

*The*  
AIRCRAFT  
YEAR BOOK  
*For 1956*

*The*  
AIRCRAFT YEAR BOOK

1956

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**THE**  
**AIRCRAFT YEAR BOOK**  
**1956**

Official Publication  
of  
**THE AIRCRAFT INDUSTRIES ASSOCIATION OF AMERICA, INC.**

Thirty-eighth Annual Edition

Editors

FRED HAMLIN

ELEANOR THAYER MILLER

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## ACKNOWLEDGMENTS

The 1956 Aircraft Year Book represents the combined editorial talent of the industry. Only through the generous collaboration of company public relations officials, writers in other branches of aviation and aircraft executives, has this edition been possible. To these people we should like to express our thanks. We should like, also, to express our special gratitude to the Aircraft Year Book Editorial Board of the Public Relations Advisory Committee of the Aircraft Industries Association, who gave much valuable time in suggesting the handling of the material. The Committee included Mr. Carlyle Jones, Director of Public Relations, Sperry Gyroscope Co.; Mr. Jack Smith, Assistant Director of Public Relations, United Aircraft Corp.; and Mr. Joe Rowland, Manager, Information Services, Martin Co. Coordinating the work of the Committee were Mr. Avery McBee, Director of Public Relations of the Aircraft Industries Association, and Mr. Burton E. English, Public Relations, AIA, to whom we are also deeply grateful.

THE EDITORS

*The* AIRCRAFT YEAR BOOK

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## FOREWORD

Significant progress in man's quest to fly higher and faster marked 1956 as a banner year in aeronautical progress. On both the civil and military fronts, the aircraft industry not only substantially maintained its production schedules, but simultaneously brought into active service a variety of manned aircraft and guided missiles of highly advanced capabilities.

New engines of greater thrust were introduced during the year and aircraft safety and operation were vastly improved by development of new systems and components.

Major advances were made in developing both the vehicles and the markets for a new era in air transportation, using the best new design and equipment ideas in both turboprop and turbojet powered aircraft. At the same time, business and utility aircraft markets were importantly extended.

During the year, the Air Force accepted substantial numbers of the "century series" supersonic fighters, and the Navy also took delivery for its air arm of numerous supersonic aircraft. As a result, the nation's three Marine air wings and the Navy's 17 carrier air groups are now almost completely equipped with modern supersonic aircraft.

America's first supersonic jet bomber made its maiden flight during 1956, and advanced production stages were attained on a fleet of jet tanker planes which will greatly increase the Air Force's long-range combat air capability.

It was during 1956 that man first flew a research aircraft at better than 2,000 miles per hour—a speed once believed totally beyond man's reach—and set an altitude mark of over 20 miles.

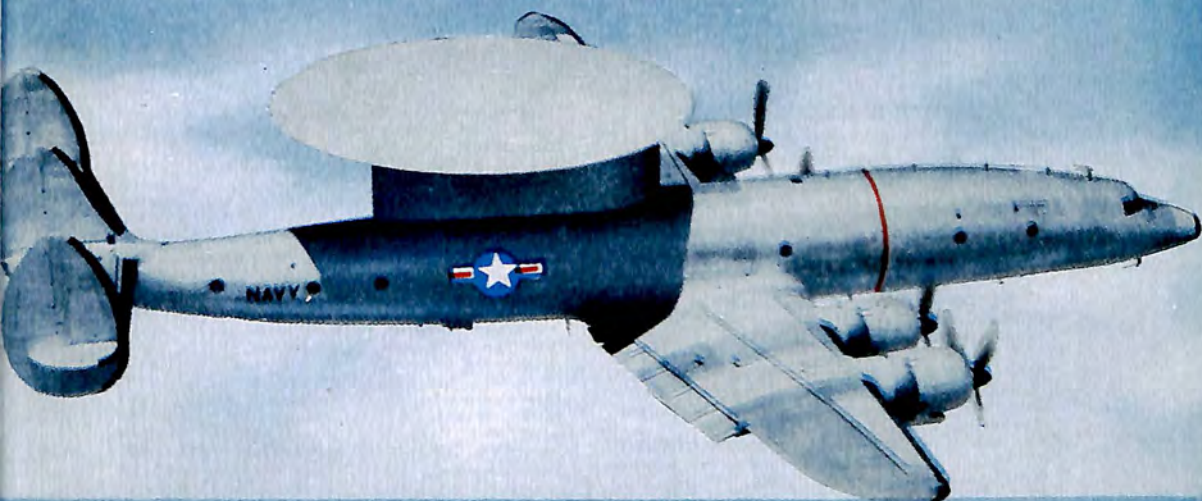
Overall, 1956 was a year that saw the aircraft industry doing its best to arm America with the weapons it needs in a time of explosive world tensions, and at the same time to produce a vast armada of peacetime aircraft, engines and equipment. The nation still is locked in a race for aerial supremacy with potential enemies of freedom. If the aircraft industry continues in 1957 to perform as well as it did in 1956, the deterrent power of the free world may yet prevent that battle from ever being joined.

This edition of the Aircraft Year Book reports not only on the aircraft industry, but on many other aspects of aviation achievement. The activities of the Air Force, Naval Aviation, the Marine Air Arm, and Army Aviation are included. The Year Book likewise deals with the work of other government departments and agencies. It reveals the major progress made by the commercial airlines, which made more than a 10 percent gain over 1955 in passenger miles in 1956. The Year Book also gives coverage to utility aircraft and their progress as servants of business, industry and agriculture, and on the development of the helicopter, which already possesses a major military role and looks toward a bright commercial future.

The Aircraft Industries Association believes that the 1956 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.

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*President*  
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<sup>1</sup>Also includes 1955 books published too late for inclusion in last year's edition.



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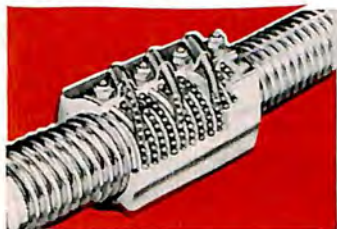
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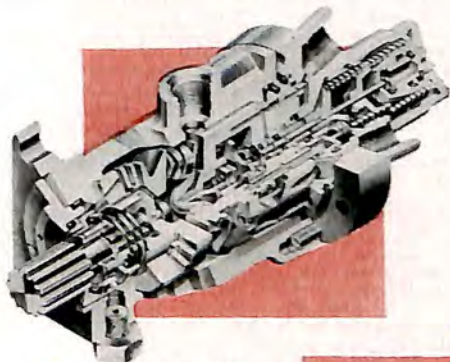
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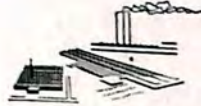
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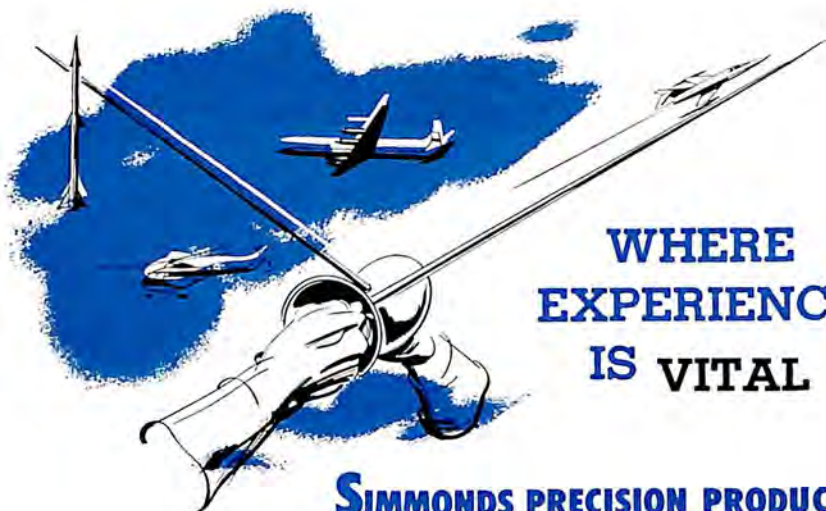
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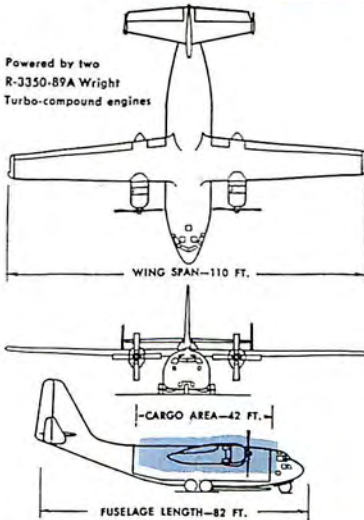
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*Interesting opportunities for qualified engineers in many fields exist at Stroukoff.*



Extending the Frontiers of Aircraft Performance

# Stroukoff

AIRCRAFT CORP.

WEST TRENTON, N. J.

U. S. CIVIL AERONAUTICS ADMINISTRATION. Statistical Handbook of Civil Aviation, 1956. Washington, U. S. Govt. Print. Off. 131p. \$3.55

U. S. DEPARTMENT OF THE ARMY. ARMY LIBRARY. Guided Missiles; a Selected List of Titles. Washington, Army Library. 91p. (Its Special Bibliography, no. 4)

### ROTOR AIRCRAFT

AMERICAN HELICOPTER SOCIETY. Proceedings of the Second Annual Western Forum, September 21 and 22, 1955, Los Angeles, New York, The Society, 1955. 171p. \$5.50

AMERICAN HELICOPTER SOCIETY. Proceedings of the Twelfth Annual National Forum, Washington, May 2-5, 1956. New York, The Society. 100p. \$4.25

BARCLAY, F. DORN and GORDON S. WILEY. Helicopter Navigation Requirements. Menlo Park, Calif., Standard Research Institute, 1955. 97 p. \$2.50

LIBERATORE, EUGENE K. Weights and Balance. Washington, Office of Technical Services, Department of Commerce. 89p. \$2.25

SHAPIRO, JACOB. Principles of Helicopter Engineering. New York, McGraw-Hill Book Company, 1955. 433p. \$12.50

THIRD CONVERTIBLE AIRCRAFT CONGRESS. Held at the Franklin Institute, Philadelphia, November 25, 1955. Report of Proceedings. Marion Station, Pa., Distributed by E. Burke Wilford. 94p. \$2.00

U. S. ARMY. FAR EAST COMMAND. Helicopters in Korea, July 1, 1951-August 31, 1953. Fort Eustis, Va., U. S. Army Transportation School, 1955. 96p.

U. S. CIVIL AERONAUTICS ADMINISTRATION. Rotorcraft Airworthiness: Transport Categories, Effective August 1, 1956. Washington, U. S. Govt. Print. Off. 34p. \$2.25

WILLIAMS, SAMUEL C. Report on the Helicopter. The Helicopter and Its Role as a Trans-

port Vehicle. Hoboken, N. J., Stevens Book Store, Stevens Institute of Technology. 220p. \$2.50

### SATELLITES

BERGAUST, ERIK and WILLIAM BELLER. Satellite! Foreword by Professor Hermann Oberth. Garden City, N. Y., Hanover House. 287p. \$3.95

EARTH SATELLITES AS RESEARCH VEHICLES. Proceedings, Symposium Held April 18, 1956, at Franklin Institute, Philadelphia, Philadelphia, The Franklin Institute. 115p. (Journal of the Franklin Institute Monograph No. 2) \$2.50

MOORE, PATRICK. Earth Satellites. Illustrated by Irving Geiss. New York, W. W. Norton. 148p. \$2.95

VAN ALLEN, JAMES A., ed. Scientific Uses of Earth Satellites. Ann Arbor, Mich., University of Michigan Press. 320p. \$10.00

### SPACE FLIGHT

CHAMBERS, BRADFORD. The Key to Interplanetary Space Travel. Illustrated by Eve Chambers. New York, Stravon Publishers. 66p. \$1.50; paper \$1.00

GAUL, ALBRO T. The Complete Book of Space Travel. Illustrated by Virgil Finlay, and Including an Album of Historical Space Travel Art Prepared by Sam Moskowitz. Cleveland, World Publishing Co. 159p. \$4.95

GOODWIN, HAROLD L. The Science Book of Space Travel. New York, Pocket Books, Inc. 213 p. (Cardinal edition C-207) \$3.35

LEY, WILLY and WERNER VON BRAUN. The Exploration of Mars. New York, The Viking Press. 176p. \$4.95

MALLAN, LLOYD. Men, Rockets and Space Rats. Foreword by T. S. Power. New York, Julian Messner, Inc. 335p. \$5.95

MALLAN, LLOYD. Secrets of Space Flight. New York, Arco Publishing Company, Inc. 144p. (A Fawcett How-to Book, 298). \$2.00

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# LEAR PRODUCES

*This roster of Lear aviation products is, of necessity, incomplete. Many of these products are frequently combined to form an infinite variety of additional products or systems. Only enough typical devices are shown here to demonstrate Lear's mastery of a field of science and technology that uses thousands of such building blocks for meeting the highly specialized requirements of modern aircraft and missiles.*

## § flight control systems

- Automatic altitude controllers
- Automatic approach couplers
- Automatic Mach number controllers
- Automatic pilots (lightplane)
- Automatic pilots (high-performance)
- Automatic pitch, yaw, and roll dampers
- Automatic rudder controllers
- Automatic wing flap systems
- Missile control systems
- Test equipment

## ○ flight reference systems

- No-gimbal-lock vertical gyro indicators
- Stable platforms
- Test equipment
- Three-axis gyro indicators
- Vertical gyro indicators

## γ navigational systems

- Automatic radio direction finders
- Glide slope receivers
- High-latitude gyro compass systems
- Integrated ADF-magnetic compass systems
- Localizer receivers
- Marker beacon receivers
- VHF Omnidirectional range receivers

## ξ electro-mechanical systems

- Artificial feel systems
- Camera positioners
- Canopy control systems
- Carburetor air door controllers
- Convertiplane rotor positioning systems
- Cowl flap positioners
- De-icing valve positioners
- Engine throttle controllers
- Gas, hydraulic, fuel, valve positioners
- Inlet screen retraction systems
- Inlet vane angle controllers
- Jettison systems
- Landing gear lock systems
- Mechanical advantage ratio changers
- Oil cooler flap controllers
- Parachute door systems
- Precision remote positioning systems
- Supercharger blower shifters
- Test equipment
- Throttle friction controllers
- Trim tab positioners
- Turbo-prop clutch valve controllers
- Wing flap positioning systems

## λ electro-mechanical components

- Linear actuators
- Rotary actuators
- Servo actuators
- Power units
- Actuator controls
- Alternators
- Capstans

- Freewheeling clutches
- Friction clutches
- Magnetic clutches
- Slip overload clutches
- Electromagnetic brakes
- Flex drive r's, hex's, L's, and r's
- Flexible shafts
- Gearboxes
- Handcranks
- Motors (AC and DC)
- Enclosed fan motors
- Explosion proof motors
- Gearhead motors
- High frequency motors
- High temperature motors
- Miniature motors
- Pneumatic motors
- Servo motors
- Torque motors
- Screwjacks
- Load limit switches
- Position limit switches
- Programming switches

## ζ instruments

- ADF indicators
- Attitude indicators, 2-axis
- Attitude indicators, 3-axis
- Directional indicators
- r's indicators
- Integrated ADF-magnetic indicators
- Trim indicators
- Tuning meters
- Omnidirectional range indicators

## μ instrument components

- Altitude transducers
- Vacuum tube amplifiers
- Magnetic amplifiers
- Printed and etched circuit amplifiers
- Transistor amplifiers
- Displacement gyros

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Dynamic pressure transducers  
Gravity-sensing switches  
Magnetic modulators  
Magnetic powder clutches  
AC and DC servo motors  
Electric gyro motors  
Flag motors  
High-frequency motors  
Torque motors  
Power converters  
Rate generators  
Rate gyros  
Resolvers  
Synchros  
Synchro repeaters

*ψ communications systems*

VHF, VHF, HF, MF, and LF receivers  
VHF transceivers  
VHF, HF, and MF transmitters  
ADF receivers  
Airport traffic transceivers  
Monitoring transceivers  
Portable transceivers  
Telemetry receivers  
Test equipment

*ε communications components*

Audio frequency amplifiers  
Vacuum tube amplifiers  
Magnetic amplifiers  
Power amplifiers  
Printed and etched circuit amplifiers  
Transistor amplifiers  
Aircraft broadband antennas  
Ground plane antennas  
LF-MF whip antennas  
Loop antennas  
Mobile antennas  
Trailing wire antennas  
VHF-VHF whip antennas  
VHF Omnidirectional antennas

Antenna fairleads  
Antenna reels  
Antenna tuning coils  
Cable assemblies  
Coil assemblies  
Crystals  
Dynamotors  
Headsets  
Loudspeakers  
Amplifying loudspeakers  
Noise-cancelling microphones  
Radio noise filters

*φ test equipment*

Bench test cable assemblies  
Electronic test sets  
Field strength meters  
Pressurizing test kits  
Universal electro-mechanical test stands  
Universal motor test stands

*η fluid handling equipment*

Absolute pressure switches  
Bombsight and instrument desiccators  
Canopy seal pressurizing kits  
Cooling units for electronic assemblies  
Dehydrators  
Fuel flow dividers  
Pneumatic actuators  
Pressurizing control panels  
Alcohol pumps  
Anti-detonant injection pumps  
Ballast pumps  
Bilge and refueling pumps  
Dry air pumps  
Electric motor driven pumps  
Ethylene glycol and coolant pumps  
Ethylene oxide pumps  
Fuel pumps  
Fuel booster pumps  
Fuel filter de-icer pumps  
Fuel transfer pumps

Hand operated pumps  
Heater fuel pumps  
Hydraulic pumps  
Hydraulic oil booster pumps  
Hydrogen peroxide pumps  
Lube oil and scavenge pumps  
Multiple-element pumps  
Oil transfer pumps  
Scavenge pumps  
Smoke pumps  
Submerged fuel booster pumps  
Vacuum pumps  
Water pumps  
Radar pressurizing kits  
Rocket engine fueling nozzles  
Air relief valves  
Check valves  
Hydraulic valves  
Hydraulic servo valves  
Isobaric relief valves  
Pressure regulating valves  
Vacuum valves

*π miscellaneous*

Airborne television installations  
Airplane brake modernization kits  
Auxiliary power supplies  
Electronic chassis assemblies  
Executive airplanes  
Periscope prism selectors  
Precision remote positioners  
Printed circuits  
Radomes  
Wire harnesses

**LEAR**



The AIRCRAFT YEAR BOOK

## SUMMARY STATISTICS

The following statistics are as nearly up-to-date as was practicable at the time the Year Book went to press. Wherever possible, last-minute, 1956 figures were included in the main text of the book, and may be found under appropriate chapter headings.

The Editors

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

(Source: Aircraft Industries Association)

Year and Month	Aircraft and Parts	Aircraft	Aircraft Engines and Parts	Aircraft Propellers and Parts	Other Aircraft Parts and Equipment
1954	40.9	40.9	40.7	39.4	41.2
1955	41.3	41.2	41.0	41.6	41.7
1956					
January	42.0	41.7	42.7	41.6	42.3
February	42.0	41.7	42.4	41.8	42.5
March	41.7	41.6	41.7	41.4	42.3
April	41.7	41.6	41.6	41.9	42.4
May	41.8	41.6	41.6	42.6	42.9
June	41.7	41.3	41.8	42.0	43.2
July	41.9a	41.7	42.2a	42.6a	42.3a
August	42.3	42.0	43.1	42.3	42.5

### AVERAGE WEEKLY EARNINGS

1954	85.07	85.07	85.06	82.35	85.70
1955	89.62	89.40	88.97	90.69	90.49
1956					
January	92.82	91.32	96.08	92.77	95.18
February	92.82	91.74	94.55	92.38	95.20
March	92.57	91.94	92.99	91.91	94.33
April	93.83	94.02	93.35	93.44	95.82
May	94.47	94.43	93.18	95.42	97.38
June	94.66	93.75	94.89	94.92	99.36
July	95.95a	95.19a	96.22a	97.13a	96.87a
August	97.29	97.02	98.70	94.75	96.90

### AVERAGE HOURLY EARNINGS

1954	2.08	2.08	2.09	2.09	2.08
1955	2.17	2.17	2.17	2.18	2.17
1956					
January	2.21	2.19	2.25	2.23	2.25
February	2.21	2.20	2.23	2.21	2.24
March	2.22	2.21	2.23	2.22	2.23
April	2.25	2.26	2.22	2.23	2.26
May	2.27	2.24	2.24	2.24	2.27
June	2.27	2.27	2.27	2.26	2.30
July	2.29a	2.29a	2.28a	2.28	2.29a
August	2.30	2.31	2.29	2.24	2.28

<sup>a</sup> Revised

Gear Type FUEL PUMPS

Vane Type FUEL PUMPS

MAIN FUEL CONTROLS

EMERGENCY CONTROLS



# NUMBER 1 CHOICE for FUEL CONTROL SYSTEMS AND ACCESSORIES

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CARBURETORS



## CHANDLER-EVANS

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SERVOMECHANISMS



PROTEK-PLUGS

The AIRCRAFT YEAR BOOK

NUMBER OF ENGINES PRODUCED

1917-1956

	Total	Military	Civil
1917-1919 .....	N.A.	44,453	N.A.
1932 .....	1,896	1,085	813
1933 .....	1,980	860	1,120
1934 .....	2,736	688	2,048
1935 .....	2,965	991	1,974
1936 .....	4,237	1,804	2,433
1937 .....	6,084	1,989	4,095
1938 .....	N.A.	N.A.	N.A.
1939 .....	11,172	N.A.	N.A.
1940 <sup>a</sup> .....	N.A.	22,667	N.A.
1941 <sup>a</sup> .....	N.A.	58,181	N.A.
1942 <sup>a</sup> .....	N.A.	138,089	N.A.
1943 <sup>a</sup> .....	N.A.	227,116	N.A.
1944 <sup>a</sup> .....	N.A.	256,911	N.A.
1945 <sup>a</sup> .....	N.A.	109,650	N.A.
1946 .....	43,407	2,585 <sup>b</sup>	40,822
1947 .....	21,178	4,808	16,370
1948 .....	N.A.	N.A.	9,039
1949 .....	N.A.	N.A.	3,982
1950 .....	N.A.	N.A.	4,314
1951 .....	N.A.	N.A.	4,580
1952 .....	31,382 <sup>c</sup>	26,000 <sup>c</sup>	5,382
1953 .....	41,147 <sup>c</sup>	34,500 <sup>c</sup>	6,647
1954 .....	27,519 <sup>c</sup>	22,000 <sup>c</sup>	5,519 <sup>c</sup>
1955 .....	20,639 <sup>c</sup>	13,000 <sup>c</sup>	7,639
1956 .....	24,500 <sup>c</sup>	12,500 <sup>c</sup>	12,000 <sup>c</sup>

<sup>a</sup>Excludes aircraft engines produced for other than aircraft use.

<sup>b</sup>Excludes experimental engines, engines classified by the armed forces as secret or confidential, engines for non-man-carrying, pilotless aircraft, jet assist mechanisms.

<sup>c</sup>AIA estimate.

Source: 1917-1947—AIA Aircraft Year Book, 1948, P. xx1.

1948-1956—Bureau of Census Facts for Industry Series M42A.

SHIPMENTS OF CIVIL AIRCRAFT ENGINES

1956

(Source: Bureau of Census, Facts for Industry, Series M42A.)

Month	Number of Engines	Horsepower (in thousands)	Total Value (Thousands of Dollars)
January .....	930	381	6,800
February .....	976	401	6,923
March .....	1,065	432	7,600
April .....	949	431	7,967
May .....	1,038	503	9,159
June .....	977	459	8,682
July .....	996	444	8,420
August .....	1,038	432	8,036
September .....	793	481	9,938
October .....	902	536	10,677

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When the weather ahead looks like this, the old rule book says "go around!" But not when you have RCA's AVQ-10 Weather Radar in the business aircraft you are operating. Its scope will point out to you, night or day, or in IFR conditions, non-turbulent paths through or between storm areas that may save time-wasting, costly detours and give you and your traveling companions a smoother, more comfortable ride.

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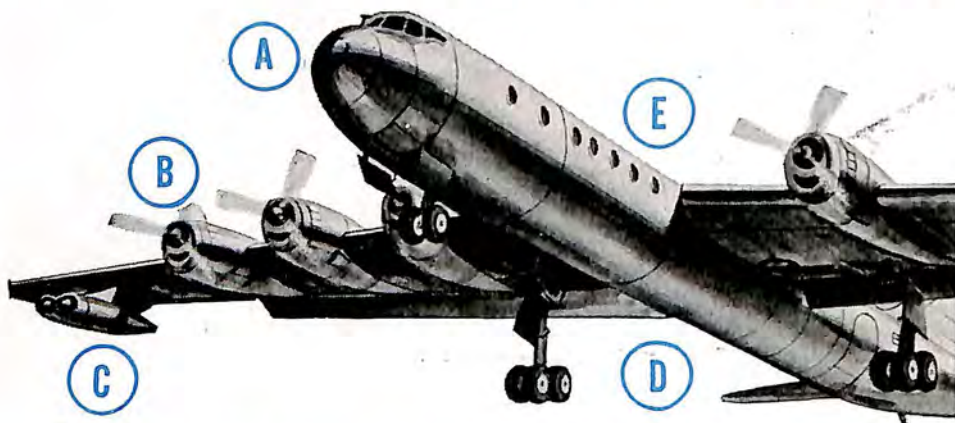
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The airplane illustrated is a composite since, obviously, no single plane carries all of the Bendix equipment on these pages. However, many Bendix products fly with every U. S. fighting plane and are used extensively on commercial, executive and private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

A

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

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

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

# in Aviation



**B**

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

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

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

**C**

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

**D**

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

**E**

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

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

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

## ADDITIONAL AVIATION PRODUCTS

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

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

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

## BENDIX IN THE WEATHER FIELD

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

\*REGISTERED TRADEMARK OF THE BENDIX AVIATION CORPORATION



# The AIRCRAFT YEAR BOOK

## U. S. CIVIL AIRCRAFT

By States

(Source: Civil Aeronautics Administration)

State	Number of civil aircraft <sup>1</sup>		State	Number of civil aircraft <sup>1</sup>	
	Jan. 1, 1955	Jan. 1, 1956		Jan. 1, 1955	Jan. 1, 1956
<b>TOTAL</b> .....	<b>92,067</b>	<b>85,320</b>	Montana .....	1,168	1,123
Alabama .....	718	668	Nebraska .....	1,737	1,565
Arizona .....	1,259	1,174	Nevada .....	476	444
Arkansas .....	1,104	1,018	New Hampshire .....	221	203
California .....	10,635	9,926	New Jersey .....	1,960	1,789
Colorado .....	1,250	1,168	New Mexico .....	830	780
Connecticut .....	685	664	New York .....	4,598	4,255
Delaware .....	210	224	North Carolina .....	1,615	1,526
District of Columbia...	512	446	North Dakota .....	1,148	974
Florida .....	2,743	2,458	Ohio .....	4,436	4,115
Georgia .....	1,255	1,121	Oklahoma .....	1,958	1,812
Idaho .....	855	802	Oregon .....	1,723	1,619
Illinois .....	5,152	4,741	Pennsylvania .....	3,830	3,388
Indiana .....	2,786	2,538	Rhode Island .....	203	184
Iowa .....	2,066	1,966	South Carolina .....	567	509
Kansas .....	2,433	2,200	South Dakota .....	1,075	992
Kentucky .....	721	641	Tennessee .....	928	845
Louisiana .....	1,338	1,326	Texas .....	6,829	6,617
Maine .....	515	434	Utah .....	503	484
Maryland .....	913	799	Vermont .....	158	149
Massachusetts .....	1,406	1,295	Virginia .....	1,244	1,075
Michigan .....	3,940	3,611	Washington .....	2,297	2,219
Minnesota .....	2,242	2,220	West Virginia .....	574	507
Mississippi .....	936	867	Wisconsin .....	1,908	1,689
Missouri .....	2,123	1,965	Wyoming .....	514	477
			Outside U. S. A. ....	1,770	1,708

<sup>1</sup>Includes gliders.

## CIVIL AIRCRAFT PRODUCTION

Number of Units

(Source: Bureau of the Census, Facts for Industry, Series M42 A)

Month	1952	1953	1954	1955	1956
January .....	224	365	278	350	537
February .....	227	382	240	357	614
March .....	248	358	312	480	656
April .....	291	402	359	453	692
May .....	330	417	309	492	714
June .....	335	339	316	543	648
July .....	353	402	293	358	507
August .....	349	350	265	249	681
September .....	337	359	265	352	613
October .....	293	235	174	353	508
November .....	268	275	288	348	.....
December .....	254	250	290	485	.....
<b>TOTAL</b> .....	<b>3,509</b>	<b>4,134</b>	<b>3,098</b>	<b>4,820</b>	<b>.....</b>

# North American has built more airplanes than any other company in the world



**T-6 Advanced Trainer**—Used by 33 Allied Nations in W.W. II. Provided close tactical ground support in Korea.



**B-25 Mitchell Bomber**—Most heavily armed medium bomber in World War II. Served in all theatres. Versatile, rugged, practical.



**P-51 Mustang**—Leading fighter of W.W. II. Served as escort, strafing, photographer, dive bomber, spotter, for close ground support. Held line in Korea before Sabres arrived.



**B-45 Tornado**—First operational multi-jet airplane to fly in U.S. First to fly non-stop across Pacific.



**T-28 Trainer**—Faster than many W. W. II fighters, with top speed of 346 M.P.H. Several thousands delivered to Air Force and Navy, including carrier-landing version.



**F-86 Sabre Jet**—Gained and held air superiority in Korea by outmatching MiG's 12 to 1 in combat kills. Now produced under license in Australia, Canada and Japan, as world's best all-round fighter for Allied program.



**F-86D Sabre Jet**—Radar-equipped, all-weather interceptor. A one-man weapon for continental defense, with deadly striking power, 700-plus mph speed. The NATO version, F-86K one-man interceptor, is also being produced under license in Italy.



**FJ-3 Fury Jet**—Added new standards of performance—in speed, climb and maneuverability—to the Navy's carrier-based jet power.



**FJ-4 Fury Jet**—Latest, most powerful of North American's FJ Series of Navy carrier-based fighters. Stepped-up performance, increased striking power.



**F-100 Super Sabre**—Holder of the first official world's supersonic speed record. Super Sabre squadrons are the backbone of the Air Force's supersonic superiority in this country and in Europe.

## NORTH AMERICAN AVIATION, INC.



Los Angeles and Fresno, California; Columbus, Ohio.

The AIRCRAFT YEAR BOOK

AIRPORTS AND AIRFIELDS

1928-1955

(Source: Civil Aeronautics Administration)

Calendar Year	Total	Commercial	Municipal	CAA Intermediate	All others
1928	1,364	365	368	210	421 <sup>1</sup>
1929	1,550	495	453	285	317 <sup>2</sup>
1930	1,782	564	550	354	314 <sup>2</sup>
1931	2,093	829	780	404	80
1932	2,117	869	777	352	119
1933	2,188	938	827	265	158
1934	2,297	872	980	259	186
1935	2,368	822	1,041	291	214
1936	2,342	774	1,037	296	235
1937	2,299	727	1,053	283	236
1938	2,374	760	1,092	267	255
1939	2,280	801	963	266	250
1940	2,331	860	1,031	289	151
1941	2,484	930	1,086	283	185
1942	2,809	1,069	1,129	273	338
1943	2,769	801	914	240	814
1944	3,427	1,027	1,067	229	1,104
1945	4,026	1,509	1,220	216	1,081
1946	4,490	1,930	1,424	201	935
1947	5,759	2,849	1,818	178	914
1948	6,414	2,989	2,050	161	1,214
1949	6,484	2,585	2,200	139	1,560
1950	6,403	2,329	2,272	76	1,726
1951	6,237	2,042	2,316	57	1,822
1952	6,042	N.A.	N.A.	N.A.	N.A.
1953	6,760	N.A.	N.A.	N.A.	N.A.
1954	6,977	N.A.	N.A.	N.A.	N.A.
1955	6,839	N.A.	N.A.	N.A.	N.A.

N.A. Not Available.

<sup>1</sup>Include auxiliary marked fields, later classified as to ownership, commercial or municipal.

ALLOCATIONS AND APPROPRIATIONS FOR AERONAUTICS, U. S. ARMY		
1899	Langley experiments.	\$25,000
1900	Langley experiments.	25,000
1908	Baldwin dirigible, revoked and later applied toward payment for Wright plane.	25,000
1909	Herring & Scott airplanes. Later for Wright plane.	21,000
1910	Wright plane.	9,000
1912	Signal Service of Army.	125,000
1913	Signal Service of Army.	100,000
1914	Signal Service of Army.	125,000
1915	Signal Service of Army.	50,000
		<b>\$505,000</b>

AVERAGE SPEED (Miles Per Hour)	
Domestic Scheduled Air Carriers (Source: CAA Statistical Handbook)	
Year	Average speed (miles per hour)
1946	160.2
1948	171.9
1950	181.2
1951	184.6
1952	190.8
1953	197.8
1954	205.8
1955	209.0

# Sun

# AERONAUTICAL TEST EQUIPMENT



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with MIL-L-4709  
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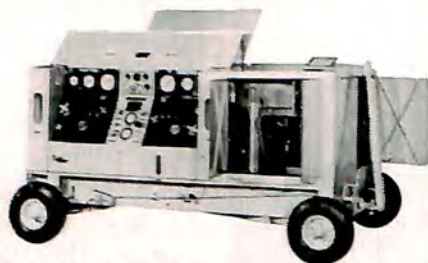
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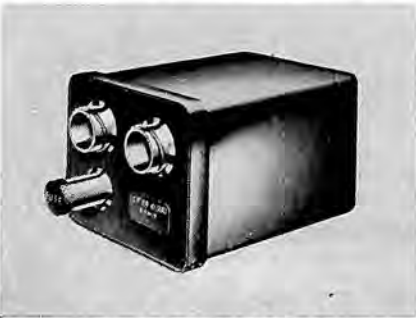
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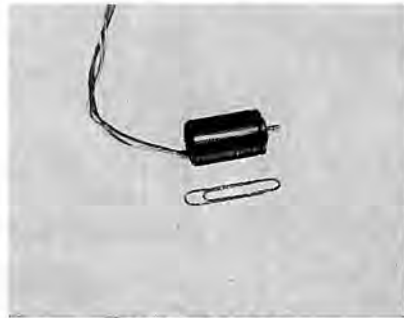
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Magnetic Variation Computer  
automatically compensates for  
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To help pilots handle fast  
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maximum efficiency.
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Magnetic amplifier types,  
precluding problems of  
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Components  
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differentials, rate generator  
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Observe the resourceful little prickly pear cactus. Tempting, green and juicy, it blossoms unmolested and thrives uneaten on the hungry, arid desert, because it has the good sense to be prickly first and succulent second. Some say you must eat or be eaten in this world. There is a third way to live. Keep some stickers showing and you, too, can take time to grow flowers. Republic makes a very efficient brand of stickers . . . they're called THUNDER-CRAFT.

