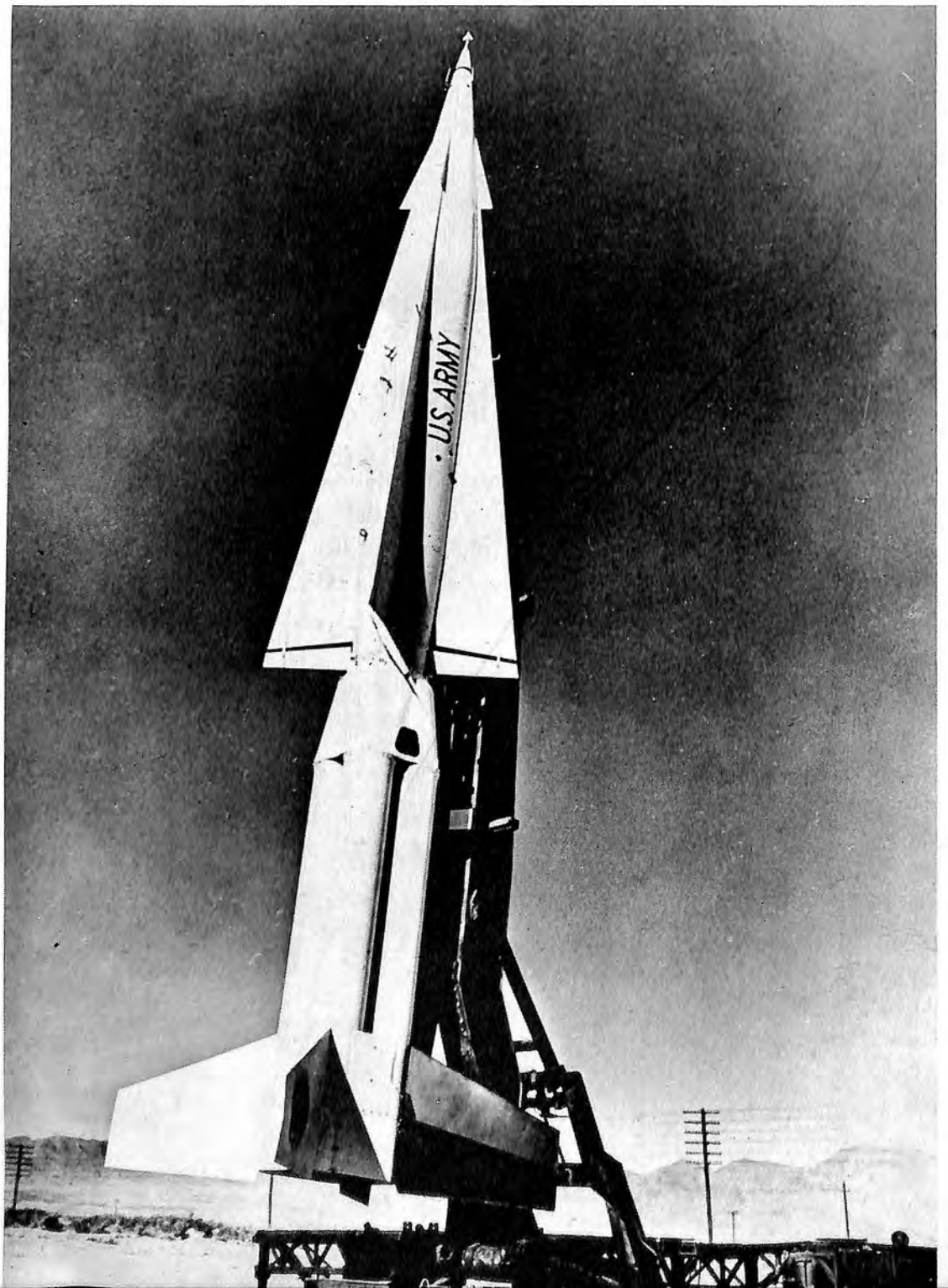
### **TALOS (right)**

A longer-ranging anti-aircraft missile of supersonic speed, Talos is a Navy Bureau of Ordnance missile. Prime contractor is Bendix Products Missile Division, while McDonnell Aircraft Corporation handles both airframe and power plant manufacture. Power is supplied by a ramjet engine, with a solid propellant booster to provide initial momentum. Also under development is Talos L, a ground launched version. Status of Talos: operational.



## NIKE-HERCULES

Longer, heavier and more than double the diameter of Nike-Ajax, the Army's Nike-Hercules is a major development in air defense missilery in that it carries a nuclear warhead. Known as Nike-B during its development stage, it is manufactured by Douglas Aircraft Company, with ground guidance and control and missile guidance equipment being handled by Western Electric Company. Nike-Hercules employs a solid propellant booster plus a solid propellant sustainer. It is scheduled for early introduction (1958) to air defense service, and will be integrated into existing Nike batteries with only slight modification to the launching sites. Statu : final test.





### **HAWK**

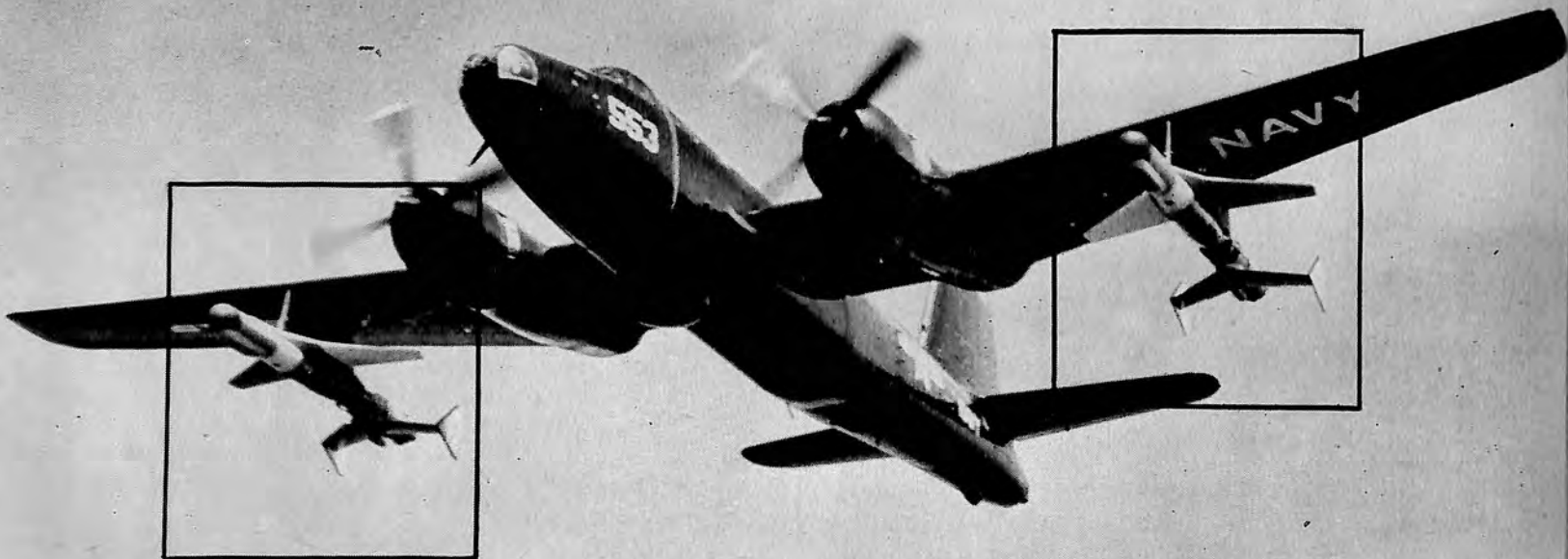
Designed to fill a gap in the air defense missile system not covered by other weapons, Hawk will be used primarily against low flying aircraft. The missile, which has a solid fuel engine developed by Thiokol Chemical Corporation, is 17 feet long and 14 inches in diameter. Production is handled by Raytheon Manufacturing Company. Primarily an Army missile, Hawk will also be used by the Marine Corps. Status: operational.

### **BOMARC**

A pilotless interceptor, the Boeing IM-99 Bomarc is designed to operate at ranges well beyond the defense perimeter of the smaller weapons like Nike and Hawk. Forty-seven feet four inches long, it weighs about 15,000 pounds and has a supersonic speed capability. Power is supplied by an Aerojet booster, liquid fueled, plus a pair of ramjets built by Marquardt which take over after initial boost. Status: in production.

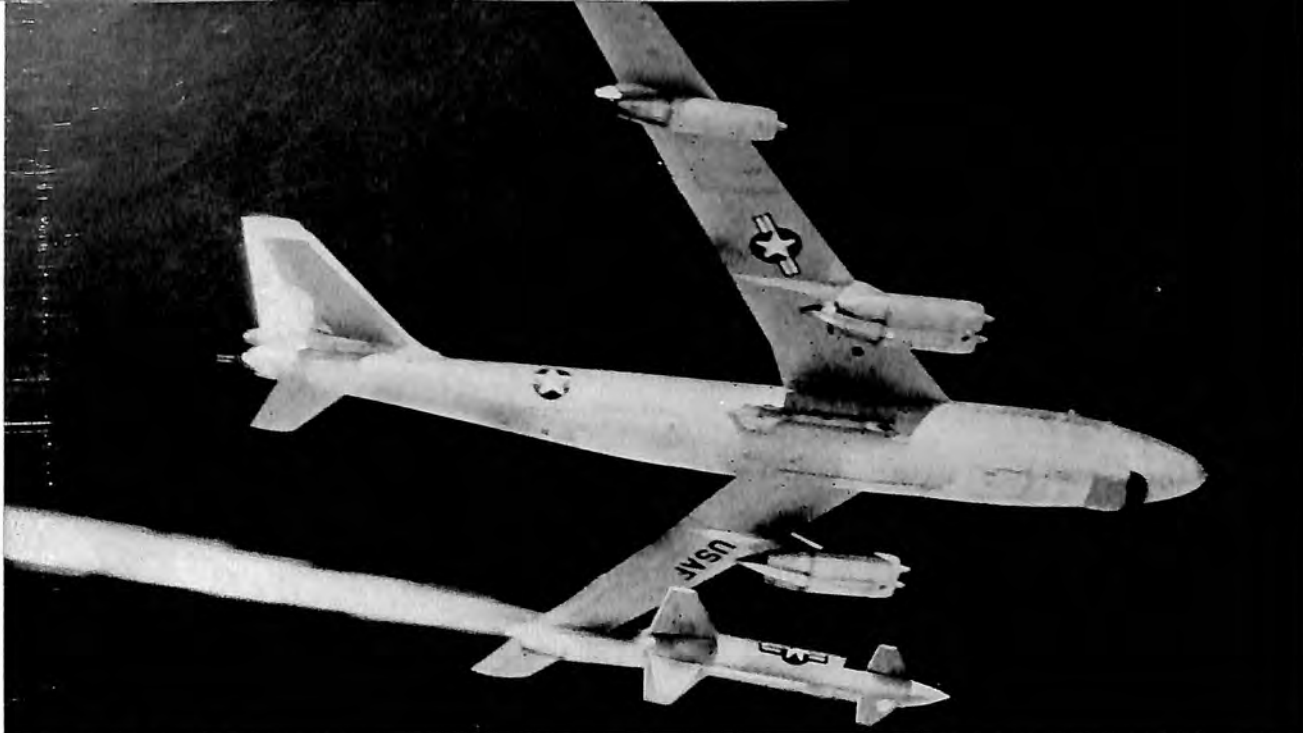


## AIR TO SURFACE



### **PETREL**

Shown here mounted under the wings of a Lockheed P2V-6B patrol bomber, the Navy Petrel is designed primarily for use against enemy ships. It is launched beyond the effective range of the target ship's defensive armament for protection of the launching bomber and its crew. Guidance is electronic and power plant is a 1000 pound thrust Fairchild J44 turbojet. Petrel is about 24 feet long and weighs close to two tons. Fairchild's Guided Missiles Division produced the weapon. Status: operational, but out of production.

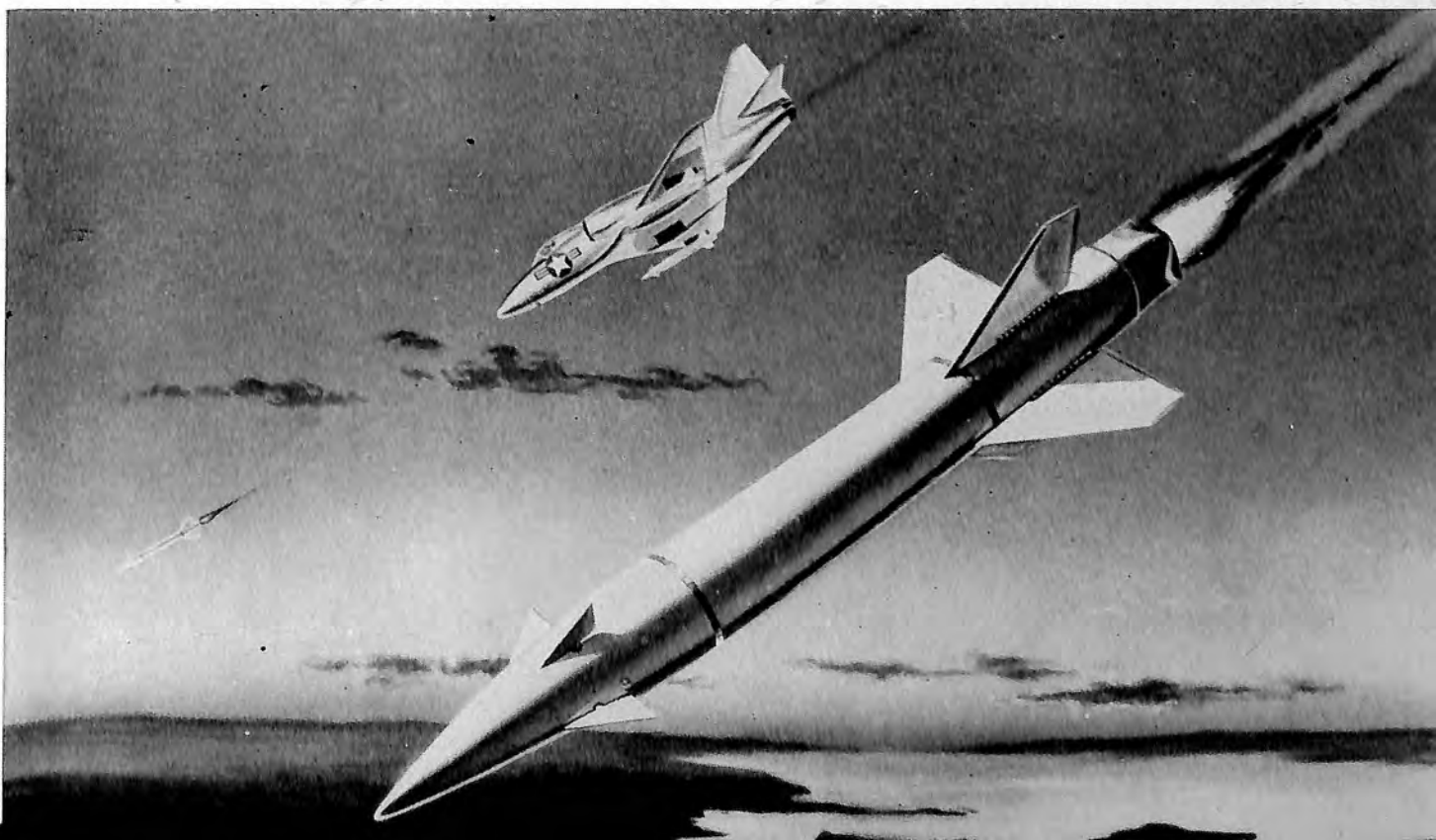


### **RASCAL**

Latest addition to the Air Force Strategic Air Command striking power is the Bell Rascal, an air-launched pilotless bomber. Rascal is carried by "mother" plane close to a target but outside the enemy's anti-aircraft defenses, from which point it continues on its own guidance. Weapon is 34 feet long and four feet in diameter. Bell Aircraft Corporation builds airframe, rocket power plant and guidance system. Status: operational.

### **BULLPUP**

Designed to provide Navy light attack aircraft with greater firepower against pill boxes, tanks, truck convoys, bridges, ships and other tactical targets, Bullpup is launched outside the range of enemy high-volume ground fire. Built by The Martin Company, the missile is about 11 feet long and weighs less than 600 pounds. Status: in development.

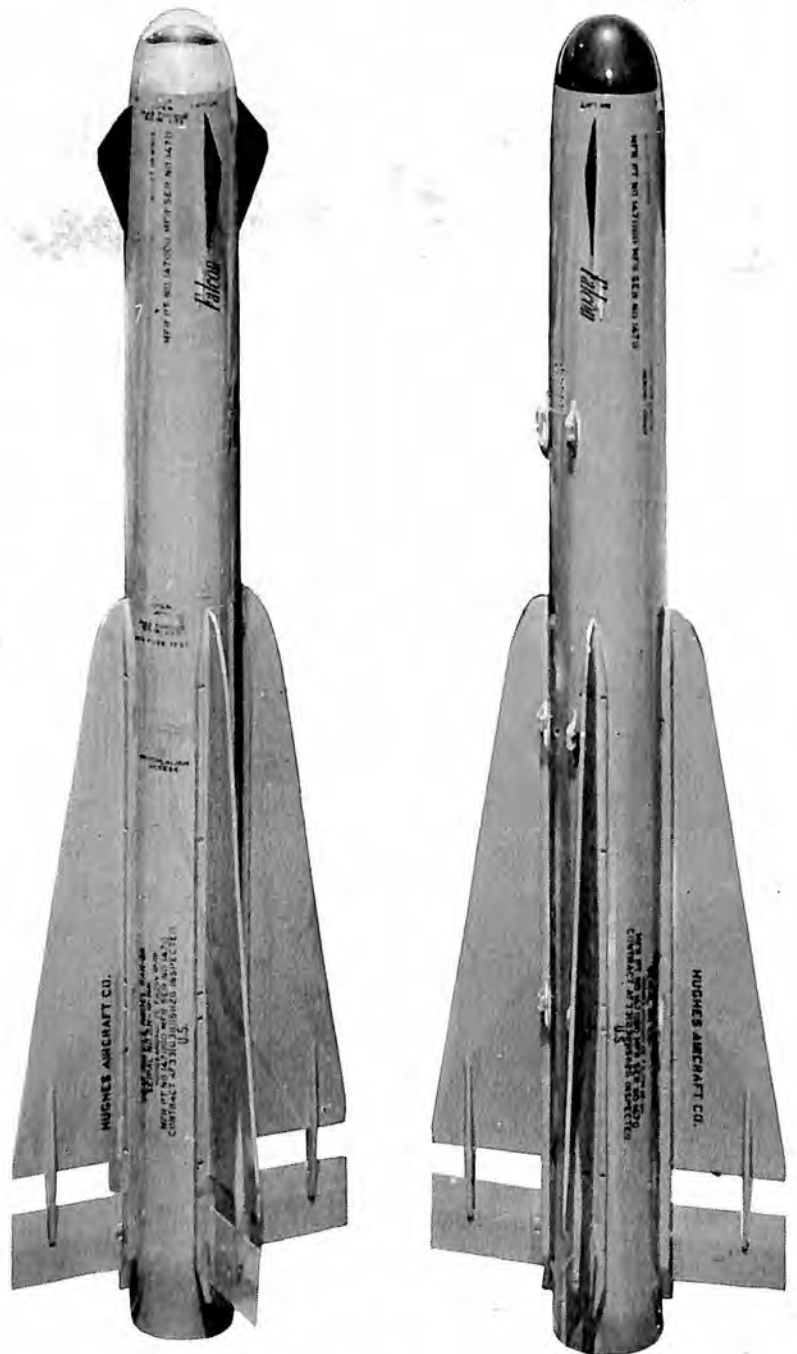


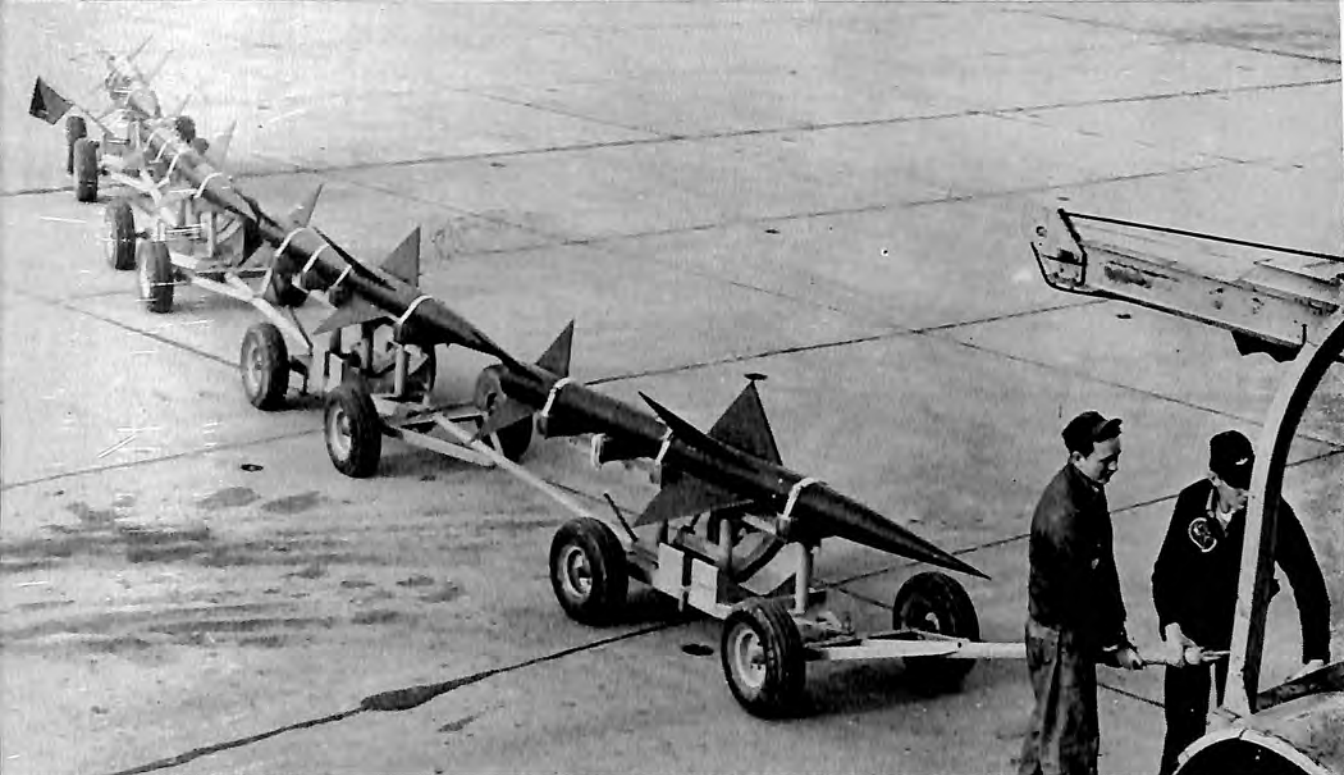
## FALCON GAR-1D (left)

Built by Hughes Aircraft Company, the GAR-1D Falcon is a supersonic guided aircraft rocket with a high "kill" capability against enemy aircraft. About six feet long, it weighs slightly more than 100 pounds and can be carried in quantity by USAF interceptors, mounted either under the wings or in pod installations. Radar-guided, it has a solid propellant power unit. Status: operational.

## FALCON GAR-2A (right)

Major difference between GAR-2A and its predecessor Falcon is the guidance unit, which senses at a distance of miles the infrared radiation thrown out by invading aircraft and homes on it. GAR-2A is six and one-half feet long and weighs about 120 pounds. It is in production at Hughes' Tucson, Arizona, plant. Status: operational.





### **SPARROW I**

Developed by the Navy Bureau of Aeronautics and Sperry Gyroscope Company, Sparrow I is guided by signals from the launching aircraft which deflect the missile's stub wings. About 12 feet long, it weighs 300 pounds. Power is an Aerojet-General solid fuel rocket. Production is handled by Sperry Farragut Company in Bristol, Tennessee. Status: operational.

### **SPARROW III**

An advanced air defense weapon, Sparrow III is an improved version of Sparrow I. It was developed for use by Navy interceptor-type aircraft by Raytheon Manufacturing Company. The missing Sparrow II, not pictured, is a Douglas experimental weapon. Status of Sparrow III: development.







### **GENIE**

A weapon which provides tremendously increased firepower to the Air Force's air defense system is the Douglas Genie, pictured above as it was launched from a Northrop F-89J interceptor in a July, 1957, test over Nevada. Genie is the first air-to-air weapon equipped with a nuclear warhead. Status: operational.

### **SIDEWINDER**

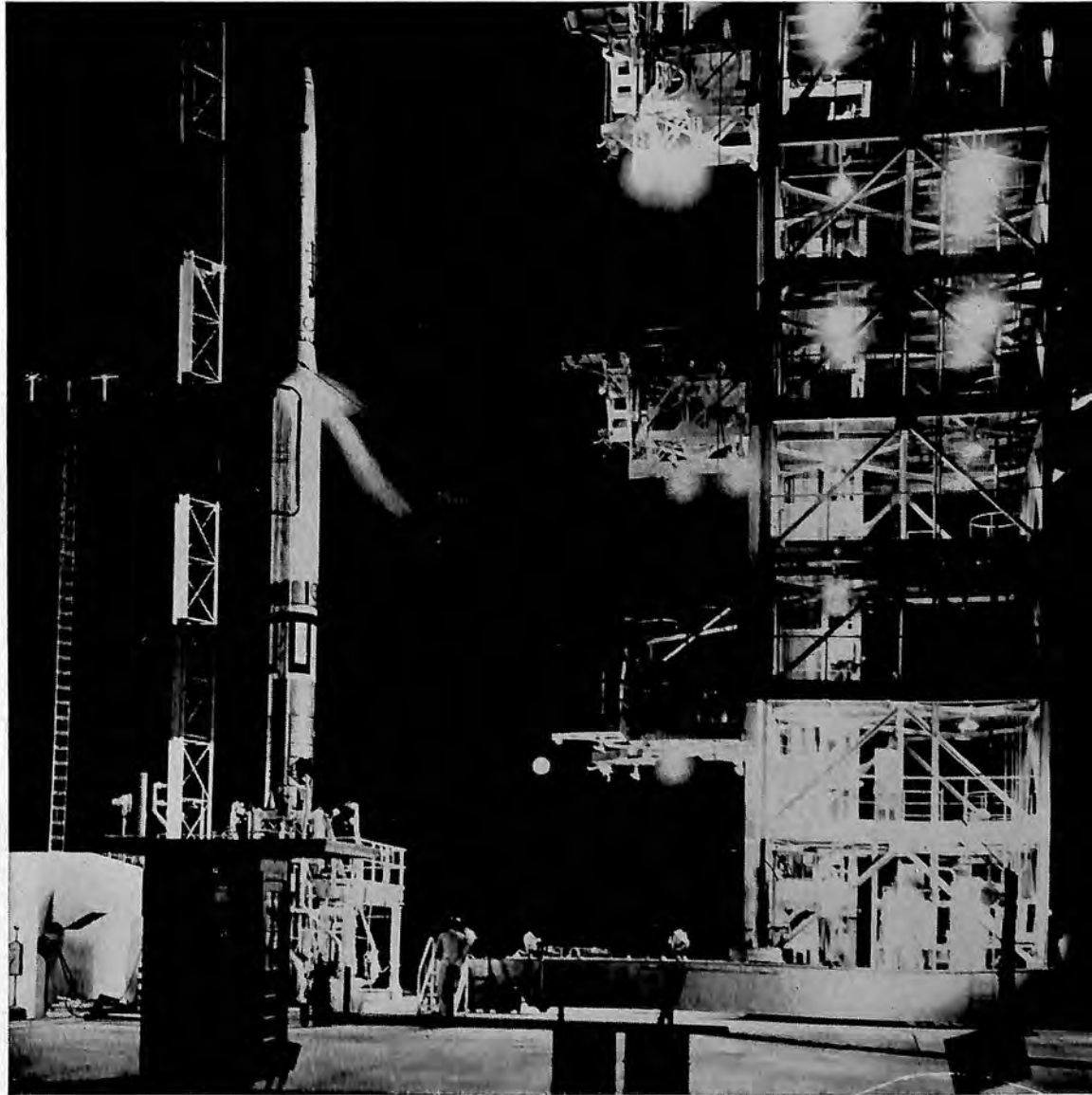
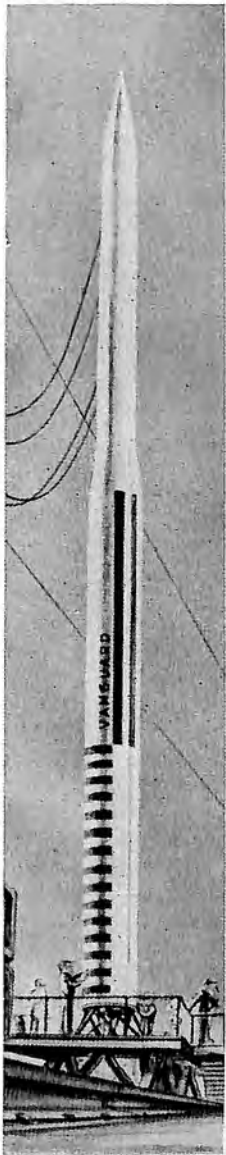
The Sidewinder is pictured below in a Grumman F9F mount. Built by Philco, the Sidewinder has a General Electric infrared guidance system which detects and homes on radiation from target. It is nine feet long; has a range of 18,000 feet and a speed of Mach 2.5. Status: operational.



## EARTH SATELLITE VEHICLES

### VANGUARD

U.S. participation in the International Geophysical Year included two earth satellite programs. The first, Project Vanguard, is a three-stage launching unit built by The Martin Company in conjunction with several other contractors, under the supervision of the Office of Naval Research. Vanguard is 72 feet long and weighs 11 tons fueled for takeoff. Propulsion is provided by a General Electric liquid-propellant rocket engine in the first stage, an Aerojet-General second stage rocket and a third stage manufactured by Grand Central Rocket Company.

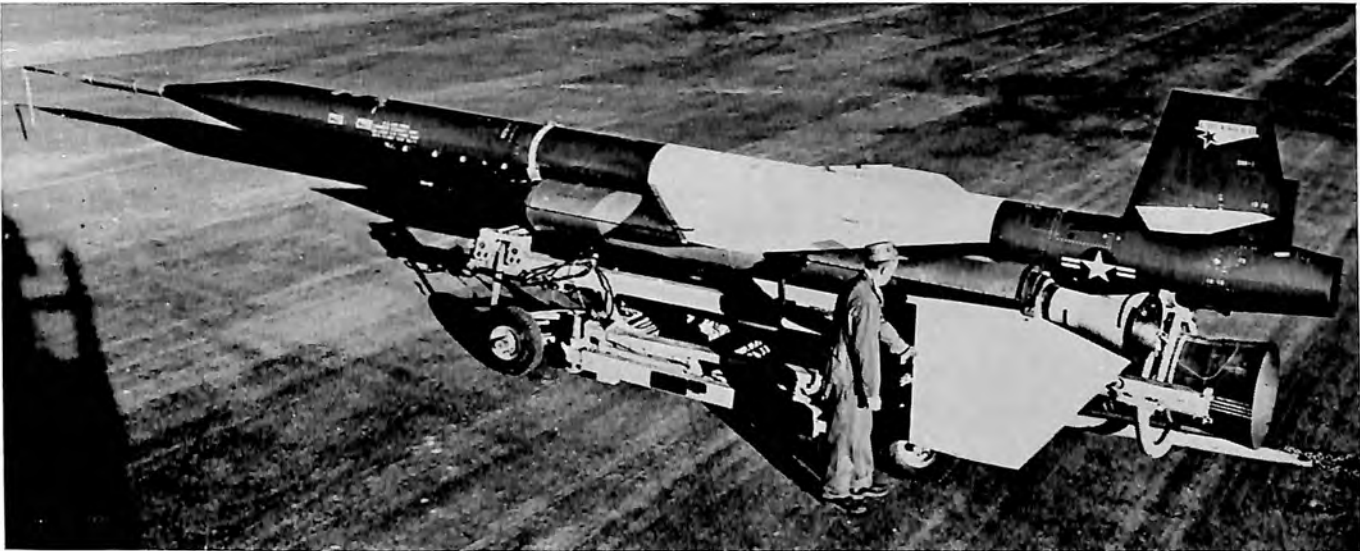


## JUPITER C

In a post-Sputnik decision to speed American efforts to put a satellite in space, the Defense Department assigned a second program to the Army Ballistic Missile Agency late in 1957. Redstone Arsenal's selection for the launching vehicle was a Jupiter C test vehicle, originally designed for upper atmosphere and re-entry research. At year-end modification of the components was under way. Final configuration of the launcher was to be somewhat different in the nose cone area from the Jupiter C pictured below. First Army satellite launchings were expected in early 1958.



## DRONES, TARGETS, SURVEILLANCE



### **Q-5**

Used as an Air Force target missile, the supersonic Q-5 has a ground controlled guidance system. It is 39 feet long, has a diameter of 20 inches and a wing span of 10 feet. Powered by a ramjet engine, it weighs about 7600 pounds. Parachute recovery system is provided. Q-5 was developed by Lockheed's Missile Systems Division. Status: in development.

### **HIGH SPEED DRONE**

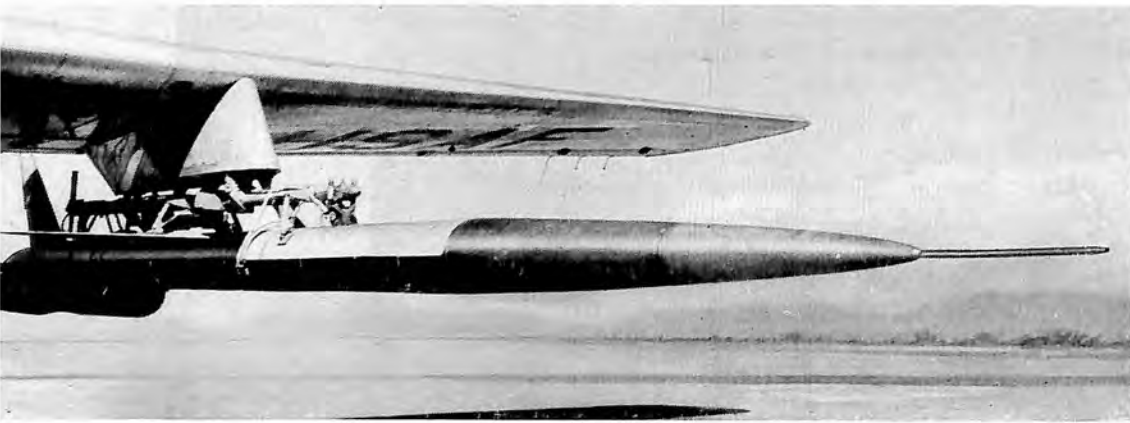
For use by Army intelligence forces in the field, Fairchild Aircraft Division's surveillance drone is designed to provide information on enemy movements. Company has received a \$12-million contract for initial test and production of the vehicle. Status: in development.





#### **SD-1**

Radioplane, a Division of Northrop Aircraft, Inc., designed and developed this propeller-driven surveillance drone for the Army. SD-1, which is radio-controlled and flies at 185 miles per hour, carries photographic, television or sensory equipment. Length is 13 feet four inches.



#### **XQ-4**

Another Radioplane development is the XQ-4 target drone, designed for evaluation of Air Force air defense systems. About 33 feet long and 20 inches in diameter, it has supersonic speed. Control is by radar and power is turbojet. XQ-4 is air launched.

#### **RP-76**

An Army project to be used as a target for surface-to-air missiles, RP-76 was also Radioplane-developed. Length is nine feet eight inches, wing span is five feet and speed is Mach .90. Radio-controlled, it has a solid-propellant rocket motor. RP-76 is also air-launched.



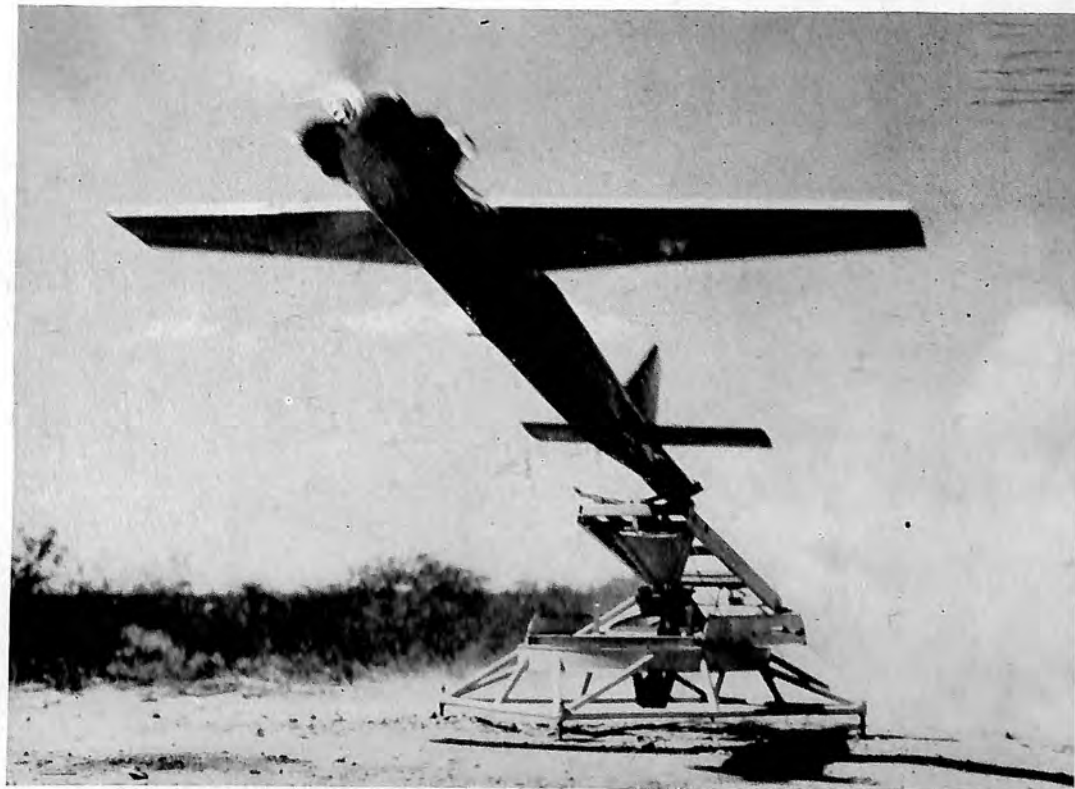


### **RP-77D**

Radioplane's RP-77D is an Army target and surveillance drone. Radio-controlled, it is powered by a Boeing 502-10F turboprop engine. Fired from a zero-length ground launcher, it is 14 feet nine inches long and has a wing span of 15 feet. Parachute recovery system is provided. Under consideration is a plan to use a modified version of RP-77D as a launcher for the RP-76 rocket target.

### **OQ-19**

Designed to serve as a target for surface-to-air missiles or anti-aircraft guns, OQ-19 is an Army project developed by Radioplane. A four-cylinder reciprocating engine provides power. Twelve feet three inches long with a wing span of 11 feet six inches, OQ-19 is radio-controlled.



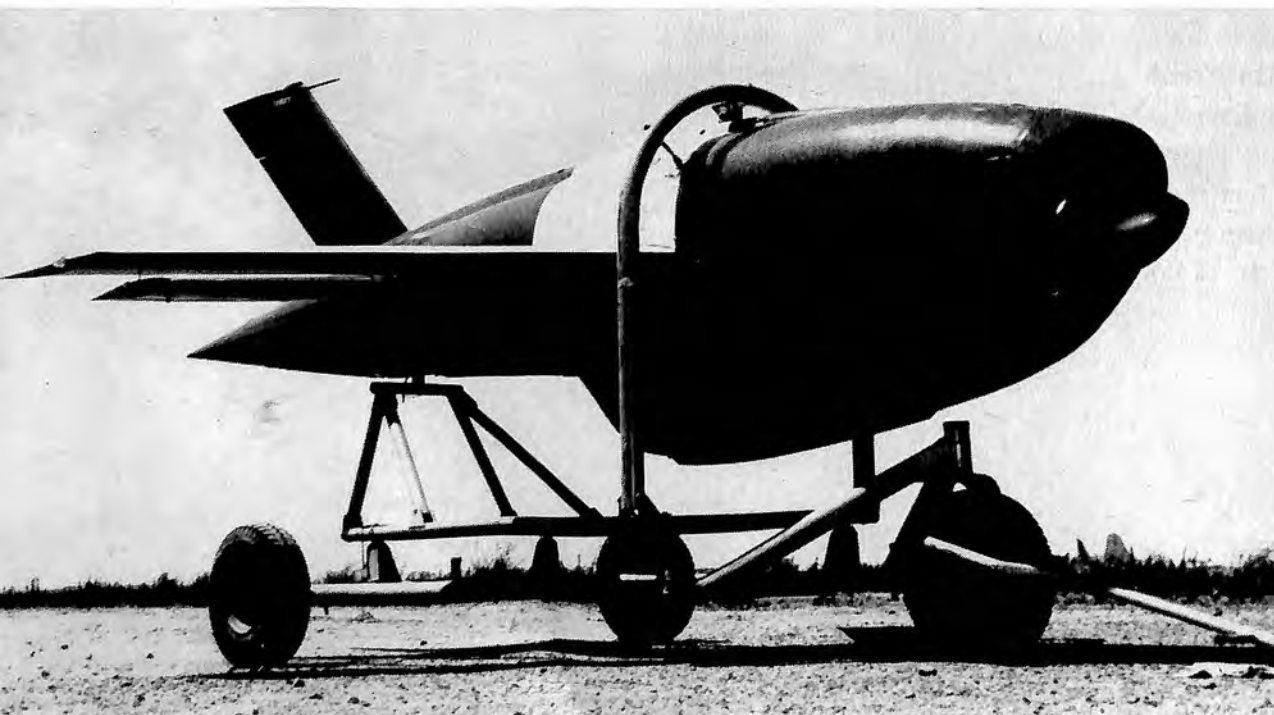
### **XKDB-1**

A remote-controlled target drone, XKDB-1 flew as high as 38,500 feet in 1957 tests at the Naval Air Missile Test Center, Point Mugu, California. Ground launched, it is designed for surface and airborne weapons systems evaluation and training. Beech Aircraft Corporation handles production.



### **Q-2 FIREBEE**

The "Firebee" spans 11 feet, is 17 feet three inches long and weighs empty 1100 pounds. A target drone, it is powered by a Continental J69 engine of 1000 pounds thrust. Top speed is 600 miles per hour and ceiling is 53,000 feet. Q-2 is built by Ryan Aeronautical Company.





### SD-3

Built by Republic Aviation Corporation, the SD-3 is an Army combat surveillance drone equipped with photography, radar and infrared devices with interchangeable nose cones. Designed for all-weather use, the drone is zero-length launched using JATO and is recoverable. Work is under way on an advanced version for the Army Signal Corps.

### XKDT-1

For air-to-air target use by Navy pilots, Temco Aircraft Corporation developed this low-cost, expendable drone, shown at left just prior to destruction by missile. About 12 feet long with a 59 inch span, XKDT-1 emits flares to make visual tracking possible and also signals "near misses" during its target runs at transonic speeds and altitudes of about 50,000 feet.

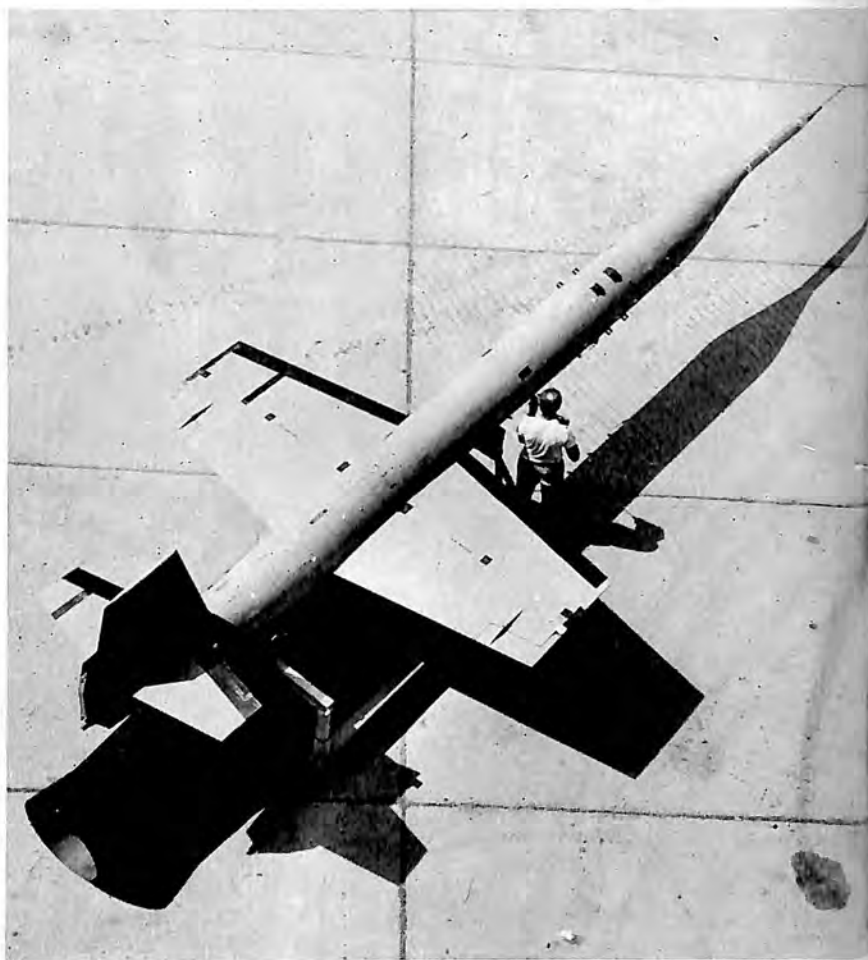




## TEST VEHICLES

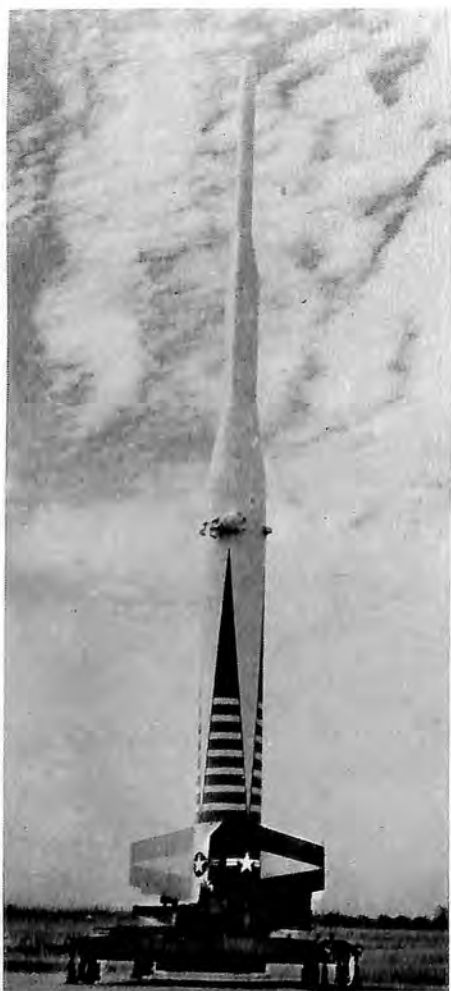
### X-7

Designed as a test bed for ramjet engines, the X-7 was built by Lockheed Aircraft Corporation's Missile Systems Division. Of supersonic speed, it can be ground launched or air dropped and has a parachute recovery system to permit repeated flights of the same vehicle. For guidance it has a ground control system. A single ramjet provides power. Status: test.