**REPUBLIC**  **AVIATION**

FARMINGDALE, LONG ISLAND, N. Y.

*Designers and Builders of the Incomparable* **THUNDER-CRAFT**



The AIRCRAFT YEAR BOOK

U.S. AIRCRAFT PRODUCTION  
(units)  
1914-1956

(Source: Aircraft Industries Association)

Year	Total	Military Aircraft	Civil Aircraft
1914	49	15	34
1915	178	26	152
1916	411	142	269
1917	2,142	2,013	135
1918	14,020	13,991	29
1919	780	682	98
1920	328	256	72
1921	437	389	48
1922	263	226	37
1923	745	689	56
1924	377	317	60
1925	789	447	342
1926	1,186	532	654
1927	1,995	621	1,374
1928	4,346	1,219	3,127
1929	6,193	677	5,516
1930	3,437	747	2,690
1931	2,800	812	1,988
1932	1,396	593	803
1933	1,324	466	858
1934	1,615	437	1,178
1935	1,710	459	1,251
1936	3,010	1,141	1,869
1937	3,773	949	2,824
1938	3,623	1,800	1,823
1939	5,856	2,195	3,661
1940	12,804	6,019 <sup>a</sup>	6,785 <sup>b</sup>
1941	26,277 <sup>c</sup>	19,433 <sup>a</sup>	6,844 <sup>b</sup>
1942	47,836 <sup>c</sup>	47,836 <sup>a</sup>	<sup>d</sup>
1943	85,898 <sup>c</sup>	85,898 <sup>a</sup>	<sup>d</sup>
1944	96,318 <sup>c</sup>	96,318 <sup>a</sup>	<sup>d</sup>
1945	49,761 <sup>c</sup>	47,714 <sup>a</sup>	2,047
1946	36,670	1,669	35,001
1947	17,717	2,100	15,617
1948	9,586	2,284	7,302
1949	6,089	2,544	3,545
1950	6,520 <sup>e</sup>	3,000 <sup>e</sup>	3,520
1951	7,877 <sup>e</sup>	5,400	2,477
1952	12,509 <sup>e</sup>	9,000 <sup>e</sup>	3,509
1953	15,134 <sup>e</sup>	11,000 <sup>e</sup>	4,134
1954	12,989 <sup>e</sup>	9,600 <sup>e</sup>	3,389
1955	13,220 <sup>e</sup>	8,400 <sup>e</sup>	4,820
1956	15,400 <sup>e</sup>	7,900 <sup>e</sup>	7,500 <sup>e</sup>

<sup>a</sup>Includes military aircraft for Lend-Lease shipments.


<sup>b</sup>Represents domestic civil production only.

<sup>c</sup>Includes United States-financed aircraft manufactured in Canada.

<sup>d</sup>No production except military.

<sup>e</sup>Estimate.

# U. S. TIME GYROS IN CONTROL



The development and production of sub-miniature precision gyroscopic type instruments are exacting problems. These problems can only be solved by combining the skills of creative, seasoned research development and production engineers within the framework of an organization long experienced in the problems of precision instrumentation.

Important example of U. S. Time's present role in the gyroscopic field has been the volume production of sub-miniature precision rate gyros. More than seven thousand of these precision-built rate gyros are currently being used in guided missiles, antenna stabilization systems, autopilots, damper systems and stable platforms. The performance characteristics of these rate gyros can be modified to suit your specific requirements.

U. S. Time's new enlarged research staff and facilities are engaged in research, design and development of miniature precision instruments—instruments to withstand and perform under the severe environment of supersonic aircraft and missile flight.

We invite inquiries in the following fields of precision instrumentation:

**STABLE PLATFORMS • FLOATED INTEGRATING GYROS • ACCELEROMETERS • RATE GYROS • TWO AXIS GYROS • DAMPER SYSTEMS • INERTIAL INSTRUMENTATION • GUIDANCE SUB-SYSTEMS**



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The AIRCRAFT YEAR BOOK

UNITED STATES AIRCRAFT EXPORTS  
Number and Value

(Source: Aircraft Industries Association)

Year <sup>1</sup>	Aircraft exported <sup>2</sup>		Value of all aeronautical exports <sup>3</sup>
	Number	Value	
1913.....	29	\$81,750	\$107,552
1914.....	34	188,924	226,149
1915.....	152	958,019	1,541,446
1916.....	269	2,158,395	7,002,005
1917.....	135	1,001,542	4,135,445
1918.....	20	206,120	9,084,097
1919.....	85	777,900	13,166,907
1920.....	65	598,274	1,152,649
1921.....	48	314,940	472,548
1922.....	37	156,630	494,930
1923.....	48	309,051	433,558
1924.....	59	412,738	798,273
1925.....	80	511,282	783,659
1926.....	50	303,149	1,027,210
1927.....	63	848,568	1,903,560
1928.....	162	1,759,653	3,664,723
1929.....	348	5,484,600	9,125,345
1930.....	321	4,819,669	8,818,110
1931.....	140	1,812,809	4,867,687
1932.....	280	4,358,967	7,946,533
1933.....	406	5,391,493	9,180,328
1934.....	490	8,195,484	17,662,938
1935.....	333	6,598,515	14,290,843
1936.....	527	11,601,893	23,143,203
1937.....	628	21,076,170	39,404,469
1938.....	875	37,977,324	68,227,689
1939.....	1,220	67,112,736	117,807,212
1940.....	3,522	196,260,556	311,871,473
1941.....	6,011	422,763,907	626,929,352
1942.....	10,448	879,994,628	1,357,345,366
1943.....	13,865	1,215,848,135	2,142,611,494
1944.....	16,544	1,589,800,893	2,825,927,362
1945.....	7,599	663,128,543	1,148,851,587
1946.....	2,302	65,257,749	115,320,235
1947.....	3,125	74,476,912	172,189,502
1948.....	2,259	66,354,000	153,629,000
1949.....	1,264 <sup>4</sup>	37,388,553 <sup>4</sup>	282,984,025
1950.....	759 <sup>5</sup>	44,292,222 <sup>5</sup>	242,362,699
1951.....	894 <sup>5</sup>	18,606,528 <sup>5</sup>	301,424,786
1952.....	1,180 <sup>5</sup>	27,500,121 <sup>5</sup>	603,181,876
1953.....	1,378 <sup>5</sup>	91,137,326 <sup>5</sup>	880,634,000
1954.....	1,151 <sup>5</sup>	120,785,000 <sup>5</sup>	619,384,000
1955.....	1,714 <sup>5</sup>	130,069,000 <sup>5</sup>	728,514,000

<sup>1</sup>1913-18, fiscal years; 1919-54, calendar years. Data for the second half of 1918 is included with calendar year 1919.

<sup>2</sup>Exclusive of gliders and barrage balloons.

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

<sup>4</sup>For security reasons the 1949 figures do not include exports after April on military and cargo aircraft and engines of 400 hp and over. Right hand column includes military.

<sup>5</sup>For security reasons these figures do not include military, cargo and used transport aircraft, engines of 400 hp and over, propellers, instruments nor any other parts or accessories. Right hand column includes military.



## New Intercontinental model of America's first jetliner

During 1956 the jet age of commercial air travel came a giant step closer. By the end of the year, 11 leading airlines had ordered 134 Boeing jet transports. These include the 707 Jet Stratoliner, which will seat up to 125 passengers, and the 707 Intercontinental, shown above, which will carry up to 170.

By 1959, when the 707 begins flying commercial routes, it will be the most thoroughly proven aircraft ever to enter service. By that date the Boeing prototype on which the 707 is based will have completed more than four years of flight test. In addition, large numbers of KC-135 transport-tankers, developed out of the same prototype, will have built up thousands of flight hours.

The 707, like the KC-135s now coming

off Boeing production lines, incorporates many design advances that could have grown only out of a prototype flight test program. The new Boeing jets benefit also from the knowledge Boeing gained developing and producing more than 1400 B-47 and B-52 multi-jet bombers.

Boeing is building B-52 nuclear weapons carriers in plants in both Seattle and Wichita. The company is also developing a defense weapons system based on its BOMARC IM-99 supersonic pilotless interceptor.

With the production of its 888th and final KC-97, Boeing during 1956 left behind the age of piston-powered aviation. Boeing's extensive production facilities are now being devoted exclusively to the building of advanced jet-powered aircraft.

# **BOEING**

The AIRCRAFT YEAR BOOK

CIVIL AIRPLANE OUTPUT

By Power and Types

(Source: Bureau of the Census, Facts for Industry Series M42A)

1937-1956<sup>1</sup>

	1937	1938	1939	1940	1941	1945	
Total .....	2,289	1,823	3,715	6,785	6,844	2,047	
By number of engines							
Single-engine .....	2,171	1,770	3,613	6,562	6,629	1,946	
Multi-engine .....	118	53	102	167	165	101	
Unclassified .....	0	0	0	56	50	0	
By horsepower							
50 hp. and under .....	1,393	1,350	1,686	490	7	0	
51-70 hp. ....	44	23	1,349	4,529	4,303	1,828	
71-100 hp. ....	183	61	311	935	1,805	105	
101-165 hp. ....	193	149	120	211	206	13	
166-225 hp. ....	47	16	9	318	309	0	
226-300 hp. ....	199	122	86	37	15	0	
301-600 hp. ....	142	54	76	72	31	28	
601-800 hp. ....	88	48	78	137	118	63	
Unclassified .....	0	0	0	0	0	10	
Unclassified .....	0	0	0	56	50	0	
By types							
Landplanes:							
1-2-place .....	1,668	1,487	3,118	5,527	6,060	1,929	
3-5-place .....	460	258	465	1,031	573	17	
6-20-place .....	48	26	21	8	3	63	
21-place and over .....	57	17	55	132	112	10	
Seaplanes .....	41	26	51	18	16	0	
Amphibians .....	15	10	5	3	30	28	
Unclassified .....	0	0	0	66	50	0	
1950      1951      1952      1953      1954      1955      1956							
Total Civil .....	3,520	2,477	3,507	4,134	3,389	4,753	5,048
Personal .....	3,391	2,279	3,057	3,825	3,098	4,508	4,788
Transport .....	129	198	452	309	291	245	260
By Place:							
2-place .....	1,029	2,275	3,056	3,822	2,982	4,305	4,596
3- to 5-place .....	2,362						
Over 5-place .....	129						
By Horsepower: <sup>2</sup>							
1-74 .....	597	2,273	3,056	3,822	2,968	4,149	4,429
75-79 .....							
100-399 .....							
400-3,999 .....	134	204	453	312	421	604	619
4,000 and over .							

<sup>1</sup>1956 figure for eight months.

<sup>2</sup>Exports excluded 1938-1941; no civil production during 1942-44; exports included 1945-50.

<sup>3</sup>Total rated horsepower of all engines.



# Rascal

longer "reach"

for the

## Air Force

Guided missiles, a fantasy yesterday, are a working reality today. One of the most important concepts in this field is the GAM-63 Rascal, a USAF air-to-surface missile for which Bell Aircraft Corp. has the weapon system responsibility.

Rascal is designed to be carried aloft by USAF strategic bombers and released miles from its objective. Even while the bomber is on the return flight to its home base, Rascal is heading at a high speed and with pin-point accuracy to its target.

The rocket-powered Rascal not only can increase the "reach" of the Air Force but also could eliminate the hazardous "run over the target" for airmen and extend the useful life of the nation's bombardment aircraft.

As the prime contractor, Bell Aircraft has been associated with a large segment of U.S. Industry in developing the entire Rascal weapon system. This system includes the airframe, guidance, rocket engine, servomechanical devices, launching and ground support equipment, flight testing and training.

*The Air Force-Industry team urgently needs scientists and engineers for projects vital to the nation's defense. Opportunities to make important contributions are offered in military or civilian careers.*

**BELL**  
*Aircraft Corp.*

BUFFALO, N. Y.

# The AIRCRAFT YEAR BOOK

## Airline Statistics

### AIRLINE REVENUE PASSENGER MILES

#### U. S. Domestic Air Carriers By Months

(Source: CAB Statistics, 1955)

Millions of Passenger Miles								
Month	1948	1949	1950	1951	1952	1953	1954	1955
January	401,214	429,935	481,428	742,598	877,482	1,070,830	1,209,413	1,529,339
February	356,859	432,226	479,650	683,196	823,887	1,030,858	1,150,961	1,361,040
March	440,106	533,548	568,162	861,466	953,855	1,188,332	1,293,975	1,569,089
April	483,233	577,852	636,440	860,750	1,026,739	1,243,900	1,378,304	1,669,604
May	539,431	608,302	684,940	888,380	1,006,840	1,257,142	1,410,400	1,645,995
June	588,677	676,842	784,870	958,610	1,153,923	1,363,953	1,579,139	1,825,344
July	561,075	640,718	746,463	949,311	1,121,926	1,351,668	1,571,160	1,823,900
August	569,583	627,127	775,238	995,394	1,187,847	1,381,237	1,457,196	1,814,248
September	549,539	634,088	741,777	967,436	1,160,558	1,303,595	1,487,709	1,752,783
October	534,758	608,837	757,721	952,359	1,159,536	1,266,785	1,465,234	1,731,674
November	452,441	504,939	639,826	840,837	100,4,905	1,099,775	1,326,075	1,502,303
December	486,355	478,164	705,953	862,682	1,050,820	1,202,208	1,472,876	1,627,987
Total	5,963,271	6,752,578	8,002,468	10,563,019	12,528,318	14,760,283	16,802,442	19,853,306

## AIR CARRIER OPERATING EXPENSES

Domestic  
(Source: Air Transport Association)

Year	Aircraft Operating Expenses (000)	% of Total	Ground and Indirect Expenses (000)	% of Total	Total Operating Expenses (000)
1946	129,250	40.11	192,970	59.89	322,220
1947	169,165	43.80	217,033	56.20	386,198
1948	199,992	46.33	231,643	53.67	431,635
1949	223,463	48.33	238,907	51.67	462,370
1950	241,060	48.73	253,586	51.27	494,646
1951	287,912	48.36	307,396	51.64	595,308
1952	361,465	49.97	361,947	50.03	723,412
1953	438,088	51.51	412,360	48.49	850,448
1954	487,379	51.76	454,201	48.24	941,580
1955	551,495	51.21	525,480	48.79	1,076,975

## BREAKDOWN OF DIRECT AIRCRAFT OPERATING EXPENSES

Year	Flying Operations (000)	% of Total	Direct Maintenance		% of Total	Depreciation Flight Equip. (000)	% of Total
			Flight Equip. (000)	% of Total			
1946	70,410	21.85	33,273	10.35	25,567	7.93	
1947	88,840	23.0	42,903	11.11	37,422	9.69	
1948	109,637	25.40	49,035	11.36	41,320	9.57	
1949	127,539	27.58	54,102	11.70	41,822	9.05	
1950	141,816	28.67	57,840	11.69	41,404	8.37	
1951	172,466	28.97	71,681	12.04	43,215	7.26	
1952	208,665	28.84	92,696	12.81	60,449	8.36	
1953	253,091	29.76	102,401	12.04	82,046	9.65	
1954	279,970	29.73	110,299	11.71	97,035	10.31	
1955	323,149	30.00	135,409	12.57	92,937	8.63	

Includes Trunks, Local Service and Territorial

# GIANT AUTOCLAVE - PART OF ROHR'S MULTI-MILLION-DOLLAR TOOL KIT

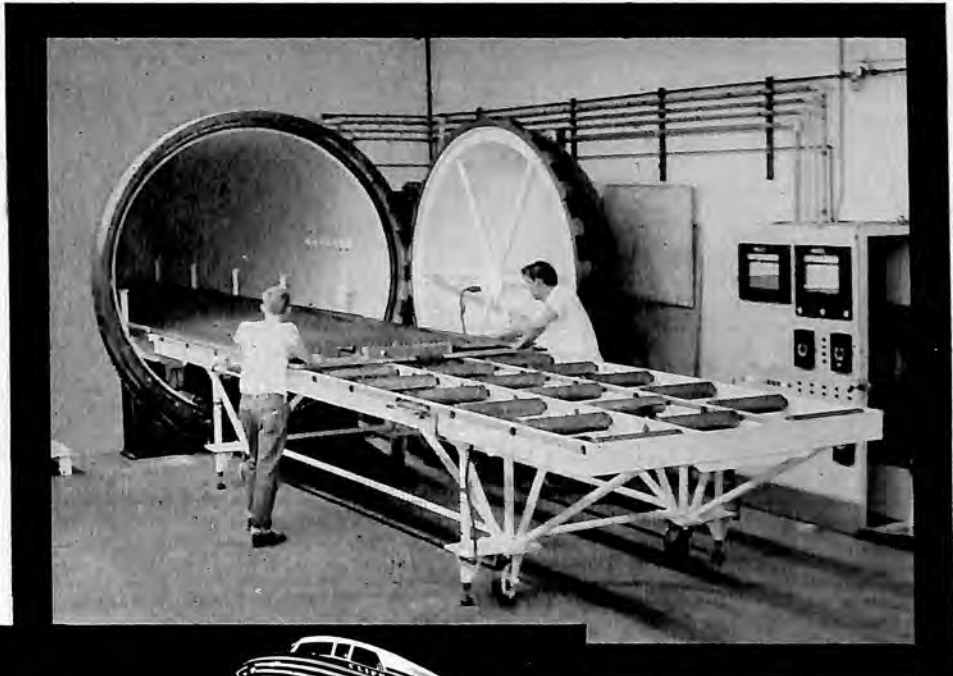
This new autoclave, shown below, extends the vital field of metal bonding at Rohr to the production of deep, complicated, contoured assemblies, requiring tremendous pressure throughout the curing cycle.

Today, with this and hundreds of other heavy manufacturing machines, Rohr is currently engaged in many advanced structures

programs—along with the production of over 30,000 different parts for aircraft of all types.

This is, of course, in addition to Rohr's being recognized as the world's largest producer of ready-to-install power packages.

For design and engineering know-how, for full production facilities look to Rohr to build more into the aircraft parts you need.



In addition to the Convair Metropolitan 440 shown here, Rohr builds power packages for many other leading commercial and military planes which have made Rohr famous as the

**WORLD'S LARGEST PRODUCER  
OF READY-TO-INSTALL  
POWER PACKAGES FOR AIRPLANES**



**ROHR**  
AIRCRAFT CORPORATION

CHULA VISTA, CALIFORNIA

ALSO PLANTS IN RIVERSIDE, CALIFORNIA; WINDER, GEORGIA; AUBURN, WASHINGTON

The AIRCRAFT YEAR BOOK

PASSENGER MILES, MAIL, EXPRESS AND FREIGHT  
TON-MILES

Trunks—Local Service—Territorial—Helicopter

(Source: Air Transport Association)

Year	Total Passenger Miles (000)	Passenger Load Factor	Air Mail Ton Miles (000)	Express Ton Miles (000)	Freight Ton Miles (000)
DOMESTIC <sup>1</sup> :					
1950	8,012,536	61.23	47,009	37,280	114,086
1951	10,566,141	67.88	63,849	41,268	102,356
1952	12,527,867	65.60	69,333	41,324	119,502
1953	14,760,309	63.45	72,905	43,468 <sup>1</sup>	134,462
1954	16,768,706	62.45	81,600	41,178 <sup>1</sup>	147,096
1955	19,819,671	63.32	87,445	51,006 <sup>1</sup>	177,065
INTERNATIONAL: (International and Overseas and Alaska)					
1950	2,228,841	59.45	21,929	44,513 <sup>2</sup>	16,050 <sup>2</sup>
1951	2,635,424	59.31	22,845	289 <sup>2</sup>	71,004 <sup>2</sup>
1952	3,091,007	61.60	23,659	281 <sup>2</sup>	72,346 <sup>2</sup>
1953	3,473,480	61.25	26,453	219 <sup>2</sup>	74,427 <sup>2</sup>
1954	3,830,276	59.01	37,381	217 <sup>2</sup>	81,886 <sup>2</sup>
1955	4,520,024	62.38	54,788	243 <sup>2</sup>	89,598 <sup>2</sup>

<sup>1</sup>Express N. A. for Territorial

<sup>2</sup>International and Overseas only.

AIR CARRIER OPERATING REVENUES

Domestic and International  
(Source: Air Transport Association)

Year	Passenger Revenue (000)	% of Total	Mail Revenue (000) <sup>1</sup>	% of Total	Express and Freight Revenue (000)	% of Total	Other Revenue (000)	% of Total	Total Revenues
DOMESTIC:									
1950	444,506	79.66	63,968	11.46	35,122	6.29	14,394	2.58	557,990
1951	591,186	84.17	57,420	8.18	36,914	5.25	16,846	2.40	817,686
1952	695,456	85.05	58,888	7.20	42,829	5.24	20,513	2.51	702,366
1953	803,869	85.75	65,114	6.94	47,791	5.10	20,708	2.21	937,482
1954	905,840	86.87	65,726	6.30	49,897	4.78	21,330	2.05	1,042,793
1955	1,060,588	88.30	55,327	4.61	61,102	5.09	24,041	2.00	1,201,058
INTERNATIONAL:									
1950	163,431	60.63	58,628	21.75	22,303	8.27	25,207	9.35	269,569
1951	188,634	62.89	56,955	18.99	26,138	8.71	28,214	9.41	299,941
1952	218,315	65.98	59,057	17.85	28,291	8.55	25,216	7.62	330,879
1953	239,354	67.12	62,806	17.61	29,182	8.18	25,244	7.08	356,586
1954	260,713	68.96	58,418	15.45	31,521	8.34	27,401	7.25	378,053
1955	302,990	74.51	35,173	8.65	34,394	8.46	34,071	8.38	406,628

<sup>1</sup>Includes subsidy.

# ✓ check the Kawneer "package" service

- Cockpit Enclosures • Major Airframe Assemblies
- Metal Bonded and Honeycomb Assemblies • Acrylic Forming and Fabrication • Jet Engine Sheet Metal Parts and Assemblies • Heliarc Welding



#### Sound, Experienced Engineering

Kawneer engineers have broad experience coupled with the initiative and desire to efficiently translate your requirements into a finished product. The department is functionally organized in groups to give you the best possible service: Project Engineering, Design & Development.



#### Proven Quality Control Methods

Kawneer Quality Control is constant—machines and instruments are periodically checked more often than required by specification to achieve *plus* quality. Kawneer's processing, fabrication, welding, anodizing, metal bonding and heat treating are all certified to Air Force Quality Control Standards. All procedures conform to MIL SPEC 5923B.



#### Efficient Production Line

Kawneer aircraft production is under one roof. The economy of well-planned production lines to integrate all functions is a cost-saving factor to you. The special plant has 104,000 square feet of floor with a 16' clear ceiling. The modern equipment includes routers, mechanical presses, milling machines, spray painting, hydro press, autoclave, platen press and associated new high quality equipment.



#### Extensive Research and Development

Kawneer research is backed by over 50 years of experience in metal working; years that have seen Kawneer discover new processes that have revolutionized metal shaping methods. Kawneer maintains complete equipment necessary for chemical and physical research. Possibly this development work can be used to your advantage.



#### Adequate Supply of Skilled Labor

Kawneer's skilled labor force is thoroughly trained in the latest application techniques of modern machines. These men come from an abundant pool of skilled labor located in the Niles, Mich., and South Bend, Indiana area, 90 miles from Chicago.

*ENGINEERS! Kawneer offers excellent opportunities for growth and advancement. Bring your family to Niles and enjoy vacationland living. Work in new, modern facilities.*

Write for the  
new Aircraft Division  
books describing  
complete facility  
details



**Kawneer**  
General Offices  
NILES, MICHIGAN

AIRCRAFT  
PRODUCTS  
DIVISION









## Mobile gas turbine power cart takes only 30 seconds to start giant B-52 jet engines

The AiResearch MA-1A mobile gas turbine compressor, the first unit of its kind qualified by the Air Force to start the intercontinental B-52 bombers of the Strategic Air Command, is now in volume production at the AiResearch Manufacturing Division of Arizona.

Entirely self-contained, this weatherproof unit furnishes a completely automatic source of compressed air power at the point of use. It weighs only 1150 pounds and may be controlled either from the instrument panel or from a remote control panel. It will start and maintain

continuous operation at ambient temperatures ranging from  $-65^{\circ}\text{F}$  to  $130^{\circ}\text{F}$ .

The two-stage gas turbine compressor may be removed easily from its trailer for use in other vehicles or as a stationary unit. It has an output capacity of 120 pounds per minute flow at 50 psia . . . enough power to meet all ground service needs for a modern airplane.

Write to our Sales Planning Department for further information on this product.

*Qualified engineers are needed now. Write for information.*



**AiResearch Manufacturing Divisions**

*Los Angeles 45, California • Phoenix, Arizona*

*Designers and manufacturers of aircraft 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

The AIRCRAFT YEAR BOOK

COMPARATIVE TRANSPORT SAFETY RECORD

Passenger Fatalities per 100,000,000 Passenger Miles

(Source: Air Transport Association)

	1946	1947	1948	1949	1950	1951	1952	1953	1954
<b>Domestic Scheduled</b>									
<b>Air Lines</b>									
Fatalities .....	75	199	83	93	96	142	46	86	16
Rate .....	1.24	3.21	1.30	1.30	1.10	1.30	.4	.60	.09
<b>Buses</b>									
Fatalities .....	140	1.40	120	120	100	130	100	NA	60
Rate .....	.19	.21	.18	.20	.17	.22	.16	NA	.11
<b>Intercity Railroads</b>									
Fatalities .....	116	74	52	32	184	126	14	31	23
Rate .....	.18	.16	.13	.09	.58	.41	.04	.10	.08
<b>Pass. Autos &amp; Taxicabs</b>									
Fatalities .....	15,400	15,300	15,200	15,300	17,600	21,000	22,600	NA	22,500
Rate .....	2.5	2.3	2.1	2.1	2.2	2.4	2.8	NA	2.6

N. A. Not available.

ASSETS AND LIABILITIES

Domestic Trunk Airlines 1948-1955

(Source: Air Transport Association)

	1948	1950	1952	1954	1955
<b>ASSETS</b>	(000)	(000)	(000)	(000)	(000)
Current Assets	178,535	213,480	357,274	374,538	452,962
Flight Equipment	307,640	387,687	589,900	809,148	918,896
Depreciation	114,661	180,141	267,881	408,240	493,401
Flight Equipment—Net	192,979	207,546	322,019	400,908	425,495
Ground Property and Equipment—Net	76,278	61,666	81,220	93,894	108,454
Property & Equipment—Net	269,257	269,212	403,239	494,802	533,949
Deferred Charges	18,020	18,247	9,934	10,535	10,626
Other Assets	34,696	62,173	39,149	38,659	50,233
<b>Total Assets</b>	<b>500,508</b>	<b>563,112</b>	<b>809,596</b>	<b>918,534</b>	<b>1,047,770</b>
<b>LIABILITIES AND CAPITAL</b>					
Current Liabilities	103,753	137,184	244,137	255,015	291,150
Long Term Debt	168,998	137,327	173,182	188,953	204,879
Operating Reserves	2,554	4,305	4,609	6,529	9,257
Capital Stock	128,284	132,947	155,944	149,755	119,032
Capital Surplus	65,399	69,209	96,007	98,883	147,277
Earned Surplus	12,558	64,610	131,297	206,805	251,298
Other Liabilities and Capital	18,962	17,530	4,420	12,594	24,877
<b>Total Liabilities and Capital</b>	<b>500,508</b>	<b>563,112</b>	<b>809,596</b>	<b>918,534</b>	<b>1,047,770</b>

# GENERAL ELECTRIC

## Airborne Systems and Components

Airborne ordnance	Hydraulic turbopumps
Airborne radar antennas	Instruments
Aircraft energizers	Jet engine control systems
Amplidynes	Jet engine ignition systems
Amplistats	Motors
Autopilots	Propeller control devices
Ballasts	Rectifiers
Capacitors	Relays
Circuit breakers	Rocket engines
Computing sight systems	Selsyns
Electric control equipment	Servo systems
Electronic and communication systems	Switches
Fuel turbopumps	Transformer-rectifiers
Generator control systems	Transformers
Generator turbodrives	Turbojet engines
Generators	Turboprop engines
Heating equipment	Turboshaft engines
Hydraulic constant-speed drives	Turbostarters
	Turbosuperchargers

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1937 — Celebrating Our 20th Anniversary — 1957



A  
portfolio of  
award winning  
aviation  
advertising  
for 1956



\*CONVAIR awarded First Prize in competition with 127 entries in Business Publications Advertising Awards—Advertising Association of the West, June, 1956.



## Well timed...

Research and development cut the time between *needing* and *having* Convair's supersonic F-102A all-weather interceptor. Application of the AREA RULE gave the F-102A an hour-glass shape, enabling it to attain even higher performance into the supersonic speed range!

A result of extensive design, testing and re-designing, the delta-wing F-102A is now being produced in quantity for the U.S.A.F. Air Defense Command—evidence again of Convair's *engineering to the Nth power!*

**CONVAIR**  
 A DIVISION OF GENERAL DYNAMICS CORPORATION **GD**

A portfolio of award winning aviation advertising for 1956

*All the world's a stage  
for Convair's luxurious new*

**440**

**metropolitan**



Now flying on leading airlines throughout the world and soon to see service with many more, Convair's new METROPOLITAN 440 offers you more *luxury!* More *speed!* And the *quietest* passenger cabin of *any* airliner flying today! In addition, the new METROPOLITAN offers you all of the qualities of passenger comfort and safety that have made the Convair first choice all over the world.

**CONVAIR**



A DIVISION OF GENERAL DYNAMICS CORPORATION



**New Flying:** SAS, Denmark, Norway, Sweden; SWISSAIR, Switzerland; SABENA, Belgium; AERO O. Y, Finland; CONTINENTAL, U.S.A.; DELTA, U.S.A.; NATIONAL, U.S.A.; REAL S.A., Brazil. **Soon to Fly:** ALITALIA, Italy; ANSETT, Australia; BRANIFF, U.S.A.; EASTERN, U.S.A.; IBERIA, Spain; JAT, Yugoslavia; LUFTHANSA, Germany; NIPPERI, Japan

A portfolio of award winning aviation advertising for 1956



# VERSATILITY...



Commercial Airliner



Flying Hospital Ship



Cargo Plane



Executive's Flying Office



Electronic Test Plane

## thru engineering to the N<sup>th</sup> power

Unmatched in its flight range for speed, efficiency, and economy of operation... unexcelled for reliability—the Convair is now flown by thirty-five leading airlines throughout the world! It performs scores of tasks for the U.S. Air Force and the U.S. Navy! It serves science as a flying electronic laboratory. And it's the choice of leading corporations as an executive transport.

The Convair continues to set new records for versatility and performance—evidence again of Convair's *engineering to the Nth power!*



Military Transport



Turboprop Transport



Navigator-Bombardier Flying Classroom

## CONVAIR

A DIVISION OF GENERAL DYNAMICS CORPORATION

A portfolio of award winning aviation advertising for 1956



## Let Freedom Ring!

From the moment the *spirit of '76* was born with the *shot heard 'round the world* and proclaimed with the ringing of the Liberty Bell... sounds have played a vital part in our American freedom!

Today, the freedom of every man, woman and child of this nation is inseparably linked with another sound — the protective roar of great new jet aircraft like Convair's delta-wing supersonic F-102A all-weather Interceptor.

The modern minutemen of the U.S.A.F. Air Defense Command who fly these jet aircraft for your protection never relax their vigil. *Let Freedom Ring!*



**CONVAIR**

A DIVISION OF GENERAL DYNAMICS CORPORATION



A portfolio of award winning aviation advertising for 1956

In aviation...  
*opportunity knocks twice*

Now, both *military* and *commercial* aviation offer unlimited promise for an exciting, challenging and rewarding life. In both fields, Convair is today producing outstanding aircraft: *Military* aircraft like the supersonic F-102A all-weather interceptor ...faster, more comfortable *commercial* airliners like the Metropolitan 440. In the near future, the youth of America will have an even greater choice of careers through the development of atomic-powered military aircraft and vastly more advanced jet passenger planes. Aviation is the high road to opportunity for the youth of today.

**CONVAIR**

CV A DIVISION OF GENERAL DYNAMICS CORPORATION GD



A portfolio of award winning aviation advertising for 1956



## The Terrier... Navy Man's "Best Friend"



Just like its wiry namesake — the Navy's new anti-aircraft missile, the Terrier, has the built-in ability to track an aggressor. Once unleashed, no evasive maneuver can save invading aircraft from this obedience-trained supersonic watchdog.

*Here is vast new protection for the Navy that protects you!*

The Terrier is a significant example of the advanced weapons systems now being mass-produced for the defense of our country by Convair, working with the U.S. Navy Bureau of Ordnance.

**CONVAIR**  
A DIVISION OF GENERAL DYNAMICS CORPORATION

A portfolio of award winning aviation advertising for 1956



CONVAIR 880  
JET-LINER

Picture of your  
bright "jet-travel" future!