### X-17

A space research vehicle designed to hurtle into space at very high velocities and explore friction temperatures on re-entry into the atmosphere, the X-17, built by Lockheed Missile Systems Division, proved a valuable tool in ballistic missile nose cone research. An Air Force vehicle, it is 40 feet long and consists of three stages, the first powered by a single large rocket, the second by a cluster of three Recruit rockets and the third by a single Recruit. Thiokol Chemical Corporation provides the solid propellant rockets.



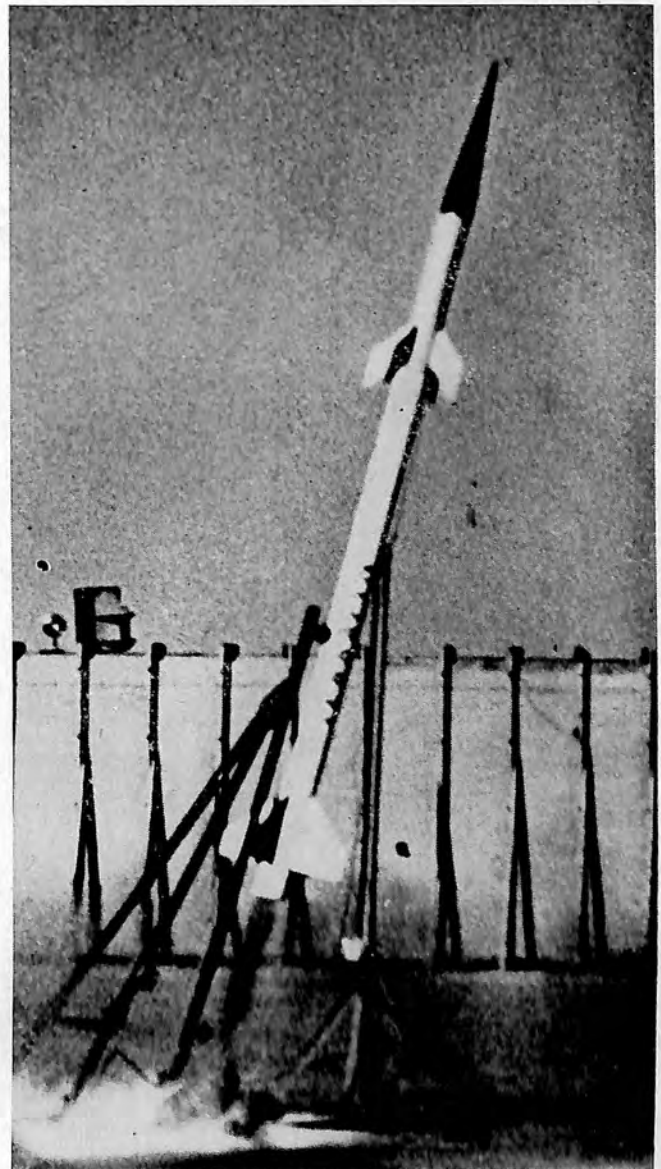


**AEROPHYSICS HTV (above)**

To explore the thermal barrier, the Air Force sponsored Aerophysics Development Corporation's HTV (Hypersonic Test Vehicle) which can fly at a speed of 7000 feet per second and reach that speed in just two seconds. HTV is a 10-foot two-stage vehicle powered by 11 solid propellant rockets, seven in the first stage. Status: test.

**TERRAPIN (below)**

Built to obtain data for use in development of space vehicles, Terrapin is a joint project of Republic Aviation Corporation and the University of Maryland. An extremely lightweight vehicle, it carries an instrument package weighing about six pounds. It is a two-stage rocket about 15 feet long and weighs 244 pounds. Power is a solid propellant rocket. Status: test.





**UNITED STATES  
CHRONOLOGY**

**1784, January 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, November 30**—First ascent by an American abroad, by Dr. John Jefferies, physician, with French aeronaut Blanchard, at London. On January 7, 1785, they make the first Channel crossing by air.

**1793, January 9**—Balloon flight by Jean Pierre Blanchard from Philadelphia, Pa., to Woodbury, N. J. (Letter from George Washington carried on this flight.)

**1837, September 18**—First parachute demonstration in America when John Wise drops animals from a balloon at Philadelphia.

**1838, August 11**—John Wise safely lands with his parachuted balloon at Easton, Pa.

**1840, September 8**—Col. John H. Sherburne urges Secretary of War to use night balloons to locate Seminoles.

**1842, October 22**—John Wise proposes to capture Vera Cruz by air.

**1844, October 16**—America's first air patent to Muzio Muzzi on direction of balloons.

**1845, September 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, August 16**—Airmail carried by John Wise in balloon flight from Lafayette to Crawfordsville, Ind.

**1860, August 21**—Capt. E. B. Hunt, Corps of Engineers, U.S.A., advocates balloon telegraphy.

**1860, October 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, August 3**—Civilian aeronaut La Mountain inaugurates aircraft carrier operations with his war balloon. Lowe follows.

*Professor T. S. C. Lowe, foreground, prepares telegraph to report aerial observation during Civil War.*





One of John Montgomery's gliders of the 1880's.

**1861, September 24**—Air Artillery adjustment from Lowe's Army balloon near Washington.

**1861, November 7**—Helicopter proposed for Union Army. After experiments, a machine is partly built before Appomattox ends the project.

**1862, March 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, October 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, March 17**—First of a series of glider flights by John Joseph Montgomery, Otay, Cal.

**1885, January 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, January 30**—Thomas E. Baldwin makes his first parachute jump at San Francisco.

**1886, July**—W. E. Irish, publisher of *Aeronautical World*, proposes balloon radio.

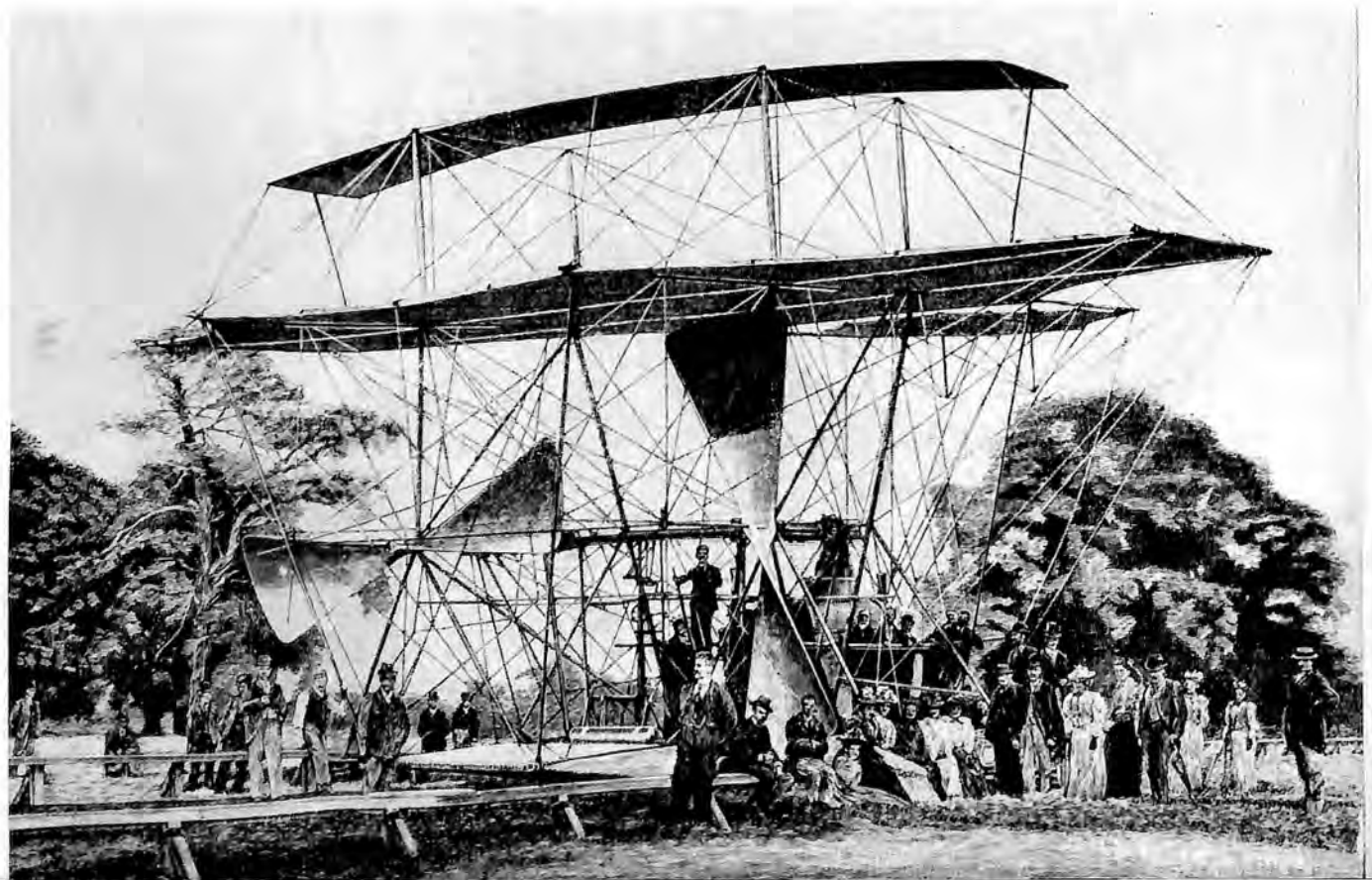
**1887**—American altitude record made by aeronaut Moore and Prof. H. A. Hazen of U. S. Signal Service, at St. Louis; 15,400 feet, in balloon of St. Louis *Post Dispatch*.

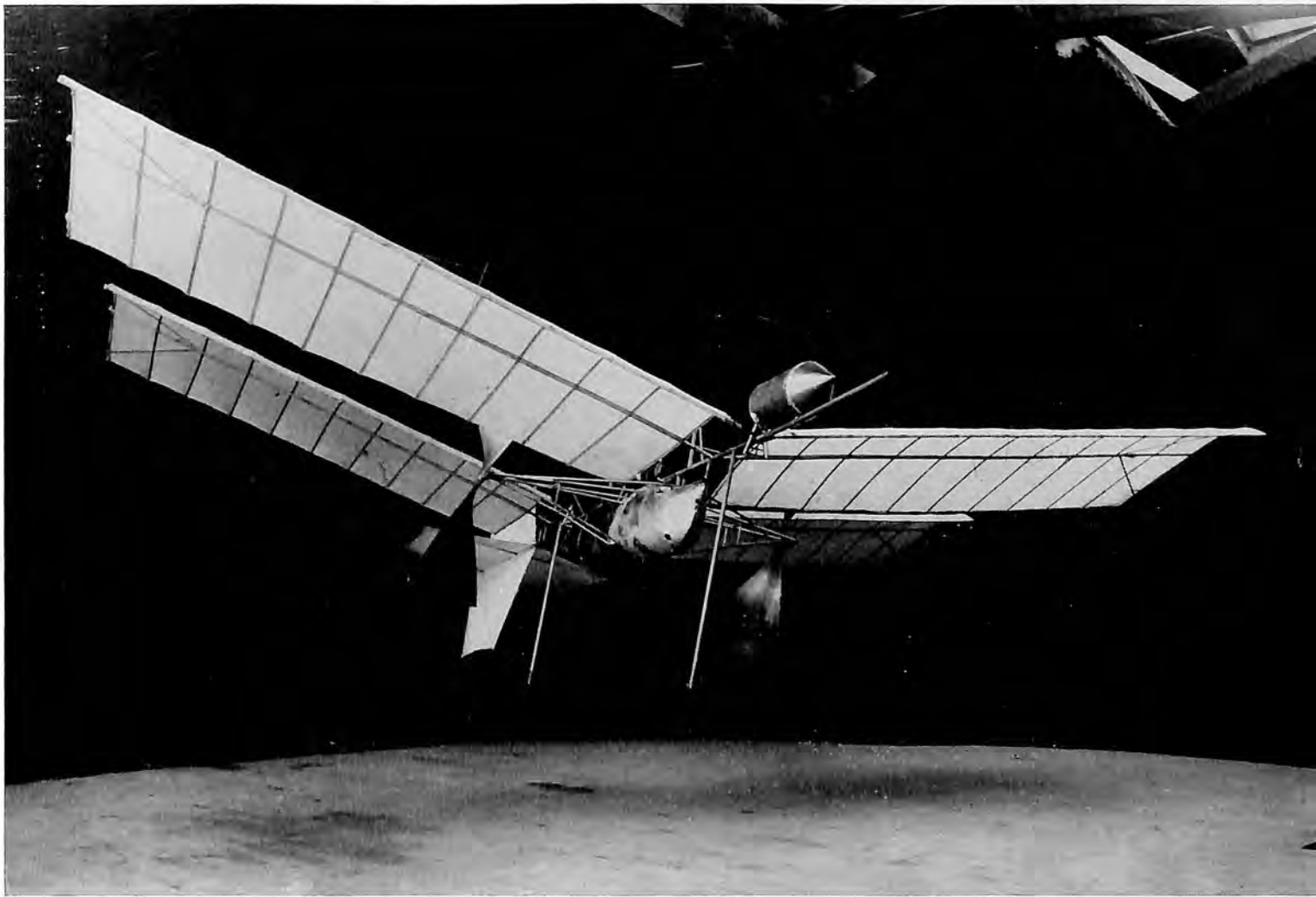
**1890, July 31**—During the month, L. Gathmann, of Chicago, explodes a shell at high altitude in attempt to produce rain.

**1890, October 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, October 10**—Balloon section is being organized with each telegraph train by Chief Signal Officer, General A. W. Greely, who anticipates military airships and airplanes.

Hiram Maxim's flying machine of 1895 never got off the ground.





*Langley Aerodrome Number 5, 1896.*

**1892, November 5**—Wingless aerial torpedo suggested by Prof. A. F. Zahm.

**1893, August 1-4**—International Conference on Aerial Navigation held at Chicago; Octave Chanute, Chairman; Dr. A. F. Zahm, Secretary.

**1893, October 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 October 31, 1893.

**1896, April 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, April 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, December 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.

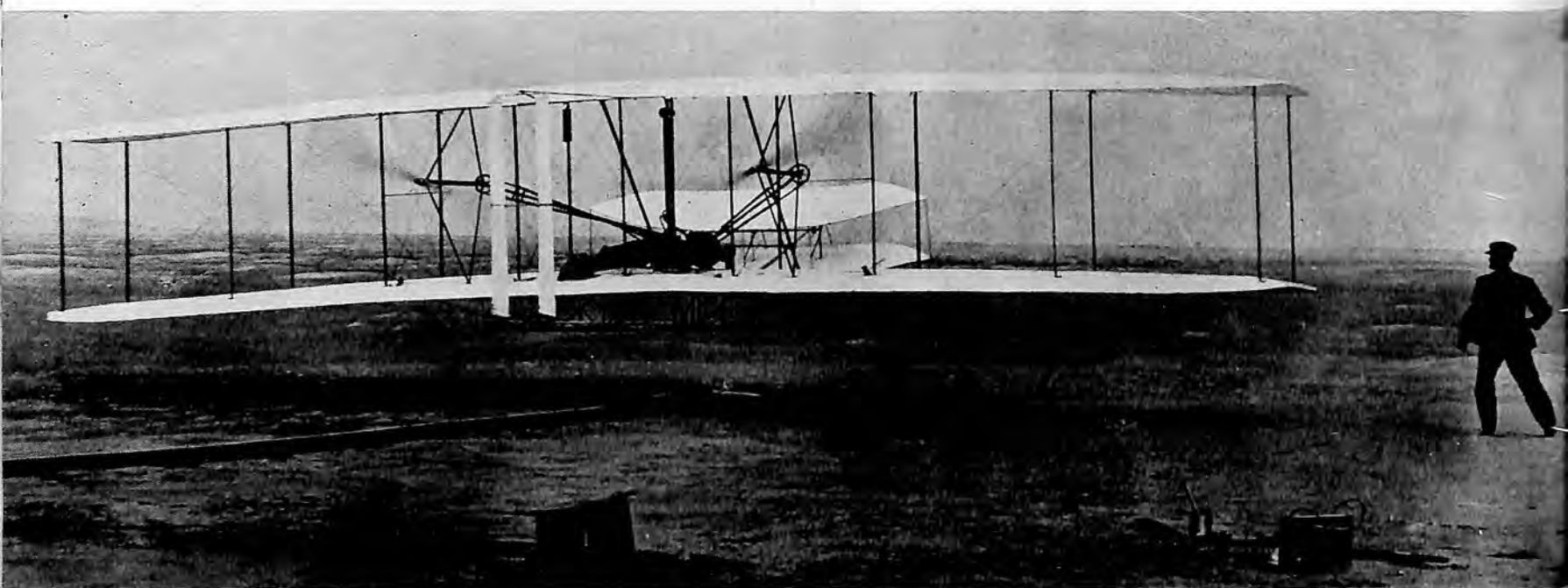
**1901, September 1**—Simon Newcomb, Ph.D., LL.D., writes in *McClures* for September: "The first successful flyer will be the handiwork of a watchmaker and will carry nothing heavier than an insect."

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, September 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.

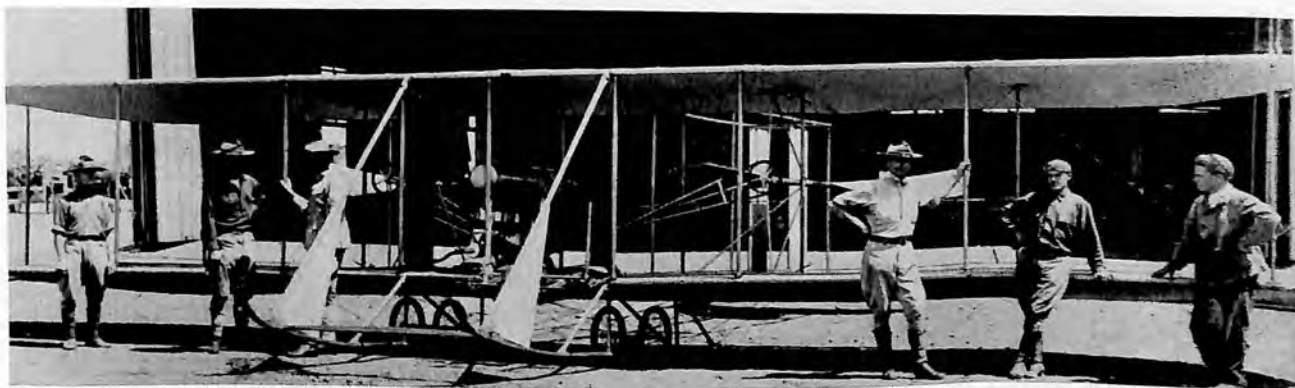
**1903, March 23**—Orville and Wilbur Wright apply for patent on their flying machine. (Patent issued May 22, 1906.)

**1903, December 8**—Samuel Langley's flying machine,



*Wright Brothers' Kitty Hawk in first flight, December 17, 1903.*

- piloted by Charles Manly, plunges in the Potomac and is wrecked on its second test, Washington, D. C.
- 1903, December 17**—First sustained controllable flight of powered heavier-than-air machine by Orville and Wilbur Wright, Kitty Hawk, N. C.
- 1904, August 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, January 18**—Wright brothers open negotiations with U. S. War Department for disposition of their invention. Correspondence is had through 1907.
- 1905, April 29**—Daniel Maloney begins series of glides with Montgomery glider, taking off from captive balloon. Later killed.
- 1905, August 5**—Charles K. Hamilton begins series of kite flights, towed by cars and boats.
- 1905, September 26-October 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, January 13-20**—First indoor aero exposition, New York.
- 1906, March**—French and British visit Wright brothers at Dayton.
- 1906, September 30**—First Bennett international balloon race won by Lt. F. P. Lahm—Paris to England.
- 1906, December 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, August 1**—Aeronautical Division established, Army Office of Chief Signal Officer.
- 1907, September 2**—Walter Wellman airship *America* fails in polar attempt.
- 1907, September 30**—Ornithopter of H. C. Gammeter, multigraph inventor, lifts temporarily.
- 1907, October 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, October 3**—Record altitude of 23,110 feet by U. S. Weather Bureau meteorological kite.
- 1907, October 18**—Air bombing prohibition signed at second Hague conference.
- 1907, October 21**—Second Bennett international balloon race, St. Louis, won by Oscar Erbsloh of Germany. Airship races are held Oct. 22-23.
- 1907, October 28-29**—International Aeronautic Congress held in New York.



Army's first airplane was a Wright Type B.

**1907, October 28**—Admiral C. M. Chester urges anti-submarine airships and shipboard airplanes at International Aeronautic Congress.

**1907, December 6**—Seven-minute towed flight from motor boat tug in Dr. Bell's kite, flown by Lt. T. E. Selfridge.

**1907, December 16**—Chief Signal Officer advertises for airship bids, resulting in purchase of Baldwin airship.

**1907, December 23**—Chief Signal Officer advertises for airplane bids, after visit of Wrights.

**1908, February 10**—First Army plane contract signed by Signal Corps with Wright brothers. (Other contracts signed with A. M. Herring and J. F. Scott.)

**1908, March 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.

*First plane fatality, September 17, 1908.*



**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, August 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-August 8**—Henri Farman of France makes first exhibition airplane flights in U.S.

**1908, August 22**—First Army Baldwin airship accepted.

**1908, September 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.



*Glenn Curtiss flying at Morris Park Race Track, N.Y., 1909.*



- 1908, December 28**—Matthew B. Sellers makes several flights with 7 hp quadroplane.
- 1909, January 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 January 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, August 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, August 25**—First Army airfield leased at College Park, Md.
- 1909, August 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, September 7-October 15**—At Berlin, Orville Wright makes flights under German contract, with more records.
- 1909, September 30**—Inception of Wright-Curtiss patent litigation.
- 1909, September 30**—Emile Berliner describes a proposed guided missile.
- 1909, October 3**—At Zurich, Switzerland, E. W. Mix wins the Bennett International balloon race the second time for America.
- 1909, October 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, October 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, October 8-November 5**—First Army aviators taught to fly by Wilbur Wright, College Park, Md.: Lt.

Glenn L. Martin's first factory was an abandoned church in Santa Ana, California.



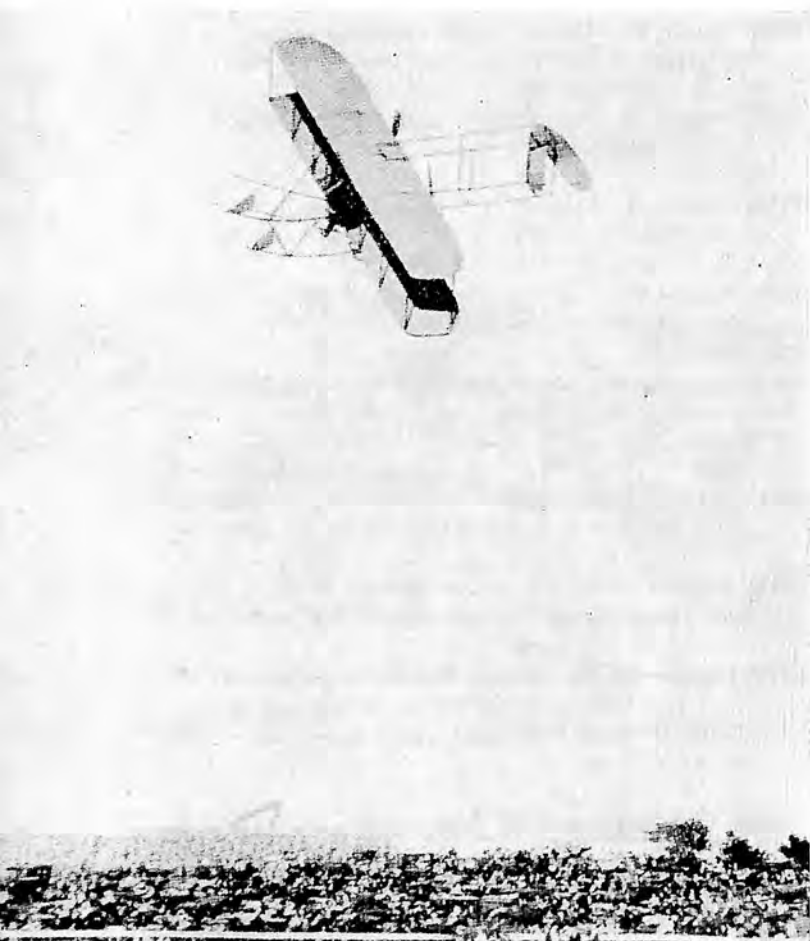
Frank P. Lahm, Lt. Frederic E. Humphreys, and Lt. B. D. Foulois.

- 1909, November 27**—Anti-aircraft firings begin at Sandy Hook by Ordnance Department.
- 1909, November 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, January 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, March 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 13-18**—First show of Wright exhibition team, Indianapolis, Ind., where Walter Brookins is star and make 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, August 4**—Plane-ground radio demonstrated by E. N. Pickerill.
- 1910, August 8**—Tricycle landing gear installed by Lt. B. D. Foulois on Army Wright at San Antonio.
- 1910, August 27**—Air-land plane radio used by J. A. D. McCurdy, Sheepshead Bay, N. Y.
- 1910, September 2**—First American woman pilot solos: Blanche Stuart Scott. First exhibition at Fort Wayne, Oct. 22.
- 1910, October 8-10**—Former President Theodore Roosevelt is flown at St. Louis exhibition by Arch Hoxsey.
- 1910, October 14-16**—Wellman airship, *America*, abandons trans-Atlantic trip after some 800 miles.
- 1910, October 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.

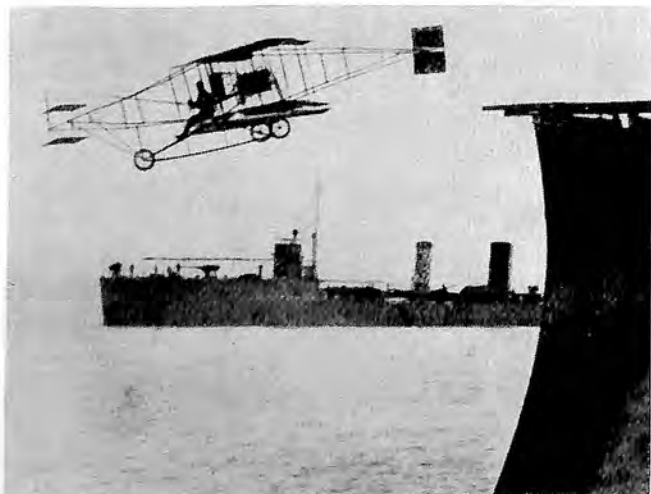
Curtiss flight, Albany-New York, 1910.





*Former President Theodore Roosevelt is flown at St. Louis exhibition by Arch Hoxsey, 1910.*

*Eugene Ely makes first flight from deck of a ship, U.S.S. Birmingham, November 14, 1910.*



**1910, November 14**—First battleship takeoff by Eugene Ely from U.S.S. *Birmingham* in Hampton Roads, Va.

**1910**—Night flights by Walter R. Brookins (Montgomery, Ala., Apr. 18) and Charles Hamilton (Camp Dickenson, Nashville, Tenn., June 21-26).

**1911, January 7**—Didier Masson flies Los Angeles-San Bernardino to deliver *Times* newspapers. Mail and papers delivered Feb. 17 by Fred J. Wiseman.

**1911, January 7-25**—Dive bombing, aerial photography, airplane radio demonstrated by Army officers in San Francisco meet.

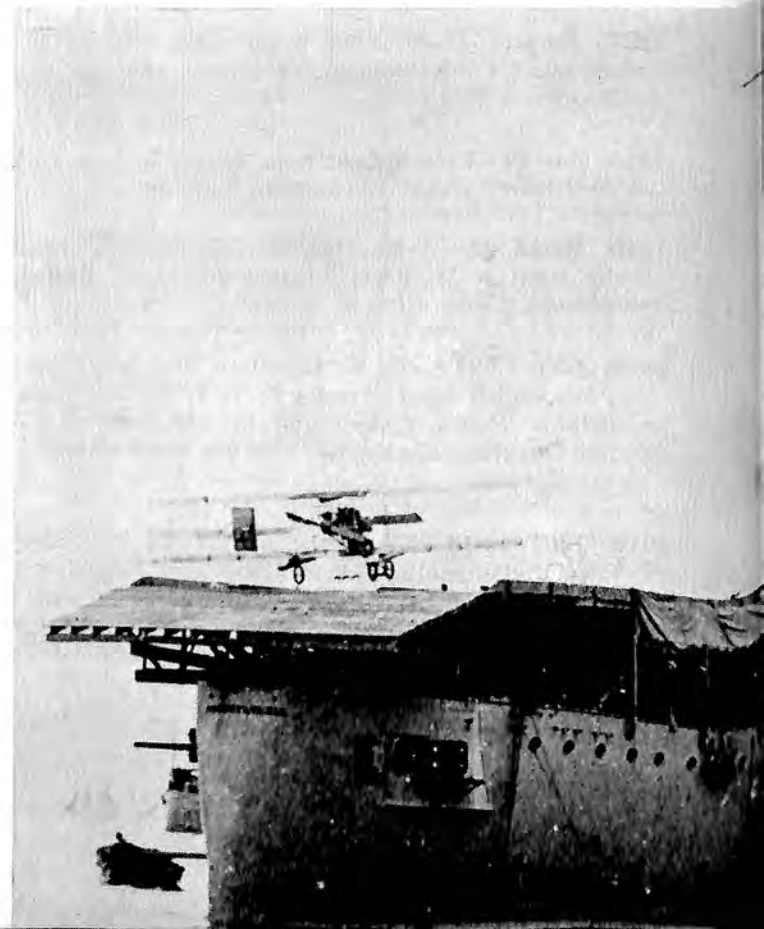
**1911, January 27-28**—Lieut. T. G. Ellyson, U.S.N., is first U.S. naval aviator when he takes his Curtiss off at San Diego during Curtiss exhibitions.

**1911, January 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, February 17**—Curtiss flies tractor seaplane from North Island to cruiser *Pennsylvania*. Plane hoisted on board and return flight later made.

**1911, March 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.

*Eugene Ely lands plane on deck of a warship for first time.*



1911, March 13—Capt. W. Irving Chambers, U.S.N., is assigned the Bureau of Navigation to devote exclusive efforts to naval aeronautics.

1911, March 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 Ass'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.



Lt. T. G. Ellyson is first naval aviator.

1911, July 31—During the month, Frank E. Boland begins flying his tailless, allegedly non-infringing airplane.

1911, August 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, August 14-25—Harry N. Atwood flies St. Louis-New York, 1155 miles by route; longest cross-country flight to this date.

1911, August 20—World altitude record set at 11,642 ft. by Lincoln Beachy in Curtiss biplane.

1911, September 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, September 7—Lt. T. G. Ellyson, U.S.N., demonstrates shipboard launching by taking off from aerial cable at Hammondsport, N. Y.

1911, September 17-November 5—Transcontinental flight by Calbraith P. Rodgers from New York to Pasadena, Calif.—3,390 mi., 49 days.

1911, September 23-30—Earle L. Ovington appointed Airmail Pilot No. 1, flying mail from Nassau Boulevard to Mineola, L. I., N. Y.

1911, September 30—Lt. H. H. Arnold is "stunt man" for the lead in pioneer air movies at Nassau Boulevard meet where Army pilots compete.

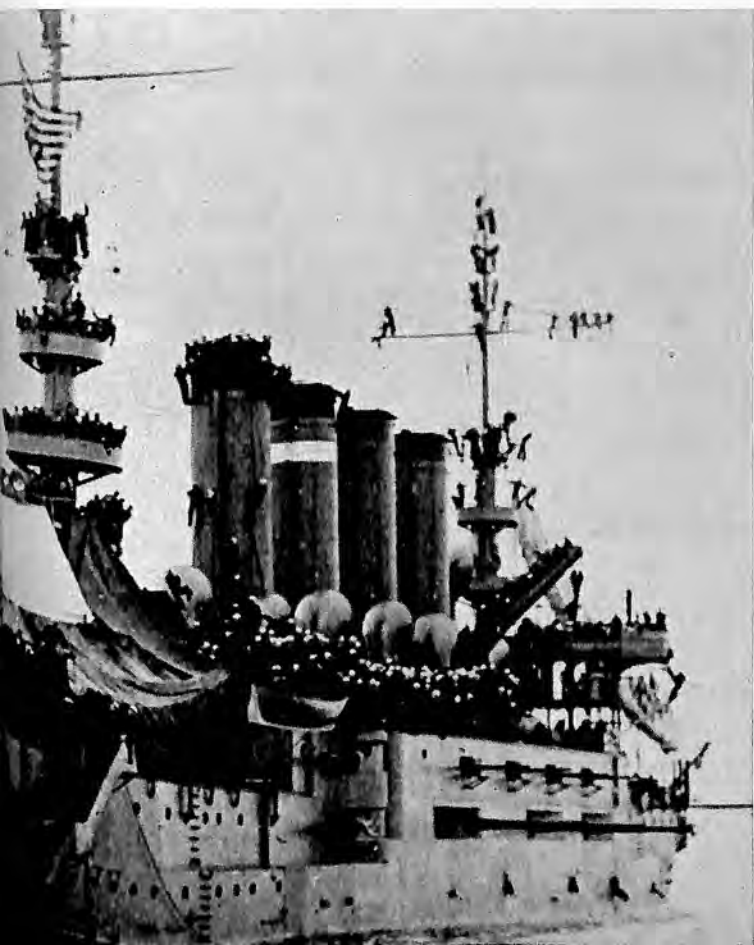
1911, October 9—Demonstration of Tarbox automatic pilot made before officers at College Park. Other similar inventions follow.

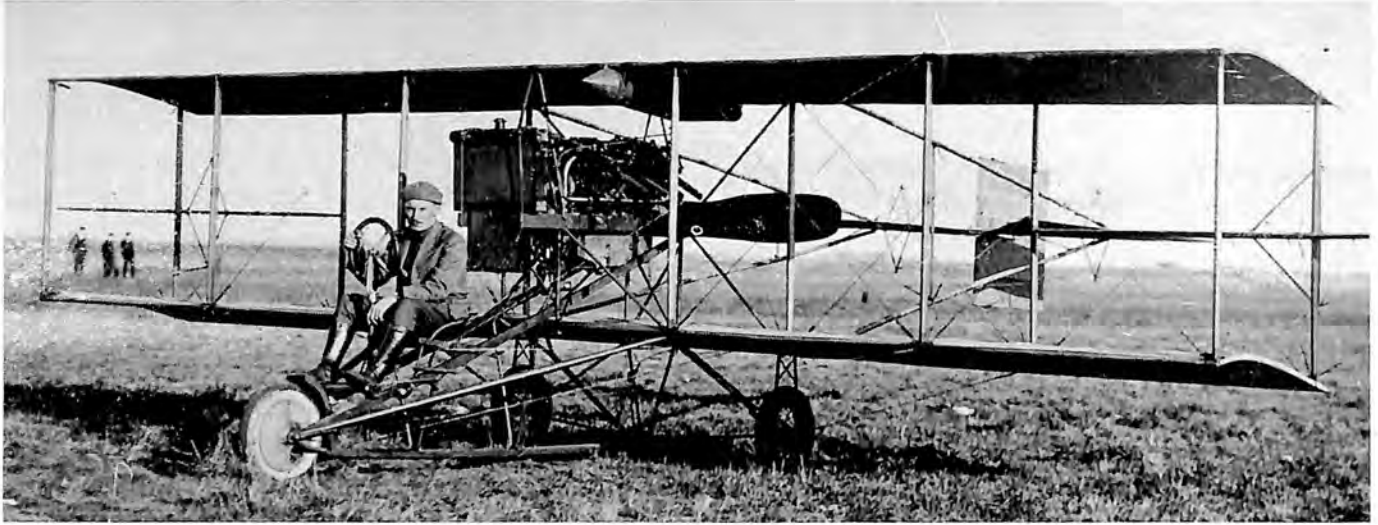
1911, October 10—Bombsighting and dropping device demonstrated by Riley Scott, College Park, Md.

1911, October 19-February 12, 1912—Eastbound transcontinental flight of Robert G. Fowler (Wright B), Los Angeles-Pablo Beach, Fla., 2520 mi. in 116 days.

1911, October 24—Orville Wright makes soaring record of 9 min. 45 sec. at Kitty Hawk.

1912, February 12—Frank T. Coffyn takes automatic movie aerials over New York harbor.





Pilot Dick Depew at controls of early Curtiss pusher model.

Glenn L. Martin (right) in front of 1913 Martin Model T.



1912, February 17—First pilot physical exam published by U. S. Army.

1912, March 1—Attached type parachute jump by Bert Berry from Benoist pusher plane, St. Louis.

1912, April 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 airship *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, August 12—First Army tractor plane, Burgess, received; flown by Lts. H. H. Arnold and Roy C. Kirtland from Marblehead, Mass.

1912, October 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, October 8—First Navy physical exam for pilots published by Bureau of Medicine and Surgery.

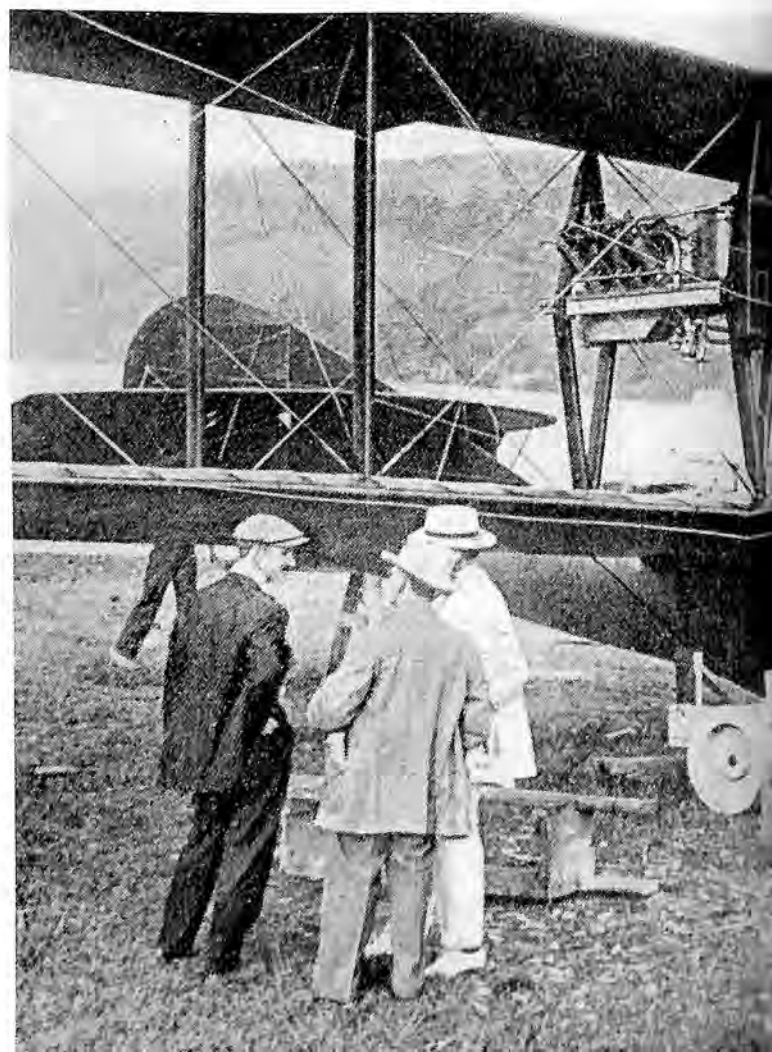
- 1912, October 9**—First competition for Mackay Trophy won by Lt. H. H. Arnold.
- 1912, November 5-13**—First U. S. airplane artillery adjustment, Ft. Riley, Kans., Lt. H. H. Arnold and observer Lt. Follett Bradley.
- 1912, November 6-December 15**—Antony Jannus (Benoist seaplane Roberts 2-cycle 100 hp) flies Omaha-New Orleans, with mail and merchandise, carrying passengers at stops en route—1835 mi., flying time: 31 hr. 43 min.
- 1913, January 13-March 31**—Air parcel post flight, Boston-New York, by Harry M. Jones (Wright B).
- 1913, February 11**—James Hay bill in Congress inaugurates the project of a separate air service.
- 1913, February 13**—Langley Field Aerodynamical Laboratory project inaugurated.
- 1913, April 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-Re-nault 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, October 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, November 27**—First exhibition loop by Lincoln Beachy in Curtiss biplane, Coronado, Cal.
- 1913, December 4**—Tactical Air Unit, First Aero Squadron, set up as provisional organization, San Diego, Cal.
- 1913, December 12**—Wright pilot Oscar Brindley reports at San Diego as Army's first civilian instructor. Scores of others subsequently employed through 1918.
- 1913, December 31**—Orville Wright demonstrates automatic pilot; awarded Collier Trophy.
- 1914, January 1**—First scheduled airline begins operations with Benoist flying boat between St. Petersburg and Tampa, Fla.; Tony Jannus, pilot.
- 1914, January 31**—During the month first U. S. Navy air station established at Pensacola, following temporary camps at San Diego and Annapolis, 1911-1912.
- 1914, February 17**—Seaplanes and flying boats classed as "vessels" by the Department of Commerce and the license No. 1 is issued to Antony Jannus.
- 1914, February 24**—Army Board condemns all pusher type airplanes.
- 1914, April 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, December 1-16**—Two-way plane-ground radio demonstrated by Lt. H. A. Dargue and Lt. J. O. Mauborgne, Manila, P. I.
- 1915, March 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, E. M. Griffith, flown by Jack Vilas, in first air forest patrol.
- 1915, September 17**—Joseph Dolgos of Philadelphia demonstrates air incendiary bombs.
- 1916, February 9**—Cpl. A. D. Smith (Martin S-Hall Scott 125) makes world seaplane duration record of 8 hr. 42 min.
- 1916, February 12**—Invitation for bids on airmail issued by Post Office in Massachusetts and Alaska.
- 1916, March 15**—First Aero Squadron, under command of Capt. B. D. Foulois, begins operations at Columbus, N. M., with Gen. Pershing's Punitive Expedition.

- 1916, April 5**—The Governors Island Training Corps organized by Philip A. Caroll.
- 1916, April 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, August 29**—First U. S. Coast Guard Aviation Division organized.
- 1916, October 2**—Allocation airship development to Army or Navy raised by Chief Signal Officer. Rigids later assigned Navy.
- 1916, November 2**—Chicago-New York commercial air-mail line asked by Glenn Muffly. Sponsored by New York *Times*, Victor Carlstrom flies mail demonstration, November 2-3.
- 1916, November 14**—More than 60 civilians are sent 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, November 18-20**—Group National Guard cross-country flight under Capt. R. C. Bolling from New York to Princeton, N. J. and return. On December 30, another is made to Philadelphia.
- 1916, November 19-20**—Ruth Law flies her 1914 Curtiss pusher Chicago-New York, with 2 stops en route, for new cross-country record.
- 1916, December 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, December 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, February 13**—Capt. Francis T. Evans, U.S.M.C., loops and spins a seaplane at Pensacola.
- 1917, February 15**—Aircraft Manufacturers Association completes organization.
- 1917, April 6**—U. S. declares war on Germany.
- 1917, April 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.

*Curtiss' Wanamaker trans-Atlantic flying boat.*



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, August 5—Original First Aero Squadron leaves Columbus, N.M. for overseas under Maj. Ralph Royce.

1917, August 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, September 5—Bristol fighter project started. Condemned July 20, 1918, after 27 planes are built.

1917, September 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, October 16—Airplane to airplane radiophone conversation is demonstrated.

1917, October 18—McCook Field established as Signal Corps Experimental Laboratory.

1917, October 18—Aviation Medical Research Board established by Signal Corps.

1917, November 15—J. Newton Williams' helicopter proposal results in recommendation of N.A.C.A. for Government prize of \$20,000, not accomplished.

1917, November 21—Robot bomber demonstrated to Army and Navy officers.

1917, November 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, January 19—U. S. School of Aviation Medicine begins operations under Signal Corps Maj. William H. Wilmer, Hazelhurst Field, Mineola, L. I., N. Y.

1918, February 28—Under President Wilson's proclamation, licenses are required for civilian pilots or owners; more than 800 are issued.

1918, March 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, March 11—First D.S.C. awarded Army air service personnel goes to Lt. Paul Baer of 103rd Squadron for his performance this date.

1918, March 14—Two pilots of First Pursuit Group (95th Squadron) go on patrol.

1918, May 9—Flight Surgeons are organized at flying fields.

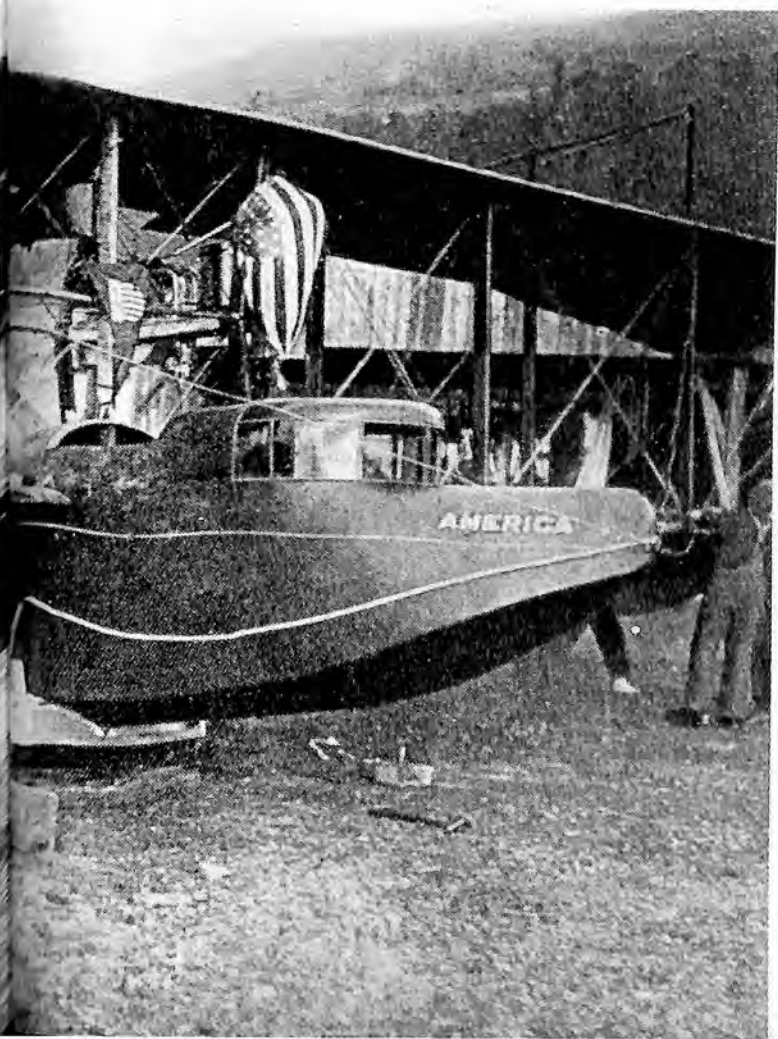
1918, May 11—U. S.-built DH-4 Liberty planes received by AEF.