**Fastest commercial airplane in the world** — 609 silent, vibrationless miles an hour! The Convair 880 JET-LINER will be powered by four of the world's most advanced commercial jet engines—General Electric CJ-805's. **The only jet transport designed to operate from over 100 already existing airports throughout America!** Big city or small, the Convair 880 JET-LINER will bring you luxurious jet-travel whether your destination is 2,000 miles away—or only 300. Soon you will travel faster, in more luxury and comfort than you've ever known before in Convair's 880—the all-new JET-LINER.



CONVAIR 880 JET-LINER WILL  
FLY FIRST OVER THE ROUTES OF  
**TWA** AND **Delta**

**CONVAIR**  
A DIVISION OF GENERAL DYNAMICS CORPORATION 

A portfolio of award winning aviation advertising for 1956

# **aviation events**

**1956**

**A pictorial review  
of some of the  
outstanding events  
in aviation  
during 1956**



Wide World Photos, Inc.

## • TOP NEWS

A top news event of the year was the visit of Air Force Chief of Staff Nathan Twining and a party of USAF officers to Russia in June. Here he is pictured in Stalingrad. Marshal Rudenko, Russian Air Force chief, is pointing out the sights.

## • TROUBLE SHOOTER

Earlier in the year, perturbed by the rapid growth of air transport and the lack of facilities to take care of it, President Eisenhower appointed Edward P. Curtis as a Special Assistant for Aviation Facilities Planning. Mr. Curtis rose from a major to a major general in the Air Force during World War II. He was a Vice President of Eastman Kodak Company when called to Washington in February.



## • GRIM REAPER

Death took a heavy toll among U. S. aircraft pioneers and leaders during the twelvemonth. Three whose names live on in the names of the companies they pioneered and headed were (Left to Right, Below) Glenn L. Martin, William Edward Boeing and Lawrence D. Bell. The fourth was a pioneer in the aircraft engine field—Frederick B. Rentschler, chairman of the board, United Aircraft Corp.



# THE NEW COMBAT SERIES

*Three stars shone brightly in the Air Force galaxy of new combat aircraft. Two are capable of carrying atomic weapons. All are lightning-fast.*

## • B-58 HUSTLER

The stilt-like 16-wheel main landing gear of America's first supersonic bomber reaches for the runway at conclusion of a test flight. The new delta-wing bomber, built by Convair Division of General Dynamics Corporation, started flight tests in November.



## • STARFIGHTER

The Lockheed F-104 Air Force combat plane climbs as fast as it flies on the straight-and-level. Speeds are said to be in the ultra-sonic regime. The plane made its public bow in April.



## • SUPER SABRE

North American introduced this new fighter-bomber version of the Super Sabre. Bombs pictured here are conventional, but the plane can carry atomic weapons if need be. The plane, called by the Air Force the F-100C, is equipped with wing tanks and in-flight refueling to assure long-range.







## • ATOMS FOR POWER

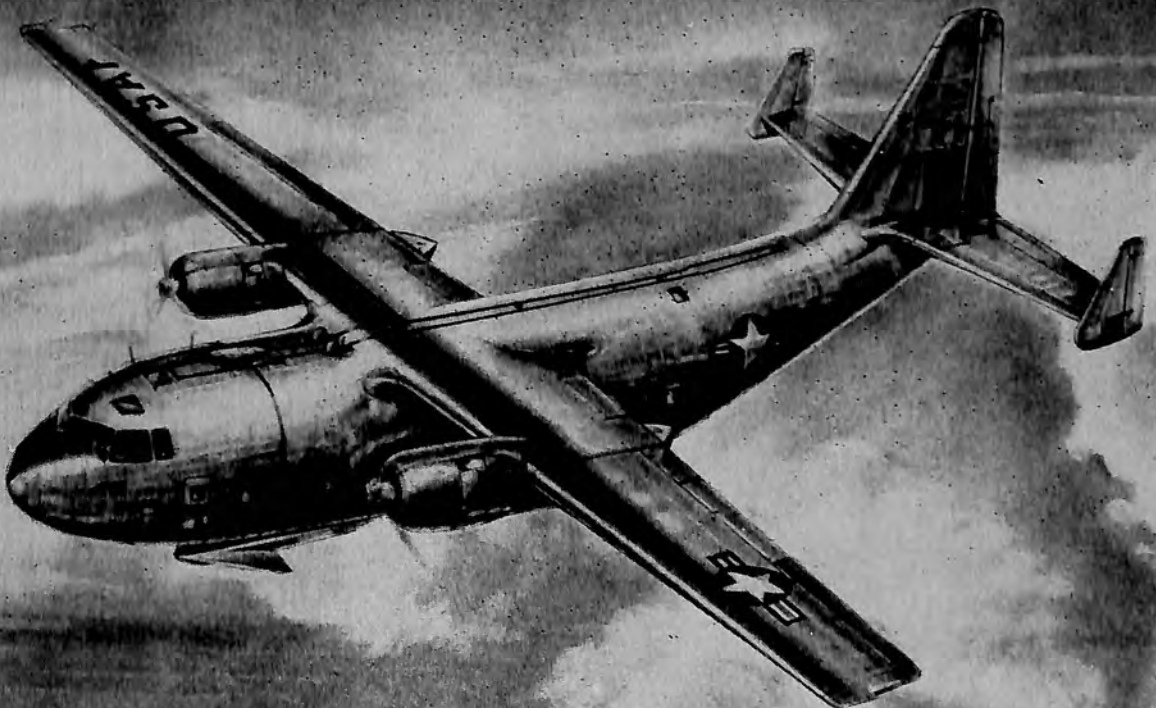
The Convair B-36 pictured here is the same intercontinental bomber that made news in other years—but with a difference. Designated the NB-36H, it first flew in 1956 with an operating atomic reactor aboard. Convair holds a contract with the Air Force to develop an airframe for an atomic-powered bomber. They are teamed with General Electric Company, which holds a contract for the engine. Lockheed Aircraft Corporation has a similar airframe contract, mated with Pratt & Whitney Division of United Aircraft Corp. for the engine.

## NEW PLANES

*Three significant planes made their debut in 1956 and are expected to go into production in the near future.*

### • 'LIGHTPLANE' ASSAULT TRANSPORT

Pictured here is the YC-134, an Air Force assault transport which will take off and land in half the space needed for comparable planes in the 65,000 lb. class—a performance said to match that of a lightplane. It is the latest production model using boundary layer control. Stroukoff Aircraft Company had plans underway for production orders at year-end.





### • FRIENDSHIP

The Friendship, first propjet aircraft tailored for executive users and short-range airlines, is built by the Aircraft Division of Fairchild Engine & Airplane Corp. The F-27 is designed to become the DC-3 of the turboprops.

### • 620

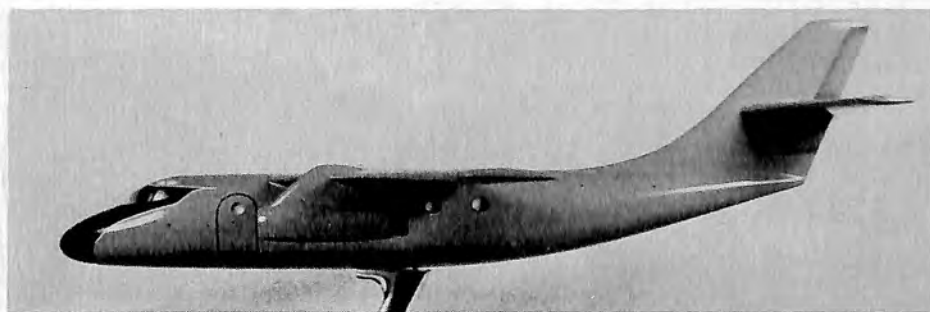
Designed by engineer-pilot Ralph Harmon, this four-engine executive transport is the Cessna 620, which first flew in August, 1956. Standard equipment will include five reclining seats and a folding table. The plane has a maximum speed of 282 mph, cruises at 260, and its range is about 1,700 miles.





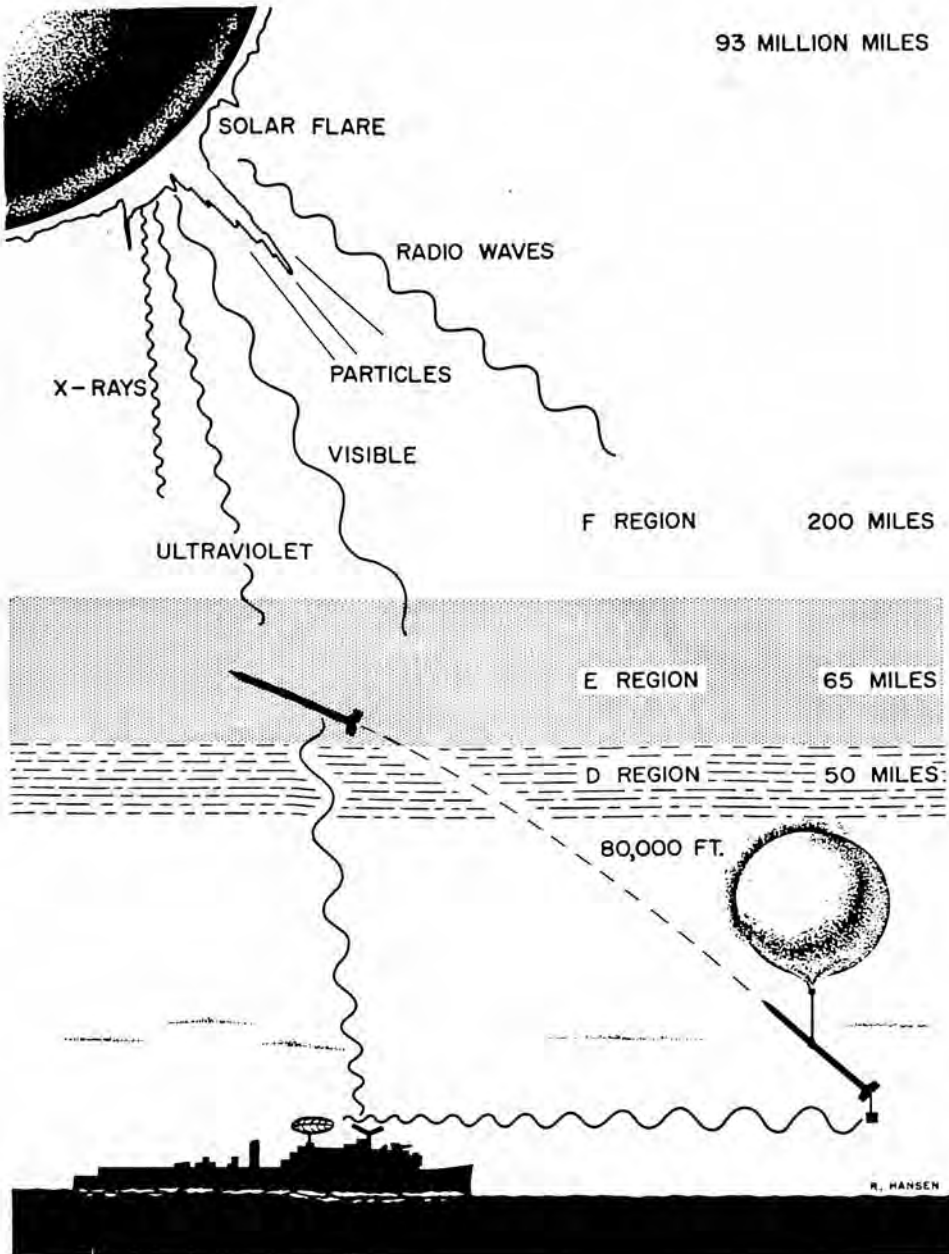
#### • EXECUTIVE JET TRANSPORT

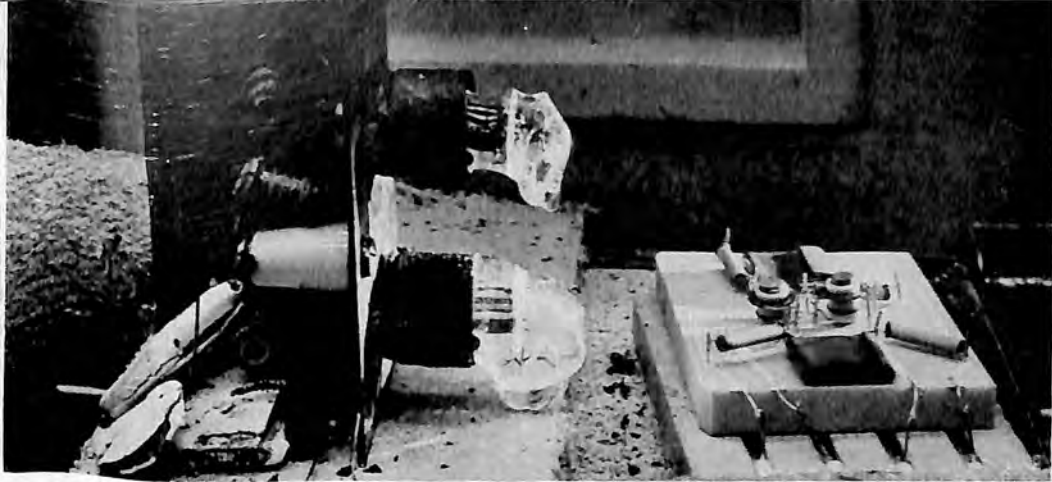
After three years of research and development, Fairchild also announced the M-185, a high-speed executive jet transport. It will fly at speeds up to 550 mph and carries a crew of two and eight or nine passengers. Initial delivery of three to the Continental Can Co., is scheduled for 1960.



## • ROCKOON

To pierce the upper atmosphere, Naval Research Laboratory scientists devised scores of advanced messengers designed to come back with valuable data. Here is pictured the Rockoon, a balloon-supported rocket which by July, 1956, had concluded a series of upper-atmosphere experiments. Perhaps its greatest value was to guide the scientists toward the design for a series of about 40 similar rockets for use during the International Geophysical Year beginning in July, 1957.





## • ELECTRONICS

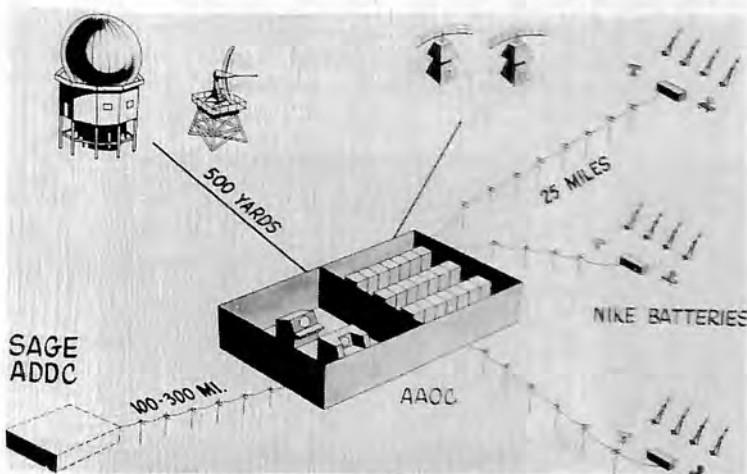
In scores of instances, the electronic tail wagged the aeronautical dog to aviation's benefit. Scores of devices were introduced to help man manage supersonic and trigger-quick defense and peace-time flying equipment. This and the following page attempt to picture some of the outstanding.

## • HOT CIRCUIT

Significant in the advancement of high-speed flight, where the heat barrier has been a major problem, is the General Electric high-temperature circuit, pictured alongside an ordinary electronic circuit, after being placed in heat of 1,500 degrees F. The ordinary circuit collapsed almost immediately. The G-E circuit can operate in such heat for thousands of hours. It gives new impetus to the nation's guided missile, satellite, and supersonic plane programs.

## • MISSILE MASTER

A ten-year-old development flowered in 1956 in the form of the Missile Master, designed by The Martin Company, Baltimore. It is the country's first electronic system designed specifically for controlling and coordinating the use of NIKE anti-aircraft missile batteries and other advanced Army weapons. Systems will be located at key anti-aircraft units across the country.





## • RADAR GAS STATION

It appears routine that the Boeing B-52 and the KC-135 tanker pictured here should be together to get fuel to the big bomber. But with the lightning speeds involved, their rendezvous is a miracle achieved by another electronic device revealed in 1956, the Sperry Gyroscope Company's APN airborne radar.

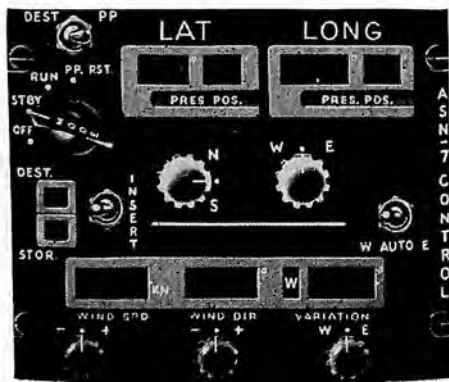


## • NO HANDS

Sperry also introduced the SP-30 automatic flight control system for precise, hands-off automatic control of jet airliners flying at wide range of airspeed and altitude. Mockup photo of Douglas DC-8 shows position (arrow) where control will be located.

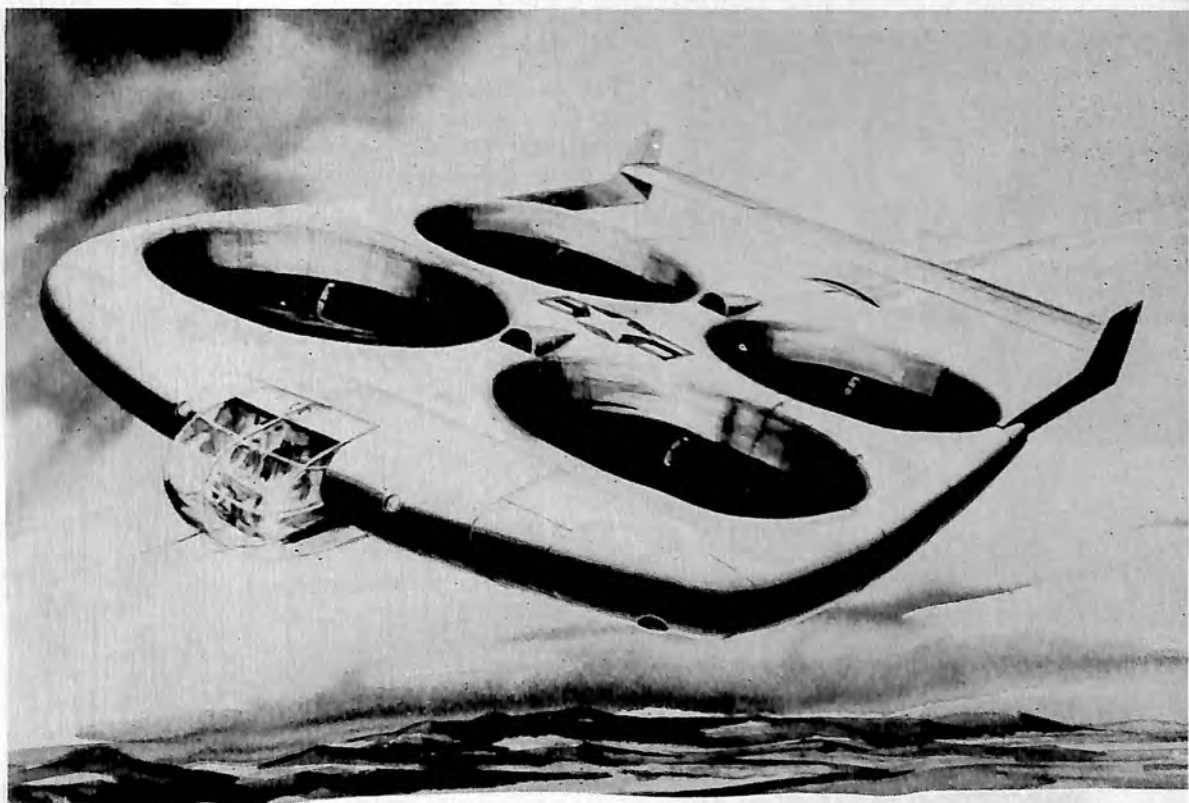
## • NAVIGATOR'S HELPER

Another less-work-for-the-pilot device reached maturity when Ford Instrument Company's dead-reckoning computer ASN-7 became operational. This miniaturized navigational system continuously displays on pilot's instrument panel his present position, course, and exact distance to destination.



## • FLYING CRANES

Six aircraft companies in 1956 were awarded Army research and development contracts to design flying cranes, platforms capable of vertical take-offs and landings carrying extra-heavy loads. Contractors now working on the problem are Bell Aircraft Corp., Hiller Helicopters, Hughes Aircraft Division, Kaman Aircraft Corp., Piasecki Aircraft Corp., and Flettner Aircraft Co. Pictured here is a Hiller artist's conception of a VTO weight-lifter using ducted fans.





## AWARDS

### • HARMON TROPHY

Four winners get together as one presents the Harmon Trophy to the other three. From left: British Group Captain John Cunningham, who won the award for the first commercial jet trip around the world; Mme. Jacqueline Auriol, the world's fastest woman pilot, with a jet record of 715.35 mph; the President; and Lt. Cmdr. Charles A. Mills, USN, a Harmon winner for a daring icing experiment with a lighter-than-aircraft.



### • H. H. ARNOLD TROPHY

For his contribution to advancing the case for the Air Force, Senator Stuart Symington (D., Mo.) received the H. H. Arnold Trophy and was named "Aviation's Man of the Year" for 1956 by the Air Force Association. Gill Robb Wilson, President of the AFA, pictured at left.



### • WRIGHT BROTHERS MEMORIAL TROPHY

For continuous achievements over a broad range of aviation since 1917, Dr. Edward Pearson Warner, President of the International Civil Aviation Organization, was unanimous choice for the Wright Brothers Memorial Trophy for 1956.





### • THOMPSON TROPHY

Here it is being awarded to Commander R. W. (Duke) Windsor, USN, by Fred C. Crawford, chairman of the board of Thompson Products, Inc., while Admiral Arleigh A. Burke, Chief of Naval Operations, looks on. To win the trophy, Windsor flew 1,015.428 mph in a Chance Vought F8U-1 Crusader.

### • COLLIER TROPHY

For development of the Boeing B-52, first all-jet long-range bomber, the Collier Trophy was awarded jointly to William M. Allen (pictured here), the U. S. Air Force, and General Nathan F. Twining.



### • BREWER TROPHY

Ray O. Mertes, Superintendent of School and College Services, United Air Lines, Inc. received the 1956 Frank G. Brewer Trophy, nation's highest award in the field of youth education and training.

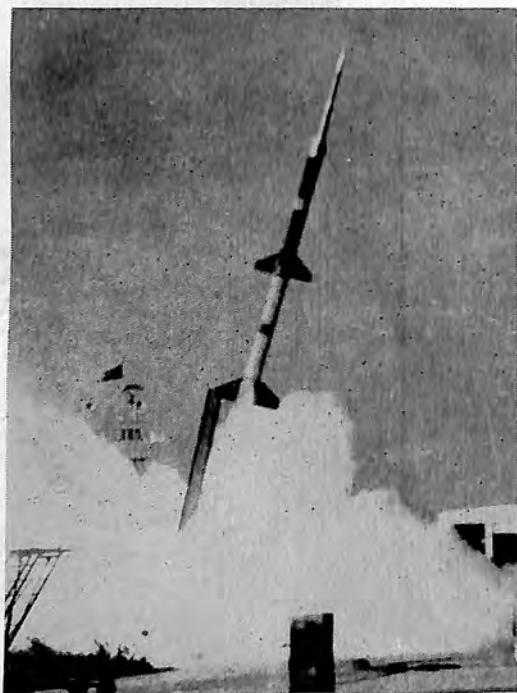


# RECORDS



## • MACH MAKER

Fastest of the speed-of-sound planes was revealed in 1956 when the Air Force reported that Bell Aircraft X-2, built to study aerodynamic heating at high speeds, "went higher and faster than man has ever flown." Outstanding feature was controllable speed for rocket engine, a Curtiss-Wright Corp. innovation.



## • MACH ROCKET

But man's speed was snail-like contrasted with the four-stage, rocket-propelled research missile fired by scientists of the National Advisory Committee for Aeronautics. This hit a record speed of more than Mach 10—6,600 mph at high altitude—and penetrated more than a million feet into the sky.



### • DISTANCE

Two Army aviators flying a Vertol H-21C set a new world helicopter record for distance in a closed circuit without payload when they flew 1,199.07 mi. non-stop in 12 hrs., 58 min. on August 11. Pilots were Lt. Col. Harry L. Bush and Maj. William C. Dysinger. The same helicopter on August 24 non-stop 2,610 mi. from west to east coast, refueling in midair along the way.

### • TRIPLE RECORD

Three world records were broken without stopping in July by Capt. Claude Hargett and Capt. L. S. Hill, U. S. Army, flying Sikorsky H-34 helicopter at Milford, Conn. The records were speed of 141.915 mph for 62.137 mi. in a closed circuit without a payload, 136.041 mph for 310.685 mi., and 132.633 mph for 621.369 mi.



## • ELDER STATESMEN OF AVIATION

Eight were named Elder Statesmen of Aviation by the National Aeronautic Association in 1956. The honor goes to aeronautical leaders who have made contributions of significance and enduring value. The eight pictured left to right, top to bottom are: Admiral DeWitt C. Ramsey (USN, Ret.), former Commander in Chief of the U. S. Navy in the Pacific and Vice Chairman of the Board, the Aircraft Industries Association; Alfred Victor Verville, pioneer aircraft designer and now with the Naval Bureau of Aeronautics; Rear Admiral Richard E. Byrd (USN, Ret.), aviation polar explorer; Harry F. Guggenheim, President of the Guggenheim Fund for the promotion of aeronautics; General Carl Spaatz, first Air Force Chief of Staff; Clarence M. Young, former Assistant Secretary of Commerce for Air and now a Vice President, Pan American World Airways; Frederick C. Crawford, Chairman of the Board, Thompson Products, Inc., and William T. Piper, lightplane aircraft builder and pilot.



## CHAPTER ONE

### The Industry

**A**S 1956 CAME TO AN END, the military services were only six months away from attaining the airpower goals (137 Air Force wings, 17 Navy carrier air groups) set by the Joint Chiefs of Staff in mid-1953. The aircraft industry's output for the military services declined from approximately 8,400 aircraft in 1955 to fewer than 7,000 in 1956, but the total number of planes produced remained at about the 13,000 level, primarily because of the increase in civilian production, notably for business and personal use. Civil plane deliveries amounted to about 7,100

While deliveries to the Armed Forces in terms of units dropped, industry dollar volume, airframe poundage produced and employment remained relatively stable. This occurred because output largely involved heavier and more expensive aircraft and because deliveries of guided missiles increased. Each month brought with it additional missile deliveries and new missile orders.

The aircraft industry continued to book orders from airlines in the U.S. and abroad for new jet and turboprop transports. By year end, manufacturers held orders or options for more than 600 gas-turbine powered airliners valued at more than \$2-billion. The industry continued to fill and obtain new orders for piston-engine transport planes.

The accomplishments of the various companies during the year are detailed on the following pages.

## AIRCRAFT MANUFACTURERS

### **Aero Design and Engineering Co.**

Production activity at Aero Design & Engineering Co. during 1956 was centered on two versions of the Aero Commander 5-7 place twin-engine executive transport. At the beginning of the year, the 560A model was in full production with eight to ten units per month being finished. In the Spring, production activity began to swing to the supercharged 680 model and by the end of the year the majority of the plant's production was centered on the 680 Super with 18 to 20 units being produced each month.

At the end of the year, the 560A was still in production and an option in the use of engines in the 560A had been announced. The high compression 295 horsepower Lycoming engine was approved for the 560A and Aero was producing a limited number of the 560A (high compression) aircraft.

Major production activity was centered at the Tulakes facility with modifications being done at Cimarron Field and additional contract work being arranged at Downtown Airpark in Oklahoma City and Meachum Field at Ft. Worth. Construction of a \$1.5-million factory on private property adjacent to Tulakes Airport was underway.

Research activities were centered at the research and development division on Max Westheimer Field at Norman, Oklahoma. Major research activities were on product refinement and development.

Financial data was not readily available but it was expected that the gross sales would go well over the 1955 \$7.5-million figure. At the end of the year, Aero was reporting a \$2-million annual payroll with a total investment of some \$5-million dollars.

### **Beech Aircraft Corporation**

Beechcraft's 24th year in 1956 was one of many milestones. Sales of commercial aircraft increased; a new business aircraft model was readied for production; military aircraft contracts were extended into future years; the backlog of both commercial and military business increased to more than \$100-million; and the company formed two wholly-owned subsidiary corporations: the Beechcraft Research & Development Corporation, as a further development of Beech Aircraft's movement into advanced and secret fields of powered flight; and the Beech Acceptance Corporation, as a further development of Beech Aircraft's leadership in the field of offering customer financing plans.

Total sales for the 1956 fiscal year ending September 30 were \$74,538,948. Net earnings were \$3,331,327 after taxes.

Commercial sales reached a new high of \$32,091,761 during the year. The previous record was \$27,245,940, made during the 1955 fiscal year. Sales by Beechcraft's U.S. distributors and dealers increased over 23 percent and export sales continued at levels comparable to those achieved in the 1955 fiscal year. Unit sales during the year increased for each of the company's business aircraft models—the Beechcraft Super 18 eight-place twin-engine executive transport, the Beechcraft Twin-Bonanza six-place

## THE INDUSTRY

"All the world will now acknowledge that any aggressor nation seeking domination of the earth must defeat the United States and must defeat us before we can achieve our maximum strength. Therefore, if global war comes to us again, the first blow will be struck not at Warsaw but at Washington; not at London but at Los Angeles; not even at Pearl Harbor but at Pittsburgh. I have no means to see into the future, no more than you—but you and I can logically deduce that we must have an adequate defense force in being on the day war begins—or we will have no need for any other."

—DWIGHT D. EISENHOWER,  
President of the United States



twin-engine executive airplane, the Beechcraft Bonanza four-place single-engine business plane.

And at year-end, the company was setting up production lines for another business plane, the Beechcraft Model 95 Travel Air.

The new Beechcraft Travel Air, a four-place twin-engine executive airplane with a cruising speed of approximately 200 mph, and powered by two 180 horsepower Lycoming engines, made its successful initial flight from Beech Field, Wichita, Kans., on August 6, 1956. The new Model 95 Beechcraft was put into a fast flight-service test program during the last five months of the year to assure deliveries as early as possible in 1957.

For Beech Aircraft, this new model added a fourth executive-type plane that was announced as non-competitive with the company's three other business planes. For the business aircraft customer seeking a small twin-engine plane, the '57 Travel Air would enlarge the field of selection to three units in the \$35,000 to \$55,000 price range.

Of major importance in the company's military sales of \$42,447,187 were the T-34 Mentor trainers for the USAF and the U.S. Navy plus large quantities of Beech-designed jet engine starters, thousands of jettisonable tanks, and major components for several different jet fighter aircraft.

During the year follow-on contracts were received by Beech with work schedules on some of the following military items extending into the 1958 fiscal year:

Additional orders for the Beechcraft L-23 Twin-Bonanza to be used as a liaison plane for the U.S. Army.

Continued production of the U.S. Navy's T-34B Beechcraft trainers.

Additional contracts for mobile ground support units for the USAF, with Beech now having designed three types of jet-engine starters.

Additional orders for complete wings for the Lockheed USAF T-33 and the Lockheed Navy T2V jet trainers, plus major assemblies for the Lockheed USAF F-104 Starfighter.

Continued major assembly production work for McDonnell's USAF F-101A Voodoo supersonic jet fighter.



## *The* AIRCRAFT YEAR BOOK

Continued major assembly production of items for Republic's USAF F-84F Thunderstreak and RF-84F Thunderflash jet fighters.

Plus new orders for major subassemblies for the Convair USAF F102A, F106A, and F106B jet fighters.

As of October 31, 1956, Beechcraft's commercial and military backlog totaled approximately \$103-million.

As a follow-on development to Beechcraft's establishment of a special engineering facility in Boulder, Colo., in July of 1955, Beech Aircraft Corporation in February of 1956 formed as a wholly-owned subsidiary, the Beechcraft Research & Development Corporation. Later in February the company announced the purchase of 760 acres of land adjacent to Colorado's new Foothills Highway just north of Boulder. During the year a special preliminary testing facility was constructed on the new site, but military security regulations cover the research projects under consideration.

Beechcraft military projects developed and announced during 1956 did include more information on the Beech-designed pilotless target-plane and on a high-speed aerial tow-target.

The Beech-designed U.S. Navy XKDB-1 is a pilotless remote-controlled target-plane planned for training both ship-to-air and air-to-air Navy weapons systems crews. In 1956 Beech revealed that their new drone was adaptable to photo and reconnaissance applications.

As a high-speed aerial tow-target, the Beechcraft Dart provides a long-needed supersonic target for jet fighter gunner practice.

As another wholly-owned subsidiary, Beech Aircraft Corporation announced in November of 1956 the incorporation of the Beech Acceptance Corporation, Inc., with nine Beech officials serving as its board of directors.

At year-end, Beech Aircraft had more than 1¾ million square feet of plant area in use in its five major production facilities at Wichita, Liberal and Herington, Kans., and employment was over 6,500.

### **Bell Aircraft Corp.**

Emphasis on the world-wide commercial helicopter market and broadening activity in the aircraft, rocket propulsion, electronics and servo-mechanism fields highlighted the company's operations during the year. Bell also moved to decentralize its diversified products business and to strengthen product lines with a reorganization of its Niagara Frontier operations.

The Niagara Frontier Division was discontinued and its activities taken over by two new operating groups, the Aircraft Division and the Weapon Systems Division, which will have complete responsibility for the design, production, procurement, sales and allied functions for their own products. The Weapon Systems division was sub-divided into the Avionics, Rockets, Guided Missiles and Research Divisions. The Aircraft Division is responsible for production of Bell airplanes and for Bell's large aircraft component sub-contracting programs for other prime contractors. It will have two principal sub-divisions, production and engineering.