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 August 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, August 2**—First DH Liberty patrol by 135th Aero Squadron.
- 1918, August 17**—First Martin bomber flown at Cleveland by Thomas Eric Springer.
- 1918, September 7**—First U. S. demonstration of troop transport by air.
- 1918, September 12-13**—Greatest air concentration of history at St. Mihiel under Gen. William Mitchell—1481 planes.
- 1918, September 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 tree type 'chute. Leslie L. Irving makes first free jump Apr. 28, 1919.
- 1918, September 18**—Altitude of 28,899 ft. reached by Maj. R. W. Schroeder.
- 1918, September 25**—First Congressional Medal of Honor awarded for air activity voted 1st Lt. Edward V. Rickenbacker of 94th Aero Squadron.
- 1918, September 26**—First phase of Meuse-Argonne attack.
- 1918, September 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, October 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, October 3**—Flight refueling demonstrated by Lt. Godfrey L. Cabot, U.S.N.R., continuing into 1920.
- 1918, October 12**—Use of oxygen tanks ordered all pilots over German lines.
- 1918, October 25**—Charles E. Hughes reports on his investigation of dishonesty in aircraft production.
- 1918, November 11**—Armistice signed.
- 1918, December 4**—First Army transcontinental 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, January 2**—Maj. Gen. Charles T. Menoher becomes Director of Air Service.
- 1919, January 21-30**—Army second transcontinental flight; Major T. C. Macauley (DH-4 Liberty), Ft. Worth-San Diego-Miami-Ft. Worth. Repeated in April.
- 1919, January 24**—At Issoudun, France, 1st Lt. Temple M. Joyce (Morane) makes 300 consecutive loops.
- 1919, March 3**—U. S.-Canada airmail flown by Edward Hubbard in Boeing seaplane, Type C.
- 1919, April 26**—Lt. Comdr. H. B. Grow, U.S.N. in F5L flying boat makes non-stop endurance record: 20 hr. 10 min.
- 1919, April 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, August 14**—Airmail from Aeromarine flying boat to White Star liner, *Adriatic*.
- 1919, August 27-29**—New York-Toronto race of military and civilian pilots.
- 1919, August 28-September 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, September 1**—Dive bombing demonstrated about this date at Aberdeen Proving Ground.
- 1919, September 16**—Flood relief provided by four JNAD's from Corpus Christi to stranded inhabitants.
- 1919, September 18**—Roland Rohlfs (Curtiss triplane-K12 Curtiss 400) makes world altitude record of 31,420 ft.
- 1919, October 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, October 30**—Reversible pitch propeller tested at McCook Field, Dayton, Ohio.
- 1919, November 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, February 27**—World altitude record of 33,113 feet set by Maj. R. W. Schroeder (Le Pere-Liberty).
- 1920, March 29-April 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**—FP-5L Navy seaplane flown by radio compass from Hampton Roads, Va., to U.S.S. *Ohio*, at sea.
- 1920, July 15-October 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, September 8**—Transcontinental mail route, combination plane-train, New York-Chicago-San Francisco, completed.
- 1920, November 1**—U. S. international passenger service started by Aeromarine West Indies Airways between Key West, Fla., and Havana, Cuba.
- 1920, November 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, December 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, February 18**—First U. S. airplane parachute escape by C. C. Eversole, airmail pilot.
- 1921, February 22-23**—Night airmail flown by Jack Knight from North Platte, Neb., to Chicago, Ill.
- 1921, February 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, March 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, August 10**—Navy Bureau of Aeronautics formed with Rear Admiral W. A. Moffett as Chief.
- 1921, September 28**—New world altitude record of 34,508 ft. set by Lt. J. A. Macready.
- 1921, November 5**—Bert Acosta (Curtiss Navy-C12 Curtiss 400) wins Pulitzer race at 176.7 mph.
- 1921, November 12**—Refueling in air: Earl S. Daugherty transfers *Wesley May* with can of gasoline from wing of another plane.
- 1921, November 15**—Italian airship *Roma* makes initial ascent in U. S. at Langley Field.
- 1921, December 1**—Helium airship, Navy dirigible C-7, flown from Hampton Roads, Va. to Washington, D. C.
- 1921, December 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, January 1**—Underwriters Laboratories starts registration of aircraft for benefit of insurance companies.
- 1922, January 1**—Aeronautical Chamber of Commerce organized, New York, with I. M. Upperco, president.
- 1922, February 21**—Airship *Roma* destroyed.

- 1922, March 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, August 5-7—Lt. Clayton Bissell completes first model airway flight, Washington-Dayton-Washington.
- 1922, August 16—Sperry airway light beacon demonstration, McCook Field.
- 1922, September 4-5—Transcontinental speed flight by Lt. James H. Doolittle, Pablo Beach, Fla.-San Francisco, Cal., in 22 hr. 35 min. elapsed time.
- 1922, September 14-23—Trancontinental 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, October 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, October 14—Lt. R. L. Maughan wins Pulitzer race at 206 mph (Army Curtiss-D12-Curtiss 375).
- 1922, October 18—World speed record of 222.97 mph set by Brig. Gen. William Mitchell in Curtiss racer.
- 1922, October 23—American Propeller Co. demonstrates reversible propeller at Bolling Field.
- 1922, December 18—Army's De Bothezat helicopter makes first successful flight, 1 min. 42 sec., Dayton, Ohio.
- 1923, March 29—Lt. R. L. Maughan makes world speed record 236.58 mph (Curtiss R6-Curtiss 465), Dayton, Ohio.
- 1923, April 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, August 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, September 5—Smoke screen demonstrated by Thomas Buck Hine during naval bombing maneuvers, Cape Hatteras, N. C.
- 1923, September 5—Langley Field bombers sink naval vessels *New Jersey* and *Virginia*.
- 1923, October 6—Lt. A. S. Williams, U.S.N. wins Pulitzer race (Curtiss R2C1-D12 Curtiss 460) at 243.68 mph.
- 1923, October 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, November 4—Lt. A. J. Williams, U.S.N. (Curtiss R2C1-D12A Curtiss 500) makes world speed record 266.59 mph.
- 1923, December 18—For \$100,000 the Christmas Aeroplane Co. assigns its aileron patent to U. S. Government.
- 1924, January 16—Navy airship *Shenandoah* tears loose from mast in storm and rides it out during the night.
- 1924, February 21—Alaskan airmail flown by Carl B. Eielson from Fairbanks to McGrath.
- 1924, February 22—Lt. J. A. Macready (Lepere-supercharged Liberty 400) reaches 41,000 ft. indicated altitude.
- 1924, April 6-September 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, October 4—Lt. H. H. Mills wins Pulitzer trophy (Verville Sperry-Curtiss HC D12A) at 216.55 mph.
- 1924, October 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, October 12-15—U. S. Navy's German airship *ZR3 (Los Angeles)* makes fourth aircraft Atlantic crossing, Friedrichshafen-Lakehurst, in delivery under reparations.
- 1924, October 29—Fog dispersal by electrified silica and sand demonstrated at Bolling Field.



*American Airlines' fleet of planes in 1930 totals six.*

- 1925, January 29**—Eclipse pictures and astronomic data secured at high altitudes by Air Service pilots.
- 1925, February 2**—Kelly Bill signed by President Coolidge authorizing private contract air transport of mail.
- 1925, March 1**—San Diego Airline service started by Ryan Airlines, Inc.—first daily scheduled service on all-season basis.
- 1925, April 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, August 1**—Survey flight of Pacific Air Transport flown by T. Claude Ryan and Vern Gorst in first Ryan M-1 mail plane.
- 1925, August 4-22**—MacMillan polar expeditions with Navy assistance.
- 1925, August 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, August 31-September 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, September 3**—Navy dirigible, *Shenandoah*, collapsed in storm over Ava, O., killing 14 of 43 on board.
- 1925, September 12**—Morrow Board appointed by President Coolidge. (Laid down U. S. air policy.)
- 1925, October 12**—Lt. Cyrus Bettis wins 6th Pulitzer race (Curtiss R3C1-V1400 Curtiss 619) at 248.97 mph.
- 1925, October 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, December 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, January 18**—A \$2,500,000 air promotion fund established by Daniel Guggenheim.
- 1926, January 29**—Lt. J. A. Macready (XCO5A-Liberty 400) makes American altitude record: 38,704 ft.
- 1926, February 11**—Strip bombing tests made at Kelly Field.
- 1926, April 16**—First cotton dusting plane purchased by Department of Agriculture.
- 1926, April 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 Richard Byrd, navigator, and Floyd Bennett, pilot, in Fokker monoplane.
- 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 reforestation by airplane, Hawaii.
- 1926, July 14—Armstrong seadrome model demonstrated at Wilmington, Del. to Air Service.
- 1926, August 18—Metal-clad airship contract let at not over \$300,000.
- 1926, August 25—JN training plane dropped by parachute, San Diego Naval Air Station.
- 1926, September 15—Pacific Air Transport begins operation of contract air mail service with Ryan M-1 monoplanes between Los Angeles and Seattle.
- 1926, December 7—Airway beacon erected by Aeronautics Branch, Department of Commerce, on Chicago-Dallas route.
- 1927, March 9—American balloon altitude record of 28,508 ft. made by Capt. H. C. Gray.
- 1927, April 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, August 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, September 1—Air express operations begun by American Railway Express and major airlines.
- 1927, September 10—Bennett international balloon race, Dearborn, Mich., won by E. J. Hillard and A. G. Schlosser with 745 miles; 15 contestants.
- 1927, October 12—Wright Field dedicated.
- 1928, February 3-December 28—Lt. H. A. Sutton conducts a series of spin tests; awarded Mackay Trophy.
- 1928, March 1-9—Transcontinental amphibian flight by Army Lt. Burnie R. Dallas and civilian Beckwith Havens in Loening.
- 1928, March 28-30—Edw. A. Stinson and George Holderman (Stinson-Wright 200) make endurance record of 53 hr. 36 min. 30 sec.
- 1928, April 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 Baldonnell, Ireland to Greenly Island, N.F., 2,070 miles in 37 hours.
- 1928, April 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 (P7 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, September 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, October 19—Parachute troop demonstration at Brooks Field.
- 1928, November 11—First Antarctic flight made by Lt. C. B. Eielson and Sir Hubert Wilkins (Lockheed-Wright 22). Other flights subsequently.
- 1928, November 23-December 30—New York-Girardot, Colombia, flight by Capt. Benjamin Mendez, 4,600 miles.



*Famous Winnie Mae on display at National Air Museum.*

- 1928, December 19**—Autogiro flight by Harold F. Pitcairn, Pitcairn Field, Willow Grove, Pa.
- 1929, January 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, April 3**—Floyd Smith trap-door parachute demonstrated.
- 1929, April 30**—Jack Barstow makes duration glider record of 15 hr. 13 min. at Point Loma, Calif.
- 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, August 5-6**—Group transcontinental flight of 9 Keystone bombers under Major Hugh J. Knerr.
- 1929, September 24**—Demonstration by Lt. James H. Doolittle results in Guggenheim report blind flying solution.
- 1929, October 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, March 15**—Glider, piloted by Capt. Frank Hawks, released from seaplane, Port Washington, N. Y.
- 1930, April 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-August 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, September 1**—Bennett international balloon race again won for U. S. by W. T. Van Orman and aide, 542 miles.
- 1931, February 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, March 30**—Airplane-airship mail transfer at Scott Field.
- 1931, April 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, October 3-5**—Trans-Pacific non-stop airplane flight by Clyde Pangborn and Hugh Herndon, Samushiro Beach, Japan, to Wenatchee, Wash.
- 1931, October 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, October 6-9**—Navy bomber tests on U.S.S. *Pittsburgh* in Chesapeake Bay.
- 1931, November 3**—Dirigible, *Akron*, carried record number of 207 persons in flight over New York and Philadelphia.
- 1931, December 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.



*Will Rogers (left) and Wiley Post.*

- 1932, May 20-21**—Amelia Earhart solos across Atlantic, St. Johns, New Brunswick to Londonderry, Ireland, in Wasp-powered Lockheed Vega.
- 1932, August 25**—First woman to complete non-stop transcontinental flight, Amelia Earhart, Los Angeles to Newark.
- 1932, December 1**—Teletypewriter weather map service inaugurated by Department of Commerce.
- 1933, January 19**—Rocket guided by sound waves from enemy aircraft proposed.
- 1933, January 23**—Steam airplane project launched by Great Lakes Aircraft and General Electric Co. Later Besley brothers fly their steam airplane.
- 1933, April 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, September 4**—World speed record for land planes

set at 304.98 mph by James R. Wedell in Wasp-powered Wedell-Williams racer.

**1933, November 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, January 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, February 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, December 31**—War Department announces instruction governing GHQ Air Force organization and operation.

**1935, January 3**—Antarctic flight by Ellsworth and Kenyon (Northrop-PW 600).

**1935, February 12**—Navy dirigible, *Macon*, crashes into sea, killing 2.

**1935, June 12-August 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, August 15**—Will Rogers and Wiley Post killed in take-off crash near Point Barrow, Alaska.

**1935, November 11**—Balloon altitude record of 72,394 ft. by Capt. O. A. Anderson and Capt. Albert Stevens.

**1935, November 21-December 5**—Antarctic flights renewed by Ellsworth and Kenyon (Northrop-PW 600).

**1935, November 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, September 10-October 20**—Regular trans-Atlantic flying boat service by Deutsche Lufthansa. (Dornier twin Diesel engine 600.) Continued in 1937 and 1938.

**1936, September**—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 PBV-1, Catalina, from San Diego to New York.

**1937, July 3-September 3**—Regular trans-Atlantic service test by Pan American Airways. Imperial Airways also similarly operate July 5-Aug. 2 and continue in 1938.

**1937, August 12**—In joint coast defense exercise, Navy patrol planes locate target ship *Utah* 300 miles off San Francisco; Air Corps planes attack.

Bell Aircraft's XP-59 Airacomet is first U.S. jet plane.





- 1937, August 23**—Wholly automatic landings made, "first in history," at Wright Field by Capt. Carl J. Crane with 2 passengers; awarded DFC.
- 1938, February 26**—Government acquires monopoly on helium by purchasing production facilities at Dexter, Kan.
- 1938, April 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, August 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, August 22**—Civil Aeronautics Act becomes effective.
- 1939, February 4-6**—Langley Field-Santiago Red Cross flight by Major C. V. Haynes in XB bomber with medicinal supplies.
- 1939, March 5**—Non-stop airmail system by pick-up demonstrated by Norman Rintoul and Victor Yesulantes in Stinson Reliant planes, Coatesville, Pa.
- 1939, April 3**—The National Defense Act, providing for aerial rearmament, signed by President Roosevelt.
- 1939, April 17**—Inclined runways for assisted takeoff studied by Air Corps Board.
- 1939, June 27**—Bill authorizing Civilian Pilot Training Program signed by President.
- 1939, July 6**—Army Air Corps adopts monoplane type for primary training for first time by ordering quantity of Ryan PT-16 military trainers.
- 1939, September 1-3**—Germany invades Poland. England and France declare war on Germany.
- 1940, March 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, September 23**—House committee asks \$80 million for airport development, in \$500 million program; \$40 million voted.
- 1941, March 17**—Milwaukee renames its airport as General Mitchell Field.
- 1941, April 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, September 5**—Mass trans-Pacific flight of heavy bombers completed by nine Army B-17 Flying Fortresses.
- 1941, December 7**—Pearl Harbor.
- 1942, April 8**—First flight of Ferry Command over Himalayan "Hump" made by Lt. Col. William D. Old, between Assam, India and Kunming, China.
- 1942, April 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, August 17**—First official bombing raid of Eighth Air Force, 12 Flying Fortresses, Brig. Gen. Ira C. Eaker commanding, Rouen, France.
- 1942, September**—Fifty American Eagle squadron pilots, RAF, all Americans, transferred to Eighth Air Force. (Fourth Fighter Group)



*Atomic bomb is dropped on Hiroshima from Enola Gay.*

- 1942, October 1**—First U.S. jet plane built and flown by Robert M. Stanley; Bell Airacomet (XP-59A), Muroc Dry Lake, Cal.
- 1942, October 2**—First non-stop cross-country flight of a fighter airplane. Jack Woolams flies Bell P-39 from March Field, Calif., to Bolling Field, Wash.
- 1943, March 1-4**—Battle of Bismarck Sea.
- 1943, March 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, October**—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.
- 1944, June 7**—Delivery of Ryan FR-1 Fireball fighters to U. S. Navy marks first Navy jet airplanes and world's first composite aircraft using jet and piston engines.
- 1945, May 8**—War in Europe ends.
- 1945, August 6**—Atomic bomb dropped on Hiroshima from B-29, *Enola Gay*, under command of Col. Paul W. Tibbets, Jr.
- 1945, August 14**—Japan's surrender ends World War II.
- 1945, October 3**—Ensign Jake C. West of Navy VF-66 Squadron makes first jet landing aboard an aircraft carrier.
- 1945, September 28-October 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, January 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, March 12**—First commercial helicopter license granted by Civil Aeronautics Administration for Bell 2-place Model 47.
- 1946, March 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, August 6**—Two B-17 radio-controlled bombers with stand-by crews, fly non-stop, Hilo, Hawaii, to Muroc Lake, Cal.
- 1947, February 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 the Air Force co-equal with Army and Navy, and creating Department of Defense.
- 1947, October 14**—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, September 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, January 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, January 14**—Capt. William Odom, flying a specially modified Beechcraft Bonanza, sets a new lightplane distance record, crossing from Honolulu to Oakland, Calif.
- 1949, February 7**—Eastern Air Lines reports new transcontinental speed record for transport aircraft set February 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, February 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, March 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, March 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, October 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, Calif.
- 1950, January 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, January 22**—Paul Mantz sets new transcontinental record flying a North American F-51 Mustang (Allison) from Burbank, Calif. to La Guardia Field, N. Y. in 4 hr. 52 min. 58 sec.
- 1950, February 9**—Navy Lockheed P2V Neptune (Wright 3350) patrol bomber completes 5,156 mile flight in 25 hr. 57 min.
- 1950, March 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, September 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, September 22**—Col. David C. Schilling and Lt. Col. William D. Ritchie fly London-New York non-stop with three in-flight refuelings 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, November 10**—A Lockheed F-80 shoots down a Russian-built MiG-15 in first jet aerial combat, Korea.
- 1951, January 17**—Convair RB-36D reconnaissance bomber makes 51 hr. 20 min. non-stop flight without refueling.
- 1951, February 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.
- 1951, April 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, August 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, August 18**—North American F-86A Sabrejet, 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, January 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, March 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, April 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, August 1**—Two Sikorsky H-19 helicopters complete first trans-Atlantic helicopter crossing and break non-stop distance record for rotary wing aircraft.

**1952, September 17**—Official world's long-distance, non-stop helicopter record established by Elton Smith in Bell Model 47D-1 flying from Fort Worth, Texas, to Wheatfield, N.Y. (Niagara Falls, N.Y., airport), a distance of 1,217.14 miles in 12 hours 57 minutes.

**1952, November 19**—New record set by North American F-86D (GE J-47 GE-17) Sabrejet, piloted by Capt. J. Slade Nash, flying at 699.92 mph. (Previous world speed record—670.981 mph.)

**1953, January 26**—Chance Vought Aircraft completes final F4U Corsair, bringing to an end the longest production record of any airplane ever built.

**1953, May 18**—Jacqueline Cochran Odlum flies at record speed of 652.337 mph over a 100 km. course, in a Canadair F-86 swept-wing Sabre.

**1953, October 3**—LCdr. James B. Verdin establishes new world speed record of 753.4 mph in Douglas XF4D-1 Skyray, Navy carrier fighter.

**1953, October 20**—TWA Lockheed Super Constellation completes first scheduled nonstop transcontinental passenger trip from Los Angeles to New York in 8 hr. 17 min.

**1953, October 29**—North American YF-100 Super Sabre establishes new world's speed record of 754.98 mph, piloted by Lt. Col. F. K. Everest.

**1953, December 12**—Maj. Charles E. Yeager, USAF pilot, establishes new world speed record of more than 1650 mph in the Bell X-1A.

**1954, January 5**—Air National Guard Col. Willard W. Millikan sets New York-Washington speed mark of 24 minutes in North American F-86F.

**1954, March 1**—Peak is reached in number of U. S. airports: 6,760.

**1954, March 29**—American Airlines DC-7 sets official Los Angeles-New York commercial speed record: 6 hrs. 10 mins.

**1954, May 24**—Martin Viking II, single stage rocket, sets altitude record soaring 158 miles high (834,240 feet) at 4300 mph. at White Sands Proving Ground, New Mexico.

**1954, May 25**—Goodyear ZPG-2 non-rigid airship sets new record for flight without refueling, landing at Key West, Fla., after 200 hrs. 4 mins. in the air.

**1954, August 21**—New altitude record of 90,000 feet set in rocket-powered Bell X-1A by Major Arthur Murray, USAF, at Edwards Air Force Base, Calif.

**1954, August 27**—Adm. DeWitt C. Ramsey, president of Aircraft Industries Association, reports that U. S. aircraft manufacturers are now building 900 to 1,000 military planes per month.

*Capt. Charles Yeager flies Bell XS-1 faster than sound.*

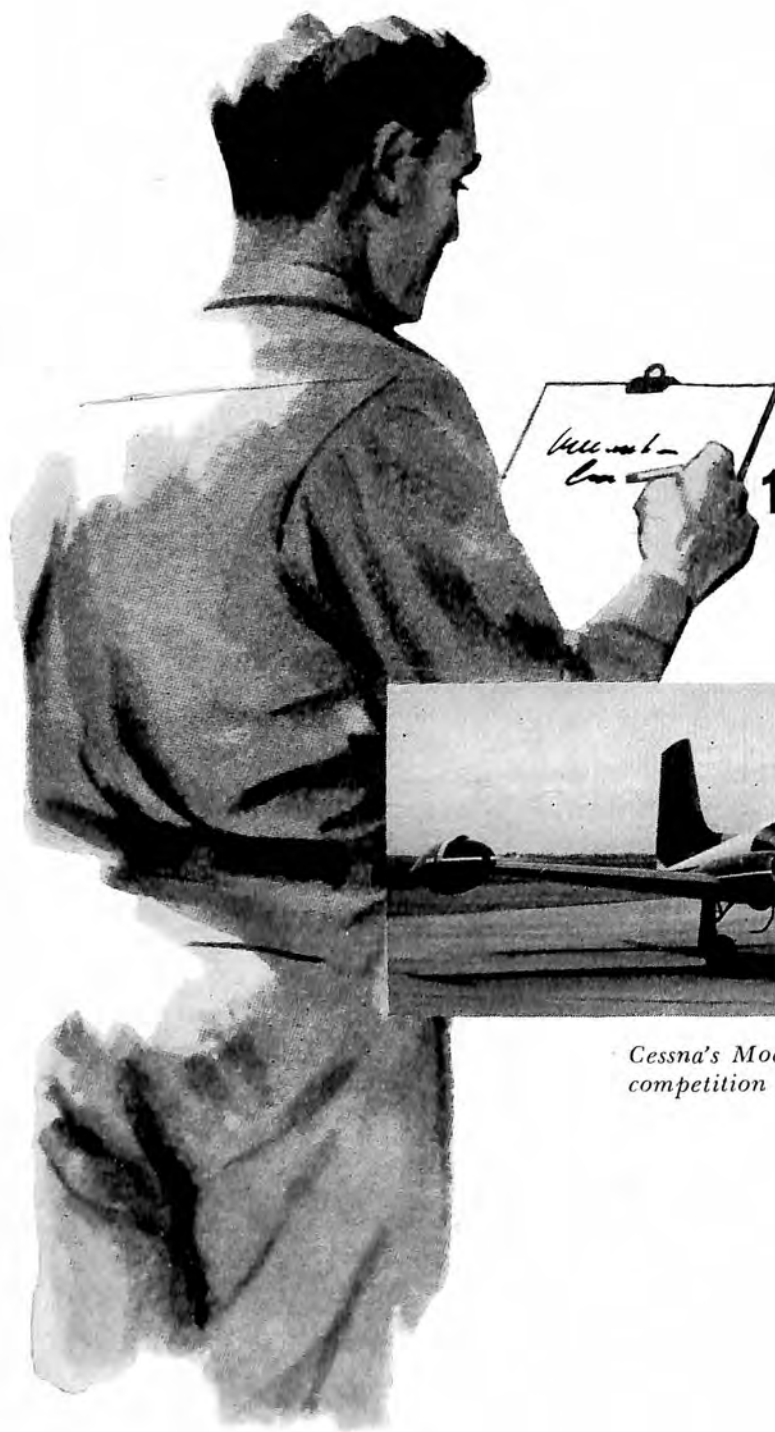




*Boeing XB-47 jet bomber sets cross-country record, 1949.*

- 1955, February 16**—Longest non-stop flight by a jet fighter-bomber—2,390 miles—made by Republic F-84F from George AFB in California to Langley AFB, Virginia. Speed averaged 605 mph.
- 1955, March 9**—Republic's F-84F Thunderstreak sets a new official transcontinental speed record, flying 2,445 miles non-stop from Los Angeles to New York in 3 hrs. 44 mins.
- 1955, May 24**—A North American F-86 sets two transcontinental records: (1) as first aircraft to cross the U. S. round trip in daylight and (2) by flying east-west leg in 5 hrs., 27 mins., 37 secs., breaking previous record.
- 1955, August 1**—White House announces that U. S. plans to launch a small unmanned satellite about the size of a basketball sometime after July, 1957. Satellite will circle earth at altitudes between 200 and 300 miles.
- 1955, August 17**—Republic's Thunderstreak sets a new world's non-stop jet fighter distance record of 5,118 mi. from London, England, to Texas.
- 1955, August 20**—North American F-100C sets the first supersonic world speed record of 822.135 mph, 70 miles faster than the previous record set in 1953.
- 1955, October 15**—Douglas A4D Skyhawk sets a new closed course world speed record of 695.163 mph.
- 1956, April 2**—Air Force reportedly fires an air-breathing guided missile (Northrop SM-62 Snark) a distance between 1,500 and 5,000 miles from Patrick Air Force Base, Fla.
- 1956, July 23**—Rocket-powered Bell X-2 sets new speed record of 1,900 miles an hour, flown by Lt. Col. Frank K. Everest, USAF.
- 1956, August 10**—McDonnell XV-1 convertiplane sets unofficial speed record for helicopters of 200 mph.
- 1956, August 11**—Vertol H-21C helicopter sets new world record for distance in a closed circuit without payload by flying 1,199.07 mi. non-stop in 11 hrs. 58 min.
- 1956, September 5**—Chance Vought F8U-1 captures Thompson Trophy for Navy by flying 1015.428 mph to establish new national speed record.
- 1956, September 7**—Capt. Iven C. Kincheloe, USAF, sets new altitude record of 126,200 feet in Bell X-2.
- 1956, September 27**—Bell X-2 sets new speed record of 2,148 miles an hour, crashes at Edwards Air Force Base, Calif. Pilot was Capt. Milburn G. Apt, USAF.
- 1956, October 11**—NACA discloses that four-stage research rockets, fired in connection with development of the ICBM and the North American X-15, have hit speeds of 6864 mph or Mach 10.4.
- 1956, November 2**—Defense Department discloses that Navy's first guided missile cruiser, the *Boston*, will be dispatched to Mediterranean to join U. S. Sixth Fleet.
- 1956, November 13**—North American F-107 reaches Mach 2 speed in flights at Edwards Air Force Base, Calif.

- 1956, November 27**—Eight B-52's break the jet bomber's record by staying aloft an estimated  $32\frac{1}{2}$  hours, covering 17,000 miles.
- 1957, January 18**—Three of five B-52 jet bombers land in Calif., culminating the first nonstop jet flight around the world. The 24,325-mile flight is accomplished in 45 hr. 20 min., slashing by one-half the previous record.
- 1957, January 28**—Lockheed YC-121F Constellation sets new west-to-east record of 4 hr. 41 min.
- 1957, February 19**—First hovering flight of Bell X-14 jet-powered VTOL at Niagara Falls, N.Y., airport.
- 1957, March 12**—Boeing 707 Stratoliner. America's first jet airliner, spans continent in record-breaking flight of 3 hr. 48 min.
- 1957, March 15**—Goodyear Aircraft Co.'s Navy ZPG-2 blimp sets new world records for continuous flight (over 300 hr.) and distance (8,000 mi.)
- 1957, March 24**—Navy Douglas A3D twin jet attack bomber cracks two speed records, flying round-trip, Los Angeles-New York in 9 hr. 35 min. 48 sec. for one mark, and east-west in 5 hr. 14 min. 58 sec.
- 1957, July 16**—Chance Vought F8U-1 Crusader, piloted by Maj. John Glenn, Jr., USMC, sets new coast-to-coast record, flying from Calif. to N.Y. in 3 hr. 23 min.
- 1957, August 12**—F3D makes first fully-automatic landing aboard an aircraft carrier, U.S.S. *Antietam*, using Bell Aircraft all-weather automatic landing system.
- 1957, August 20**—A manned balloon sets new altitude record of over 100,000 ft. during Air Force project to determine human reactions in space flight; Maj. David Simons, sealed in a pressurized capsule, stays aloft for 32 hrs.
- 1957, October 10**—Following Russia's launching of first earth satellite (Sputnik) on Oct. 4, President Eisenhower announces that the U. S. will attempt to launch a four-pound "test" satellite in December.
- 1957, October 22**—The Jupiter, Army's intermediate-range ballistic missile, flies its prescribed course and lands in pre-selected target area.
- 1957, October 22**—Air Force reports sending rocket at least 1,000 miles and perhaps 4,000 miles above the earth at Eniwetok Atoll in Operation Far Side.
- 1957, November 1**—GAM-63 Rascal air-to-surface guided missile officially becomes operational with Strategic Air Command at Pinecastle AFB, Fla.
- 1957, November 13**—Boeing KC-135, piloted by Gen. Curtis LeMay, sets new distance nonstop record, flying 6,350 miles from Westover AFB, Mass. to Buenos Aires; the KC-135's return trip sets new speed record, Buenos Aires-Washington, D. C., over 5,200 miles in 11 hr. 5 min.
- 1957, November 27**—Air Force McDonnell Voodoo jets shatter three transcontinental speed records: Los Angeles to New York and back: 6 hr. 42 min. 6 sec.; east-west, 3 hr. 34 min. 8 sec.; west-east, 3 hr. 5 min. 39.2 sec.
- 1957, December 6**—Vanguard vehicle fails in attempt to launch first U.S. satellite.
- 1957, December 12**—McDonnell F-101A, piloted by Maj. Adrian Drew, captures world speed record for Air Force by flying 1207.6 mph.



# 1957 DAY BY DAY



*Cessna's Model 310 wins Air Force competition for twin-engine plane.*

## JANUARY

- **January 2**

Cessna Aircraft Co.'s Model 310 wins Air Force competition for a light twin-engine administrative liaison and cargo plane.

- **January 3**

Air Force and Navy award \$3.235-billion in contracts for aircraft, missiles, drones and related production facilities during first four months of fiscal 1957.

James R. Durfee is designated to serve again as Civil Aeronautics Board chairman for 1957.

- **January 8**

Brooklyn Dodgers (later Los Angeles), with purchase of Convair 440, are first major league baseball team to purchase airplane for transportation of team.

- **January 9**

Navy awards \$27-million contract to Bendix Aviation Corp. for Talos anti-aircraft guided missile.

Lockheed Aircraft Corp. holds airframe responsibility for Polaris mid-range ballistic missile, Navy discloses, with Aerojet-General developing the propulsion unit and General Electric and Mass. Inst. of Tech. working guidance system.

Kollsman Instrument Corp. receives \$26-million contract for new-type automatic astro compass.

- **January 10**

Allison Div., GMC, receives \$20-million Air Materiel Command contract for J71 engines for F3H aircraft.

New in-flight refueling system, permitting refueling at speeds in excess of 350 knots and altitudes up to 40,000 feet, is announced jointly by McDonnell Aircraft Corp. and Beech Aircraft Corp.

Aircraft industry remains nation's top employer with 839,400 workers in October, Bureau of Labor Statistics reports.

- **January 11**

First flight of Hiller Helicopters' XROE-1, one-man collapsible rotorcycle, is announced by Navy.

- **January 14**

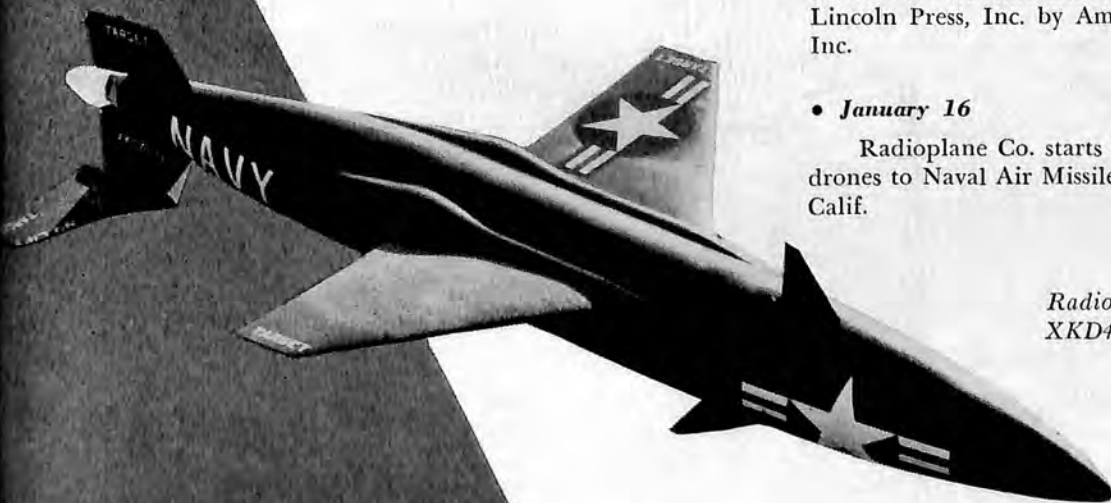
Publishing rights to AIRCRAFT YEAR BOOK and AVIATION FACTS AND FIGURES, both official publications of the Aircraft Industries Association, are acquired from Lincoln Press, Inc. by American Aviation Publications, Inc.

- **January 16**

Radioplane Co. starts deliveries of XKD4R-1 target drones to Naval Air Missile Test Center at Point Mugu, Calif.

*Radioplane Co. starts deliveries of XKD4R-1 target drones in January.*

# CHRONOLOGY





• **January 17**

President Eisenhower requests \$38.5-billion for defense in record peacetime budget; new budget would cut Air Force by nine wings to 128 wings and would include \$6.2-billion in new money for aircraft and \$2.6-billion for missiles.

• **January 18**

Three of five B-52 jet bombers land in Calif., culminating the first nonstop jet flight around the world. The 24,325-mile flight was accomplished in 45 hr. 20 min., slashing by one-half the previous record set by a B-50 in 1949.

• **January 21**

New Navy helicopter trainer, designated HTL-7, will be developed and produced by Bell with first delivery slated for late 1957.

Cessna delivers first five T-37 twin-jet trainers to Air Force.

A new two-man helicopter, Model 269, designed by Aircraft Div. of Hughes Tool Co., undergoes flight tests in Calif.

• **January 28**

Lockheed YC-121F Constellation sets new west-to-east record of 4 hr. 41 min., averaging 490 mph over the 2340-mile route, eclipsing 1954 mark of 6 hr. 10 min. set by American Airlines DC-7.

• **January 30**

Sikorsky HSS anti-submarine helicopter (powered by a GE T58 gas turbine engine) flies for first time.

• **January 31**

DC-7B and F-89D collide over southern California.

## FEBRUARY

• **February 1**

Northeast Airlines DC-6A crashes shortly after take-

off from La Guardia Airport (N.Y.) killing 20 of 101 persons aboard.

Air Force awards Bell Aircraft Corp. \$22-million contract for further research and development of Rascal air-to-ground rocket missile.

• **February 4**

First Boeing KC-135 jet tanker is delivered to Air Force for testing.

North American X-10 pilotless research vehicle flight tests concluded; operations begin on XSM-64 Navaho ramjet missile.

• **February 5**

Civil Aeronautics Board orders that, effective Feb. 20, all test flights, civil and military, be made over open water or sparsely settled areas approved by the Civil Aeronautics Administrator.

• **February 6**

Special Senate Armed Services Subcommittee task force, headed by Sen. Stuart Symington (D.Mo.), will probe aircraft procurement, maintenance, operations, training and training facilities.

Aircraft Industries Association reports that utility aircraft exports rose \$5-million in 1956.

• **February 7**

Ryan Aeronautical Co.'s XQ-2B Firebee jet target drone missile (powered by a Continental J69-T-19A jet engine) sets new altitude and endurance records by soaring to 53,000 ft. and remaining in the air on remote control for 1 hr. 44½ min.

Ryan receives \$5.25-million orders from Air Force and Navy for Firebee.

• **February 8**

Kaman Aircraft Corp.'s HU2K-1 (single rotor helicopter) wins Navy design competition.

• **February 11**

Brig. Gen. Dale O. Smith is named chief of the U.S. Military and Assistance Advisory Group in Saudi Arabia and comdr. of the 2nd Air Div. at Dhahran.

*Air Force awards Bell contract for further development of Rascal air-to-ground rocket missile.*



• **February 12**

AIA reports that utility aircraft unit and dollar volume was up 52 percent in 1956 over 1955.

• **February 15**

Air Force awards \$1.5-million development contract to Hiller Helicopters, Inc. for X-18 tilt-wing research aircraft using two Allison T40 turboprop engines.

• **February 18**

Guggenheim foundation gives \$250,000 for Aviation Health and Safety center at Harvard.

• **February 19**

First hovering flight of Bell X-14 jet-powered VTOL.

• **February 20**

Five airlines to date indicate they will ask CAB for a six percent increase in fares.

• **February 21**

First nuclear air-to-air rocket is now available in Air Defense Command, Defense Secretary Wilson announces.

• **February 26**

Defense Secretary Charles Wilson merges the Office of Engineering and Office of Research and Development into single new Office of Research and Engineering headed by Asst. Defense Secretary Frank Newbury.

• **February 27**

Air Force awards production support contract for new T-38 supersonic trainer to Northrop Aircraft, Inc.

• **February 28**

A completely automatic all-weather landing system is successfully demonstrated by Bell Aircraft Co.

## MARCH

• **March 1**

The supersonic Republic F-105 is chosen by Air Force as "next generation" fighter-bomber for Tactical Air Command.

• **March 4**

Plans for construction of a \$5-million electronic control center in New York city for handling passenger reservations and information services is announced by Eastern Air Lines.

Grumman Aircraft Co. announces successful flight of carrier-based WF-2 early warning aircraft.

• **March 6**

Army orders general court martial for Col. John



*General Nathan Twining succeeds Admiral Arthur Radford as Chairman of Joint Chiefs of Staff.*

Nickerson, Jr., charged with giving newsmen secret documents dealing with ballistic missile development. (In June, Col. Nickerson pleads guilty to 15 counts of breaching security regulations and receives a fine, a reprimand and reassignment to a non-security post.)

• **March 11**

Production of Aero Commander 560-E, powered by two Lycoming 295-hp engines, is announced by Aero Design and Engineering Co.

Boeing 707 Stratoliner, America's first jet airliner, spans continent in record-breaking flight of 3 hr. 48 min., from Seattle, Wash. to Baltimore, Md.

• **March 13**

Convair wins Navy design competition for radically advanced anti-submarine warfare flying-boat.

Navy ZPG-2 blimp, built by Goodyear Aircraft Co., sets new world records for continuous flight (over 300 hr.) and distance (8000 mi.).

• **March 21**

Distinguished Service Medal is presented to Dr. Jerome Hunsacker by NACA.

• **March 22**

First photographs of Republic F-105 Thunderchief, new supersonic fighter-bomber, are officially released.

• **March 24**

New Lycoming T55, a 1650 horsepower turbine-propeller powerplant weighing about 600 lbs., is unveiled.

Asst. Defense Secretary Frank Newbury states aim of new Office of Research and Engineering is to spend more on research and less on defense.

Navy Douglas A3D twin-jet attack bomber cracks two speed records flying round-trip Los Angeles-New York in 9 hr. 35 min. 48 sec. for one mark and east-west in 5 hr. 14 min. 58 sec.

• **March 26**

First Lacrosse surface-to-surface guided missile comes off production line, according to Martin Co.-Army Ordnance joint announcement.



*McDonnell F-101B Voodoo makes first flight in April.*

- **March 27**

President Eisenhower nominates Gen. Nathan Twining to succeed Adm. Arthur Radford as Chairman of Joint Chiefs of Staff; Donald Quarles, Air Force Secretary, is named as Deputy Defense Secretary; James H. Douglas replaces Quarles in Air Force post.

- **March 28**

Boeing Airplane Co. announces development of Model 717, a medium-range jet transport.

#### APRIL

- **April 1**

U.S. aircraft exports in 1956 exceeded \$1-billion for first time since 1946, AIA reports.

- **April 3**

Over \$52-million for 334 airport projects in 46 projects in 46 states is allocated in fiscal Federal-Aid Airport Program.

- **April 5**

Gen. Curtis LeMay is named Air Force Vice Chief of Staff to succeed Gen. Thomas White who moves into the Number 1 spot.

- **April 8**

McDonnell F-101B Voodoo, powered by advanced version of P&W J57 engine, makes first flight.

New in-flight refueling system, developed by North American Aviation, Inc. and Flight Refueling, Inc., is successfully tested over Mojave Desert.

- **April 11**

Air Force-Ryan X-13 Vertijet, jet-powered vertical takeoff and landing research airplane, makes first vertical-horizontal flights.

- **April 15**

Martin receives \$24-million Navy contract to modernize 80 P5M-1 Marlin anti-submarine seaplanes.

- **April 24**

Lockheed X-17 research rocket sets new speed record

of more than 9000 mph in firings at Patrick AFB.

Combined sales of nation's 12 leading airframe manufacturers in 1956 amounted to \$5.637-billion, 9 percent over 1955 level and just \$129-million short of World War II peak, according to AIA report.

- **April 25**

More than \$15.1-billion was expended by Dept. of Defense for military electronics during period 1950 through 1956, according to computation by Radio-Electronics-Television Manufacturers Assn.

#### MAY

- **May 6**

William M. Holaday is named Special Asst. to Secretary of Defense for Guided Missiles, replacing Eger V. Murphree.

- **May 9**

General Electric Co. gets \$58.5-million Navy contract to develop new 2600-shp turboprop/turboshaft engine; General Electric is also chosen to develop advanced turbojet engine for Air Force long-range interceptor and WS-110 chemical bomber.

McDonnell Aircraft Corp. reports its F-101A as having gross weight of 49,000 lbs., altitude capability of 55,000 ft., and top speed in excess of 1100 mph.

Rear Adm. James S. Russell will become Chief of Staff of Atlantic Fleet.

- **May 13**

American Helicopter Society honors late Capt. Wayne W. Eggert, Air Force, (formerly helicopter test pilot) with the Dr. Alexander Klemin Award. Other honors go to Robert Suggs (Kossler Award), Jean Ross Howard and S. Paul Johnston (honorary fellowships).

- **May 15**

Air Force and Pratt & Whitney jointly announce Wayne W. Eggert, Air Force (former helicopter test pilot) with the Dr. Alexander Klemin Award. Other in the free world."

Special Presidential Aide Edward P. Curtis recommends independent Federal Aviation Agency to ab-

sorb CAA, and assume safety regulatory, investigatory and enforcement powers of CAB.

• **May 16**

North American Aviation, Inc. wins Air Force design competition for new long-range manned interceptor.

Boeing Airplane Co. receives Air Force production contract for its Bomarc IM-99 interceptor missile; Bomarc is revealed to have a range capacity "permitting it to shoot down enemy aircraft at a far greater distance than any other missile presently in use in air defense."

• **May 20**

Grumman Aircraft Engineering Corp. is winner of Navy BuAer competition for high performance observation aircraft for Army and Marine Corps.

• **May 21**

North American F-100 Sabre, piloted by Maj. Robinson Risner, flies Lindbergh's transatlantic route in 6 hr. 40 min. (as compared to 33½ hr.).

• **May 22**

General Electric Co. unveils its J79 turbojet engine stating that "it produces more thrust per pound of engine weight than any other large jet engine in production today."

Curtiss-Wright announces its TJ38 high performance, low noise level, 2-spool, triple jet powerplant designed specifically for commercial airline use and developed jointly by Curtiss-Wright & Bristol Aeroplane Co., Ltd. of England.

• **May 23**

Harry J. Allen, chief of NACA Ames Aero. Lab., receives NACA's Distinguished Service Medal for discovery five years ago of blunt-shaped nose cone for ballistic missiles.

• **May 27**

General Electric Co. introduces its CJ805 jet engine, describing it as a "powerful engine that is light and also efficient."

• **May 28**

Martin Co. announces development of portable jet engine muffler said to be capable of reducing jet engine noise at a point within 500 ft. of an aircraft to a level no greater than encountered within a radius of 5 mi. from the aircraft.

Navy & Martin Co. announces new air-to-surface, missile, the Bullpup, currently undergoing Navy evaluation.

## JUNE

• **June 2**

A huge plastic balloon carries Air Force Capt. J. W. Kittinger, Jr. to 96,000 ft., where he remained for two hours, to set a new record for manned lighter-than-air

flight, and obtain data on man's ability to endure at high altitudes.

• **June 3**

Chance Vought Aircraft, Inc. gets \$35-million Navy contract for continued development of F8U-3 fighter, successor to F8U-1 Crusader.

Helio Aircraft Corp. announces first details of its Strato-Courier, a high altitude, photographic design powered by a 340 hp Lycoming engine and reportedly rated to operate at altitudes exceeding 30,000 ft. at full payload.

• **June 4**

Westinghouse Gas Turbine Div. unveils its J54 6000 lb. thrust jet engine.

• **June 5**

Army announces successful firing of Jupiter mid-range ballistic missile to approximately 1,500 mi., limit of its designed range; the vehicle attained an altitude of 250 to 300 miles.

• **June 11**

Richard C. Horner is nominated by White House as Asst. Air Force Secretary for Research & Development; Mr. Horner has been acting asst. since early 1956.

• **June 12**

Army announces first details of the Hawk, new ground-to-air missile "designed to reinforce the low altitude capability of our air defenses." Raytheon Mfg. Co. is named as prime contractor for entire weapon system.

• **June 14**

Lt. Gen. Elwood Quesada (USAF, Ret.) succeeds Edward P. Curtis as special Presidential Aide for aviation facilities.

• **June 17**

Formation of the International Council of the Aeronautical Sciences is officially announced.