Bell also formed a new wholly-owned subsidiary, the Bell Automation

## THE INDUSTRY

Corporation, in Rochester, N. Y., to specialize in the field of automatic controls and systems. First product introduced was the Electro-Way, an electronically-controlled continuous weighing system for the conveyor belt handling of bulk materials. Installations were made in a number of industries including cement, gypsum and power plants.

The year also saw Bell enter the field of nuclear research with the formation of a nuclear engineering department. In the planning stage was a nuclear research facility consisting of a "Hot Laboratory" and gamma irradiation source with the capability of expanding to include other phases of nuclear research for military and commercial applications of nuclear energy.

Loss of the stainless steel X-2 experimental rocket plane in September left a gap in the USAF-NACA supersonic rocket research program, but not until the airplane had rocketed to heights and speeds never before reached by man, reportedly 126,000 feet and more than 2,100 miles an hour.

It was expected Bell's X-1B and X-1E would be used to fill out, as far as possible, studies in the regions of very high speeds and altitudes. The Bell X-1E, NACA rocket aircraft, differs from Bell's earlier supersonic research aircraft because of its very thin wing and tail sections and pumped propellants. The new wing is only 4 percent thick in contrast to the 10 percent thick panels of the first X-1.

Work also was going forward on the Bell X-14, an advanced version of the jet-powered VTOL test vehicle which was test flown successfully in 1955. The original model was powered by two jet engines which allowed the aircraft to take off vertically and were rotated for horizontal flight. The engines were returned to the vertical position to allow the plane to land vertically.

The company also was one of seven contractors developing and manufacturing major sub-systems for the B-58 supersonic bomber being built by Convair.

The Weapons Systems Division continued the operational refinement of the GAM-63 Rascal, an air-to-surface guided missile weapons system for the Air Force.

As an outgrowth of the company's work with Rascal, orders were received from other aircraft firms to supply guidance components and rocket power plants for guided missiles and missile systems. Among these were liquid propellant ceramic rocket thrust chambers for the Army's NIKE, being built for Douglas.

Deliveries of the Bell-developed proportional control system to Chance Vought Aircraft Company continued at an increasing rate for installation in the Navy's Regulus missile.

The company worked closely with the Air Force on the development of a completely automatic landing system, an adaptation of the Carrier Landing System which was originally designed to land piloted airplanes on aircraft carriers in zero-zero weather. The system also has considerable civilian potential. Automatic electronic devices can lock on an incoming aircraft

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within radar range and bring it in to a safe landing in any weather without help from the pilot.

Also in the electronic field, Bell's helicopter flight simulator underwent further evaluation as a training device at the Navy's helicopter flight school in Pensacola, Florida.

Bell's largest and longest production contract came to an end in 1956. The last of more than 8000 jet engine nacelles was rolled off the production line at the company's Kenmore, N. Y., plant bringing to an end a \$280-million contract awarded Bell in 1949.

Jet pods were delivered to three companies manufacturing the Boeing B-47: Boeing's Wichita division, Lockheed's Marietta, Ga., division and the Tulsa, Okla., division of Douglas. Four hundred of the pods also were built for the Convair B-36.

Comparable in size and weight to a modern interceptor, the nacelles contain the necessary electrical, fuel, water and fire detection systems for the jet engines which are contained in the unit.

The company began a multi-million dollar contract to produce jet engine nacelles for the B-52 superfortress. Production under this contract was expected to run well into 1959.

Bell Aircraft Corporation's Texas Division, located midway between Dallas and Fort Worth, Texas, celebrated its fifth birthday during the year by announcing further expansion of its five facilities in the area.

As part of the company-wide reorganization, this division was scheduled to become a wholly-owned subsidiary, Bell Helicopter Corporation, on January 1, 1957.

Volume production continued on both single and tandem rotor helicopters, including commercial and military variations of the Model 47 Bell helicopter series. The single rotor models are: three-place, 200 hp Model 47G (Navy HTL-6; Army, AF H-13G); three-place, derated 250 hp Model 47G-2 (Army, AF H-13H); three-place, 200 hp executive Model 47H-1; and four-place, derated 250 hp Model 47J (Navy HUL-1).

Work continued on the tandem-rotor Navy HSL-1 anti-submarine warfare helicopter during the year. Although production of the 1800 hp sub hunter began to phase out during 1956, the Navy announced that tests were being conducted on a modified version of the powerful Bell machine for aerial mine sweeping.

The turbine powered Army H-40 utility helicopter made rapid progress during the year. First helicopter scheduled for production to incorporate the T-53 free-turbine Lycoming engine, the single-rotor, low-silhouette helicopter offers maximum versatility, speed and economy of operation.

Bell's XV-3 tilting-rotor-type convertiplane underwent exhaustive flight testing during the year. It was announced in August that the hybrid craft had successfully made 15 degree conversions in flight, proven its autorotative abilities from 500 feet altitude, and promised to exceed the most optimistic speed predictions. Flight test operations continued at the Texas Division.

During 1956 Bell announced the company's tri-turbine helicopter trans-

## THE INDUSTRY



**Bell 47G three-place utility aircraft**

port design, the Bell D216. Operators, after evaluating the design, predicted that the craft was capable of operating at the lowest possible per-mile seat cost in the industry.

Other projects being carried on by the division for the military included both a long and a short-range helicopter instrument study, metal bonding development programs and other allied activities in rotary-wing aviation.

Commercially, Bell Helicopter Corp. enjoyed its best year in history. At the three-quarter mark 100 commercial Bell helicopters had been sold and delivered, an increase of 30 percent over 1955's commercial sales for the same period. Bell helicopters are in service in approximately 55 countries.

For the nine-month period ended October, the Bell Aircraft Corp. reported sales of \$136,539,172 and net income after taxes of \$3,182,861. Unfilled orders amounted to \$167,816,194. Consolidated net working capital amounted to \$16,334,956.

Employment totalled 18,126 persons, including 14,567 in the firm's Niagara Frontier Division and 3,559 in the Texas Division at Fort Worth.

### **Boeing Airplane Co.**

Rollout, first flight and delivery to the Air Force of the first KC-135 jet tanker-transport, and added orders for the 707 jet transport by both domestic and foreign commercial airlines provided the top highlights for Boeing Airplane Company for 1956.

B-52 Stratofortresses also gained their share of the headlines as the big bombers continued to roll from Boeing plants at Seattle, Wash., and Wichita, Kans., on schedule, while the B-47 Stratojet and KC-97 Strato-

freighter programs were phasing out at Wichita and Renton, Wash., respectively.

It was on July 18, just 21 months and 13 days after being officially ordered, that the KC-135, America's first production jet transport, rolled from the Renton plant near Seattle, following by only a few minutes the appearance of the 888th and last of the piston-powered KC-97's.

The rollout of the two planes came within three days of coinciding with the 40th anniversary of the Boeing company on July 15. Since that date in 1916 more than 23,450 planes of well over 200 different types have borne the Boeing trade mark.

The rollout of the last KC-97 marked the 84th consecutive month with but one minor exception of on-schedule production of the big double-decked planes. Now the Air Force's standard aerial refueling tanker and multi-purpose transport, the Stratofreighters will be succeeded by KC-135's.

As the year opened, six commercial airlines in the U. S. and abroad had announced their intentions of purchasing a total of 76 Boeing jet transports. By fall of 1956, five others had joined them, and firm orders or letters of intent for a total of 134 airplanes had been received. First production 707 is scheduled for completion in late 1957. Pan American World Airways will get the first of the new jets late in 1958.

Meanwhile the 707 prototype continued its intensive flight test program, and by mid-October had passed the 600-hour mark in flight time.

Early in the year Boeing revealed details of the new 707 Intercontinental which will make possible non-stop airline schedules between cities, continents apart, never before served on a non-stop basis. With full payload, the Intercontinental will be capable of circling the earth in less than 40 hours flying time with only five stops for fuel. The plane will weigh more than 280,000 pounds and will cruise at speeds of from 550 to 600 miles per hour. Like others in the 707 family, the Intercontinental will be equipped with Boeing-developed jet engine sound-suppressors and thrust-reversers. Both have been under development by Boeing for more than three years, with full-scale tests of the devices continuing on the 707 prototype at Seattle.

Boeing also unveiled a full-scale \$500,000 mockup of the 707 jet Strato-liner during the year in a Manhattan building. The luxurious passenger cabin, complete with air-conditioning, lighting system, running water, ovens and refrigerators, was the first such jet transport interior to be completed in this country. It was also equipped to duplicate many flight conditions such as jet engine sounds, and with lighting effects that give the impression of both day and night flights in Boeing jet transports. Primary purpose of the mockup was to provide airlines with a means of visualizing the potentialities of the 707 interiors.

The first Wichita-built B-52 heavy bomber, which had been rolled out the previous December 7, made its maiden flight on May 14, and was delivered to the Air Force on June 26, being flown to Castle Air Force Base, Calif. Loring Air Force Base at Limestone, Me., and Westover Air Force Base, Mass. also received the intercontinental bombers during the year.

## THE INDUSTRY

Incorporation of a unique capsule design feature in two production B-52 models, enabling the 400,000-pound planes to perform multiple strategic roles, was also revealed during 1956. To give the Strategic Air Command a more versatile, multi-purpose airplane, Boeing designed a pressurized, inhabited "fuselage-within-a-fuselage" bomb bay capsule, which looks much like a huge cylindrical boiler. Fully pressurized, air-conditioned, and equipped with stations for a two-man crew, the capsule has provisions for four aerial cameras, interchangeable electronics equipment and antennas. Bomb bay areas of both the B-52B and B-52C are equipped with fittings to accommodate the multi-purpose capsule.

The design allows the B-52 to be utilized for conventional and nuclear weapons delivery, photographic reconnaissance and electronic missions at speeds of more than 650 miles per hour and at altitudes of more than 50,000 feet. Previously a separate airplane type or modification of basic service types was needed for each specific mission. B-52C's were built at the Seattle plant through the first half of the year, when the shift was made to B-52D production. The B-52D, strictly a bomber airplane, also was being produced at Wichita.

At Wichita, the last of the B-47E Stratojets was delivered to the Air Force late in the year.

It was also announced early in the year that an undisclosed number of RB-47K airplanes had been delivered. Modified for the Strategic Air Command, the "K" is equipped for both weather reconnaissance and photo work, with the weather data collected used to supplement that obtained regularly by the Air Weather Service.

Also in the B-47 picture, the second of two experimental turboprop XB-47D's modified at the request of the Air Force to serve as test beds for the new Curtiss-Wright T49 engine, made its maiden flight on Febru-

### Boeing 707 and B-52 refuel in mid-air



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Military sub-contract work continued to show healthy progress during the year. Work on the program to provide the Boeing B-47 with empennage assemblies phased out during mid-1956 with total billings amounting to more than \$56-million. A contract for horizontal stabilizer assemblies for the Boeing B-52 was underway and contracts at year-end were expected to carry production through June, 1958.

Sub-contracts from Republic Aviation to provide stabilizer assemblies for the F-84F will extend production through June, 1957 while additional sub-contracts for empennage and aft fuselage assemblies for the Lockheed T2V-1 Navy jet trainer and the Lockheed T-33 will carry production through August, 1957.

### **Chance Vought Aircraft, Inc.**

Chance Vought Aircraft, Incorporated, its F8U-1 Crusader established as the world's fastest Navy fighter and holder of the Thompson Trophy national speed record of 1,015.428 miles an hour, delivered the faster-than-sound fighter to the Navy in December, 1956, for a fleet indoctrination program.

At the same time, emphasis was placed on the company's newest guided missile, the supersonic, high performance Regulus II.

Development of both the Crusader and Regulus II, coupled with successful utilization of Regulus I, introduced into the Fleet during 1955 as the Navy's first operational attack missile, was reflected in the company's backlog of approximately \$517-million for the period ending October 31, 1956.

Approximately 14,000 employees were on the payroll at year's end, including employees stationed in California in connection with Regulus and Crusader testing operations. The weekly payroll was approximately \$1.4-million.

Keeping ahead of jet age requirements, Chance Vought broke ground in December for a \$3.8-million high speed wind tunnel designed to provide for testing of models of aircraft and guided missiles at speeds up to 3,800 miles an hour, five times the speed of sound. The new wind tunnel, expected to be operational early in 1958, will complement the company's low speed tunnel, completed early in 1956.

The Crusader, piloted by Commander R. W. "Duke" Windsor, USN, swept the Thompson Trophy mark beyond the 1,000-miles-an-hour figure for the first time in August over a 15.1 kilometer course on the desert at China Lake, California. Announcement of the new speed record was made by the Navy in September during the 1956 National Aircraft Show in Oklahoma City, Oklahoma.

In October, the nucleus of the Navy's first 1,000-miles-an-hour-plus carrier fighter squadrons began training to fly the Crusader. An intensive indoctrination course at the Chance Vought plant in Dallas, Texas, marked the initial phase of readying trained pilots to man the faster-than-sound F8U-1.

The company's newest entry in the field of high performance military

## THE INDUSTRY

aircraft, the Crusader is equipped with a two-position wing, permitting the airplane to fly not only at speeds of more than 1,000 miles an hour but also at the comparatively low speeds required for aircraft carrier landing operations.

The wing configuration was kept under a tight security wrap for more than a year but the Navy later disclosed that the Crusader has a two-position wing which is hinged at the rear and raises in front for takeoffs and landings. The thin swept wing is mounted high on the fuselage and is set well back from the cockpit. The horizontal tail is joined low on the fuselage. A short pointed nose, fairing smoothly into a small cockpit canopy, helps reduce drag and aids over-the-nose visibility.

Powered by a Pratt & Whitney Aircraft afterburner-equipped J-57 turbo-jet, the aircraft made its initial flight in March, 1955—exceeding the speed of sound—and went into production in September, 1955. Now in quantity production, the airplane completed its carrier qualification trials aboard the *USS Forrestal* in April, 1956.

Regulus II, a larger, faster and longer-range version of Regulus I, was developed from the successful accomplishments of the earlier missile. The company entered the guided missile field in 1946 and development of Regulus I began in 1947 when the Navy asked for design of a surface-to-surface missile with provision for a recoverable test version as well as a tactical version.

A Navy contract for production of Regulus II was announced in July. Two months earlier, development of the new missile was revealed for the first time in Chance Vought's annual report to stockholders. In December the Navy announced that the new supersonic weapon had been successfully fired and is currently under test.

Regulus I, now operating from aircraft carriers, submarines, cruisers and from shore bases, is capable of delivering a warhead over a range of hundreds of miles, guided by a built-in electronic "brain." The recoverable test and training version, equipped with a retractable landing gear, flies pilotless missions and lands intact to be flown again. As many as 16 flights have been made by single missiles.

Fleet introduction was underlined by development of a new weapon system capability, the steam catapulting of Regulus from the decks of aircraft carriers. The new capability was made possible by a launcher cart developed by Chance Vought for the Navy.

Continued expansion of Regulus activities led to development of a target drone version and confirmed the Navy's early confidence in the missile's broad weapon system capabilities.

In addition to being a prime contractor for the Navy, Chance Vought manufactured components for the North American F-100 Air Force jet fighter, the Boeing B-47 Air Force jet bomber and the Lockheed P2V long-range Navy patrol bomber.

At year's end, preparations were being made for celebration of the company's 40th anniversary in 1957, as a designer and builder of high performance military aircraft.



## **Convair**

### **A Division of General Dynamics Corporation**

Highlighting the 1956 production and facility progress and employee activities of the Convair Division of General Dynamics Corporation at its five San Diego and Pomona, California, and Fort Worth and Daingerfield, Texas, operations were these events of record:

First flight of the Air Force B-58 Hustler, America's first supersonic bomber;

Establishment of and ground breaking for Convair's newest facility, the \$40-million Astronautics Division;

Announcement and initial sales of America's newest entry into the commercial jet transport field, the Convair 880;

First simultaneous refueling on record of four fighters by any tanker—a Convair R3Y-2 Navy Tradewind seaplane;

Establishment of a Hawaii-to-California seaplane speed record by a Convair R3Y-1 Navy Tradewind seaplane tanker;

Established of a world safety record by employees of the San Diego plant;

Lease of new 500,000-square-foot central warehouse to serve all facilities in San Diego;

Recognition of Convair Pres. Joseph T. McNarney as "National Management Man of the Year."

Following its initial taxi run on October 29, 1956, the delta-wing B-58 Hustler made a 38-minute successful maiden flight at Fort Worth on November 11. At the controls was B. A. Erickson, chief test pilot and flight manager for Convair-Fort Worth.

In late summer, ground was broken in San Diego for the newly-established Astronautics Division, formed for the research, development, manufacture, and testing of the Air Force Atlas intercontinental ballistic missile.

In September, detailed specifications of the world's fastest airliner, the Convair 880 four-engine jet transport, were established and definitive contracts signed with Trans World Airlines and Delta Air Lines, Inc., for 40 of the luxury planes.

September also saw four Navy F9F-8 Cougar fighters refueled at the same time off the Southern California coast by a Convair R3Y-2 Tradewind turboprop seaplane tanker, world's first seaplane capable of multiple refueling.

On October 18, a Convair R3Y-1 Tradewind tanker-transport spanned the Pacific from Honolulu to Alameda, California, in six hours 45 minutes, to break a record set in 1948 by a Martin Mars seaplane by three hours 49 minutes.

Both the San Diego and Pomona divisions broke the 1955 United States safety record for the aircraft manufacturing and assembly industry, a record set by Convair-San Diego in late 1955, while the San Diego plant went on to work 21,814,875 successive manhours without a disabling accident, July 22 to Nov. 3, 1956, to establish a world safety record in the industry

## THE INDUSTRY



**Convair TF-102A combat trainer test sled**

In November 1956, Convair signed a lease for a new 500,000-square-foot warehouse in San Diego to centralize functions formerly carried on in scattered off-site warehouses over the city.

At the annual convention of the National Management Association in St. Louis in September, General McNarney received NMA's award as "National Management Man of the Year."

Designed for supersonic speeds and altitudes above 50,000 feet, the Convair B-58 Hustler has a wing span of about 55 feet, is about 95 feet long, and 30 feet in height. It is powered by four General Electric J-79 turbojet engines, mounted in separate nacelles slung below the delta wing. The fuselage incorporates the NACA area rule (pinched-in) fuselage to minimize transonic drag rise. The B-58's triangular wing has elevons in the trailing edge. These combine the control functions of conventional ailerons and elevators. A sharply swept-back vertical stabilizer and rudder give directional control and stability.

Sixteen complex major subsystems in the B-58, including the bomber's own defense system, are virtually automatic and capable of accomplishing their work with a minimum of supervision from the crew.

Under the new weapon system management concept, the Air Force assigned to Convair full responsibility for designing and building not only the airframe but also for procuring and installing all other equipment except

the engines. These the government supplied. Total of subcontractors and other suppliers on the Hustler program numbered approximately 3,000.

In designing the B-58, Convair-Fort Worth employed the delta-wing configuration pioneered by Convair in 1947 with the XF-92A research interceptor, world's first powered delta-wing aircraft. Convair also used the delta-wing design for the F-102A supersonic all-weather interceptor, now in volume production at San Diego for the Air Defense Command.

Even as preparations led up to the B-58's taxi tests and flight, Fort Worth was busy on other fronts. In April, the Air Force announced that the plant had been awarded a contract to develop an airframe for a nuclear-powered airplane. Since 1951, the company had been at work on an Air Force contract for research and development leading to the design of the airframe for such a plane. As part of the original study contract, the Fort Worth plant conducted numerous flights in late 1955 and during 1956 with the Convair-built Air Force NB-36H intercontinental bomber equipped with a Convair-built atomic reactor.

During the year, the Fort Worth plant built nose sections for the F-102A two-place combat proficiency trainer for shipment to San Diego, and completed converting 36 C-54 transports for day or night all-weather search and rescue operations over land or sea, by the Air Rescue Service of the Military Air Transport Service. They are designated SC-54.

Strategic Air Command's fleet of Convair-built B-36 bombers were being rotated through the Fort Worth facility in a modernization, inspection, and maintenance program, while the plant continued production on an undisclosed number of tail fins and outboard wing assemblies for the Boeing B-52 jet bomber. The plant also began a modification "Test-to-Tact" program on early F-102As built at San Diego, to match later versions off the line and fit them for delivery to the Air Force for Air Defense Command tactical use.

Employment at Convair-Fort Worth reached its highest since 1952, with 25,417 persons employed as of December 9, 1956.

The name of the new division—Convair-Astronautics—and the fact that it would be devoted to the Atlas ICBM program were announced by Convair July 10, with Air Force approval. In May, the Air Force itself had announced that Convair would construct a new facility near San Diego for the development and production of a guided missile system, and that construction of facilities and equipment would cost nearly \$40-million.

Convair-Astronautics activities will continue to be centered in Convair-San Diego's Plant I until the new facility is completed, late in 1957. Employment was 6,395 on December 9, 1956.

In the commercial transport field, Convair's decision in June to produce the Convair 880 jetliner was the company's biggest news of the year, next to delivery of a third of the 119 Metropolitan 440 piston engine medium-range transports on order as of November 1, 1956. TWA ordered 30 Model 880s, and Delta Air Lines ordered 10.

Performance guarantees for the Convair 880 include a level flight maximum cruise speed of 609 mph at 25,000 feet, at 130,000 pounds gross

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weight; payload of 21,700 pounds for the 80-passenger configuration and 26,320 for the 108-passenger coach configuration: maximum takeoff weight at sea level, 173,500 pounds; maximum allowable landing weight, 130,000 pounds; empty gross weight, 80,800 pounds; dimensions—wing span of 118 ft. 4 in.; length, 124 ft. 2 in.; height, 37 ft. 4 in.

Eight Metropolitan 440 piston-powered twin-engine transports were being produced monthly toward the end of the year, and commercial and military contract commitments were expected to keep the production line open into February 1958.

Continued and anticipated production activities in San Diego boosted the plant's employment to 30,789 as of December 9, 1956.

Employment at Convair-San Diego will rise to a peak of about 33,600 by July 1957. Increase will be absorbed chiefly into engineering activities and in the volume production of Air Force F-102A all-weather supersonic delta-wing interceptors. The F-102As joined four squadrons of the Air Defense Command initially in 1956, together with the side-by-side, two-place TF-102A combat proficiency trainers, in limited production at San Diego. Twenty ADC squadrons are expected to receive F-102As and TF-102As in 1957. In May, it was announced that Convair had received an \$83-million initial production contract for Air Force F-102B supersonic interceptors, later designated as F-106A aircraft. The new interceptor was scheduled for its initial flight in December 1956.

During 1956, it was officially announced that the F-102A is armed with Hughes air-to-air Falcon guided missiles, as well as rockets, electronically controlled. The F-102A's electronic gear enables it to intercept enemy bombers at stratospheric altitudes at any time of day or night, in any kind of weather.

The San Diego plant was scheduled to complete delivery of its 11 R3Y-1 and R3Y-2 Tradewind turboprop seaplane tanker-transport to the U. S. Navy by year's end. Six of the R3Ys were assigned to Air Transportation Squadron 2 (VR-2) of Fleet Logistic Air Wing at Alameda Naval Air Station, near Oakland, for transpacific service.

R3Y Tradewinds established two records during 1956. In September, an R3Y-2—the bow-loading "Flying LST" version—simultaneously refueled four Navy Grumman F-9F-8 Cougar jet fighters, first such operation in aviation history.

The other Tradewind record was set by an R3Y-1 conventional seaplane tanker-transport, when it covered the 2,435-statute-mile homeward leg of an Alameda-to-Honolulu round-trip flight in six hours 45 minutes, flying at an average of 360 mph and cutting three hours 49 minutes from the 1948 record. The Tradewind is the first turboprop seaplane to see Navy service.

Under another Navy contract, the San Diego plant delivered the remaining 16 of 36 R4Y-1 twin-engine land transports, a military version of the Convair-Liner 340. The Air Force had already received a number of this type of aircraft for training and transport purposes, all bearing C-131 designations. Testing continued at San Diego on the single-ski configura-

tion of the XF2Y-1 Sea-Dart Navy jet seaplane fighter, while limited developmental work was accomplished on the XFY-1 Pogo Navy vertical takeoff turboprop fighter.

The National Safety Council reported that only one other company in NSC record-keeping history, regardless of type of industry, ever achieved so long a period of freedom from lost-time injury as Convair-San Diego. Greatest safety record was that achieved by E. I. Du Pont de Nemours Co., a chemical firm, with 28,743,768 manhours. The San Diego record of 21,814,875 manhours, covering a 105-day period, earned the plant NSC's Award of Honor, its third straight and the sixth since 1945. Convair-Pomona received the same NSC award as it entered its second year of freedom from a disabling accident. Pomona passed the 365-day mark October 25 and was still accident free on December 18. Previous aircraft industry safety mark was set by Convair-San Diego in 1955, at 9,075,355 manhours, during 68 days. Pomona exceeded this mark earlier in 1956 but fell short of a national record because San Diego was, at the same time and with more employees, headed for its world record. NSC's top honor also went to Fort Worth for the fourth consecutive year.

In the spring of 1956, the second Navy guided missile cruiser, the USS *Canberra* (CAG-2), was commissioned as a Terrier-equipped cruiser. The first, the USS *Boston* (CAG-1), was commissioned in November 1955 as the world's first guided missile ship. Late in October 1956, the *Boston* joined the Sixth Fleet in the Middle East, where trouble brewed over the Egyptian-Israeli situation. Convair-Pomona also was producing Terriers for the U. S. Marine Corps during the year, and likewise initiated production of components for the Air Force F-102A interceptor. Pomona employment was 4,974 on December 9, 1956.

Convair Division employment as a whole increased from 46,403 in late October 1955 to 68,191 on December 9, 1956.

In response to the ever-increasing demands made on fundamental scientific knowledge by complex new products, such as hypersonic, high-altitude missile and aircraft weapon systems, Convair in 1956 launched a program of basic, scientific research in selected areas of the physical sciences. At the factory level, new manufacturing techniques were perfected through vigorous research and development programs in all Convair plants.

Convair's scientific research program was formally initiated in March 1956. It called for support of scientific research (1) by the establishment of the Convair Scientific Research Laboratory with a staff of full-time scientists, (2) by letting contracts to research agencies outside Convair, and (3) by supporting the work of the operating division personnel who desire to conduct research. A staff of 15 scientists and technicians were engaged in theoretical and experimental research at a temporary laboratory location in San Diego. Fields of research included fluid dynamics, physics, chemistry, metallurgy, mathematics, and combustion, with some emphasis on upper atmosphere study. The Scientific Research Laboratory, while administered by Convair General Offices at San Diego, will be located permanently at the new Convair-Astronautics Division.

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Several research subcontracts were awarded to research organizations outside Convair. Among these is a study into possible ways of generating high temperature airstreams in an aero-thermodynamic test facility. Another study concerns the fundamental nature of adhesion.

The Convair Scientific Research Laboratory is supporting operating division personnel in several different areas. Studies are in progress for facilities which will enable investigation of phenomena occurring in the upper atmosphere, including the effects of air ionization and cosmic dust on high-flying vehicles. An experimental and theoretical study of high-velocity, high-temperature testing is also in progress. Among division research programs is an analytical study of the phenomena affecting the behavior of solids at high temperatures under transient conditions. An approach to a mathematical description of turbulent flow is being undertaken. Certain aspects of microwave propagation are being studied with the support of the Convair Office of Scientific Research.

To keep manufacturing capability abreast of the engineering state of

"I am confident that our air power is clearly out ahead of its nearest competitor. I believe further that if we stay on course there will be no time in the future when the United States' air power will be insufficient to its great role in the task of maintaining peace in the world."

—DONALD A. QUARLES, Secretary of the Air Force



the art, Convair manufacturing research and development programs encompass the application of new materials, techniques, and equipment required to produce reliable supersonic and hypersonic aircraft and missiles.

Research and development programs by Convair operating divisions included the following:

Convair has been operating its Daingerfield, Texas, plant, known as the Ordnance Aerophysics Laboratory, since 1945 for the Navy Bureau of Ordnance under the technical direction of The Johns Hopkins University Applied Physics Laboratory. Research and developmental testing of supersonic ramjet-powered guided missiles is being carried out for the Bureau of Ordnance Bumblebee program, as well as similar work and supersonic aircraft model testing and turbojet testing for the U. S. Navy Bureau of Aeronautics and the U. S. Air Force. The Laboratory comprises essentially a supersonic wind tunnel, two sea-level jet engine test cells, two high-altitude jet engine test cells, and the necessary supporting groups and equipment.

At Pomona, Convair and the Navy are joined in a comprehensive

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program of research, development and quantity production of supersonic surface-to-air operational Terrier guided missiles. Work at Pomona includes weapons, systems analysis, and the preliminary design of new and improved missiles and components. These projects were undertaken in the Naval Industrial Reserve Ordnance Plant facilities, operated by Convair under contract to the U. S. Navy Bureau of Ordnance.

Although Convair-Astronautics will not move into its new facility in suburban San Diego until late in 1957, certain research and development projects were initiated and continued by division personnel leading to the manufacture and testing of the Air Force Atlas intercontinental ballistic missile.

As world conditions and industry-wide competition heightened the need for better aircraft, Convair-San Diego broadened and laid new emphasis on its research activities during 1956. A new 300-foot model seaplane towing tank with electrically operated overhead monorail for high-speed testing of model hulls was placed in operation in April. It is the first unit of a tri-section tow basin eventually to be 700 feet long and the West Coast's largest.

Ejection seat system tests for supersonic aircraft were conducted by Convair-San Diego engineers, using dummies placed in a rocket-driven cockpit sled on a 10,000-foot long track. A similar rocket sled was used to test rain erosion effects on aircraft fore-sections at supersonic speeds. Convair was awarded an industry-wide contract to manage Air Force development of upward seat-ejection systems for supersonic aircraft and in this connection performed experiments with a rocket-propelled ejection seat. It was found in matching this seat against the standard ejection system, that the rocket-propelled seat materially reduced tumbling and the injurious effects of deceleration after ejection.

Expanded research led to new facility construction at Convair-San Diego during the year. A major addition to be completed in 1957 was a new \$3.5-million Mach 5 supersonic wind tunnel begun in May 1956 at the division's seaplane ramp.

At Edward Air Force Base, California, where F-102A flight research is conducted, Convair moved into a new \$600,000 hangar and office building. The hangar accommodates ten F-102As. Also supporting the F-102A research program is a new \$120,000 fuel and oil systems evaluation laboratory at the San Diego seaplane ramp.

A new physics group of engineer-scientists was formed at Convair-San Diego to pursue many facets of aircraft research. Projects included studies of nuclear physics with respect to aircraft powerplants, upper atmosphere operations, solid state physics, metallurgy, compressions, control systems, heat and pressure resistant materials and other fields. A human engineering group is studying such aircraft components as design of cockpit layouts, instrument panels, high-speed seat ejections and other areas relating to pilot and crew.

In April, the Air Force announced that Convair-Fort Worth had been awarded a contract to develop an airframe for a nuclear-powered aircraft.

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Since 1951, Convair has been carrying out the first Air Force contract for research and development leading to the design of the airframe for such a plane.

As part of the original study contract, the Fort Worth plant conducted numerous flights in late 1955 and during 1956 with a Convair-built Air Force B-36 intercontinental bomber equipped with a Convair-built atomic reactor. The reactor does not power the experimental plane, designated NB-36H, but is activated in flight to study the problems of shielding the crew and equipment against radiation and the effect of radiation upon materials, the aircraft and its systems, and to develop nuclear instrumentation.

Construction of a new \$2-million high-altitude test facility for aircraft systems, parts and equipment started in October 1956 at Convair-Fort Worth. Operating it, engineers will be able to simulate altitudes up to 100,000 feet and produce temperature from a minus 100 to a plus 500 degrees F.

### Douglas Aircraft Co.

Phenomenal expansion of the world's air transport industry had a significant effect on activities of Douglas Aircraft Company during the past year as it went into production with its DC-8, four-engined jet transport. The 550-mile-per-hour luxury liner was ordered by 12 airlines around the world. Firm orders for the craft totaled 118.

Douglas delivered the first of its DC-7C type aircraft to international operators in mid-1956. Called the last of the big propeller-driven Douglas transports, the long range of the "Seven Seas" permits schedules heretofore impossible for airlines to maintain. Fourteen airlines had ordered 116 of these aircraft before the end of 1956.

The commercial model production line at Douglas' Santa Monica division was accelerated throughout the year, and going into the final quarter it was turning out 10 aircraft per month of the DC-6 and 7 series. By spring of 1957 the rate was expected to be 15 a month, an all time high.

On the military side, the Douglas Destroyer made its appearance in the Air Force inventory of combat aircraft. First of the B-66 series was delivered to the Tactical Air Command early in the year.

The B-66, a 600-700-mile-per-hour light bomber of swept-wing jet configuration, was produced at Douglas Long Beach division, along with a reconnaissance version, the RB-66. Still a third reconversion, the RB-66C was built at the company's Tulsa division.

Also at the Long Beach division the giant C-133A made its first flight. The huge turbo-prop logistics carrier, largest production transport in the world, is capable of carrying payloads up to 100,000 pounds.

Late in the year announcement was made of an even larger military carrier, the C-132, being built at the Tulsa division. The C-132, with a gross weight of approximately 400,000 pounds and a speed in the vicinity of 500 miles per hour, will dwarf even the huge C-133A.

In October the nation's smallest jet combat aircraft, the A4D Skyhawk,



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went into service with the Navy. With fleet delivery of this airplane, the El Segundo division of Douglas hung up a record as the first manufacturer to qualify three production aircraft for the fleet in a single year.

The other two Douglas aircraft to enter fleet service during the year were the A3D Skywarrior, the Navy's largest carrier-based airplane, and the F4D Skyray, supersonic, bat-winged jet interceptor.

A new supersonic fighter, the F5D made its first flight in April, and another version of the historic AD Skyraider series, the AD-7, was produced at the El Segundo plant.

Alone or in collaboration with leading electronics firms the Douglas company was engaged in work on eight major missile projects for the Air Force, Army and Navy during the year.

One of the newest of these was the Air Force intermediate range ballistic missile known as Thor, for which Douglas has the airframe development responsibility.