• **June 19**

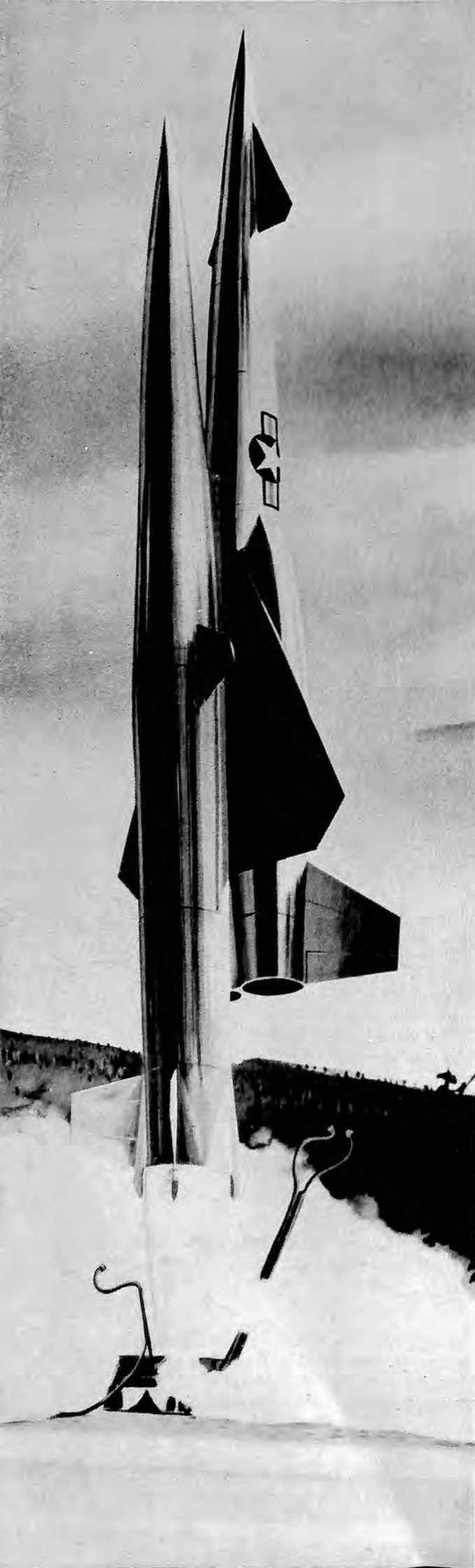
Lt. Col. Frank K. Everest receives 1957 Octave Chanute Award for "outstanding contributions to the development of rocket-powered flight test techniques."

• **June 26**

Kaman Aircraft Co. wins Air Force design competition for new crash rescue helicopter.

• **June 27**

Air Force & Bell Aircraft Corp. release details of Bell's X-14, newest jet-powered VTOL. Powered by Armstrong-Siddely jet engines, the X-14 takes off vertically in a conventional horizontal position.



*North American's Navaho missile program is cancelled by Air Force in July.*

## JULY

- **July 1**

Ethyl Corp. reports development of new anti-knock additive, AK-33, for aviation gasoline which ups fuel's power 20 percent.

- **July 3**

Dr. D. P. Barnard is sworn in as Deputy Asst. Secretary of Defense for Research and Engrg., a post previously filled by Frank Newbury.

- **July 5**

1958 Defense Dept. Appropriations Bill passes Senate providing \$6.126-million for Air Force aircraft and related equipment, and \$1.912-million for Navy.

- **July 8**

Maj. Gen. David H. Baker retires as Director of Procurement and Production for Air Force Air Materiel Command, effective July 31.

- **July 11**

Convair disclosed that its B-58 Hustler has a top speed of over 1200 mph.

North American's Navaho missile program is cancelled by Air Force; the company estimates this will result in reduction of 15,600 employees from its payroll.

- **July 12**

Fairchild gets Army Signal Corps \$12-million contract for research, development & manufacture of new high-speed surveillance drones.

- **July 16**

A Chance Vought F8U-1 Crusader, piloted by Maj. John Glenn, Jr., USMC, sets new coast-to-coast transcontinental record, flying from Calif. to N. Y., a distance of 2460 mi. in 3 hr. 23 min.; average flight speed: 760 mph.

- **July 18**

Defense Secretary Charles Wilson orders cuts in military manpower and slowdown in contract awards in effort to curb military spending.

Hebert Investigations Subcommittee launches its probe of aircraft engine industry.

- **July 19**

Northrop F-89J fires air-to-air atomic rocket in Nevada.

*Convair discloses that its B-58 Hustler has a top speed of over 1200 mph.*



• **July 22**

Fourteen airlines on Atlantic route show 27.5 percent increase in passengers in first six months of 1957 as compared to the same 1956 period.

Defense Secretary Wilson accepts Coolidge Committee recommendation calling for end of military efforts to classify information about equipment which cannot be held secret because of general public accessibility.

• **July 23**

Republic Aviation Corp. announces development of a low-cost "buddy" refueling system for supersonic jet fighters.

• **July 28**

Republic's new F-105B supersonic fighter-bomber has first public showing.

A new record for the Bendix Trophy Race is set by Capt. Kenneth D. Chandler, flying a Convair F-102 delta-winged plane from Chicago to Washington in less than 55 min.; average speed: 670.053 mph.

• **July 30**

Kaman Aircraft Corp. conducts world's first pilotless helicopter flight at Bloomfield, Conn.

**AUGUST**

• **August 1**

Air Force must reduce its fiscal 1958 spending estimate by a little over \$1-billion to stay within \$38-billion Defense spending ceiling, Air Force Secretary James Douglas states.

*Training version of Convair's F-102.*





Neil H. McElroy



Charles E. Wilson



• **August 8**

CAB turns down request by seven airlines for six percent emergency fare increase.

Neil H. McElroy, president of Procter & Gamble, is named by President Eisenhower to succeed Charles Wilson as Defense Secretary.

• **August 12**

Development of a lightweight, low-cost airborne weather radar for Air Force administrative aircraft is announced by ARDC and the west coast div. of RCA.

First production models of Air Force's ASN-7 all-weather robot navigator, developed jointly with Ford Instrument Co., is slated for delivery within several months.

Lt. Col. Frank E. Everest, Air Force, is designated to receive the 1957 Harmon International Trophy for Outstanding Aviator, and Malcolm D. Ross and Lt. Comdr. Morton L. Lewis, USN, will receive the Outstanding Aeronaut (lighter-than-air pilot) award.

F-3-D makes first fully automatic landing aboard aircraft carrier U.S.S. Antietam in Gulf of Mexico using Bell Aircraft all-weather automatic landing system.

• **August 13**

Air Force calls upon its contractors, except those engaged in ballistic missile development, to reduce employment five percent by Oct. 31; similar cut will be made in Air Force civilian personnel.

• **August 15**

Eastern Air Lines is authorized by CAB to provide first U. S.-flag nonstop service from New York and Washington to Mexico City.

• **August 20**

A manned balloon sets new altitude record of over 100,000 ft. during Air Force project to determine hu-

man reactions in space flight; Maj. David Simons, sealed in a pressurized capsule, stays aloft for 32 hr.

• **August 22**

Navy reduces its fiscal 1958 plane procurement from 1220 new airplanes to 1025. Slated for purchase are: Douglas A3D and A4D, North American A3J, McDonnell F3H, Grumman WF, Sikorsky HSS, HR2S, HUS, and Kaman HU2K-1, Lockheed T2V, North American T2J, Grumman F9F-8T, and a small quantity of Chance Vought Regulus II.

**SEPTEMBER**

• **September 4**

American Airlines is selected by CAB as U. S. carrier to operate Chicago-Mexico City service under new air agreement with Mexico.

Lockheed's 10-passenger JetStar utility transport completes a 34-minute maiden flight at Edwards AFB, Calif. just 241 days after start of engineering design.

• **September 9**

As result of military spending cutback, Air Force plans to buy slightly less than 1000 new aircraft in fiscal '58, as compared with 1515 planes originally slated for purchase.

• **September 12**

Passengers carried on scheduled services of member airlines of the International Air Transport Assn. increased 188.4 percent between 1949 and 1956, according to IATA report just released.

• **September 16**

Air Force activates headquarters of first Ballistic Missile Div. at Cooke AFB, Lompoc, Calif., under the command of Col. William A. Sheppard.

• **September 18**

Air Force announces that its first intercontinental guided missile squadron will be organized for operational use by end of year.

• **September 30**

Lockheed X-7 ramjet missile establishes three new speed records: fastest speed for any ramjet powered missile; fastest speed for any ground controlled missile; and fastest speed for any recoverable missile.

First completely integrated missile system, the TM-76 Matador Weapons System, is presented to Air Force Developmental Engineering Inspection team by The Martin Co.

**OCTOBER**

• **October 4**

Russia launches first earth satellite; the 184 pound Sputnik attains orbital velocity of 5 mi. per second.

• **October 7**

Igor Sikorsky receives Annual Meritorious Award of National Business Aircraft Association in recognition of his pioneering in: multi-engine aircraft, transocean flying-boats and helicopters.

• **October 10**

President Eisenhower announces that the U. S. will attempt to launch a four-pound "test" satellite in December.

Lockheed Aircraft Corp. and Air Force release first details of new Q-5 supersonic target missile now in the

flight-test stage; the drone missile is ramjet powered and reportedly travels at more than twice the speed of sound.

• **October 11**

Arthur E. Raymond, v.p. enrg., Douglas Aircraft Co. receives 1957 Daniel Guggenheim Medal "for notable achievements in the advancement of aeronautics."

• **October 22**

Defense Secretary Neil McElroy orders service secretaries to submit weekly reports to him on their missile programs.

The Jupiter, Army's intermediate-range ballistic missile, flies its prescribed course and lands in pre-selected target area.

• **October 24**

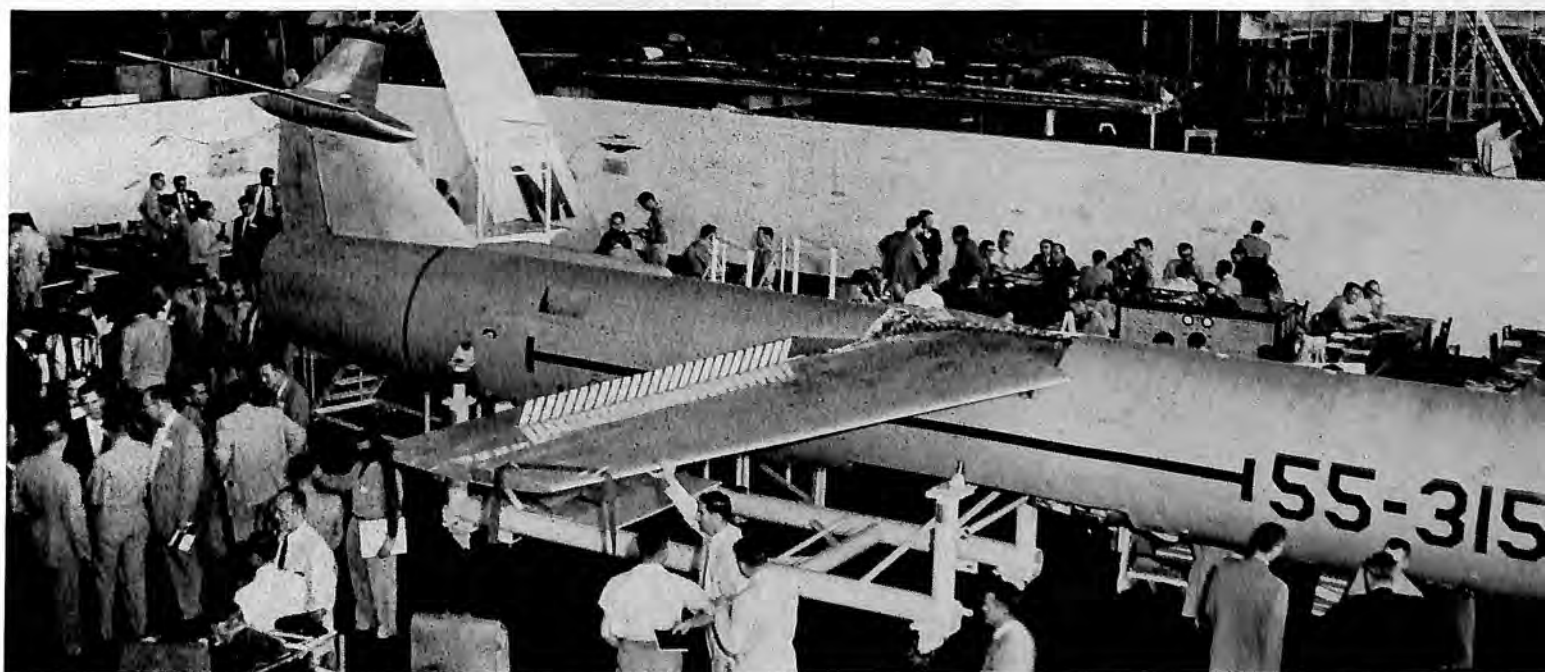
Navy successfully launches its Vanguard test vehicle at Patrick AFB; it was the third of the Vanguard tests and consisted of an actual first stage powered by a 27,000 lb. General Electric engine, but only dummy second and third stages.

• **October 25**

Donald W. Douglas, Jr. is elected president of Douglas Aircraft Co., Inc., succeeding his father, Donald Douglas, Sr., who remains chairman of the board and chief executive officer.

Air Force Thor IRBM is launched successfully at Patrick AFB, being its third straight successful launching; Defense Dept. reports successful test of Bomarc interceptor missile.

*Air Force Engineering Team receives briefing on Martin's TM-76 Matador Weapons System.*





• **October 27**

Air Force reports sending rocket at least 1000 miles and perhaps 4000 miles above the earth at Eniwetok Atoll in Operation Far Side.

• **October 28**

Boeing Airplane Co. rolls out first production 707 jet transport which is expected to fly in December.

Total employment in aircraft industry will drop from peak of 909,100 in April '57 to about 800,000 monthly average, according to American DAILY survey.

Air Force announces GAM-63 Rascal air-to-surface guided missile has hit 3000-foot diameter target on last four launches.

## NOVEMBER

• **November 1**

GAM-63 Rascal air-to-surface guided missile officially becomes operational with Strategic Air Command at Pinecastle Air Force Base, Fla.

• **November 7**

Capital Airlines files with CAB for subsidy payments which would amount to over \$3-million for the remainder of 1957.

President Eisenhower appoints Mass. Inst. of Tech. president James R. Killian, Jr. as Special Assistant to the President for Science and Technology.

• **November 12**

Defense Secretary Neil H. McElroy orders Army to prepare to launch an earth satellite; a modified Jupiter-C test vehicle will be used.

• **November 13**

Boeing KC-135, piloted by Gen. Curtis LeMay, sets new distance nonstop record, flying 6350 miles from Westover AFB, Mass., to Buenos Aires; the KC-135's return trip sets new speed record, Buenos Aires—Washington, D. C., over 5200 miles in 11 hr. 5 min.

• **November 14**

Chance Vought Regulus II completes successful rocket-boosted flight test by Navy.

Flight Safety Foundation, Inc. presents awards to Edward P. Curtis and George H. Tryon III for distinguished service in achieving safer utilization of aircraft.

• **November 20**

Vertol 105 twin-turbine powered helicopter, using two Lycoming T-53B's, flies for first time.

• **November 22**

American Rocket Society names five 1957 award winners: Thomas F. Dixon, Capt. Levering Smith (USN), Capt. Grayson Merrill (USN, ret.), Krafft A. Ehrlicke, and William H. Pickering.

• **November 25**

Senate Preparedness Subcommittee launches sweeping probe of U. S. missile and satellite programs by summoning a galaxy of scientists for opening day's public testimony.

Lockheed Aircraft Corp. receives Air Force contract to make studies of a reconnaissance satellite which may be built and launched in the early 1960s.

Air Force announces that artificial meteors were launched successfully sometime in October at speeds up to 40,000 mph, or about 15,000 mph above the earth's escape velocity.

• **November 27**

Jupiter and Thor intermediate-range ballistic missiles are ordered into production by Defense Secretary McElroy.

Air Force McDonnell Voodoo jets shatter three transcontinental speed records by flying from Los Angeles to New York and back in 6 hr. 42 min. 6 sec. The time from New York to Los Angeles was 3 hr. 34 min. 8 sec.; the west-east record was 3 hr. 5 min. 39.2 sec.

## DECEMBER

• **December 6**

Vanguard vehicle fails in attempt to launch first U. S. satellite.

Lockheed Electra makes first successful flight.

• **December 12**

McDonnell F-101A, piloted by Maj. Adrian Drew, captures world speed record for Air Force by flying 1207.6 mph.

• **December 16**

Senator Stuart Symington is named 1957 winner of Wright Brother Memorial Trophy.

• **December 18**

First successful firing of Air Force-Convair Atlas intercontinental ballistics missile is revealed by Defense Department.

• **December 20**

Production model Boeing 707 makes first flight.

• **December 24**

North American Aviation, Inc. wins competition for WS-110A chemical bomber, a plane capable of speeds in excess of 2000 miles per hours at altitudes in excess of 70,000 feet.

Chance Vought receives \$200-million Navy contract for production of F8U-2, and continued production of F8U-1.

• **December 31**

Grumman Aircraft Engineering Corp. wins Navy competition for attack aircraft.

Air Force takes delivery of first production Bomarc, area defense missile.

# OFFICIAL RECORDS

The Federation Aeronautique Internationale, Paris, France, better known as the FAI, currently composed of the National Aero Clubs of forty-five 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 world "class" 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 fifty-two years, the rules are markedly complete. All attempts to establish official aircraft records must meet identical FAI standards.

FAI-NAA rules have these goals: (1) an equal opportunity to every competitor, (2) competent, unbiased judging, and (3) scientifically accurate recording.

The National Aeronautic Association, representing the FAI in the United States, not only supervises the establishment of official World and World "Class" Records in our nation, but accords its stamp of approval also on aircraft performances which have a special national interest, such as aircraft speeds between cities.

## OFFICIAL RECORDS ESTABLISHED IN U. S. DURING 1957

### WORLD RECORDS

\*ALTITUDE, WITHOUT LOAD ..... 101,486 Feet

Maj. David G. Simons, USAF, United States, AF-WRI-1 balloon of 3,000,000 cubic feet, takeoff near Crosby, Minnesota, August 19, 1957, landing near Frederick, South Dakota, August 20, 1957.

\*MAXIMUM SPEED OVER A STRAIGHTAWAY COURSE (UNRESTRICTED ALTITUDE) ..... 1207.6 mph

Maj. Adrian E. Drew, USAF, United States, McDonnell F-101A Voodoo, 2 Pratt and Whitney J57 turbojet engines, Edwards, California, December 12, 1957.

### WORLD "CLASS" RECORDS

LOS ANGELES TO NEW YORK ..... 723.517 mph

Maj. John H. Glenn, USMC, United States, Chance Vought F8U Crusader, Pratt & Whitney J57 turbojet engine, July 16, 1957.

\*LOS ANGELES TO NEW YORK ..... 749.950 mph

Capt. Ray W. Schrecengost, Jr., USAF, United States, McDonnell RF-101C Voodoo, 2 Pratt & Whitney J57-P-13 turbojet engines, November 27, 1957.

\*LOS ANGELES TO NEW YORK ..... 765.690 mph

Capt. Robert J. Kilpatrick, USAF, United States, McDonnell RF-101C Voodoo, 2 Pratt & Whitney J57-P-13 turbojet engines, November 27, 1957.

\*LOS ANGELES TO NEW YORK ..... 781.741 mph

Lt. Gustav B. Klatt, USAF, United States, McDonnell RF-101C Voodoo, 2 Pratt & Whitney J57-P-13 turbojet engines, November 27, 1957.

NEW YORK TO LOS ANGELES ..... 469.383 mph

Comdr. Dale V. Cox, USN, and Crew; United States, Douglas A3D Skywarrior, 2 Pratt & Whitney J57 turbojet engines, March 21-22, 1957 (GMT). Elapsed time: 5 hours, 12 minutes, 39.24 seconds.

\*NEW YORK TO LOS ANGELES.....607.818 mph

Capt. Ray W. Schrecengost, Jr., USAF, United States, McDonnell RF-101C Voodoo, 2 Pratt & Whitney J57-P-13 turbojet engines, November 27, 1957.

\*NEW YORK TO LOS ANGELES.....677.726 mph

Capt. Robert M. Sweet, USAF, United States, McDonnell RF-101C Voodoo, 2 Pratt & Whitney J57-P-13 turbojet engines, November 27, 1957.

LOS ANGELES-NEW YORK-LOS ANGELES.....513.496 mph

Comdr. Dale V. Cox, USN, and Crew; United States, Douglas A3D Skywarrior, 2 Pratt & Whitney J57 turbojet engines, March 21-22, 1957 (GMT). Elapsed time: 9 hours, 31 minutes, 35.4 seconds.

\*LOS ANGELES-NEW YORK-LOS ANGELES.....671.445 mph

Capt. Ray W. Schrecengost, Jr., USAF, United States, McDonnell RF-101C Voodoo, 2 Pratt & Whitney J57-P-13 turbojet engines, November 27, 1957.

\*LOS ANGELES-NEW YORK-LOS ANGELES.....721.853 mph

Capt. Robert M. Sweet, USAF, United States, McDonnell RF-101C Voodoo, 2 Pratt & Whitney J57-P-13 turbojet engines, November 27, 1957.

\*DISTANCE IN A STRAIGHT LINE WITHOUT REFUELING (Turbojet Aircraft).....6325 miles

Gen. Curtis E. LeMay, USAF, Capt. Charles L. Gandy, Jr., USAF, Capt. Ernest E. Bradley, Jr., USAF, Capt. Frank L. Wright, USAF, pilots; Capt. Howard T. Dries, USAF and 1st Lt. L. E. Carter, USAF, navigators; crew of eleven and three passengers, Boeing KC-135 Tanker, 4 Pratt & Whitney J57-P43W turbojet engines, from Westover AFB, Chicopee Falls, Massachusetts to Ezeiza Airport, Buenos Aires, Argentina, via Fortaleza, Brazil, November 11-12, 1957.

\*BUENOS AIRES, ARGENTINA TO WASHINGTON, D. C. COURSE RECORD .....469 mph

Gen. Curtis E. LeMay, USAF, Capt. Charles L. Gandy, Jr., USAF, Capt. Ernest E. Bradley, Jr., USAF, Capt. Frank L. Wright, USAF, pilots;

Capt. Howard T. Dries, USAF and 1st Lt. L. E. Carter, USAF, navigators; crew of nine and eight passengers, Boeing KC-135 Tanker, 4 Pratt & Whitney J57-P43W turbojet engines, from Ezeiza Airport, Buenos Aires, Argentina to Washington National Airport, Washington, D. C., November 13, 1957.

DISTANCE IN A STRAIGHT LINE (Light Landplanes, 4th Category) .....1504.74 miles

Miss Jerrie Cobb, United States, Aero Commander 560E, 2 Lycoming 295 hp engines, gross weight 6117 pounds, from Guatemala City to Oklahoma City, Oklahoma, May 25, 1957.

ALTITUDE, WITHOUT LOAD (Light Landplanes, 4th Category) .....30,361 feet

Miss Jerrie Cobb, United States, Aero Commander 680-S, 2 Lycoming GSO-480-AIA-6 engines, gross weight 6613 pounds, Tulakes Airport, Oklahoma City, Oklahoma, July 5, 1957.

### GLIDERS

SPEED FOR 200 KILOMETERS OVER A TRIANGULAR COURSE .....55.02 mph

Paul E. Bikle, United States, Schweizer SGS 123 E Sailplane, El Mirage-Ludlow-Daggett Airport-El Mirage, California, August 18, 1957.

### NATIONAL (U. S.) RECORDS

WRIGHTSTOWN, NEW JERSEY TO PARIS, FRANCE .....555.350 mpm

Maj. Robinson Risner, USAF, United States, North American F-100F, Pratt & Whitney J57 turbojet engine, May 21, 1957. Elapsed time: 6 hours, 37 minutes, 45.8 seconds.

LOS ANGELES, CALIFORNIA TO HOUSTON, TEXAS .....332.373 mph

Lee McBride and Jack McKee, pilots; Delta Air Lines Douglas DC-7B, 4 Wright DA4 turbo compound engines, August 14, 1957. Elapsed time: 4 hours, 10 minutes, 56.4 seconds.

\*Records not yet officially documented nor homologated by Federation Aeronautique Internationale.