While several of the Douglas missile projects are still in the development stage, the company has produced three missiles now in the hands of operational units. These are the Army's Honest John and Nike and the Navy's Sparrow.

Stepped up volume of military and commercial business in the company increased employment to more than 80,000, a new peacetime high for the organization. Payroll at the five Douglas divisions, Santa Monica, El Segundo, Long Beach, Tulsa and Charlotte, N. C., amounts to more than \$8-million weekly.

Going into the fourth quarter of last year, the company showed an increase in sales but a reduction in earnings compared with the previous year.

At that time the company had orders valued at \$2,279,842,000. And for the first time in the history of Douglas the commercial portion was up to an even 50 percent of the backlog.

Net earnings of \$20,595,609, equivalent to \$5.56 per share, were realized on sales of \$711,285,995 for the first three quarters of the year.

This compares with a net of \$23,368,508, or \$6.31 per share of capital stock, on sales of \$679,157,313 for the comparable period of 1955.

Higher development costs, largely attributable to the increased tempo in the DC-8 program, accounted for a sizeable portion of the dip in earnings. For that period the figure of \$16,752,288 was more than twice the experimental and development costs for the first three quarters of 1955.

Construction neared completion during the year on a giant new installation east of the Long Beach division plant. The new structure, covering 24 acres of floor space, will house the final assembly activity in connection with DC-8 production.

The new facility at Long Beach represented an investment of \$15-million in actual construction costs. Another \$5-million to \$10-million was slated for machinery and equipment for the DC-8 assembly installation. Meanwhile another \$5-million worth of construction was underway

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**Douglas Air Force RB-66**

at the Santa Monica division, occasioned by the demands also for the DC-8 expansion and for the missiles programs.

Much public attention has been focused on research efforts aimed at noise reduction of jet engines with the advent of the commercial jet age. Douglas acoustical engineers have been making quiet, steady progress in this field, leading Donald W. Douglas to state publicly that by the time the DC-8 flies, he is confident engine sound will be reduced to a level acceptable to the public.

Meanwhile, generally, the Douglas research and development effort reported significant progress in the following fields:

Titanium and stainless steel research and development as related to parts functioning at elevated temperatures.

Plastic research toward the same end, but also to include heat generated in flight.

Continuing research of airfoil surfaces—both for airplanes and missiles—at the Cooperative Wind Tunnel at California Institute of Technology.

New machining and forming techniques through treatment of materials.

Research to discover new and unique methods to detect fatigue limits of materials and fabricated parts.

### **Fairchild Engine and Airplane Corp.**

Re-entry into the commercial transport field with the 40-passenger propjet F-27, expanded production of C-123 Provider cargo and assault transports, contracts for the development and production of a new type lightweight turbojet engine, announcement of a new four-jet executive transport, development of a series of revolutionary lightweight weapons, and

additional contracts for guided missile systems highlighted activities of the Fairchild Engine and Airplane Corporation in 1956.

Within a few months after announcement that Fairchild would manufacture and sell the F-27—designed as a successor to the DC-3—orders and short term options for more than 60 of the 280-mile-per-hour, high-wing aircraft were signed by local service airlines and corporations. Early airline purchasers included Frontier Airlines, Mackey Airlines, West Coast Airlines, Bonanza Air Lines, Piedmont Airlines, and Quebecair.

Tooling for production of the F-27 was underway at the Fairchild Aircraft Division facility at Hagerstown, Md. First production model was scheduled for completion late in the summer of 1957, with first deliveries to customers expected to be in October, 1957. The F-27 was designed and developed by Fokker Aircraft Company, Amsterdam, and Fairchild, and prototype models have been undergoing extensive flight testing in Europe for nearly two years.

Several corporations also have placed orders for F-27A's to be used for executive transport.

Air Force "follow-on" contracts for 42 more C-123's increased the number built or on order to a total of 279. Under present orders, production was scheduled to run through 1958.

The Fairchild Aircraft Division became the largest of more than 2,000 Boeing B-52 subcontractors in 1956 with new contracts calling for the production of two large fuselage sections and "follow-on" contracts for vertical tail fins and outer wing panels. Fins and wing assemblies for the all-jet intercontinental bomber have been manufactured by Fairchild since 1953.

During the year, the Aircraft Division reported that it was entering the light jet utility transport field with its M-185, a four-engine design undertaken with Fairchild Engine and Airplane Corporation research and development funds.

A mock-up of the M-185 was built, and the prototype model will be started early in 1957, with late 1957 or early 1958 tentatively set for flight testing. The M-185 will be powered by four Fairchild J-83 jet engines.

The scope of the division's overhaul and repair work was expanded at both the main plant in Hagerstown and the modification center in St. Augustine, Fla., with contracts to inspect, repair and overhaul several hundred B-26 bombers.

In April, the Army announced that it had awarded a research and development contract to the Aircraft Division for an STOL-VTOL airplane. Under the first such contract ever given directly by the Army, the project calls for studies on a new type of high-lift aircraft employing conventional piston engines located along the entire length of the wing.

Research work on the C-123 included the fatigue testing of standard landing gear assemblies and the design and prototyping of a radical wheel-ski landing gear for the assault transport. The wheel-ski system, built and flown during the closing months of 1956, is designed for Arctic operations where surfaced runway facilities are absent.

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The fatigue studies, in which some 5,000 landings were simulated with varying load and stress factors, were undertaken with an Air Force research contract to aid in developing gear systems for the C-123 and other types of military aircraft. The tests were conducted with special equipment designed and built by the division's engineering test laboratory.

The C-123's ability to parachute personnel and equipment into combat drop zones was demonstrated earlier in the year when the transports dropped equipment bundles and more than 1,000 paratroopers in a series of Air Force-Army tests at Fort Bragg.

The new weapons, developed by the Armalite Division at Hollywood, Calif., include (1) a survival rifle weighing only two pounds, six ounces, (2) Parasniper rifles calibered for the .308 W and other cartridges, (3) several shotguns, and (4) an automatic rifle in the new NATO 7.62 mm cartridge. Each basically is produced with an aluminum barrel of special alloy with a stainless steel liner, and aluminum and stainless steel action, stainless steel clip and fiberglass and plastic foam stock with rubber butt plate.

The survival gun, which has been adopted as US Air Force Standard, can be produced in .222, .22 Hornet, or .22 calibers. Barrel and action can be quickly disassembled without tools for storage in the stock. It will float in water whether assembled or disassembled.

Weight of the Fairchild AR-10 automatic rifle is 6.85 pounds—pounds

### **Two Fairchild Petrel Air-to-Surface Guided Missiles pylon mounted on Navy P2V-6B**



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less than two other automatic rifles undergoing tests by the military services. It has a 700 shot per minute rate of fire. The shotguns, also employing the Armalite principle, are designed primarily for civilian use.

All development work on the guns, which has been carried on since 1953, has been conducted with Fairchild funds as a part of Fairchild's extensive company-financed research and development program.

First details of the Fairchild Petrel air-to-surface missile, in production at the Fairchild Guided Missiles Division's plant at Wyandanch, Long Island, were announced during the year by the Navy. Referred to as "a sophisticated weapon" because its electronic brain enables it to think for itself, Petrel provides long-range patrol aircraft with an all-weather capability against surface ship targets. It is launched from Navy P2V-6B aircraft.

In addition to contracts for guided missiles systems received during the year, continued emphasis was placed on the research and development of advanced missile weapon systems. These programs involved all three branches of the military services.

The Division also redesigned and produced bombing system simulators to train bombardiers for optical and radar bombing systems under new contracts from the U. S. Naval Training Center at Sands Point, N. Y.

A stepped-up program was initiated at the Division's Molded Plastics Department at Copiague, Long Island. A number of new contracts for plastic items were received, including an order from the U. S. Air Force for J-57 turbojet engine containers. Other fiberglass reinforced plastic items produced included bazookas, missile components, switchboard, battery, radio, and sextant cases for the military services.

During 1956 the Stratos Division expanded its operations into the high pressure pneumatic field, and enlarged its facilities for the production of aircraft air conditioning systems, auxiliary power turbines and other engineered aircraft accessories. The Division renovated the Manhattan Beach, Calif., plant it acquired in 1955 for its Western Branch and approximately doubled the floor space of the Western plant through the addition of a large new manufacturing section. Additional manufacturing space was added to the Division's main plant at Bay Shore, Long Island, N. Y., and to a nearby Industrial Products Branch plant located at Babylon.

Stratos increased the production rate of air conditioning systems it produces for the B-52, and developed several new air cycle air conditioning systems. A considerable amount of development work on freon refrigerating equipment for aircraft was completed.

The year 1956 also saw the introduction by Stratos of a new type of compressor. Called the Heli-Rotor, the new machine was first used as a compressor in freon refrigeration systems. Other aeronautical applications were under development as the year ended. The compressor is unique in that it is both rotary and positive displacement, filling a gap between the centrifugal and axial compressors and reciprocating positive displacement machines.

A superior type of temperature-resistant, honeycomb-core material

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called "Ribboncore" was developed during the year by the Fairchild Electrotechnics Division at Costa Mesa, Calif. Machinery for the resistance welding of this steel-honeycomb-core material to steel-skin facings, and production of Ribboncore, is scheduled for completion in 1957.

### **Goodyear Aircraft Corp.**

Production continued at Goodyear in the lighter-than-air field with the models ZPG-2W and ZS2G-1 Airships. In addition to these, design progressed on a new larger model designated as the ZPG-3W, this new airship being a larger version of the ZPG-2W designed specifically for air-borne-early warning missions.

Three models of thrust reversers were completed and tested. Tests showed excellent reverse thrust effectiveness and good engine modulation characteristics. In addition, parallel investigations were conducted on jet noise sound-suppression with promising results.

Goodyear Aircraft's ejectable seat capsule was altered and redesigned to permit use in tomorrow's aircraft. Aircraft designers were particularly interested in personnel survival factor exhibited by the air-blast protection provided.

Guided missile support equipment was in production. The prime mover chassis was designed to accommodate the Terra-Tire, a product of the parent company, Goodyear Tire and Rubber Company. The principles involved greatly reduced the number of vehicles required for squadron support and permits operation over all types of terrain.

The corporation had more than 10,000 employes working on assignments at the six Akron plants and adjacent Wingfoot Lake Airship Base. Another 2,500 were employed at the company's Arizona Division in Phoenix.

Construction of a new building, housing all engineering personnel and research and development programs at the Arizona facility, was completed. A similar building was underway at the Akron site with occupancy expected in early 1957.

### **Grumman Aircraft Engineering Corp.**

During 1956 Grumman Aircraft Engineering Corporation continued military deliveries of F11F-1 Tiger and F9F-8 Cougar jet fighters, the twin-engine S2F-1 Tracker anti-submarine warfare aircraft, and the air-sea-rescue Albatross amphibian, and, in addition, developed and produced variations on each of these basic airframes.

In August, Grumman acquired a fifty percent interest in Dynamic Developments, Inc., a leading hydrofoil research organization. Initial joint effort of the companies involved study on the application of hydrofoils to military craft, flying boats and amphibious aircraft.

The previous month, Grumman received a \$5.5-million contract to build Albatross amphibians for the Republic of Indonesia. Under terms of the contract the first Albatross will be delivered in 1958 and continue at one a

month until the agreement is completed. The Indonesian Air Force will use the twin-engine aircraft for rescue and utility missions.

Re-entering the missile field, the company completed preliminary design proposals on three projects. As another step in its expanding research and development program Grumman built a supersonic wind tunnel on the facility of the Polytechnic Institute of Brooklyn Aerodynamics Laboratory, Freeport, Long Island. Latest type testing equipment now in use includes facilities for simulating flight loads of a complete aircraft, telemetering for monitoring supersonic in-flight test data, and flight simulators. The Research Department purchased an additional \$25-million worth of analog computers. Cockpit capsule research and titanium development projects were also underway.

Two prototype F11F-1F's—faster versions of the Navy's F11F-1 Tiger—were developed and flight tested successfully at Edwards Air Force Base, Calif. Equipped with a General Electric J-79 turbojet and afterburner, the modified Tigers displayed a marked increment in performance while retaining the inherent stability of the F11F-1. Relatively minor revisions required to install the larger J-79 powerplant included increasing the capacity of the inlet ducts and rebuilding the aft fuselage.

Testing at Navy and contractor facilities continued on the basic supersonic F11F-1, which is powered by a Curtiss-Wright J-65 engine and afterburner.

Early in the year the company received a Navy contract to build in excess of 100 F9F-8T Cougar fighter-trainers. This two-seat version matches the performance of the basic operational F9F-8 Cougar fighter. Armed with two 20mm cannons and capable of carrying a wide variety of external stores, the F9F-8T will be used aboard carriers as an operational fighter in addition to its advanced jet trainer mission. First flight was February 29th, and during the next 29 days the aircraft completed 29 flights without incident.

A photo-reconnaissance version, the F9F-8P Cougar, was also delivered in quantity to the Navy. Equipped with the latest type cameras and camera control installations, it provides the fleet with its fastest and most versatile operational fighter-photo aircraft.

The operational F9F-8 Cougar jet fighter continued in production and on October 5th demonstrated its speed and long range capabilities, setting an unofficial round trip transcontinental speed record. On a navigational training flight, three Navy pilots from Fighter Squadron 144 flew their Cougars from San Diego, Calif., to Grumman's Peconic River Plant on eastern Long Island and returned to the west coast again in 10 hours, 49.41 minutes for the 4,924 mile trip. They refueled each way at NAS, Olathe, Kans.

The F9F-8 Cougar's ability as a gun platform was demonstrated at the Navy's first Air Gunnery Meet at El Centro, Calif., on June 23-25, placing first in the squadron and individual flying competitions.

Delivery of the twin-engine S2F-1 Tracker, the world's first carrier-based aircraft specifically designed to detect, identify, track and destroy

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**Grumman S2F-1 Tracker**

submarines, continued to the fleet's growing anti-submarine warfare division. Design and equipment improvements have been incorporated in the aircraft, further increasing its ASW mission potential. Still further variations of the basic airframe are in development or flight evaluation status. Under the Mutual Defense Aid Program, six S2F's went to Italy and 30 are to be delivered to the Japanese government. This delivery schedule began late in 1956 and will continue through 1957 and into 1958.

The excellent load carrying capabilities, short field and single-engine performance demonstrated by the carrier-based TF-1 Trader resulted in a \$24-million re-order from the Navy during the year. The Trader, a passenger-cargo-utility-trainer version of the S2F-1 Tracker, has been assigned to the Fleet Logistic Air Wings as a re-supply craft.

The SA-16B, a faster version of the SA-16A Albatross with increased range and single-engine performance, was developed for the Air Force's Air Rescue Service, and Grumman received a contract for conversions to begin in 1957.

The redesigned SA-16B features a 16.5 foot longer wing span and larger horizontal and vertical tail surfaces. Wing tip slots were replaced with cambered leading edges which improved control at low speeds and at higher angles of attack. Antenna housings were modified to reduce drag and new high pressure de-icing boots were installed on wing and tail to expedite ice removal.

During the year Grumman received sub-contracts for military and commercial products from some of the nation's largest corporations.



### **Helio Aircraft Corp.**

The Helioplane, a four-place, all-metal executive airplane, was in production at the manufacturing division of Helio Aircraft Corp. in Pittsburg, Kansas. High speed, long range economy with stall-proof, slow flight and ultra short field utility were combined to bring to the business market a safe, convenient executive airplane.

At the company's research and development shop in Norwood, Massachusetts, sub-contract production more than doubled since the early part of the year.

Effective August 29, 1956, Helio Aircraft Corporation acquired complete ownership and control of the aircraft plant, equipment and organization which had for the preceding year been producing the Helio Courier as an independent contractor. This plant, employing 150 production employees, incorporated as the Mid-States Manufacturing Corporation of Pittsburg, Kansas, has now become the Mid-States Division of Helio Aircraft Corporation. The transaction involved approximately \$1-million in common stock and notes.

In line with new demand, another in the family of helioplanes was added. The new addition was a 340 hp supercharged model to carry camera loads to 30,000 ft. for aerial mapping and other specialized operations.

### **Hiller Helicopters**

One of the most significant aviation developments in 1956 for Hiller Helicopters was the rapidly increasing interest in VTO aircraft by all military and commercial groups. As a pioneer in the field, Hiller shared a large part of this interest, and continued its past diversification of projects aimed to bring about practical aircraft for various types of missions embodying vertical takeoff and landing capabilities.

A growing emphasis was placed on VTO research and development by all the services, with the result that Hiller had major projects under way with the Army, Air Force, Navy, and Marines.

One of the industry's most significant projects of recent years was announced in 1956 when the Air Force revealed a contract with Hiller Helicopters for the development of a transport-size tilt wing propelloplane research aircraft. With a design gross weight of 33,000 pounds and more than 10,000 horsepower in twin nacelles, this aircraft, designated the X-18, is to be flown to investigate the radical flight principle of tilting wing and propeller units, to combine vertical takeoff and landing characteristics with the high performance characteristics of today's conventional transport airplane.

Meanwhile, in the completely different category of ducted wing aircraft (in which Hiller pioneered during 1955 with the announcement of its one-man Flying Platform), the company, in close cooperation with the Army, initiated the second phase of this development program. Prototypes of a multi-engine Flying Platform were under construction at Palo Alto. As in

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the case of the original Hiller Platform model, the pilot stands above the lifting duct and relies on instinctive body balance for directional control.

One of the Army's principle concerns in using aircraft to attain mobility is that vehicles be radically simplified, both from the standpoint of logistics support and flight safety. With the Army's acceptance of the ram jet YH-32 at Fort Rucker for field evaluation in the fall, another forward step was taken toward attainment of helicopter simplicity. The YH-32 has twin 12 pound ram jet engines with no moving parts, which develop 45 horsepower each, installed on rotor blades for tip propulsion, completely eliminating complexities of conventional piston driven engines and transmission drive systems; and makes extensive use of fiberglass for both structural and non-structural parts. This aircraft, commonly called the Hornet, is a two-place helicopter with a useful load equal to its own empty weight.

Among other projects on which Hiller was engaged: development of a retractable rotor system for the Air Force, which could be incorporated on a convertiplane; and development of a compact one-man helicopter for the Marines which is foldable into a small package for easy transportation or parachute drop and quick assembly.

On the production front, the H-23C continued as the three-place helicopter produced in quantity for the Army. Although handicapped early in the year by a model change-over from the "B" to the "C," the company met all production schedules. The H-23D, to go into production the fall of 1957, is the first helicopter designed under the Army's concept of achieving lower operating costs through extended overhaul periods. The "D" will have a Lycoming 265 horsepower engine and a completely new transmission system designed for 1000 hours' service between overhauls.

Plant facilities continued to grow commensurate with projects. By year-end Hiller had approximately 170,000 square feet of floor area in nine buildings. During 1956 a small heliport was built into the newly landscaped front of the plant, on which visitors coming by helicopter can now land less than 100 feet from the main lobby. Employment passed the 850 mark.

Hiller aircraft continued to play a vital role in the expansion of Army aviation activities in field operations. Used in a variety of missions, including observation, training programs, liaison, survey, and exploration, the H-23C is in service throughout the United States and the Caribbean area. The National Guard also continues to use these helicopters.

On the commercial sales front, the Hiller 12-C continued to go into service in countries around the world. Typical examples: in England, the helicopter training program set up by Air Service Training, Southampton, with 12-C's was so successful that additional 12-C's were added; in Viet Nam, the government added more Hillers to the fleet which has seen much service in years past; in Colombia, increasing exploration for oil brought about the use of more Hillers; and in Melbourne, Trans Australia Air lines purchased another 12-C following integration of the first helicopter into its operations.

### **Kaman Aircraft Corp.**

Kaman Aircraft continued with a heavy program of research and development during 1956 in addition to its production of HOK-1 helicopters for the Navy and Marines, and subcontract work on tools for the Martin P6M Seamaster and canopy parts for the McDonnell F-101 Voodoo.

In research and development, Kaman Aircraft carried on twenty research and development programs under contract to the Navy Bureau of Aeronautics, the Navy Bureau of Ordnance, the Office of Naval Research, the Air Force, the Army Signal Corps and the Army Transportation Corps. Also the company executed several R&D programs with its own funds. While most of the programs were under wraps for security reasons, several significant ones were cleared for release, including the robot (remote radio controlled) helicopter, rotachutes of varying sizes and uses, the application of Lycoming's new T-53 gas turbine as a helicopter powerplant, an automatically hovered helicopter used as a surveying target, and research on a ring-wing type aircraft.

### **Kellett Aircraft Corp.**

Highlighting the continued growth of the company during 1956 was the move to its new and larger facility at Willow Grove, Pa. Completed in 1956, the new building provides new and modern accommodations for the firm's engineering, manufacturing and flight test activities.

Kellett's research and development activities in the field of rotary wing continued with several prime contracts for the Army, Air Force, and Navy. Work was started on the study, design, fabrication, and flight testing of stabilizing devices as applied to both single rotor and tandem configurations. An analysis of a propeller-rotor employing new design concepts was initiated and will be applied to a tilting wing VTOL aircraft.

A Navy contract involving the installation of wings and several rotor system modifications to a tandem helicopter was completed by the company. The construction and instrumentation of a Model Rotor System relating to a theoretical study of helicopter rotors employing large offset hinges were completed. The system is currently undergoing wind tunnel tests for the armed forces.

Development of the small KH-15 rocket powered helicopter was continued, and its unique gyro stabilizing system was evaluated by the military services.

### **Lockheed Aircraft Corp.**

Lockheed Aircraft Corporation pilots unveiled the first in a series of rapid-fire aviation advances in 1956, the stubby, thin-winged F-104A Starfighter, the fastest combat airplane in the world. Its speed: secret.

The Starfighter is a sleek needle with a high, T-shaped tail and mosquito-like wings that extend but 7½ feet from the fuselage. Its straight wings are so sharp they must be covered with felt to protect workmen servicing the airplane.

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Almost simultaneously Lockheed announced the first of the two-seat F-104Bs, expected to be the fastest two-place airplane ever built. First of the two-seaters flew before the year was out, and both models moved into quantity production.

A reconnaissance model of the F-104 was also in the early stages.

Lockheed's Georgia Division established its nuclear aircraft research center on 10,000 acres of undeveloped land near Dawsonville, Ga., in 1956, and let contracts for facilities in a continuing program of atomic powered aircraft research and development. During the year scientists and engineers from the California Division joined the Georgia atomic aircraft staff for a single coordinated program which first began at Lockheed in 1948.

Lockheed's Missile Systems Division in Van Nuys, Calif., disclosed two closely guarded unmanned vehicles, one designated the USAF X-7 with ramjet power for development of new forms of power and other important missile components, and the other of undisclosed designation with rocket power for probing into key problems in the nation's intercontinental ballistic missile program.

These were but two of a dozen major projects, all highly classified, at Lockheed's 5,000-man Missile Systems Division.

The division's installations at Van Nuys were kept in full operation. Projected buildings in Northern California totaled 376,000 square feet, and Lockheed employment in the Bay area was expected to be about 2,000 by the end of 1957. First moves into the division's scientific laboratories near Stanford University in Palo Alto took place in September, and into new engineering, administration and manufacturing facilities in nearby Sunnyvale in October.

In El Centro, Calif., Georgia-built USAF C-130A Hercules transports set records in 1956 for parachute discharge of cargo, including a 27,000 pound load as the heaviest single-item drop ever undertaken by parachute, and a 29,000 pound load in 18 containers as the largest number of units in a multiple cargo load ever dropped. Additionally the new propjet (a) passed its USAF climatic tests at Eglin AFB, Fla., and (b) successfully completed personnel and cargo parachute delivery tests at Fort Bragg, N. C., prior to delivery of first units to the Tactical Air Command.

During August, Lockheed unveiled its experimental "flying saucer" Super Constellation radar airplane built for the U. S. Navy. The saucer is a radar housing that measures more than 30 feet across. The huge disk-like structure is perched atop a modified WV-2 radar sentry airplane as the latest advance in protection against sneak attack.

Soon after, the manufacturer rolled out a new Model 1049H Super Constellation that looked like a standard Super-G luxury airliner. It measured the same and it performed the same. Yet it incorporated a beefed-up flooring and an extra-sized door which permit the airplane to be assigned to heavy cargo use when necessary.

Also in 1956 Lockheed introduced its new re-winged 1649A Super Constellation as the longest-range airliner in the world. Measuring 150 feet from wingtip to wingtip and having a fuel capacity of 9,600 gallons, the

first of the new challengers in the long-range luxury field rolled from Lockheed's Burbank assembly lines September 13, four days ahead of production schedules established 18 months earlier.

First flight of the Model 1649A took place October 10 to begin a six-month certification program leading to delivery to Trans World Airlines, Air France, Linee Aeree Italiane, Deutsche Lufthansa and Viacao Aerea Rio Grandense (Varig of Brazil).

Concurrently with flight-testing the company's new SeaStar jet trainer for the U. S. Navy, research engineers slammed the T2V-1 to the ground repeatedly in carrier landing qualification requirements—one of the toughest test conditions to be met by any aircraft, lifting and dropping an entire trainer from higher than a man's head.

For Lockheed test pilots, 1956 was one of their busiest years. Their test work included continuing production and development on Super-G Constellations, RC-121C and WV-2 early-warning radar airplanes, and P2V-7 Neptunes.

All of these airplanes—and the new propjet Electra—contributed to Lockheed's peace-time high in production backlog which amounted to \$1.6-billion at the beginning of the year's fourth quarter.

Seven models of military planes, commercial transports and missiles were included in the record backlog.

Sales through September totaled \$514,433,000. Of this figure, military sales accounted for \$433,498,000, up \$20-million from the first nine months of 1955. Commercial sales of \$80,935,000 were second highest nine-month aggregate in Lockheed history.

Work was undertaken on more than \$19-million worth of expansions and improvements in 1956 as part of a multi-million dollar long-range growth plan.

At the California Division construction of a new 80,000 square foot flight test hangar was under way, first unit of a modern, fully equipped engineering test center.

The year saw completion of a new paint hangar and a new tank seal building, and renovation of the former Lockheed Aircraft Service, Inc., facilities to provide 279,000 square feet of hangar area for assembly operations on the Electra and P2V Neptune.

The California Division installed upwards of \$1.5-million worth of new machinery and equipment at Burbank and Maywood plants to meet pressing production demands imposed by the Electra and 1649A and increased orders for the F-104A and F-104B.

### **McDonnell Aircraft Corp.**

McDonnell Aircraft Corporation's sales for the year were up 20.4 percent to an all-time record high figure of \$186,204,381. This compares with \$154,588,816 for fiscal 1955. Earnings after taxes increased to \$6,751,569 in fiscal 1956, from \$4,555,795 in fiscal 1955, and backlog of orders more than doubled.

The expanded work load required commencement of a second five-year

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facilities program on which over \$2-million had been expended by year-end. Included in this amount was over \$1-million for construction and equipment of a building occupied by the Missile Engineering Division. This is the first unit of an Engineering Campus on which construction of a second unit began on April 9, 1956. During the year the company completed an earlier five-year \$21-million facilities expansion program.

Total employment on June 30 was 16,436, a new high. Payroll totaled \$79,647,214, also a record figure. Total floor space on June 30 was 2,761,121 square feet.

A new Research Department was established during the year to enable the company to maintain its pioneering position in the development of aircraft and weapons systems.

Also during the year the U. S. Navy increased its order for the development and initial production of the F4H-1, a twin-jet supersonic all-weather attack fighter.

The F-101A Voodoo, which is still classed as the world's most powerful fighter, completed most of its development testing during the year, and the output of airplanes per month steadily increased.

The F-101, which combines long range and speed greatly beyond the

### McDonnell-USAF Convertiplane



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speed of sound, has been ordered in three versions by the U. S. Air Force. It is scheduled to be the first tactical airplane to be utilized by all three major commands of the Air Force.

As the only supersonic airplane to be exposed in flight to an H-Bomb explosion at Bikini Atoll last May, the F-101A indicated its capability of withstanding radiation and blast effects.

The F3H-2N all-weather Demon completed all Navy trial and evaluation programs required for fleet release, and the first two Demon squadrons went into service with the Atlantic and Pacific Fleets during the year. Also, first F3H-2M missile-carrying Demons were delivered to fleet squadrons during the year.

Successful performance of the Demon, the Navy's fastest all-weather fighter, resulted in the placement of an additional \$55-million order for Demons in March 1956. Production under this contract was scheduled to continue through March, 1958.

Radar-equipped F2H-3 and F2H-4 Banshees continued as the U. S. Navy's standard all-weather fighter and atomic weapon deliverer. Two carrier squadrons of the Royal Canadian Navy based at Halifax, Nova Scotia, also operated F2H-3 Banshees.

In the helicopter field, the XV-1, world's first aircraft to make a successful conversion from helicopter to airplane flight, continued its program of development during the year, incorporating and testing many improvements and modifications. The XHCH-1 flying crane program for the Navy also made steady progress with a major portion of the rotor, power plant and control systems being constructed and assembled.

Missile activity at McDonnell continued to increase, with work being performed on two major missile programs in conjunction with the Navy and on two with the Air Force.

The \$34-million backlog of missile work represented a 126.5 percent increase during 1956. In that same period, the number of Missile Engineering Division personnel increased nearly 50 percent. A number of versions of Talos, a supersonic, surface-to-air missile, were successfully tested.

### **Martin Company**

Focal points of greatest interest for Martin during 1956 were: (1) receipt of a contract to develop a new USAF experimental tactical bomber; (2) announcement of successful first flight of the second XP6M-1 Sea-Master and receipt of a contract for production quantities; (3) disclosure of first flights and production of two new versions of the B-57; (4) revelation by the Secretary of the Air Force that Martin's Denver Division is developing the ICBM Titan; (5) receipt of a contract for erection of a nuclear power plant in the Dominican Republic; (6) disclosure that a new guided missile, the Lacrosse, had gone into production for the Ordnance Corps, U. S. Army; and (7) development of Missile Master, an electronic system for controlling Army anti-aircraft batteries.

On May 29, 1956, the USAF and Martin announced that the Company had been selected the winner of a competition to develop a new experimental

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tactical bomber. The previous August the Air Force had announced the award of Phase I contracts to two aircraft manufacturers, one of which was the Martin Company.

The Navy's second XP6M-1 Martin SeaMaster made its first flight on May 18, 1956, and was airborne for about 1½ hours. In September, the U. S. Navy announced it had placed an order totaling more than \$121-million for 24 SeaMasters, spares, ground handling equipment and special tools.

On April 25, 1956, a statement revealed that two new versions of the B-57 had completed first flights and were in production status: (1) the RB-57D, a high altitude test bed for two J-57 engines, and (2) the B-57E, a tow-target version of the basic B-57 with relatively quick convertability to a tactical bomber.

Air Force Secretary Donald A. Quarles stated on March 21, 1956, that the Denver Division of the Martin Company was developing the Intercontinental Ballistic Missile Titan. Work on the Titan was started in the Company's Baltimore plant. Martin moved the work on Titan to Denver when its new division was established there.

On June 12, 1956, Generalissimo Trujillo of the Dominican Republic announced that pending U. S. agreement, an atoms-for-peace power plant will be installed in his country by Martin. It is estimated that the Martin nuclear power plant will increase the capital electrical supply by more than 26 percent.

On October 5, 1956, the Company announced production of a new surface-to-surface guided missile called Lacrosse for the Ordnance Corps of the U. S. Army. Designed for close support operation on the battlefield, with emphasis on accuracy and mobility, the essential components are the missile, a launcher mounted on a standard Army truck, and a guidance station.

The U. S. Army and Martin announced jointly on March 23, 1956, the development of Missile Master, the country's first electronic system designed specifically for controlling and coordinating the use of Nike anti-aircraft missile batteries and other advanced Army weapons as they become available.

During the year production went forward on USAF B-57 bombers; USN P5M-2 Marlin anti-submarine warfare seaplanes; USAF TM-61 Matador tactical missiles; and USN P6M-1 SeaMaster attack seaplanes. On January 10, 1956, the USAF announced an additional order for a substantial quantity of TM-61 Matadors, and on September 5, 1956, the Martin Company stated it had received a contract in excess of \$4-million calling for modification of a number of Matadors to increase still further their effectivity. Early in March the Martin Company revealed that successful test firings had been made with a new version of the Matador—the TM-61B. This version is longer than its predecessor, carries a larger nose section, and has an entirely new airborne guidance system.

During the year, considerable progress was made also with Project Vanguard, for which the Martin Company is building the launching vehicle,



which will put the earth satellite into its orbit during the International Geophysical Year. It was stated in September 1956 that before this occurs a flight test program will be conducted at the Air Force Missile Test Center, Cocoa Beach, Florida. First test firings were to begin during the fall of 1956. The first Vanguard propulsion unit to be tested will be the third stage solid rocket. This will be carried aloft in a modified Martin Viking rocket. The final test configuration will consist of all three Vanguard stages, and will, therefore, be virtually identical with the three-stage rocket employed for launching the satellite. However, no orbit will be attempted during the test program since all of the vehicles will be heavily loaded with test instruments.

Disclosure was made on April 30, 1956, that engineering studies were underway at Martin looking to development of an airframe for a nuclear powered seaplane. At that time the program had been in operation for more than a year under a special contract with the Office of Naval Research and the Bureau of Aeronautics.

RIAS, Inc., moved into separate quarters in Baltimore during September 1956 with a staff of 25 scientists. The objectives of this facility remained unchanged, i.e., to pursue fundamental research under industrial management without constraining its investigating scientists to product development. Fields under investigation include metallurgy, photo-synthesis, mathematics, solid state physics and biochemistry.

Sizable new building facilities were completed and occupied at Middle River while still others were in process of construction.

In August 1956, an addition to the Personal Building totaling 14,600 square feet was put to use, and two months later a new Engineering Building with 65,000 square feet was fully occupied. Meanwhile, a 22,400 sq. ft. hanger was being built at the Martin Airport; a 40,000 sq. ft. structural test facility was scheduled to be ready during the first quarter of 1957; a structural test tower for the Vanguard rockets was nearing completion in October 1956; and a three-story cafeteria building with more than 18,000 square feet of floor space was scheduled for availability at least by the year's end.

During the year of 1955 the Martin Company was using 275,000 square feet in off-premise locations. In 1956, this total increased to 343,000 square feet.

On September 14, 1956, the Company announced it had purchased a 10 square mile site on the outskirts of Orlando, Florida, and the president, George M. Bunker, said the new location is required to execute Martin's commitments in the fields of electronics, nucleonics, and missiles as well as piloted aircraft.

During 1956, the Martin Manufacturing Research and Development Laboratory developed Marbraze, a new aluminum dip brazing. It utilizes a paste filler applied with a brush to the joints to be brazed instead of the sheet or wire filler which formerly had to be formed to fit the joint.

Martin engineers worked out a process for welding titanium by flowing inert gas over the joint being welded and using a metal or helium back-up.



**Martin B-57Es—jet-powered tow-target airplanes**

This eliminates the necessity of welding in a chamber to exclude the atmosphere.

Research personnel discovered, also, how to form titanium without cracks on ordinary cold forming machines through the application of resistance heating.

Research in the utilization of radioactive isotopes in inspection, safety devices and other possible phases of aircraft production was actively pursued.

Investigation was begun and is continuing on the efficiency of ceramic cutting tools.

Because of the increasing use of plastics in modern airplanes, Martin found it desirable to set up a prototype radome facility. The equipment in this modern facility is of laboratory rather than production type. It enables Martin technicians to prove or disprove tools and processes under simulated shop conditions in advance of release of the production item.

Martin, also, pioneered a number of unusual uses for stainless steel in aircraft construction and concurrently developed some fabricating processes.

One example was the development of stainless steel sandwich panels, containing honeycomb or corrugated cores. In this instance the company found that prices for outside procurement and delivery schedules were prohibitive so Martin developed its own new processes for producing stainless steel honeycomb. Other examples: sheet forming of jet engine exhaust stack rings, nacelle structures and other structural parts; in plating and finishing; in dip brazing, riveting, and welding.

A VANGUARD Satellite Essay Contest was announced by the com-

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pany in October 1956, with awards totaling \$24,000. Ten prizes totaling \$12,000 were offered students, plus duplicate awards to the accredited institutions sponsoring winning papers. Contestants were required to write on some problem associated with the design, manufacture, or use of orbital vehicles.

In January 1956, announcement was made of a program involving the loan of staff members of the Company to colleges as full-time professors of engineering or science. In addition to this "professional lend-lease," Drexel Institute and Martin, later in the year, concluded an arrangement by which any qualified engineer in the Company's employ at Middle River may earn an accredited master's degree in engineering or physics while still carrying on normal day-to-day work assignments.

Martin's sales for the first nine months of 1956 were \$228,766,424 as against \$194,805,592 for the same period of 1955. Current backlog is over \$660-million. Employment at the end of September 1956 was over 26,000.

### **North American Aviation, Inc.**

In 1956, North American Aviation, Inc., had eight different models of aircraft in production at its Los Angeles and Columbus plants, including six jet fighters and two trainer types. In addition, an extensive modernization and modification program was carried on at these plants and at the Fresno, Calif., division.

Aircraft produced at Los Angeles included the F-86F Sabre Jet fighter, the F-100C and F-100D Super Sabres, and a new two-place version of the F-100, the F-100F. Initial delivery of the latter airplane to the Air Force was scheduled for early 1957.

The Columbus Division produced the FJ-3 and FJ-4 versions of the Fury carrier-based jet fighter, the T-28B trainer and the later T-28C carrier-based version, and both the F-100C and F-100D.

Production of parts to support the assembly of Sabre interceptors and fighters in Italy and Japan under Air Force contracts and licensing and technical assistance agreements was also carried on. Fiat of Italy is currently producing the F-86K interceptor version of the Sabre for use by the NATO countries, and the F-86F Sabre is being built by Mitsubishi Heavy Industries Reorganized Ltd., in Japan; first of Japanese-built airplanes was flown in August, with North American test pilot John Bryan at the controls.

Sabre fighters are also produced by Australia and Canada under licensing and technical assistance agreements.

A similar agreement with Construcciones Aeronauticas Sociedad Anonima (CASA) of Madrid, Spain, resulted in the repair and overhaul of F-86F Sabres turned over to the Spanish government by the U. S. Air Force.

Manufacture of F-86 Sabres at the Los Angeles plant was concluded late in December, after eight years of production. In February, the first of a number of F-100 Super Sabres was flown to Europe for Air Force units there, to start conversion of the USAFE to supersonic status. Addi-

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tional Air Force units at bases throughout the United States were also equipped with the F-100 during the year.

Initial development of two new aircraft types for the Navy was carried on at the Columbus plant; these were the T2J-1, a two place basic jet trainer, and the A3J-1, a carrier-based attack weapon. The prototype of a twin-engine jet utility airplane and combat readiness trainer is being developed at company expense at the Los Angeles division.

North American's missile development program was expanded, with extensive work on the SM-64 Navaho, a cruise-type missile powered by both rocket and air-breathing engines. The Navaho program included the design and fabrication of X-10 missile test vehicles, powered by two turbo-jet engines, which underwent tests at Patrick Air Force Base, Florida.

The X-15 research airplane, to be flown at extremely high altitudes and very high speeds was under development under an Air Force contract.

An F-100C, flown by Capt. Manuel J. Fernandez, Jr., set a new Bendix Trophy Event record when it was flown from George AFB, California, to the National Aircraft Show in Oklahoma City in one hour, 40 minutes and 38.8 seconds, for an average speed of 666.661 miles per hour.

A North American Aviation Trophy was awarded at the aircraft show, going to Lieut. (j.g.) David Grosshuesch, who flew an FJ-3 Fury from the carrier Shangri-La, off the West Coast, to Oklahoma City at an average speed of 537.849 miles per hour.

In June, the Thunderbirds, official U. S. Air Force precision flying team, became the first supersonic aerial demonstration group when they were equipped with F-100 Super Sabres.

### **North American B-45 with Pratt & Whitney J-75 engine installed in bomb bay**



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The company's operating divisions increased to seven during the year, with the establishment of the Los Angeles aircraft operations as a separate division.

In addition to Los Angeles, Columbus and Fresno, the divisions include Autonetics and Missile Development divisions in Downey, Calif., and Rocketdyne and Atomics International in Canoga Park, Calif.

Autonetics, engaged in the development of autonavigation, flight control, computing and other electro-mechanical equipment, announced that its NADAR system was being installed in four types of Air Defense Command interceptors. NADAR is a lightweight automatic recorder which translates mission data from the radar system onto a tape which can be "played back" for pilot and aircrew evaluation and training. Production of the MG-4 armament control system for F-86K interceptors was continued.

Rocketdyne was engaged in the production of liquid propellant engines for most of the nation's large intercontinental and intermediate range missiles, including the Navaho, the Army's Redstone, and the Air Force ballistic missile program which includes the Thor, Atlas and Titan. Testing was carried out at the company's Propulsion Field Laboratory in the Santa Susana Mountains in Southern California. Construction of a \$13-million rocket engine plant at Neosho, Mo., which will be government owned and Rocketdyne-operated, was started in mid-year.

Atomics International, North American's atomic energy division completed manufacture and installation of the nation's first privately-owned industrial research reactor, built for the Armour Research Foundation, Chicago. The division also announced orders for smaller reactors from several foreign countries, including Denmark, Japan and Germany, and continued its work on the Sodium Reactor Experiment being constructed in the Santa Susana mountains; the latter will be used to generate electricity for the Southern California Edison Company. A full-scale 75,000 kilowatt sodium graphite nuclear power plant was designed in cooperation with the Atomic Energy Commission, and an organic moderated 12,500 kilowatt power plant was being designed for the city of Piqua, Ohio.

Construction of a new three-story building near Los Angeles International Airport for North American's general offices and related staff functions started in January, and the building was scheduled for occupancy in early 1957. Two wind tunnels, one in Los Angeles and one in Columbus, were under construction or in the planning stage, and flight test facilities at Columbus and at Palmdale, Calif., were expanded. Also being constructed was a new headquarters building for Autonetics, and a number of new engineering and manufacturing facilities were put into use by Rocketdyne, Autonetics and Atomics International. Floor area in use as of September 30 by the company and its divisions totaled more than 11-million square feet, an increase of 15 percent over 1955.

Employment reached a post-World War II high, with approximately 70,000 employees at the years end; nearly 5,000 of these employees have been with the company ten or more years.

During the year, purchase orders totaling in excess of \$625-million were

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placed with some 12,800 firms, the majority of which were in the small business class, with fewer than 500 employees.

Net sales were increased over 1955, and a substantial backlog of unfilled orders pointed to a successful continuity of production and employment.

### **Northrop Aircraft, Inc.**

Northrop Aircraft, Inc., of Hawthorne, California, recorded new strides in the guided missiles and manned aircraft fields in 1956.

For the first time the U. S. Air Force permitted release of some information concerning its Northrop Snark SM-62 intercontinental guided missile. The swept-wing pilotless bomber is the first U. S. intercontinental missile. Designed to deliver an atomic or thermonuclear warhead over transoceanic distances, the Snark was first displayed to the public on Armed Forces Day at Bolling Air Force Base.

A new version of the Scorpion—the F-89H—was introduced by Northrop as the first operational aircraft armed with Hughes Falcon air-to-air missiles. The F-89H carries six Falcons and 42 air-to-air rockets in its wing tip pods. America's most heavily armed fighter, it is operational with units of the Air Defense Command.

Modification and modernization of earlier Scorpion models are being conducted at Northrop's Palmdale facility where more than 1,250 persons are employed. The modified aircraft will be re-designated the F-89J. The conversion program is expected to continue through 1958.

In May, 1956, Northrop was awarded an Air Force contract for a supersonic jet trainer, based on a design developed by the company after two years research.

The trainer plane is a high speed aircraft of advanced configuration. It is simple in design, relatively inexpensive to produce, operate and maintain. It is designed to match the performance of operational aircraft of tomorrow.

Northrop will occupy one of the world's most advanced engineering and science centers with the completion in early 1957 of multi-million dollar facilities under construction at Hawthorne. It will house Northrop's advanced new engineering projects such as the new supersonic trainer airplane.

Other new facilities, now well advanced and scheduled for completion in early 1957, include a new engineering test laboratory, a new wind tunnel, a cafeteria, guided missile engine test facility and an environmental and electrical test laboratory.

Northrop's Anaheim division now manufactures a diversified range of products including optical, electronic and mechanical devices for all four military branches.

An important product introduced by the Anaheim plant during the year was "Sky Screen," an optical projection device capable of rapid and accurate transmission of radar data into a viewing screen for aircraft control and identification.

Anaheim's engineering department has been enlarged to provide greater

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potential capabilities and the secret Hawk missile program is advancing under a sub-contract from the Raytheon Manufacturing Company.

Consolidated sales for Northrop and Radioplane Company, a wholly owned subsidiary of Northrop, for the fiscal year ended July 31, 1956, reached a record high of \$332,513,290, as compared with \$283,462,522 for the 1954-55 fiscal year.

At year end Northrop employment totaled approximately 22,000.

### **Piasecki Aircraft Corp.**

In 1956 Piasecki Aircraft Corporation acquired the 330-acre plant, machinery and other physical assets of the Aircraft Division of the Bellanca Corporation. Acquisition of the property increased Piasecki's manufacturing capabilities ten-fold.

Negotiations were also underway with Philadelphia's Department of Commerce and its aviation division for additional expansion including production and administrative areas totaling 100,000 square feet at the company's Philadelphia International Airport plant that will remain the company's home base.

Piasecki Aircraft, one of the nation's newest in the aviation field, was chartered in Pennsylvania in June of 1955. It is engaged in research, design, development and production of aeronautical products and equipment with particular emphasis on vertical lift aircraft that can rise vertically from a standstill.

In 1956 the company was awarded a contract by the Navy to design, ground test and wind tunnel test a new concept of this VTOL aircraft. It will combine the versatility of the helicopter with the capabilities of high, level flight speed.

The company had eleven other prime contracts from the United States Army and Navy. Seven of these have not been publicly announced. Numerous other proposals were being evaluated by the armed forces.

Among its contracts, Piasecki had one for the original design of an unmanned, remotely controlled configuration named the "Sea Bat" for the Navy. It will have the capability to "hang in the air" and maneuver in any direction under complete electronic control.

Piasecki was also working on advanced designs of "flying crane" helicopters that would lift up to 16 tons, distances up to 100 miles. These are for the United States Army's Transportation Corps' Research and Development Command.

In addition, the company also had a contract from the Army's Transportation Corps to design, manufacture and flight test a radically new, low-maintenance helicopter rotor that will greatly reduce the cost of rotary wing aircraft operations.

The company was also conducting engineering research on a mine-sweeping system for the Navy.

### **Taylorcraft, Inc.**

In 1956, Taylorcraft introduced another fiberglass series airplane, a floatplane version, named the Seabird.

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"We must possess an adequate air atomic retaliatory force, one which by its visible strength in readiness will assure any aggressor of the rapid destruction of his war-making capabilities should he attack the United States or its friends. I believe we have done well in developing this type of force."

—MAXWELL D. TAYLOR,  
General and Chief of Staff, U. S. Army



CAA-approved at 3040 pounds gross weight, using 2870 Edo Floats, it carries the highest gross weight of any floatplane in its class. The four-passenger Seabird is powered by a 225 h.p. Continental Engine, and has a cruising airspeed of 130 mph.

The new model has exceptional take-off performance, due to the high-lift airfoil fiberglass wing design.

Taylorcraft has had a great demand for a fiberglass floatplane model since the introduction of the fiberglass Ranch Wagon and Topper series. The sturdy, tubular construction reinforced by the glass fabric makes the Seabird an ideal plane for all purposes. Since fiberglass is non-corrosive to salt water, can withstand all types of weather, eliminating the necessity of hangar storage, and is easily maintained and repaired, it is natural material for floatplane construction.

Taylorcraft introduced the fiberglass constructed airplane and flew its first model on October 28, 1954. It received its Type Certificate on May 18, 1955.

There are two basic models. The Ranch Wagon is a four-passenger model, powered by 225 hp Continental Engine with gross weight of 2,750 lb. Another model, Topper, is used for crop dusting, seeding and spraying, and its maximum allowable gross weight is 3,767 lb.

### **Piper Aircraft Corp.**

Retail sales of new aircraft by the Piper Aircraft Corporation's distributors amounted to \$31-million in 1956, a 55 percent sales increase over 1955.

Three airplanes in production—the twin engine Apache executive transport, Tri-Pacer four-passenger business aircraft and Super Cub utility and agricultural airplane—were responsible for Piper's record-breaking year.

Plant expansion, begun in 1956 and continuing into 1957, made possible increased output from Piper's Lock Haven, Pa., factory. Completion of a new 60,000 square foot final assembly area in mid-1956 permitted Apache production to go to two a day. Tri-Pacer production was maintained at five a day and Super Cub production was stepped up during 1956 from three to four a day.



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Total Piper employment, numbering 1,600 during 1956, was expected to be increased to 2,000 in order to initiate and handle Comanche production.

During 1956 Piper established a world-wide network of factory certified service centers, staffed by service personnel who attended a special Service School conducted at the Piper plant. Graduates of this school numbered 118 in 1956.

Piper Apache sales passed the 800 mark in 1956. The Apache is powered by two Lycoming O-320 engines rated at 150 horsepower, driving Hartzell full-feathering, constant speed propellers. Apache cruising speed at 6,000 feet at recommended 75 percent cruise power is 170 mph. Fuel capacity of the Standard and Custom models is 72 gallons for 4 to 5 hours' range, depending on power setting. The Super Custom Apache carries 108 gallons for a range up to 1,200 miles. Dual generators and dual vacuum pumps are also offered in the Super Custom model.

The 4-passenger Piper Tri-Pacer, powered by a 150 hp Lycoming engine, continued in great demand during 1956. Over 4,000 Tri-Pacers have been delivered since this tricycle-gear business plane was introduced in 1951. Simplified controls, with inter-connected springs linking rudder and aileron, permit the Tri-Pacer to make coordinated turns with wheel or rudder pedals alone.

The Tri-Pacer is offered in Standard, Custom and Super Custom models. The Super Custom, which represented approximately two-thirds of Tri-Pacer sales in 1956, includes full instrumentation with all gyro and other flight instruments mounted in a panel to the left directly in front of the pilot and all radios in the center.

The Piper Super Cub, general utility plane widely used for farm and ranch work, uranium hunting, survey and patrol, military liaison and training, was offered in two versions—model "95" with a 90-hp Continental engine and model "150" with a 150 hp Lycoming engine. Equipped with flaps, the Super Cub 150 will take off and land in less than 50 yards.

Piper also offered the PA-18-A, agricultural version of the Super Cub, either as a duster or sprayer or as a combination unit which can be quickly converted for the application of either dry or liquid chemicals. The PA-18-A hopper has a capacity of 110 gallons of liquid or 18 cubic feet of dust.

Preliminary details of the new Piper Comanche disclose that the all-metal, low wing plane will make its debut in April, 1957, with a 4 cylinder, 180 hp Lycoming engine. A second Comanche, powered by a new 250 hp, 6 cylinder engine, will be ready for delivery late in 1957.

### **Radioplane Co.**

In 1956, Radioplane Company, a subsidiary of Northrop Aircraft, broadened the scope of its activities by moving further into the field of complete drone and missile systems.

A principal production item continued to be the OQ-19 target drone system, used in large quantities by the Army and Air Force as a radio-controlled target for anti-aircraft gunnery and missile training. Large scale

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production was also initiated on the KD2R-5 drone for the Navy. Features of this improved model include increased radar tracking capabilities and an advanced control system. Considerable production was also accomplished on the RP-71 surveillance drone for operational suitability testing by the Army Signal Corps. This drone system provides a completely mobile operating unit designed to provide close-in reconnaissance photographic support to front-line commanders.

Other developments beyond the 200-knot OQ-19 class included the RP-77 series of intermediate capability drones culminating in supercharged and turbo-prop versions, and the RP-70 rocket-powered series designed for speeds in the Mach 0.9 range. Both of these drones have highly increased altitude capabilities and are significantly advanced in other design features which include new control and scoring systems, and use of glass-fiber reinforced plastic construction for maximum strength and economy.

Other details of the company's increasing activity in Air Force Research and Development programs concerned with supersonic drones and guided missiles have not been released for reasons of military security.

Besides its work in the drone and missile fields, the company continued to engage in research and production of parachute deceleration and recovery systems.

Radioplane during the year carried out an intensified plant expansion program including the addition of a new facility in El Paso, Texas. Plant space was increased from 215,000 square feet to 385,000 square feet. Employment grew from 2,200 at the start of the year to approximately 3,200 at year's end.

This company maintains a large field support and service organization and also specializes in the development and organization of contractor-operated service programs for the military. Complete drone systems are provided to customers, including all accessories and support equipment.

### **Republic Aviation Corp.**

In 1956, Republic's silver anniversary year, the company took a searching look at its past and present, then laid the foundation for an aggressive future.

In 1956 the F-84F Thunderstreak fighter-bomber and RF-84F Thunderflash reconnaissance fighter were supplied in increasing numbers to North Atlantic Treaty Organization nation air forces. Both aircraft are active around the world with the U. S. Air Force and also serve in the Air National Guard.

The new West German Air Force received its initial complement of Thunderstreaks and Thunderflashes. Backing up integration of these aircraft into Germany's re-vitalized air force, the company, through its wholly-owned European subsidiary, Republic Aviation International signed an agreement with the Weser Company of Bremen, Germany, for providing technical assistance, equipment and personnel to Weser as that firm processes Thundercraft for delivery to GAF.

The agreement was one of a series of steps increasing Republic's Eu-

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ropean facilities in support of the more than 2,000 Republic-built aircraft on the continent and in the Near East.

In 1956 initial production was begun on the F-105 supersonic fighter-bomber. Still a military secret, the F-105 is described as having short, very thin swept-back wings and a long cylindrical fuselage. Air intake ducts are installed at the wing roots, permitting radar equipment to be installed in the needle nose. A one-piece flying tail (stabilator) is set low on the aft section of the fuselage, on the underside of which is located a ventral fin to provide lateral stability. Several variations of the F-105 have been designed, the "F" fighter-bomber and "RF" reconnaissance models being the only ones revealed to date.

During the year drag parachutes and Republic-developed hydraulic tandem actuators for aircraft primary controls were introduced into the latest F-84s coming off the assembly lines. A modification program provides for retrofit of these items into earlier Thundercraft both at Republic and in the field. Primary purpose of the drag chute is to enable landings on short runways, while the new tandem actuator provides the pilot with an automatic emergency control system.

In the field, F-84 Thundercraft distinguished themselves in Operation Sagebrush, mock atomic war; USAF World-Wide Weapons Meet; International Reconnaissance Competition; and other "battle skill" maneuvers.

All rights to the Republic Seabee light amphibian plane were sold in 1956 to American Aviation Corporation, Saginaw, Mich. The sale included all of the tools, dies, jigs, engineering data and records and was based to a large extent on American's ability to continue supplying Seabee owners with the same spare parts service they had been getting at Republic.

In 1956 Republic's Guided Missiles Division revealed two new products, a two-stage high altitude research missile which streaks 80 miles into space at Mach 5.6 and a nuclear bombing-trainer designed to teach pilots to drop atomic bombs accurately.

The bomb-trainer, which carries four miniature practice bombs and electronically simulates an actual bomb drop, has been ordered into initial production for the U. S. Navy. A similar unit is also being developed for the Air Force.

Terrapin, Republic's low-cost research rocket, was developed in conjunction with the University of Maryland for a Department of Defense upper atmosphere research program administered by the University. Less than 15 feet long, 6¼ inches in diameter at its thickest point, and weighing only 224 pounds, Terrapin reaches its 80 mile peak altitude in a matter of minutes, then radios measurements of primary cosmic radiation, temperatures and other "space" data. The missile plus its zero-length launcher costs less than the fins of many of its "big brother" research missiles.

During 1956 the Guided Missiles Division was also engaged in development of guidance systems for an air-to-surface missile and a surface-to-surface missile, an air-to-air missile system and a project described only as "more advanced than the earth satellite."

To keep pace with these and other projects still secret, the company's

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**Jet engine noise suppressors at Republic**

Missiles Division facilities were doubled in 1956 with acquisition of a fifth Republic installation in Mineola, Long Island.

Looking into the future, Republic began in 1956 a sharply-expanded program of research and development of hypersonic and ultrasonic military aircraft, guided missiles and other aviation projects.

In May the company announced creation of an ultra-specialized scientific research staff to engage in all aspects of jet and rocket combat aircraft and guided missile design.

An ambitious program of increasing laboratory facilities for use of this group and for other research projects at Republic was under way. The program included both transonic and supersonic wind tunnels with a combined capacity from Mach .85 to Mach 4.

Working on the more immediate problems of the future, Republic's engineering research department in 1956 continued its investigation of materials which will remain stable in the heat barrier range of hypersonic flight. Particular projects include workability of titanium, skin surface coatings, high temperature hydraulics and structural integrity. Research was also performed in the areas of electronics, avionics, instrumentation, radio and radar.

One important development by Republic engineers in 1956 was a method of obtaining area rule application by shooting electrical current through a scale model and measuring stylus. The electrical record is reproduced on transcribing paper in a graphic plot form which is immediately usable without further interpolation. With this method data can be obtained in a matter of hours, replacing the elaborate mathematical calculations previously required for area rule application.

Manufacturing research and development continued in the fields of

plastic tooling, honeycomb structures, chemical milling and new welding and fabricating techniques.

lem. Five Dura-Stack type engine run-up mufflers were installed. Tests have shown that the mufflers reduce engine noise intensity about 90 percent. Other measures taken included construction of specially-designed "baffle" fences to divert sound, repositioning of aircraft in engine-test lines and rescheduling of engine test periods.

Net income for the first nine months of the year was \$4,814,705. Sales for the period amounted to \$232,370,178.

### **Ryan Aeronautical Co.**

The year 1956 marked broadening of Ryan Aeronautical Company's aircraft engine production line. At the same time tooling for accelerated production of giant airframe components reached its peak and significant progress was made in the development of advanced electronic devices. Ryan also continued to improve its famed Firebee jet target drone missile, for which increasing output was ordered by the Air Force and the Navy.

Entry into the field of ready-to-install jet power packages was heralded by award of a \$20-million initial contract by Douglas Aircraft Co. for production of the complex engine pods for the DC-8 jet airliner. The order also calls for building access doors and the pylon structures which support the engines beneath the wing. During the course of production adaptations will be made for three engine types, the Pratt & Whitney J-57, the more advanced P&W J-75, and the Rolls-Royce Conway.

This work widens Ryan's already highly diversified activity in the jet and piston engine field, encompassing afterburners, exhaust systems, complete rocket motors, ramjet engine assemblies, and components for turbo-compound engines.

The year also marked the end of an era, with completion of the last of almost 900 Boeing KC-97 aft fuselage sections over a period of more than seven years uninterrupted, on-schedule production. At the same time, work on a much bigger job for Boeing, the aft sections and other components for the KC-135 jet tanker-transport and the 707 commercial Stratoliner was stepped up, and deliveries of KC-135 units to the Boeing plant in Renton, Wash., begun.

Already in high gear was production of other airframe units, including the aft fuselage of the North American F-86 Sabrejets and complete Firebee missiles.

Ryan's dedication to a daring concept in aviation, vertical takeoff and landing (VTOL) of fixed-wing aircraft, was further exemplified during 1956 with the unveiling of plans to build its "Vertiplane" for the Army in a contract administered by the Office of Naval Research.

Already under test at Edwards Air Force Base is the Ryan X-13 Vertijet, built for the Air Force as the world's first jet VTOL plane. In contrast to the Vertijet, the Vertiplane will be propeller-driven, and its ability to take off straight up and land without a ground run will depend on employment of the deflected slipstream principle through use of large

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propellers and double, retractable wing flaps extending far below and to the rear of the wing's trailing edge. A true VTOL, the Vertiplane will hover, make full transition from vertical to horizontal flight, and be capable of flying backward, forward and sideways.

On the heels of a multi-million dollar contract from the Navy for a new system of automatic navigation (the AN/APN-67), obtained in 1955, came another Navy contract during 1956 for a new helicopter ground speed indicator which enables pilots to safely place their craft in the motionless position necessary for detection of enemy submarines. Neither the automatic navigator nor the helicopter hovering detector needs aid from ground stations or wind data.

The automatic navigator system, which was used in flights over the South Pole during the year with Admiral Byrd's Antarctic expedition, has become the first operationally suitable, light-weight, self-contained navigation system which inherently and automatically compensates for the effects of wind drift in navigation. It is the only light-weight system of its type in production today.

A study into the unique problems confronting pilots of VTOL aircraft was launched by Ryan during the past year in a contract from the Air Force to make a major human engineering dynamics analysis of cockpit arrangement and instrument display requirements. A mock-up of a cockpit will be built to incorporate recommendations describing optimum cockpit and instrument arrangement, from the standpoint of most efficient pilot use.

To cope with skyrocketing production demands, new company-owned machine tools valued at approximately \$1-million were installed during 1956, and construction of new warehouse, office and production areas sent the floor space under roof to over 900,000 square-foot mark. With additional facilities being planned, it is anticipated that by the end of 1957, Ryan will have 1-million square feet of floor space under roof on its 44 acre site at Lindbergh Field, San Diego's municipal airport.

Ryan's payroll also continued to climb, reaching by year's end a total of approximately 5,500 employees (almost 1,000 above the 1955 figure), the highest since the peak of World War II, and continued increases are anticipated.

Based on the financial report for the first nine months of the fiscal year, sales during the full year were expected to approximate \$45-million, compared with \$41.5-million in 1955. Net profits, due to the extensive "make-ready" tooling program, were expected to be slightly below the \$1,550,590 amount for fiscal 1955.

### **Sikorsky Aircraft Div. United Aircraft Corp.**

In 1956—15 years after the first flights of Igor Sikorsky's VS-300—the Sikorsky Aircraft division of United Aircraft Corporation continued full production of S-55 and S-56 helicopters at its Stratford, Connecticut, plant, turned out quantities of S-58s at its Bridgeport, Connecticut, plant,

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and put into operation a complete overhaul and repair facility at the Bridgeport Airport.

Early in the year, administrative offices were transferred from Bridgeport to the Stratford plant. Engineering remained at Bridgeport. Flight testing operations were begun at Stratford, adding to those already conducted at Bridgeport. Company pilots were also engaged in checking out modified or overhauled aircraft at the Bridgeport Airport.

During the spring, CAA testing of the 12-passenger S-58, already in service with the United States Army and Navy and the Royal Canadian Air Force, was completed. Upon certification in midsummer, initial deliveries of the commercial version were made to Sabena Belgian World Airlines, New York Airways, and Okanagan Helicopters, Ltd., of Canada. Additional orders for the S-58 were placed by the oil industry to supplement fleets of S-55 helicopters now being used in survey work and for transport of equipment and personnel in the Gulf of Mexico, the Canadian bush, and other inaccessible areas.

The 1,000th S-55, a Marine HRS-3, was delivered in late summer. Orders on hand indicated production of the eight-passenger aircraft would continue several more years. The S-55, in service with all U. S. armed forces, continues as the mainstay in air-sea rescue services with domestic and foreign military units. Featuring the typical Sikorsky single main rotor configuration, the S-55 is powered, depending upon the model, by the Pratt & Whitney Aircraft R-1340 engine or the Wright R-1300.

Deliveries of the S-56, known as the HR2S by the Marine Corps and designated H-37 by the Army, were begun in the spring. The first aircraft was flight-delivered to the Naval Air Test Center, Patuxent River, Maryland. Upon acceptance of a number of the twin-engine helicopters, an extensive testing program was begun and is still in progress. The Army's first H-37 also went to N.A.T.C. for testing by Navy personnel.

Powered by two Pratt & Whitney Aircraft R-2800 engines, the helicopter was designed for the Marines as an assault transport capable of carrying 26 fully equipped troops. It has a single main rotor of five blades coupled with a four-bladed, torque-compensating tail rotor.

In October, the HR2S-1W, a new configuration of the S-56, was unveiled by the U. S. Navy. Equipped to carry radar, the helicopter will operate from fleet aircraft carriers, considerably extending present sea radar coverage.

Army Captains Claude Hargett and Ellis Hill, flying an H-34 (S-58), in the summer of 1956, established new F.A.I.-acknowledged speed records for closed circuits. The new world records were 141.9 mph for the 100-kilometer course, 136 mph for 500 kilometers, and 132.6 mph for 1,000 kilometers. An unofficial endurance record was set by Marine Lieutenants J. K. Donaldson and D. B. Waldron in an HO4S (S-55), remaining aloft 13 hours, 2 minutes, without refueling. The international straight run speed record of 156.006 mph, established by a Sikorsky S-59 in 1954, remained unbroken.

Commercially, a Sabena S-58 set an unofficial "city center" to "city

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center" speed record. On the last leg of a delivery flight from Paris to Brussels, a distance of 185 miles, the aircraft averaged 146 mph.

Late in the year, Sikorsky Aircraft disclosed plans for the expansion of its year-old Stratford plant. The new addition is to house engineering and experimental offices, laboratories, and test areas. It will consist of 433,000 square feet and will include the engineering, service, and technical publications departments, now located in Bridgeport. The company estimates future expansion of the engineering department will amount to nearly 25 percent.

Altogether, Sikorsky Aircraft employed approximately 10,000 office, production, and test personnel as 1956 drew to a close.

### **Stroukoff Aircraft Corp.**

1956 was a year of continued engineering, design and manufacturing by the Stroukoff Aircraft Corporation at its facilities in West Trenton, N. J. It also proved to be a most successful year from the angle of engineering accomplishment. Early in the year the Stroukoff developed USAF C-123-E Pantobase established itself unquestionably as the most versatile assault transport.

Early in 1956 the C-123-E Pantobase aircraft proved itself as a completely amphibious craft through a series of stringent land and water tests out of Palm Beach Air Force Base and on Lake Okeechobee. These tests were made in water conditions approaching gale force. The ship was then flown to Bimidji, Minn., for a complete cycle of flights which were made under semi-Arctic conditions. One of these flights, March 10, 1956, established a new record for takeoff from snow for skis. The C-123-E took off without Rato, and without the assistance of flaps, at a gross weight of 55,165, exceeding its own standard gross weight of 50,000 by 5,165 pounds. This was accomplished with surface conditions of 21 inches of unpacked snow plus drifts at a temperature of 17° Fahrenheit. Prior record for straight ski operation, incidentally, with flaps was for 52,800 pounds in February of 1953 in Newfoundland, made by the Navy, during tests for an Arctic type transport. All flights and instrumentation tests were successfully completed by the U. S. Air Force, Wright Air Development Center Directorate of Flight, and the C-123-E was approved by the Air Research and Development Command.

By year's end the newest Stroukoff design for the U. S. Air Force, the YC-134 number one was ready. The YC-134-A is a series of aircraft that will have the Stroukoff developed Boundary Layer Control System, and Pantobase gear, a new landing gear system, a new loading and unloading system, as well as numerous aircraft operational improvements. The first ship designated the YC-134 was predecessor and test vehicle for the YC-134-A series which will be the true advanced model. These latter aircraft will be flying in the early spring. Powered with two Wright R-3350 Turbo-Compound engines plus the added lift of a new BLC, the YC-134-A series will provide the Air Force with a completely amphibious to any surface, assault transport of over 66,600 pounds gross weight capable of taking off



in less than half the time and distance for ordinary aircraft from regular runways.

During 1956 Stroukoff conducted a series of advanced investigations in the field of Boundary Layer Control developments, as a sequel to the successful experiments completed three years ago. These engineering efforts were conducted in the laboratories and wind tunnel that are part of the aeronautical engineering establishment of Stroukoff at West Trenton.

### **Temco Aircraft Corp.**

Highlight of the year's activity for Temco Aircraft Corporation was acceptance by the U. S. Navy of Temco's Model 51 primary jet trainer. Designated TT-1 by the Navy, 14 of the trainers are now in production at the Temco-Dallas, Texas, plant. Delivery of the first production model was scheduled for July of 1957.