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*This list of aviation books published in the United States in 1957 was compiled by Arthur G. Renstrom, Library of Congress.*

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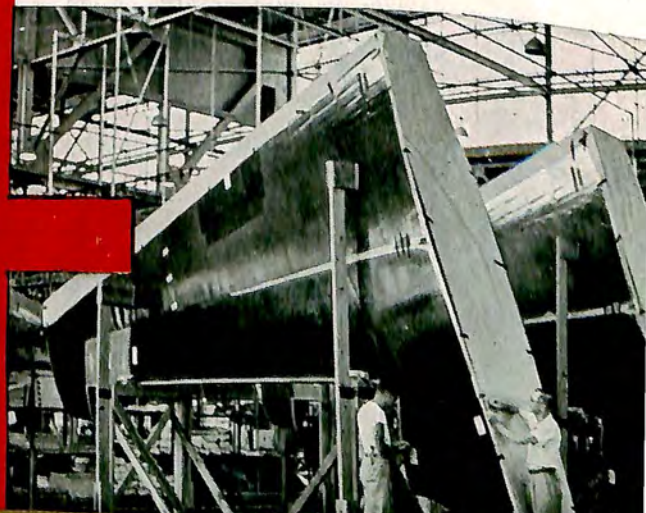
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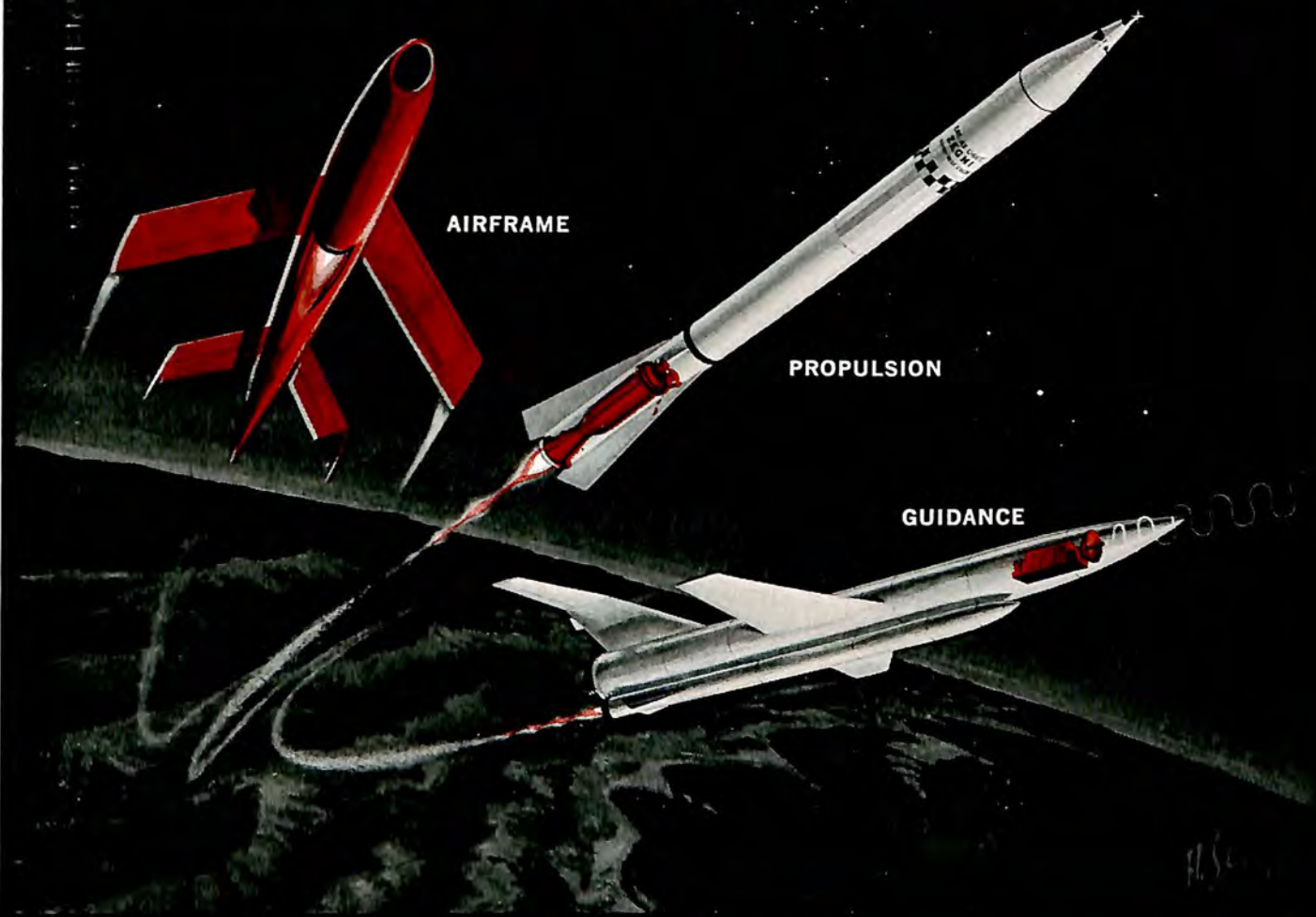
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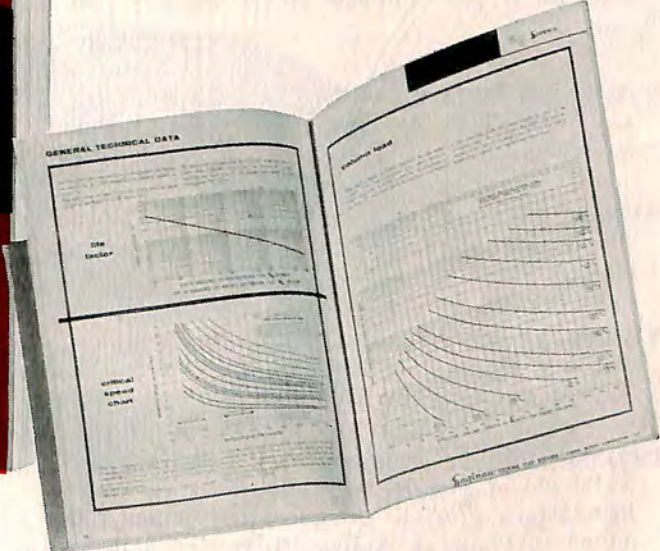
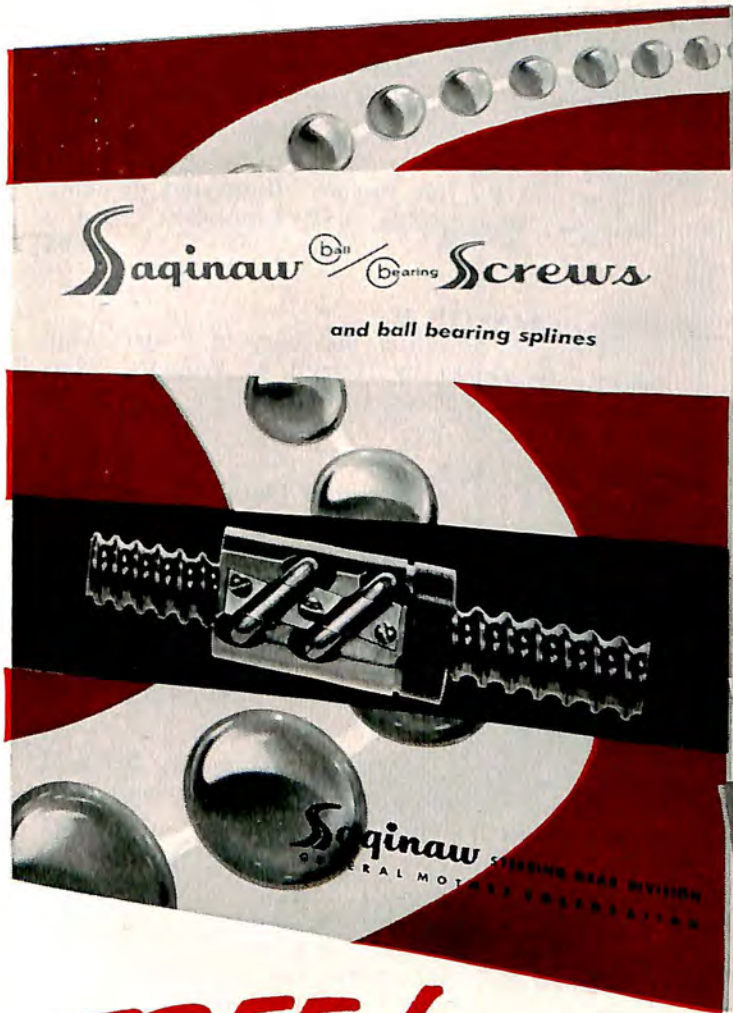
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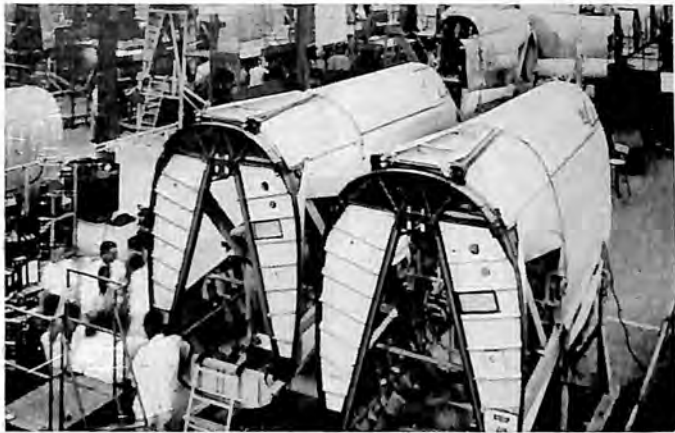
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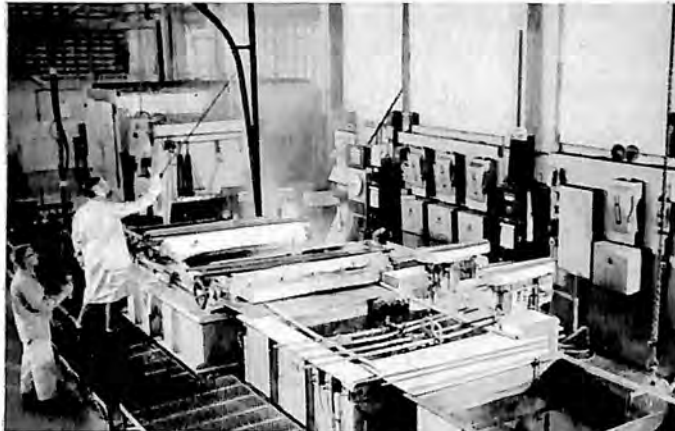
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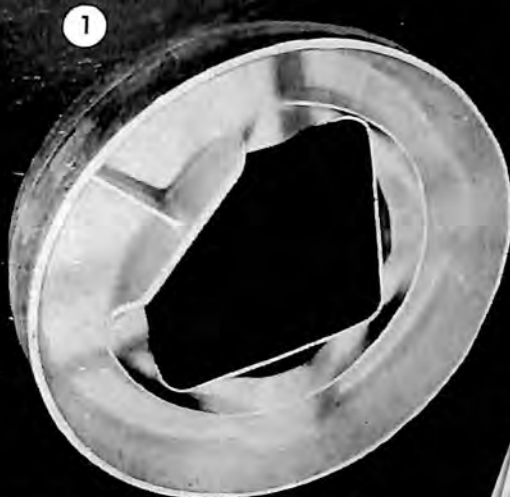
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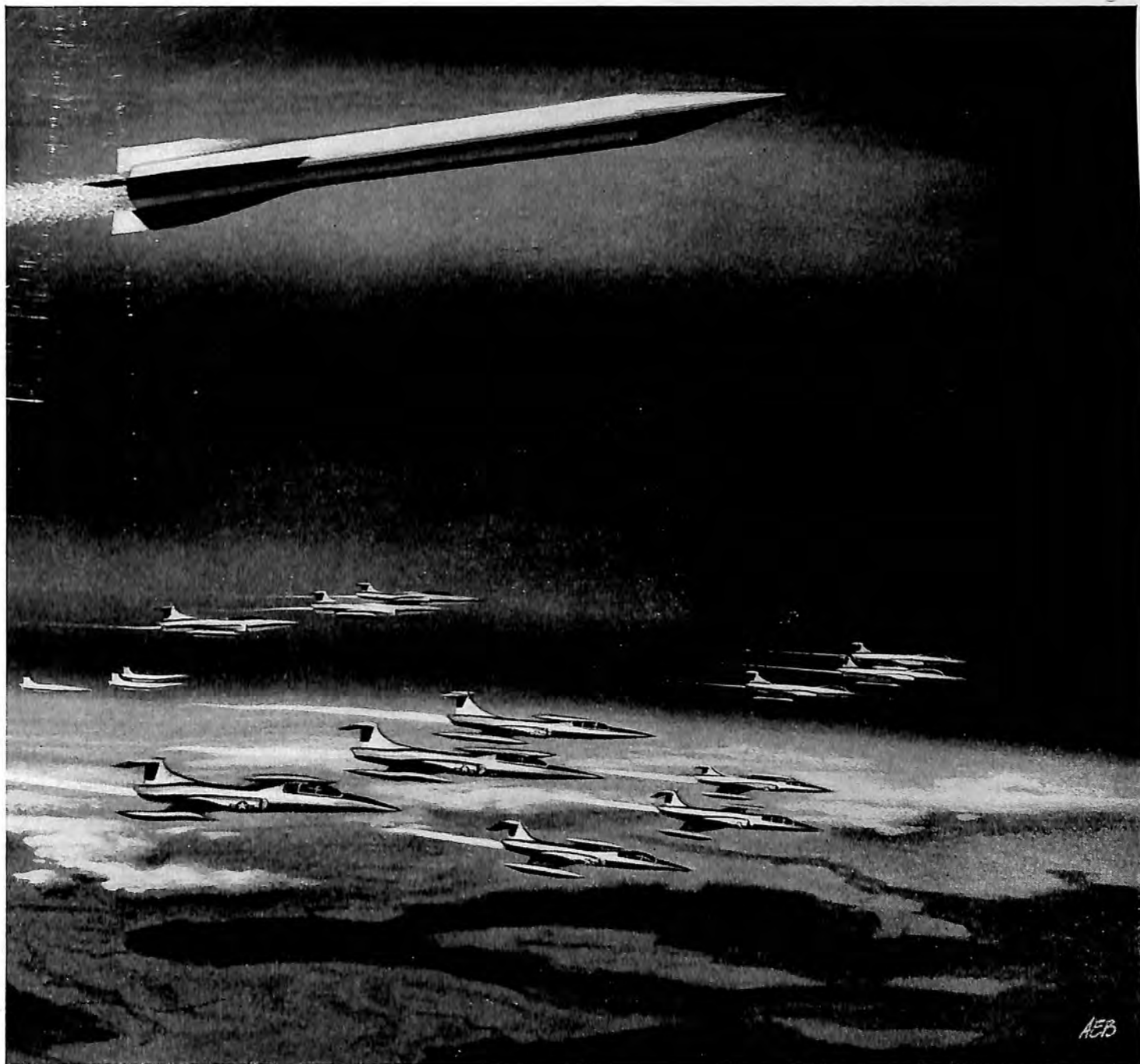
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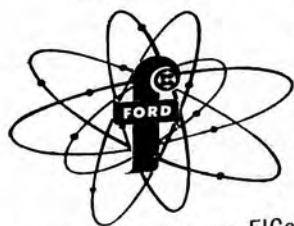
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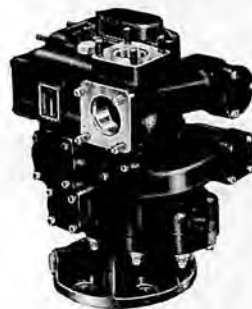
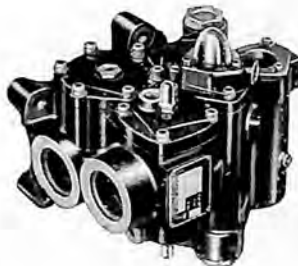
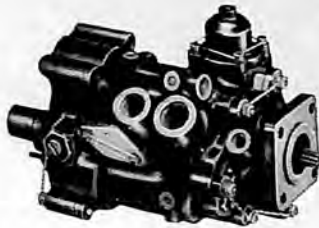
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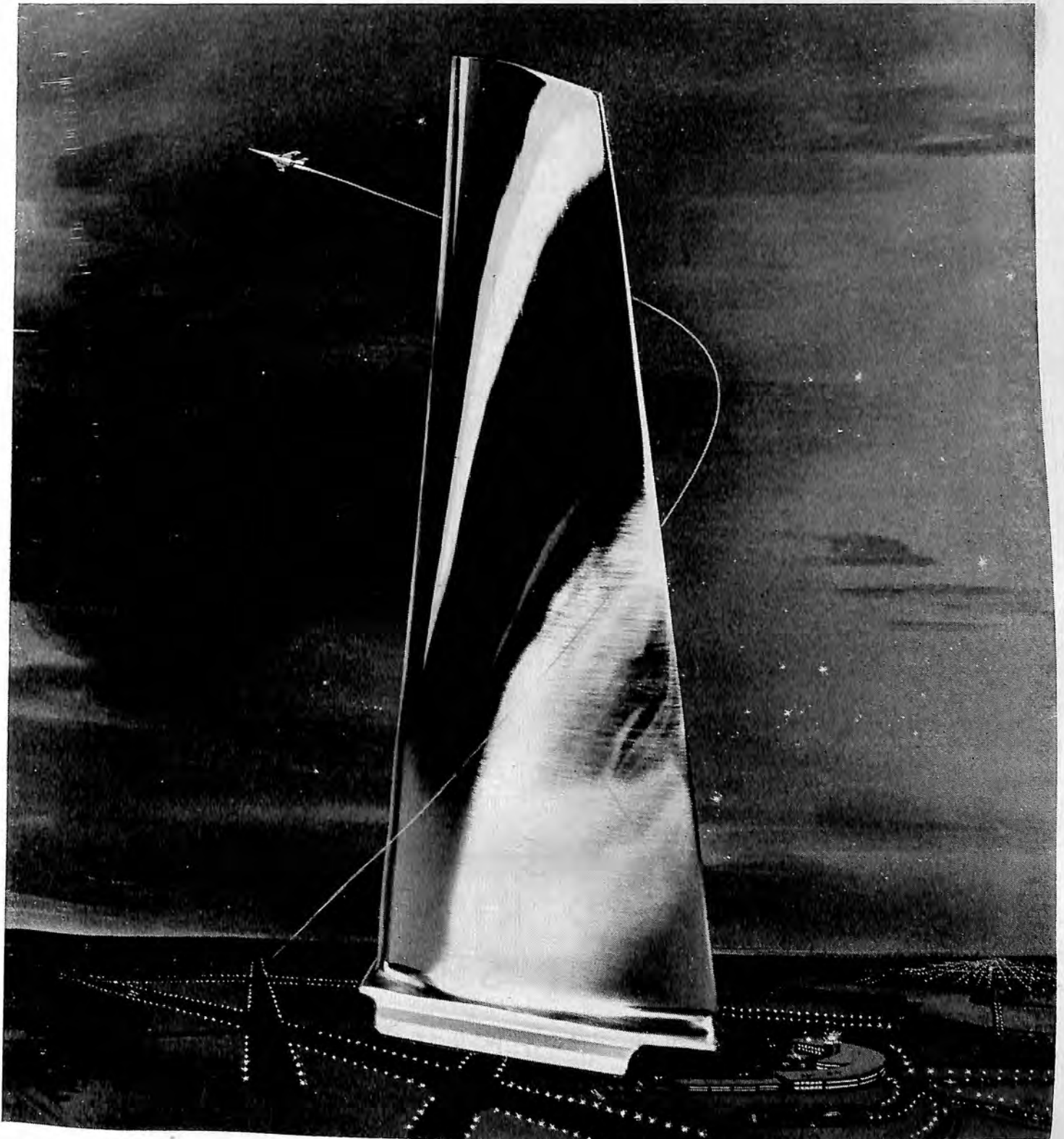
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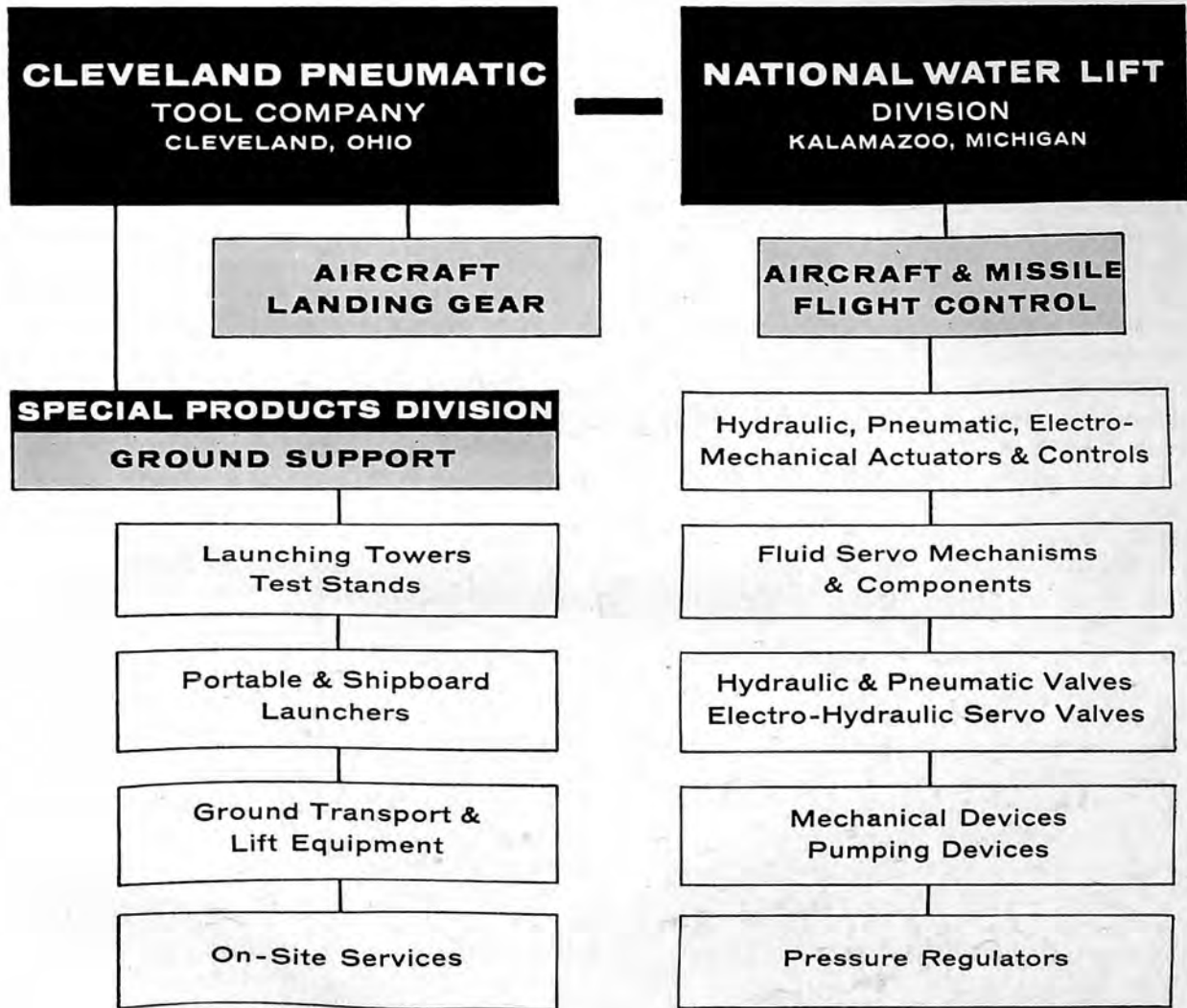
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