Primarily designed to shorten the number of hours required to complete a student's flight training, the TT-1 introduces a new trend in military aviation training—that of commencing a student's flight training in jet-propelled aircraft. Powered by a Continental J-69-T-9 turbojet engine developing 920 pounds of thrust at sea level, the TT-1 combines an unusually high dive speed (450 knots) with a stall speed (62 knots) low enough for a student's first solo.

The TT-1 is the first jet aircraft to be completely designed, built, and flight tested by the 11 year old company.

In addition to the development and subsequent acceptance of the TT-1 by the Navy, 1956 found Temco's engineers busily engaged in research and development projects on missiles and weapons systems of the company's own design.

A Navy contract for development and testing of the XKDT-1, a rocket-powered target drone, was awarded Temco in October. The contract calls for an extensive test and demonstration program in 1957 at the Point Mugu Naval Air Missile Test Center. Designed to fly at predetermined altitudes and at speeds of Mach .95, the XKDT-1 is a low-cost, expendable target system for air-to-air and surface-to-air missile practice.

Temco also continued to make appreciable gains in sub-contract projects. Work continued at the Dallas and Garland plants for production of parts and assemblies for the Boeing B-52 and B-47, Lockheed's P2V-7, C-130 and Electra propjet transport, McDonnell's F-101, RF-101 and F3H, Republic's F-84F, North American's F-100, and engine test stands for Lockheed's C-130 Hercules propjet transport. In addition, contracts were let during the year for tooling and production of wings for the Lockheed F-104 Starfighter, power packs for the Fairchild C-123, compressor assemblies for the Ford version of the J-57 jet engine and design and tooling for Convair's supersonic B-58 Hustler bomber.

In the field of overhaul, 1956 saw Temco receiving its first contracts covering a jet aircraft, the Republic F-84G.

Electronic modification activities as well as Air Force orders for overhaul and IRAN (Inspect and Repair as Necessary) of C-54 and C-97 type

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aircraft continued at the Temco-Greenville, Texas, plant. In addition, conversion of the single-engined Navion into an executive transport, the Riley-Twin, contributed in filling that facility to its capacity.

As a result, Temco's policy of diversification in the fields of aircraft research and development, aircraft subcontracting, and aircraft overhaul and modification had produced active engagement in some 79 different and distinct projects by October 1956.

Employment continued to break all previous records, topping the 10,000 mark in early August.

Co-incident with employment increases, Temco in July announced that contracts had been let for the construction of a new \$1-million engineering center to be built adjacent to the Garland plant. Ground breaking for the new center took place on October 31, 1956, and work on the building commenced immediately thereafter. Scheduled for completion early next year and covering more than 100,000 square feet of floor space, it will provide space for administration, design laboratories and a high bay area for experiment operations and testing. All engineering functions with the exception of liaison are to be transferred to the new building.

With the addition of the new engineering center, Temco's total square footage for its three plants will be increased to more than 2-million.

Temco's total sales for the nine month period ending September 30, 1956, registered \$61,196,203—a gain of 6.6 percent over the \$57,428,170 recorded in the first nine months of 1955. Net earnings after provision for Federal Income Taxes totalled \$2,059,189—a decline of 12.4 percent from 1955 earnings of \$2,350,708. This drop is attributable primarily to the increased amounts Temco is spending in research and development projects.

### **United Aircraft Corp.**

Because United Aircraft Corporation's three divisions operate autonomously, discussion of the company's 1956 operating activities is found under the names of the divisions: Pratt & Whitney Aircraft (engines), Hamilton Standard (propellers and aircraft equipment), and Sikorsky Aircraft (helicopters). All of the divisions maintained a high level of development and production during the year.

The company's postwar expansion continued during the year, with large additions to Pratt & Whitney Aircraft's North Haven branch plant and the Willgoos Gas Turbine test facility. Work was started on a major expansion of the Hamilton Standard plant in Windsor Locks, Connecticut.

The Research Department of United Aircraft Corporation made substantial contributions in support of the research and development programs of each of the three operating divisions. A hypersonic tunnel, capable of simulating flight conditions at very high altitudes and operating at speeds ten times the speed of sound, was put into operation during the year. This was one of three new tunnels installed in the high-speed laboratory of the Research Department. An addition to the wind tunnel facility was under construction to house the growing array of electronic computer equipment in the department's computation laboratory.

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In 1955, the last complete year for which figures are available, United Aircraft Corporation reported a net income of \$31,064,924 on sales totaling \$697,921,704. Total current assets at December 31, 1955, amounted to \$197,910,346 compared to total liabilities of \$109,161,770 at that date. Contracts, orders, and government letters of intent at December 31, 1955, amounted to \$1.4-billion.

### **Vertol Aircraft Corp.**

Peak production of the H-21 type helicopter continued throughout 1956 for Vertol. Along with deliveries of the H-21 to the U. S. Army, U. S. Air Force and Royal Canadian Air Force, deliveries were begun on contracts for 100 H-21's, awarded Vertol by the French government. Negotiations were underway with other European countries for sale of H-21's.

At the same time, U. S. military services assigned H-21's to Europe and the Far East. With this broadening of the base of operations for the H-21, Vertol was moving quickly to certify the aircraft for commercial use. The program was the first joint certification to be carried out by the U. S. Civil Aeronautics Administration and the Canadian Department of Transport.

A contract for development of a twin turbine version of the H-21 was announced in mid-1956. Designated the H-21D, the advanced model will be powered by General Electric T-58 gas turbine engines.

Interest in multiple engine installations in helicopters has been strongly expressed by both military and commercial operators. Installation of the twin turbine power plants in place of the single piston engine, now in use, will give the helicopter multi-engine reliability, higher payload and increased speed. It will also improve the helicopter's all-weather flying potential. Combined, these advantages will provide a new standard in air convenience and reliability.

Payload of the turbine powered H-21 will be increased by 40 percent over the piston engine version. The turbine power plants will make possible cruising speeds up to about 150 mph, or 50 mph faster than the current aircraft. The increases in cruise speed and payload will more than double the ton-mph capability of the H-21. The hovering ceiling also will be increased by several thousand feet.

The company has indicated it will seek CAA certification for this multi-turbine model.

The company's name was changed to Vertol Aircraft Corporation in March 1956. At that time, the company announced it was placing increased emphasis on research and development in the broader field of vertical take-off and landing aircraft.

Employment remained close to 5,000 throughout the year.

During the year, Vertol completed comparative studies of a variety of types of VTOL designs for a specific Army mission. As the result of the work done, the tilt-wing configuration was chosen as a promising arrangement and a test bed program was initiated by the Army and Office of Naval Research. The flying test bed was in final design stage by year-end. Completion of the test craft is scheduled for late spring 1957.

## THE INDUSTRY

Research and Preliminary Design engineers pursued further VTOL studies for high speed flight. In addition, feasibility studies of STOL type aircraft were conducted and preliminary designs completed. Wind tunnel tests of STOL models were conducted in conjunction with these studies.

Sales and earnings were expected to be substantially higher than in 1955 when earnings were \$1,550,937 on sales of \$57,690,074. The company's backlog was a little over \$134-million.

On August 12, 1956, an Army H-21C established a new world helicopter record for distance-within-a-closed-circuit. The helicopter, flown by Lt. Col. Harry L. Bush and Major William C. Dysinger from the Army's CONARC Board Nr. 6, completed a 1,199.07 mile non-stop flight in 11 hours and 58 minutes. The flight was carried out according to the requirements of the Federation Aeronautique Internationale, of Paris, in order to receive official recognition.

The H-21 also made the first successful non-stop transcontinental helicopter flight in August. Employing in-flight refueling techniques, the H-21C flew from San Diego, Calif. to Washington, D. C., a total of 2,610 miles.

## ENGINE MANUFACTURERS

### Aerojet-General Corp.

Aerojet-General Corporation continued design and production of both solid and liquid propellant rocket engines during 1956, expanding its Sacramento facilities over a 20,000 acre site and inaugurating new construction which will bring the total value of facilities there to approximately \$60-million. During the year, the company also organized a subsidiary, Aerojet-General Nucleonics, located in San Ramon, California, the first privately owned production plant for nuclear reactors intended to be sold directly to outside consumers. The company also expanded its Architect Engineer Division by opening a permanent branch office of this unit in Orlando, Florida.

At its Azusa, California, headquarters, the company began construction in mid-year of a new two-story engineering building to cost an estimated \$900-thousand. The building is designed to house between 800 and 1,000 engineering personnel and is scheduled for completion early in 1957. Early in October, ground was broken at Sacramento for a \$13-million facility for production of large liquid rocket engines for the Air Force's ballistic missiles program. The company's Liquid Rocket Plant at Sacramento also was expanded to comprise eight huge rocket test stands, providing a total of 24 test positions, the largest of which can handle engines up to 1-million pounds thrust. Employment at Aerojet passed the 8,600 mark at the end of October.

In the solid propellant rocket field the company expanded both its development and production facilities and schedules. A new solid rocket test facility was put into operation at Sacramento. Production of the Solid Rocket Plant is largely under U. S. Navy contract.

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Aerojet also engaged during 1956 in two major projects for the International Geophysical Year. The first was the design and fabrication of the liquid-propellant second stage propulsion system for Project Vanguard, the earth satellite vehicle, which is expected to be launched by the United States sometime during 1957. Production also went forward on a large number of Aerobee and Aerobee-Hi high altitude sounding rockets to be used by the Office of Naval Research and the Air Force's Cambridge Air Research Center during the year. Aerojet-General constructed launching facilities at Ft. Churchill, Manitoba, Canada, for the launching of these and other research rockets during the Geophysical Year.

On June 29, 1956, a Navy-launched Aerojet Aerobee-Hi reached a record altitude of 163 miles for a single stage "boosted" rocket. International interest in the Aerobee-Hi resulted in the display of a precisely-built working model of this rocket at the Berlin International Trade Fair, September 15 through October 1. A full-scale Aerobee was also loaned to the Air Force for display at the International Astronautical Conference in Rome during September.

The development and production of underwater propulsion devices, electronic equipment and various types of ordnance was expanded. In November, the Army Chemical Corps announced satisfactory tests of Aerojet's new light-weight "one shot" flame thrower for use by parachute troops. This unit weighs only 26½ pounds when combat loaded, as compared with 72 pounds for the conventional multiple-shot models. Continued work was carried on by the company on its AEROMarker and AERObrake, developments which gave great promise for both military and civilian applications. The AERObrake, which permits up to 50 percent reverse thrust to be obtained, may find application in commercial aviation which is about to put jet transports into use on major air lines. The AERObrake is an American application by Aerojet of a device developed by the Societe Nationale d'Etude et de Construction de Moteurs d'Aviation (SNECMA) of Paris, France.

Officials indicated that the company's sales for 1956 would be approximately \$130-million as compared with \$70-million in 1955.

### **Allison Div.**

#### **General Motors Corp.**

On-schedule testing and evaluation of the Allison Model 501 commercial Prop-jet engines and Aeroproducts 606 propellers during 1956 brought Allison Division of General Motors Corporation another step closer to the first flight of the Allison-powered Lockheed Electra commercial airliner in early 1958.

Around the clock engine testing was accomplished on permanently installed indoor and outdoor test stands which permitted the 501 to be run through complete airline operating schedules from starting, idle, taxi, take-off and climb out, short and long range cruising, and let down. Using an actual commercial airline operating schedule, the Allison engineers paral-

## THE INDUSTRY

leled commercial routes from "block to block" shutting down the engines for the normal 20-minute debarking and embarking operations.

While this extensive ground testing was underway Allison continued to log valuable hours in its converted Convair 240 Allison Turbo-Liner flight testing Prop-jet engines and Aeroproducts propellers. Air starts successfully were made in excess of 30,000 feet by the Turbo-Liner and extended cruising airspeeds of 320 mph were reached which is approximately 100 mph faster than the standard piston-engine configured Convairliner. Locked throttle climbs to 37,000 feet were made in 37 minutes. The T56 engines, military version of the commercial Model 501, were installed in the Turbo-Liner in May and in September the Model 501 commercial engines were installed.

The first of 22 Model 501 consignment engines was delivered to Lockheed and Allison, and Lockheed jointly installed the Prop-jet engine in a C-130 nacelle in the number 4 position of Lockheed Constellation test bed "Old 1961," giving the airframe manufacturer an opportunity to test and evaluate the Allison-Aeroproducts power package for the Electras. The second engine will be installed in an Electra nacelle. The remaining 20 engines will be delivered to Lockheed in 1957.

The C-130 Hercules, Lockheed combat transport plane, continued to accumulate impressive air time with its four Allison T56 Prop-jet engines. First production models of the C-130 were delivered to Tactical Air Command at Ardmore Air Force Base, Oklahoma, in December and it is expected that TAC will log 350,000 hours with the Prop-jet powered Hercules before the prototype Electra flies in February 1958. This

### Allison Prop-jet Model 501



figure is expected to be increased to more than 800,000 flight hours before the Electra enters commercial service in September of 1958. Continuing its program of flight testing its own engines in operational aircraft Allison received on bailment from the USAF a C-130 in October and flights immediately were started from the Allison Flight Test Research facilities at Weir Cook Municipal Airport in Indianapolis logging more than 60 hours a month.

The USAF B-17 Allison flying test bed, with four conventional piston engines and a T56 Prop-jet in the nose (bombardier position), gave impressive results with air starts and high altitude operations.

Braniff, KLM Royal Dutch, and Western Airlines purchased Allison Model 501 Prop-jet engines in 1956 to power their Lockheed Electras bringing sales to 128 planes and 512 engines purchased by the above three airlines and American, Eastern, and National Airlines. Five of the airlines have purchased Aeroproducts 606 propeller giving them the complete General Motors power package.

The 501 engine consists of a single turbine power section connected by an extension shaft and a supporting structure to a reduction gear assembly having a single propeller shaft. The 13.54:1 ratio reduction gear assembly reduces the power section shaft speed of 13,820 rpm to the rated propeller shaft speed of 1020 rpm. The engine has a 14-stage axial-flow compressor, six combustor liners, and a four-stage turbine. It weighs only 1750 pounds and is 145 inches long, 27 inches wide. The Aeroproducts propeller is of hollow steel construction and measures 13.5 feet in diameter. The engine produces 3750 horsepower and testing is underway on a greater 4050 horsepower engine.

At year's end Allison had accumulated an impressive 120,740.8 hours in Prop-jet experience including Turbo-Liner, C-130, R3Y, YC-131C, B-17, and Constellation flight time and development test and test cell operations. Before the Electra enters commercial service it is expected that Allison will have compiled more than one million hours of Prop-jet experience.

Culminating 10 years of extensive research by the Navy, Allison, and Convair, a Navy R3Y-1 Tradewind water-based inflight refueling tanker made its first flight from Naval Air Station, Alameda, Calif., to Keehi Lagoon, Honolulu, October 16 and returned to Alameda October 18 setting a new seaplane record on the return trip of six hours and 41 minutes. Powered by four Allison T40 Prop-jet engines, each developing 5850 horsepower and driving six-bladed Aeroproducts contra-rotating propellers, the first Tradewind was delivered to Navy Air Transport Squadron TWO (VR-2) at Alameda March 31 making VR-2 the first squadron in the world to place Prop-jet powered seaplanes into operational service. The squadron was up to its full allowance of seven planes by October.

VR-2 pilots eagerly accepted the new revolutionary-powered planes, remarking that an entirely new concept of powered flight is offered by the Prop-jet Tradewinds. Complete revision of squadron training syllabus incorporating new water-handling techniques, instrument range work, and

## THE INDUSTRY

beaching operation has resulted from the enormous power offered by the Prop-jet. Navy will use the Tradewind series for inflight refueling tankers for carrier-based jet fighters and bombers thus extending the operational range of these planes of the Navy's Fast Carrier Task Forces.

Another Allison-powered Navy plane, the McDonnell F3H-2N all-weather day and night fighter, joined Navy operational squadrons and became the backbone of the fleet's night fighters with its single Allison J71-A-2 turbojet engine. In the 10,000-pound thrust class the J71 gives the Demon speeds in the 600 mph bracket. Five squadrons in the Pacific and Atlantic Fleets are flying these swept-wing fighters which are operating from both Essex and Forrestal class carriers. J71 production for the Demons is scheduled through 1958.

Allison J71-A-11 continued in production for the twin-jet USAF B-66 bombers and RB-66 reconnaissance bombers which made their first appearance in Europe in the fall when the USAF deployed an undisclosed number of Destroyers to Germany and Italy.

J33 engines, Allison workhorses in the jet field for more than 11 years, continued in production to power USAF Martin TM-61 Matador and Navy Chance Vought Regulus guided missiles, USAF Lockheed T-33 and Navy TV-2 jet trainers.

In January 1956 Allison rolled off the production line its 100,000th engine, a T56 Prop-jet, giving Allison a yearly average of 5,900 Prop-jet, turbo-jet, and piston engines since 1939.

Construction of new Engineering Administration Building and Research and Development Center in Indianapolis continues on schedule with target date for complete occupancy in 1959. Allison sales and engineering administrative staffs began moving to the new quarters in late December. The Allison Flight Test Research facility gained new aircraft parking ramps and taxi-ways, adding 166,100 square feet of cemented areas to the facility.

Allison employment, including Aeroproducts Operations in Dayton, Ohio, was 18,871 in 1956, an increase of 11.6 percent over previous year. Total floor space reached nearly 5½-million square feet.

### **Curtiss-Wright Corp.**

During the year 1956 the Curtiss-Wright Corporation continued to grow and to expand its activities in both aircraft manufacturing and related fields. While many of its new divisions produced specific products with wide application in general industry, it is important to note that such new activities as the development and production of ultrasonic devices, plastics, nuclear equipment, castings, forgings and electronics are of prime importance to the aircraft industry.

In a major transaction of national significance, Curtiss-Wright Corporation and Studebaker-Packard Corporation announced a program for the design, development, testing and production of diesel and gasoline engines and components for the aviation, automotive, industrial and marine fields.



Under the new program, Curtiss-Wright made payments aggregating \$35-million for long term leases on the automotive company's Utica, Michigan, and Chippewa, South Bend, Ind., plants, each of which exceeds 1-million square feet in floor area; for the outright purchase from Studebaker-Packard of Aerophysics Development Corporation of Santa Barbara, California, and for the purchase of certain defense assets. All three plants will be operated as wholly-owned subsidiaries of Curtiss-Wright.

. By the terms of the agreement, Curtiss-Wright will be able to place approximately \$100-million of defense orders annually in the leased plants. The new, leased facilities will be used to produce engine components, spare parts and diesel engines, and ultimately also to manufacture aircraft turbine engines and missiles now under development.

During 1956 expansion of the company's facilities continued on a major scale. A \$50-million expansion of facilities at the Curtiss-Wright Research and Development Center in Quehanna, Pa., where \$20-million already has been invested, was announced.

Jet engine production and development continued at an accelerated pace during 1956. In addition to the Curtiss-Wright J65 turbojet which powers modern fighters and bombers, the Company has under development a family of turbojet, turboprop and other jet engine types. During the first half of 1956 at the Wright Aeronautical Division Jet Overhaul Facility in Clifton, N. J., J65 engine overhaul reached a new low price—significantly lower than any price for comparable engines in any facility in the country. The Navy's new supersonic fighter, the F11F-1 Tiger, went into production during 1956 powered by the Curtiss-Wright J65 turbojet with afterburner. Rated at 7,800 pounds thrust without afterburner, the thrust of the afterburner is still classified. The J65's also power the Republic F84F and RF84F, the North American FJ-3 and FJ-4 Furies carrier-based fighters, the Douglas A4D Skyhawk bantam attack plane, and the twin-jet Martin B-57 attack bomber. Advanced models of J65 have been specified for additional projects of classified status.

The Curtiss-Wright Turbo Compound engine exceeded the 26-billion seat-mile mark in commercial service with a perfect safety record during 1956. Rated at 3400-3700 hp, this 18 cylinder, radial engine has power recovery turbines to utilize normally wasted exhaust gases. This combination makes it one of the most efficient engines ever built. The Turbo Compound presently powers fleets of Lockheed Super Constellations and Douglas DC-7's of 41 of the world's leading airlines. The EA-2 Turbo Compound with a 3:5 to 1 reduction gear has been designated to power the new Lockheed 1649A Super Star Constellation extra long range transport.

The Curtiss-Wright throttleable rocket engine, developed by Curtiss-Wright's Propeller Division, powered the Bell X-2 to an unofficial speed mark of better than 2,200 mph and a new altitude mark of 126,000 feet at Edwards AFB, California. Known as the XLR25-CW-1, it is the first throttle engine in the rocket field, and will idle with no thrust. Thrust rating of this engine is still classified as secret.

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Construction of new facilities on the west coast is nearing completion in North Hollywood, California, and Santa Barbara, California. At North Hollywood, a new overhaul plant of the Caldwell-Wright Division will contain 74,000 square feet of space for offices, modern overhaul facilities and specialized machinery for the efficient production line handling of the overhaul of more than 40 Turbo Compound engines per month. Significantly, its first orders for engine overhaul are contained in a \$10-million contract from Flying Tiger Line, which is the largest commercial overhaul agreement of its kind ever negotiated. The contract will provide for major overhaul of the Curtiss-Wright EA-3 Turbo Compound engines to be used on FTL's new fleet of ten Lockheed 1049H Super Constellation air freighters.

At Santa Barbara, a new plant of 100,000 square feet for the Aerophysics Development Corporation, a wholly-owned subsidiary, is under construction for the production and development of guided missiles and missile systems. Aerophysics has successfully developed the Hypersonic Test Vehicle, a two-stage solid propellant rocket vehicle that reaches seven times the speed of sound in two seconds. Fifteen experimental models have already been fired and tested at ARDC's Holman Air Development Center, Alamogordo, New Mexico. The Dart, a new anti-tank missile for the Army, is in production at the Utica-Bend Corporation following successful development by Army Ordnance under research and development contracts with Aerophysics. The Dart is designed for employment against tanks by infantry and armored combat units.

Ground-breaking ceremonies for a new plant for Turbomotor Division at Princeton, New Jersey, were held late in the year. The Turbomotor Division formerly of Hempstead, Long Island, N. Y., was acquired by Curtiss-Wright in January 1956. Operated independently of other divisions of the company, it will contribute to the development of engines in categories suitable for aircraft, helicopters, missiles, drones and non-aircraft uses. In addition, it will contribute to the overall advancement of the science of propulsion.

A Curtiss-Wright Turboelectric propeller installed on a Boeing YC-97J Turbofreighter became the first propeller on a 6,000 hp turbine-propeller engine to exceed 1,000 hours' flying time, according to an announcement made by MATS' 1700th Test Group, Kelly AFB, Texas. MATS officials also revealed that the Curtiss-Wright Turboelectric, also in use on the Douglas C-133A transport, is the first Turboprop type propeller to operate 300 hours without a periodic inspection, and that overhaul time has been advanced from 800 to 1100 hours, with a further extension to 1500 hours expected in the near future.

The Curtiss-Wright Electronics Division received five more orders for B-52 Simulators from the Air Force. During the year orders were received for Simulators for the Lockheed C-130A turboprop military transport. Design work was started on the first Simulator for the Douglas C-133A turboprop. The Simulators are exact reproductions of the flight cockpits

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of the aircraft they represent, incorporating intricate electronic computers which simulate all flight characteristics, and include every conceivable flight condition associated with aircraft operation.

Widening acceptance of Curtiss-Wright Simulators in civilian aviation was evidenced during the year as additional orders were received from many of the world's leading airlines.

Implementing Curtiss-Wright's policy of diversification and fortification, many new products were added to the list. In addition to Flight Simulators, the Electronics Division in Carlstadt received orders for recently developed electronic equipment. Nuclear measuring systems to control uniformity of any material produced continuously in sheet form, such as paper, represent the most modern techniques in quality control. The measurement instrument is called the Beta Gauge, based on the principle of the absorption of beta rays emitted by radio-active isotopes.

The Industrial and Scientific Products Division continued active in the field of ultrasonics by introducing the portable Ultrasonic Immerscope and Dual Channel Flaw Calibrator to its non-destructive test equipment which includes immersion tanks, "B" scans, and automatic scanning machines. These products are used in conjunction with each other for immersed non-destructive testing of metal parts. The division also is producing ultrasonic cleaning and degreasing equipment of various capacities.

The Curtiss-Wright Plastics Division, located in a modern plant in Quehanna, Pa., has made strong impact on domestic markets with Curon—a new family of multi-cellular plastic materials.

Production operation of the world's largest horizontal steel extrusion press, a 12,000-ton giant, with a planned capacity in excess of \$20-million per year, is in use at the company's Metals Processing Division in Buffalo. Shipments during the year included extrusions of alloy and stainless steels, titanium, and vacuum melted alloys.

Curtiss-Wright Europa, N. V., with offices in Amsterdam, the Netherlands, continued during 1956 to service and supply the corporation's products to NATO nations.

The sale of spare parts and servicing of Curtiss-Wright engines and other equipment for the military, the airlines, and private plane operators is a function of Caldwell-Wright Division.

Marquette Metal Products, a corporation subsidiary at Cleveland, Ohio, continued producing electric and hydraulic windshield wipers for all types of aircraft, including high-speed jet fighters.

Curtiss-Wright reported for the nine months ended September 30, 1956, a consolidated net profit of \$30,912,561 after provision for federal income taxes. This compares with a consolidated net profit, after taxes, of \$24,012,833 for the nine months ended September 30, 1955.

Unfilled orders, plus scheduled production under advance contracts, of Curtiss-Wright Corporation and its subsidiaries totaled approximately \$770-million as of September 30, 1956.

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### Fairchild Engine Div. Fairchild Engine and Airplane Corp.

The state of the art of small turbojet engines received a substantial boost during the year when the USAF announced that more than \$35-million in contracts have been given to the Fairchild Engine Division to speed the development and production of an entirely new type lightweight turbojet engine designated the XJ-83, in the 2,000 pound thrust category.

The Long Island Engine Division of Fairchild began initial design and development work more than a year ago, and it is expected the first engines under the program will be scheduled for installation in both pilotless and piloted air vehicles.

In addition to the new engine development, Fairchild received continued orders for the bantam-weight J-44, 1,000 pound thrust engine. This was the first midget engine to pioneer the small engine field and the first to receive an Approved Type Certificate from the Civil Aeronautics Administration. It also received certification for the 150 hour Military Qualification Test.

Orders from the U. S. Navy for these additional engines, plus funding for further product improvement, amounted to more than \$3-million. The engines were slated for installation in the Ryan-built KDA Firebee target drone.

The first inhabited aircraft installation of the J-44 on a commercial aircraft was completed during the latter part of 1956, when a J-44 was installed on a Trans World Airlines cargo plane to provide thrust assist. The TWA craft is scheduled for operation in Europe and the Middle East.

During the year the Division paused in the production of major components for the newer, larger turbojet engines, and continued its sub-contract activity for the four major large engine producers. A substantial amount of this new business includes major components for the General Electric J-79. Production of J-47 components also continued during 1956.

Advance testing and crew training continued on Fairchild's X-1 midget submarine under the direction of the U. S. Navy at eastern submarine training bases. This tiny underwater craft, dubbed the "vest pocket submarine," was due for further testing, evaluation and many specialized duties.

Research and development in the Division's new gas turbine research laboratory moved into high gear the latter part of 1956 upon completion of instrumentation and equipping of the new facility. The laboratory has a capacity for testing small jet engines at altitudes up to 50,000 feet and at Mach 1 speeds.

The Al-Fin Division developed many applications of bonded bi-metallic products for the aircraft industry. These include low inertia gimbals for flight simulators, hydraulic manifolds, lightweight hydraulic elbows, fuel pump impellers, and cast aluminum aerodynamic control surfaces with bonded-in alloy steel shafts. These and other molecularly bonded bi-metallic products have been developed by Al-Fin and its licenses, which include the Aluminum Company of America, Bohn Aluminum and Brass Corpora-

tion, Brown Engineering Service Co., R. C. Hitchcock & Sons, Inc., Rolle Manufacturing Co., South Gate Aluminum and Magnesium Company, Arthur Tickle Engineering Works, Inc., and others.

### **General Electric Co.**

Total General Electric owned facilities of the Aircraft Gas Turbine Division represented a replacement value of \$100-million in 1956, and there were 14,400 employees in this Division at Evendale, Ohio.

The J79 engine was in production but the specifications and performance were classified. The J79 powers the Air Force's Lockheed F-104A Starfighter and Convair B-58 Hustler, a supersonic bomber which made its first flight early in November. This engine has also been used in a prototype model of the Navy Grumman F11F.

General Electric engineers developed a technique that enables them to evaluate the performance of a jet engine that is still in the design stage. Using the IBM 704 computer, one of the fastest large-scale scientific computers on the market, company technicians can "fly" a theoretical engine. Two of the giant electronic brains were installed in General Electric's new computation building.

In April, the Air Force authorized the General Electric J47-25 jet engines to be operated up to 1,700 hours before major overhaul—longer than is permitted for any USAF reciprocating engine and the most permitted for any axial flow turbojet engine. This was the second increase in allowable operating time during a six-month period for this J47 model. The first increase was from 1,200 to 1,400 hours.

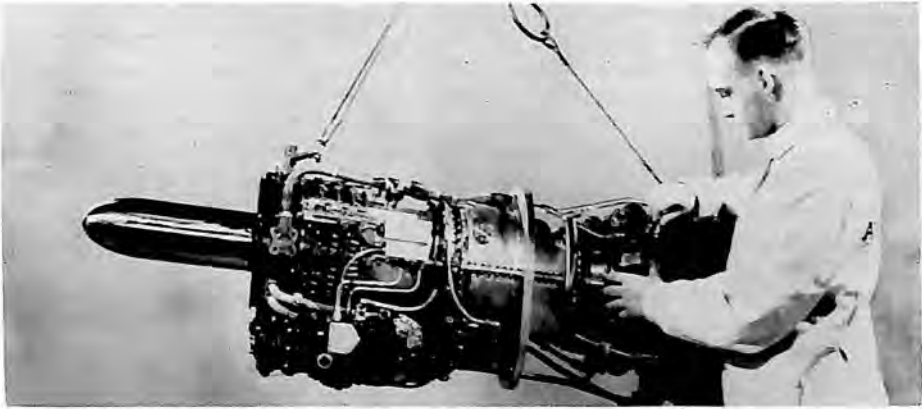
In June, General Electric announced that a jet engine flight test record had been set by accumulating on a J73-3 engine more service hours in a shorter period of time than has ever been achieved before on either a military or commercial jet engine. In less than four months a 500-hour accelerated service test was performed on the J73 engine in a North American F-86H aircraft. Normal time for completion of such a test is from 10 to 12 months.

In April, General Electric announced that the J79 successfully powered a Navy Douglas XF4D fighter, a test aircraft, in flight. This flight marked the first time a U. S. engine manufacturer has flight-tested a military jet engine in a single-engine aircraft before turning the engine over to an airframe manufacturer for testing in the aircraft for which it is scheduled.

In June, it was announced that General Electric's CJ805 jet engine, a commercial version of the new GE J79, would power the Convair 880, ordered in quantity by Trans World Airlines and Delta Air Lines. The Convair transport is currently the only commercial liner to cruise at more than 600 miles an hour. General Electric's light-weight engine will produce more thrust per pound of engine weight than any other engine in its power class.

A major innovation with far reaching effects both for the Air Force and industry in the support of aircraft engines reached a milestone early in November with the first shipment of jet engine spare parts

## THE INDUSTRY



**General Electric's T-58 turboshaft engine**

directly from the General Electric Evendale, Ohio, plant to Air Force users. The shipment was a result of a General Electric service contract, the first let by the Air Force's Air Materiel Command to an engine manufacturer for assuming storage and issue responsibilities for spare parts in support of an airplane engine during its developmental and early production stages. The innovation of the new agreement is the shipping of spare parts directly to Air Force users instead of shipping them to various Air Materiel Command supply depots for storage and distribution.

In 1956, the Development Department of GE was renamed the Flight Propulsion Laboratory Department of the Aircraft Gas Turbine Division. The change of title reflects a widening scope for the department. The Flight Propulsion Laboratory Department creates and demonstrates the feasibility of advanced concepts of extraterrestrial, transport, and flight propulsion systems.

During the year FPLD established a group of non-citizen engineers to conduct propulsion studies, working from generally available information and without access to classified data. And at Danville, California, an advanced engineering development group was created.

The Rocket Engine Section of FPLD is producing 13 X405 engines for Project Vanguard, the Government's earth satellite program. The X405 is a bi-liquid propellant engine and has a thrust of more than 27,000 pounds. It will operate for approximately 140 seconds to accelerate the earth satellite vehicle to a speed of 4,000 miles per hour.

It was announced in 1956 that the T58 turboshaft engine will soon fly in the Sikorsky S-58 and the Vertol H-21 helicopters. This was made possible when the engine was declared qualified to fly in experimental aircraft. In advance of actual flying, however, the T58 underwent exhaustive testing to prove engine-helicopter rotor compatibility in a specially constructed rotor test stand at General Electric's Flight Test Center in Schenectady, N. Y.

The T58 was received with keen interest and enthusiasm by the aviation industry when it was shown publicly for the first time in 1956. Revelation of the engine's specifications indicated the T58 to be "pound-for-pound" the most powerful turboshaft yet announced. It produces more than 1,000 hp while weighing only 325 lbs. including reduction gearing which is believed to be the most favorable power-to-weight ratio of any similar engine in the medium-small class of power plants. Compared to the T58's better than 3-to-1 power to weight, today's conventional piston engines deliver one lb. for every pound of power.

Designed and developed by General Electric's Small Aircraft Engine Department for the Navy's Bureau of Aeronautics, the T58 is less than five feet long and measures 16 inches in diameter. Specific fuel consumption is 0.69 lbs. per hour per horsepower at normal rating. This combination of low specific fuel consumption and outstanding power-to-weight ratio will give T58 powered helicopters superiority over equivalent piston-powered helicopters in endurance, payload, range and speed in several applications.

Fast, economical servicing of the T58 will be possible because the engine can be handled without the use of extensive ground equipment. A minimum of special tools is needed to disassemble all major components of the engine.

A free turbine incorporated in the T58 introduces fluid power transmission to helicopter powerplants. The fluid is combustion gases which after passing through a two-stage turbine connected to the compressor sends an unconnected (free) turbine which via a shaft turns the helicopter's rotors.

Because of its ability to use a variety of low-cost fuels the T58's operating cost should be reduced and supply made easier.

The benefits which the T58 will bring to military users will be available to commercial operators as well.

While the T58 has been designed for use initially as a helicopter powerplant it can be used for various other aviation and non-aviation applications. In addition, it can be modified as a powerplant for fixed-wing aircraft either as a turboprop or turbojet.

Another small gas turbine engine under development by the department received the official designation J85. This small lightweight turbojet is being developed for the Air Force.

Successfully tested in 1956 by GE's Aircraft Accessory Turbine Dept. was a 5½-ounce turbine wheel that generates 20 hp and utilizes 76 titanium buckets loosely pinned around its disc. Developed for an air turbine-driven pump, the wheel directly drives a 25,000 rpm radial-action ball-piston pump producing 8 gpm at 3,000 psi.

A new and lighter fuel pump weighing only 30 pounds delivers fuel to the afterburner of a jet engine at the rate of 120 gpm and 850 psi when sudden accelerations are required. Turbine driven, it replaces heavier equipment involving combinations of electrical and pneumatic systems.

Also nearing completion by the Department was a turbine-driven fuel-boost and transfer pump. A small turbine driven by air drawn from the

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jet-engine compressor connects directly to the pump. Located within the fuel tank, the complete unit incorporates a separator to insure delivery of vapor-free fuel.

In conjunction with Standard Oil of Indiana, a new, smokeless propellant was developed for use in a jet-engine starter. Weighing only 60 pounds, the complete unit starts and assists jet engines to idling speeds within 25 seconds. The starter cartridge burns for about 10 seconds.

The Specialty Heating Operation of GE in Coxsackie, N. Y., produced electric blankets for guided missiles, naval torpedoes, and aerial cameras. This organization, through successful design of electric coverings, greatly improved the performance of many weapons by protecting delicate control mechanisms and propellant fuels.

Although development of the B-47 turret was announced prior to 1956 by the Aircraft Products Department, Johnson City, N. Y., the first photo stories concerning test flying of this equipment on indoor ranges and actual operation of the turret at a SAC base (Portsmouth) were released during the year. The 20 mm Vulcan cannon for jet aircraft, developed by A&OS (now Aircraft Products), was announced in 1956. Based on the principle of the old Gatling machine gun, the Vulcan gun was developed by U. S. Army Ordnance and General Electric engineers, starting in 1946. Capable of an outstanding rate of fire, the weapon can be fired either electrically or hydraulically.

In late 1956 Specialty Heating, and A&OS (Aeronautical and Ordnance Systems) merged with the Johnson City operation under the heading of Aircraft Products Department. The department now includes facilities at Johnson City, Coxsackie, and Schenectady, N. Y., and Burlington, Vt.

During the year General Electric furnished the MA-1 Compass System to the Bureau of Aeronautics for use on Navy fighter aircraft. This equipment demonstrated its ability to operate satisfactorily under difficult conditions during "Operation Deep Freeze"—the United States expedition at the South Pole earlier this year. Thirty-five aircraft with the Admiral Byrd task force were outfitted with General Electric compass systems three to four times more accurate than previous navigational aids. The devices, on rescue helicopters and transport planes, were found to provide consistently accurate heading information.

The secret of the system's accuracy in polar regions is a component which provides latitude-drift compensation, imperative in areas where directional reference from the earth's magnetic field is unreliable.

Developed by Instrument Department engineers at West Lynn, Massachusetts, the MA-1 meets today's low-drift requirements and yet weighs less than 20 pounds.

In production since early 1954, GE MA-1 Compass Systems are in operational use on Navy aircraft including helicopters, piston-driven attack planes, transports, and jet fighters.

The Instrument Dept. also supplied to the Bureau of Aeronautics small-size compass transmitters designed for use in thin-wing aircraft where space is at a premium.



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Announcement of plans for a new multi-million dollar research and development headquarters at Valley Forge, Pa., for work on special defense systems was made in the spring by the former GE Special Defense Projects Department. Later in the year a merger of the department with the Naval Ordnance Systems Department was effected under the new name of Missile and Ordnance Systems Department. By the end of 1956 the department expected to employ 1,000 persons at its temporary headquarters in Philadelphia.

During the year three new advanced engineering operations, covering the areas of guided missile airframes, guidance, and nuclear weapon utilization, were organized in the department.

Multi-million dollar contracts for the development and production of arming and fuzing systems to ready and detonate guided missile warheads were received from the Army Ordnance Corps.

The department also was awarded a U. S. Air Force contract for the development of nose cones for strategic ballistic missiles.

The first long-range operation of electronic components for atomic reactors at high temperatures and in high-intensity nuclear radiation was announced by General Electric Company's Aircraft Nuclear Propulsion Department in 1956.

It was announced that two important electronic assemblies used in power reactor controls had been tested successfully by ANPD inside a reactor for more than 1,000 hours under 90 percent of maximum reactor radiation and in temperatures up to 842 degrees Fahrenheit.

### **Lycoming Div. Avco Manufacturing Corp.**

Development of new aircraft engines and components plus heightened activity in production on prime and sub-contract items highlighted Avco Lycoming's year.

At the Stratford, Conn., headquarters, the T53, first in a family of gas turbine engines being developed by Lycoming, was first in its field to complete the 50 hour preliminary flight rating test. Pre-production contracts for the Army-funded engine were received, and engines were dispatched to the Kaman and Bell Aircraft Companies for experimental flight tests. Both the Kaman HOK and the Bell XH-40, powered by these engines, were successfully test flown under Army sponsored programs. The engine was also being adapted for Navy use and for applications in VTOL-STOL aircraft. At the same time, development of a classified gas turbine engine of similar design but with a higher horsepower rating continued.

At the Williamsport, Pa., section of Avco Lycoming a new four cylinder opposed aircraft engine with the highest horsepower rating of any certificated engine in its class was announced. The O-360 powered the new light twin engine Beech and the prototype of the new Piper Comanche. It is rated at 180 hp at 2,700 rpm, weighs 282 pounds, including starter and generator. Also, new engine type certificates were received for Lycoming

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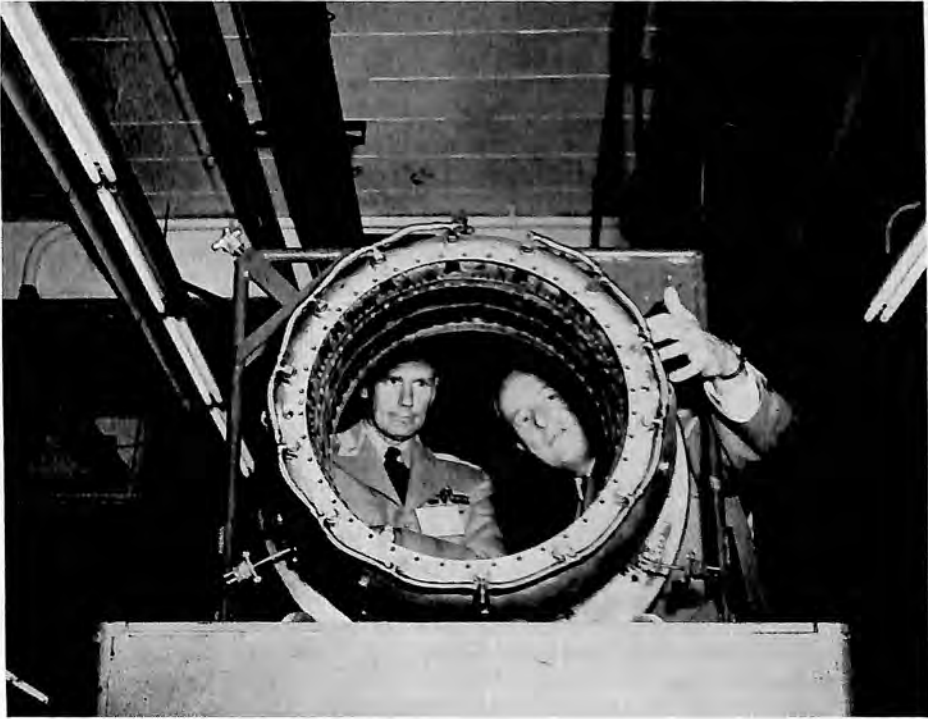
aircraft powerplants including the 275 hp GO-480 and the 340 hp GSO-480, currently being used in the Aero Commander 680.

A number of development projects were undertaken during the year, some of them of a classified nature. A new mechanical constant output speed drive, smaller and lighter than any comparable unit in existence, and operating over a wide temperature range, was designed at the Stratford plant for the Navy. A new temperature accelerator indicator for engineering test personnel to predict failures of bearings and anti-friction devices was developed. Other projects included a centrifugal mercury signal transmitter, a ground power control valve, frequency meter for field service use. Lycoming also worked with Army Ordnance in the design of an amphibious wheeled vehicle.

Increased demand for R-1820 and R-1300 reciprocating engines manufactured by Avco Lycoming under Curtiss Wright license raised production levels for 1956 above those achieved previously. Spare part production for these engines also hit a new peak during the year.

Large ramjet components of Inconel and other heat-resistant alloys were among the sub-contract items undertaken by Avco Lycoming during the year. Others included design and development of a gearbox for the

### Avco Lycoming's new T53 light turbine engine



B-50 tanker conversion program, major components of the pneumatic hydraulic power pack and turbo-alternator for the B-52 program, precision machine parts and assemblies for the J57, J75 and J79 jet engines, and hydrospin components for guided missiles. Lycoming also became the major source for rotor components for the Vertol H-21 helicopter and undertook substantial precision machine part work for Sikorsky aircraft.

Production of private and executive plane aircraft engines and large reciprocating engines in both Williamsport and Stratford plants showed marked increases during the year.

### **Marquardt Aircraft Co.**

Expansion was the keynote at Marquardt Aircraft Company during the year. Production programs for the supersonic ramjet and emergency ram air turbines plus accelerated research and development in supersonic and hypersonic propulsion were among the growth factors.

Early in 1956, Marquardt received contracts from the U. S. Air Force for production quantities of one model of supersonic ramjet, being built in support of Boeing Airplane Company's Bomarc interceptor missile. Two ramjets provide the cruise power for this missile.

The same basic engine configuration is also used on the Lockheed X-7, a test vehicle that has played a major role in the development of ramjet engines for the Air Research and Development Command's missile program.

Under the Department of Defense dispersal policy, Ogden, Utah, was selected as the site for production of Marquardt ramjets for the Bomarc program. Ground was broken on July 11, 1956. A production acceptance test facility was also to be constructed at Ogden.

In the interim, Marquardt was occupying leased space in downtown Ogden to get its staffing, training and ramjet manufacturing operations underway.

At the same time Marquardt was expanding its production, research and development, testing, and administration facilities at Van Nuys, Calif., in order to keep pace with accelerated ramjet development and allied activities. New construction and additions doubled the floor space at the Southern California site during 1956. Capacity of the Marquardt Jet Laboratory, one of the most powerful jet engine research and development test facilities in the country, was being doubled under an expansion and modernization program.

Marquardt's hiring program was paced with this over-all expansion. Employment increased 70 percent during the last half of the year, having passed the 2,000 mark in September.

Ramjet engine projects accounted for approximately 85 percent of Marquardt's gross sales. The balance was divided among development and production of ram air turbine power units and development projects such as afterburners for turbojet engines, turbojet engine controls, and variable inlet controls for turbojet engines.

Marquardt's ram air turbine power units provide a source of emergency

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electric and hydraulic power in the event of failure of the main engine on single-engine fighter aircraft. Two such units were in production during the year for supersonic fighters.

Marquardt also participated in an integrated research and development program established jointly with Olin Mathieson Chemical Corporation (fuels) and Reaction Motors, Inc. (rockets). The three companies participated in an inter-company team effort known as the OMAR program.

During the year Marquardt completed a financing program to cover its immediate expansion needs. Approximately \$3-million was being expended for expansion of the company's Van Nuys facilities and for construction of the Ogden manufacturing plant.

### **Pratt & Whitney Aircraft Div. United Aircraft Corp.**

Expansion of its research, development, and production facilities was a major program of Pratt & Whitney Aircraft division of United Aircraft Corporation in 1956. The expansion of the physical plant required in turn a new alignment of the division's top management.

At the year end, Pratt & Whitney Aircraft occupied more than 7 million square feet of floor area in Connecticut. Satellite activities occupied division personnel in 12 Connecticut towns in addition to the main plants in East Hartford. Requirement for a total of 40,000 employees was close to fulfillment at the end of December.

With urgent need for additional and special research and development area the division found no available room within the state. Further, the area's reservoir of manpower had been practically exhausted.

Consequently a site in a remote section of Palm Beach County, Florida, was obtained, and in September plans were announced for the construction there of a facility for the design and development of highly advanced turbine powerplants.

Meanwhile the division's main production continued to be the J-57. This twin-spool, axial-flow jet-turbine engine continued through 1956 to demonstrate outstanding performance and fuel economy in a large number of first line Air Force and Navy fighters, interceptors, bombers, and military tanker-transport. The never-ending process of development substantially increased the thrust of the J-57 which had been the first production engine in the 10,000 pound class. With afterburner, additional thrust became increasingly available. At the year end, more than 6,500 J-57's had been delivered. This total included the engines manufactured by the Aircraft Engine Division of the Ford Motor Company under a Pratt & Whitney Aircraft royalty-free licensee arrangement.

Progress was also made on the development and flight testing of the more advanced J-75 jet-turbine and the T-57 propeller-turbine engines. An accelerated research and development program on a nuclear-powered aircraft engine Pratt & Whitney Aircraft is designing and developing was continued.

Commercial version of the J-57 and J-75 engines, designated the JT-3

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and JT-4 respectively, improved their positions in 1956. Most of the world's leading airlines have specified either the JT-3 or JT-4 to power the more than 200 Boeing 707's and Douglas DC-8's now on order. By mid-October some 400 J-3's and 1,300 JT-4's had been ordered for installation in these four-engined transports.

The Air Force-sponsored J-57, in its fourth year of production, earned the distinction of having powered more aircraft faster than the speed of sound in stabilized level flight than all the other jet engines in the Western world combined. It also powered the Navy's Chance Vought F8U Crusader to a new official national speed record of 1,015.428 mph on August 21, 1956.

Fighter aircraft powered by the J-57 with afterburner included the Air Force's North American F-100, McDonnell F-101, and Convair F-102, and the Navy's Douglas F4D and Chance Vought F8U.

Bombers included the eight-engined Boeing B-52 intercontinental bomber for the Air Force, and the Navy's Douglas A3D carrier-based attack bomber. The world's first jet tanker-transport to come off the production lines, the Boeing KC-135 is powered by four J-57's, and by the end of the year was undergoing extensive service flight testing prior to being placed in operational use.

Development of the larger and more powerful J-75 was stepped up sharply. An intensified program of flight testing with the J-75 mounted in the bomb bay of a modified B-45 bomber was started during 1956, and as this engine nears the production stage it has already been specified to power the Air Force's Republic F-105 and all production models of the Navy's four-engined Martin Seamaster, plus several other military aircraft still classified.

The T-57, a propeller-turbine adaptation of the J-57, took to the air for flight testing in the late summer of 1956. Mounted in the nose of a modified Air Force C-124, the T-57 steadily indicated outstanding power and excellent fuel economy. The Air Force had a project under way for a propeller-turbine powered transport capable of carrying extremely large payloads on intercontinental missions. The T-57 is slated to be the powerplant for this aircraft.

The 6,000 equivalent shaft horsepower T-34 propeller-turbine registered satisfactory performance in Military Air Transport Service testing.

Production of the 7,250 pound thrust centrifugal-flow J-48 jet turbine continued throughout the year. This engine powers the Grumman F9F-5, F9F-6 and F9F-8 for the Navy, and an afterburner version powers the Lockheed F-94C for the Air Force.

Manufacture of the R-2800 piston engine continued at a steady pace with many new orders, both military and commercial, being received. While this was the only Pratt & Whitney piston engine in production, spare parts were being made for other piston engines.

In addition, good progress was made on several advanced jet-turbine projects for both the Air Force and the Navy.

Research and development work on an atomic-powered aircraft engine under way since 1951 was stepped up sharply in 1956. Increased personnel

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and facilities assigned to the project were significant. Besides the main effort being conducted at leased facilities in South Windsor, operations were started in an AEC laboratory in Livermore, California, and engineers and scientists were substantially supporting reactor research at the Oak Ridge National Laboratory.

Work on the new Connecticut Aircraft Nuclear Engine Laboratory (CANEL), under construction in Middletown, Connecticut, by the Air Force, proceeded satisfactorily, and it was expected that Pratt & Whitney Aircraft would begin operating this plant in 1957 for continuing development of an aircraft nuclear powerplant.

A major development in the reduction of sound from jet aircraft engines being ground tested was designed and built by P&WA, and in late May, the company made the design available free of charge to aircraft manufacturing firms, the airlines and the military. Pratt & Whitney Aircraft also offered to license qualified companies specializing in acoustical engineering and equipped to produce the device under royalty free contracts.

As 1956 drew to a close, Pratt & Whitney Aircraft neared an all-time peak of 40,000 employees, had greatly enlarged its production and development facilities, and was still moving forward as advanced aircraft engine developments were brought nearer to reality.

### **Westinghouse Electric Corp.**

The diversified activity of Westinghouse in the aircraft industry continued during 1956.

At the aviation gas turbine division, the Westinghouse J34 turbojet was once again placed in production for the Navy, nearly ten years after the first J34's were delivered. Through continuous development effort, Westinghouse has kept the J34 modern. The new engines will be used in a new single-engined Navy trainer and as auxiliary powerplants on two other Navy aircraft. In response to commercial interest in the J34, Westinghouse requested and received in 1956 CAA approval of one of the latest versions, designated as the W-340, for commercial aircraft use.

Westinghouse continued its leadership in the field of wind tunnel drive and control. One outstanding achievement in this field was the design and construction of the world's largest axial-flow compressors and drive motors (two 83,000 hp synchronous motors each started by a 25,000 hp wound rotor motor) for the Air Force's giant Propulsion Wind Tunnel at the Arnold Engineering Development Center, Tullahoma, Tenn.

The transonic tunnel was expected to be in operation in January, 1957, and the companion supersonic tunnel will be completed later. Each tunnel will be served by its own enormous axial-flow compressor and both will be driven by four motors totaling 216,000 hp, the largest concentration of motor horsepower on a single shaft in the world.

Westinghouse has also designed and built precision wind tunnel components such as a sting support and a side-wall balance for the transonic loop of the PWT.

An extremely lightweight, mobile radar set of revolutionary design and



"Our country must have a nuclear-powered Navy for the preservation of world peace and the security of our own land. The atomic-supersonic-nuclear weapon-missile age is here. There is no turning back. We can't hide from it; we can't ignore it in the hope it will disappear. Our naval air power must serve first as an added deterrent to atomic war and, second, as a major reprisal force if it should ever happen."

—CHARLES S. THOMAS, Secretary of the Navy

long range was developed by the Westinghouse Electric Corporation for the U. S. Air Force.

The air-inflated Paraballoon antenna is the key to a large and truly mobile radar set. It is now possible to employ high-power radars in tactical situations and locations where time and transportability are of utmost importance.

Westinghouse is also building the Navy's newest fire control system for fighter aircraft.

The equipment, known as the Aero 13 fire control system, will be installed in the Douglas F4D Skyray, a carrier based all-weather jet fighter-interceptor. Production deliveries have begun and will continue into 1957.

Development of the Aero 13 has resulted in installation of a new cylindrically packaged unit located in the nose of the aircraft. This compact design has provided important savings in space and weight and, at the same time, greater ease of maintenance aboard the Navy's carrier. Exhaustive evaluation tests during 1956 by the Navy and Westinghouse have indicated high standards of reliability and performance.

Designed for the detection and destruction of enemy aircraft at night and under no-visibility weather conditions, the Aero 13 is the direct outgrowth of an earlier design by Westinghouse which obtained the first blind "kill" of an enemy aircraft over Korea. This was the Navy's APQ-35 fire control system in the Douglas F3D Skyknight, predecessor of the present F4D Skyray.

Airborne computers, the devices that from radar information predict target position and direct guns accordingly, are also on a weight and size reduction program. WETAC (Westinghouse Electronic Tubeless Analog Computer) is a typical example. A major element of this computer, the instrument servo, consists of an amplifier, servo motor, gear box, and a bank of potentiometers.

Weight of the servo amplifier was reduced from 33 to 4 ounces. The new all-transistorized amplifier replaces five molded units using vacuum tubes. The transistors are silicon to operate through a wider temperature range, and the amplifier also employs a feedback loop to correct

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for many temperature deviations in transistor characteristics. Another advantage of the transistorized circuit is the low-power consumption. This is especially true during nulls, when the power consumption of the transistorized amplifier is about one watt—the previous system required 40 watts.

Size reduction was also aided by fewer total components—39 for the original version to 24 for the transistor servo. This includes such items as resistors, capacitors, diodes, and transformers. For example, six tubes in the original version have been replaced by five transistors.

A new air-cooled generator that produces three-phase power at 400 cycles, 208/120 volts has been developed by the Westinghouse Small Motor Division, Lima, Ohio. The machine is driven by a constant-speed drive. Excitation power is fed to the shunt winding on the exciter stator poles from a Magamp regulator. The three-phase power generated in the rotating exciter armature is fed to a three-phase full-wave bridge of silicon rectifiers mounted inside the shaft. D-c power from the bridge is fed to the main rotating field. The main three-phase power is generated in the a-c stator. Both 30 and 40 kva ratings are now designed and in production for the Boeing 707 jet liner.

Teaming up with the new brushless generators is a Magamp regulator that controls their output voltage. The new regulator not only handles more power output per pound than previous units, but also maintains more accurate control. Its weight is 10 pounds compared to 14 for its predecessor, and it has a continuous output of 65 watts compared to 45 for the previous unit. The new regulator controls the output voltage to within  $\pm$  one percent over the rated load and frequency ( $\pm$  five percent) range; also, it controls voltage to within  $\pm$  two percent over the rated load and frequency range, and in a temperature range of from  $-55$  degrees C to  $+71$  degrees C, from sea level to 65,000 feet. It will handle generators rated from 20 to 60 kva.

Still another running mate for the brushless generator and the Magamp voltage regulator is a new transistorized control and protection panel for parallel a-c aircraft electrical systems. The control and protection function are performed by static sensing circuits and logic circuits that provide signals through transistor amplifiers to open or close a generator control relay, generator circuit breaker, or bus tie circuit breaker. This unit replaces a relay package containing several different types of relays. Elimination of the multitude of relays adds considerably more reliability to the unit. The new panel can be used in three-phase, single-generator or parallel aircraft systems, and although designed for use with 30 or 40 kva generators, is equally suited to other ratings.

In addition to enabling a practical brushless generator, the advent of silicon power rectifiers has brought other advantages to aircraft systems. For one, it has made possible much improved transformer-rectifier units for providing d-c power. Previously, d-c power could be supplied by one of two means—a d-c generator, or by a transformer rectifier utilizing selenium rectifiers. Silicon offers significant advantages over both. In-



portantly, it permits higher temperature operation, with a concurrent reduction in size and weight.

A new line of regulated and non-regulated transformer-rectifier units has been developed for high-temperature applications. They convert 200 volt, 400 cycle, three-phase power to 27 volts d-c power with 12-phase output voltage ripple characteristics. Regulated units use 12-phase self-saturating magnetic amplifiers to regulate the voltage applied to the silicon rectifiers. One special six-phase regulated design capable of withstanding 40 g's vibration has been developed for a guided missile. Typical standard ratings for conventional military or commercial aircraft are 200, 150, 100, and 50 amperes d-c, either regulated or non-regulated.

The advantages of printed circuits—consistency of manufacture with little variation from piece to piece, and manufacturing advantages that produce a more reliable product—have been put to use for improving the molded units used in aircraft equipment.

A standardized panel has been developed, utilizing a 1/10 inch grid system. Conductor paths are etched on this laminate panel, and holes for connecting leads from components are punched from a universal template. Standardized spacing is employed, so that component leads are prebent in jigs, and need merely be fitted into place in the proper holes. Dip soldering techniques are employed.

Compactness necessary for airborne electronic equipment demands small size, with consequent higher operating temperatures. Components must be designed accordingly. High-temperature electronic transformer now uses a new solventless silicone rubber and resin. The outer silicone rubber coat acts as a container, and the transformer is then impregnated with the solventless silicone resin.

A compact, tubular heater developed by the Westinghouse Electric Corporation has proved to be the solution to an icing problem in the Boeing B-52 tail surface control system.

Less than two feet long and about as thick as a cigar, the Corox element heater prevents the formation of ice on this vital control mechanism as the giant plane descends from high altitudes to moist lower altitudes.

The heater fits inside a hollow externally-threaded screw that controls the action of a hydraulic actuator. This actuator in turn amplifies the force delivered through the screw and moves the flight control surfaces of the tail assembly. These control surfaces are used by the aircraft commander or pilot to maneuver the plane in flight.

While directed and motivated electrically by the pilot from the nose of the plane, the threaded screw and actuator are located in an unpressurized, unheated rear section of the fuselage. The heater insures instant operation of the screw and actuator linkage by keeping these parts always at a temperature above freezing.

Expansion and consolidation of facilities to meet extensive programs for development and production of equipment for aircraft and airborne operation also keynoted the 40th year of Westinghouse activity.

Under construction for more laboratory floor space, 70,000 square feet

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will be added to the Westinghouse Electric Corporation's air arm division, Baltimore, Md. The addition will be used for the evaluation of airborne electronic systems being built for the U. S. Air Force.

Adjacent to the air arm plant, is a multimillion dollar electronics plant now complete. Occupying more than 210,000 square feet of floor space, this plant will manufacture radar, fire control and guidance systems. Engineering laboratories and administrative offices will occupy an additional 140,000 square feet.

A new wing of the Westinghouse research laboratory containing 150,000 square feet of laboratory and office space is now complete. This addition represents another forward step in expansion for scientific research and development for air national defense.

In full operation now at the Company's air arm division in Baltimore, Md., is a two-part environmental testing chamber. In a matter of minutes the temperature can be raised to a sizzling 500 degrees F. Also, the temperature can be reduced to a minus 100 degrees F. In this chamber electronic systems are "taken up" to 80,000 feet in 25 minutes, at an initial rate of 5,000 feet per minute. In the other sections are the humidity rain-making and salt-spraying devices.

A key tube is under development at the Elmira, N. Y., plant of the Westinghouse electronic tube division for the U. S. Air Force's "Cat Eye" system. The "Cat Eye" is approximately a thousand times more sensitive than the standard television camera and permits pilots to "see in the dark with daylight clarity."

Under contract to ARDC Rome Air Development Center, the Westinghouse Electric Corporation's electronics division, Baltimore, Md., is operating an over-the-horizon UHF tropospheric scatter transmission system between locations at Verona, N. Y. and Baltimore, Md. The study is in the bands of 900 mc and 2,000 mc.

The data resulting from this study will make it possible to determine scatter transmission system performance in terms of signal attenuations, fading limits, and bandwidth capability as well as practical antenna sizes for maximum gain and diversity considerations.

Another area in which computers have been put to work is in jet engine design at the Company's aviation gas turbine division, Kansas City, Mo. Part of this program involves the evaluation of one jet engine design against another, which means a study of performance over an extreme range of flight speeds and altitudes. It also involves matching studies of engine to airplane over the full range of anticipated flight conditions.

At present a considerable amount of computer programming has been accomplished; this has already been used in some calculations, and can be applied in later design calculations. Development of the Westinghouse-sponsored axial flow J54-WE-2 turbojet progressed rapidly during the year, with sea level testing at the aviation gas turbine division and altitude chamber testing at the Naval Air Turbine Test Center confirming the engine's ability to meet all specification guarantees. Using the latest aerodynamic, mechanical and metallurgical advancements, Westinghouse

has designed the J54 to feature unusually low weight and specific fuel consumption ratings without sacrificing the reliability and simplicity so urgently needed for both military and commercial aircraft powerplants. It has successfully completed two 50-hour flight substantiation tests and one 150-hour endurance test and is now being flight tested by the Westinghouse flight test department at NAS-Olathe, Kansas.

A special turntable is being developed at the Westinghouse air arm division for field testing the gyroscopes used in airplanes aboard aircraft carriers. Periodically, the fire-control gyros must be removed from the aircraft and checked for accuracy.

Metallurgists at the Westinghouse research laboratories are conducting tensile tests on metals at temperatures as low as minus 452 degrees Fahrenheit. The metal specimens are stressed within a specially designed chamber which has been cooled with liquid helium. Results of these tests will provide engineers with needed information regarding types of metals that are best suited for use under extreme temperature ranges. Information of this sort may well be useful in the design and development of guided missiles and future supersonic aircraft.

## **PROPELLER MANUFACTURERS**

### **Aeroproducts Operations Allison Div.**

Aeroproducts turbo propellers were selected by five major United States airlines for installation on the Lockheed Electra during the year. With thousands of hours of successful flight operation, these propellers, with the Allison Prop-jet engine, provide the commercial airlines with a proven Prop-jet power package.

As a result of the excellent operation of the Aeroproducts turbo propeller on the Allison Turboliner and the Convair YC-131C, both powered by the Allison T-56 engine, Aeroproducts was awarded the prime production contract for propellers for the Lockheed C-130 Hercules Transport. Production of propellers for the C-130 began in June, 1956, and will reach peak monthly production in early 1957.

During 1956, the Navy-Convair R3Y Tradewind, equipped with Aeroproducts dual rotation turbo propellers, set a new seaplane speed record from California to Hawaii and return, following its assignment to fleet operation. Aeroproducts Model A644FN-C2 turbo propellers were selected for the Stroukoff YC-134 Pantobase airplane, and successful supersonic turbo propeller flights were demonstrated on the Republic F-84H airplane. Production of propellers for Douglas AD-4, Fairchild C-119 and North American T-28 aircraft continued during 1956.

With future requirements in mind, Aeroproducts engaged in propeller studies and design for application to smaller Prop-jet engines such as the Lycoming T-53 and General Electric T-58 free turbine engines. Propellers of this type were supplied to Lycoming for test operation.

Design work also progressed on propellers for turbine engines with nose-mount rather than shaft-mount configuration of propeller installation.

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Aeroproducts linear hydraulic actuators, incorporating self-locking, synchronized features, were supplied for jet engine afterburner control during the year. Also, linear, hydraulic actuators with pneumatic emergency operation were used to control in-flight wing incidence change on the supersonic Chance Vought F8U-1 Navy fighter.

Research and development in 1956 produced actuator designs which incorporate metallic seal configurations that enable afterburner and thrust reverser actuators to operate in ambient temperatures of 1000° F. Materials now have been extended to include titanium. Pneumatic actuators are also being researched to establish compatibility with high temperatures and modulation requirements.

Aeroproducts was in production of a ram air driven hydraulic pump for the North American F-100D Super Sabre. Aeroproducts was in pre-production stages other ram air hydraulic pumps of various powers and capacities which are of both the ducted and pop-out type units.

Aeroproducts also delivered emergency ram air driven generators to Douglas Aircraft for installation on the Navy's Douglas A4D Skyhawk and the F4D Skyray. As with the hydraulic pump, the generator is driven by a two-bladed variable pitch propeller incorporating a simple governor which maintains a constant rpm of the generator rotor. The power output of the generator is sufficient to operate flight control surfaces necessary to fly and land the aircraft, and to electrically operate instruments and other electrical equipment necessary for flight. Its practicability has been demonstrated many times in flight testing. Although it was designed to meet the aircraft industry's need for a dependable light weight emergency power source, this generator has also been used for applications such as high speed tow targets and drones.

The experience which Aeroproducts has had in research and development in the field of aerodynamics and propeller governing systems has been directly applicable to the design of ram air driven power units.

Ram air is also utilized to drive a four-bladed feathering drive motor that is fitted with a standard output pad and shaft adapting it to either electric generators or hydraulic pumps. It can deliver a minimum of 44 hp at a constant driveshaft rpm, and for non-operational duty, the blades can be driven to a self-seeking feather angle which produces minimum drag.

### **Hamilton Standard Div. United Aircraft Corp.**

Progress and expansion were the keynotes at Hamilton Standard in 1956. Among the highlights were:

Start of construction of a major addition to the factory, and completion of a third floor on the office building.

Establishment of an engineering branch in St. Petersburg, Florida, and purchase of a large tract of land on the outskirts of St. Petersburg as a site for a possible new engineering and development structure.

Establishment of a new and completely integrated electronics department.

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Attainment of a new high in the division's commercial propeller backlog. Continued gains in the development and production of specialized equipment for turbine-powered aircraft.

Purchase of the Aero-Pneumatics Division of Pacific Airmotive Corporation.

Outstanding success of nickel coating as a means of reducing propeller maintenance costs.

Development and production of a radically-new hollow aluminum propeller blade.

Substantial progress in the development and testing of turbine propellers.

Employment increases which, by the end of the year, had pushed the total to approximately 10,000, equal to the division's World War II peak.

The factory expansion, intended primarily for the production of jet engine fuel controls, will provide 316,000 square feet of manufacturing space and 81,000 square feet of mezzanine office space. The expansion program will bring Hamilton Standard's plant facilities in Connecticut to 1,684,000 square feet.

Hamilton Standard's operations in Florida started in March with the leasing of a 30,000-square foot section of a former U. S. Maritime School on the St. Petersburg waterfront. Products developed there will continue to be manufactured in the main plant in Windsor Locks, Connecticut.

Hamilton Standard's new integrated electronics department is centralized in the company's Broad Brook, Connecticut, branch plant where engineering and manufacturing groups have been developing and producing electronic products for several years. Decision to create the new department stemmed from the possibilities for electronics business over and above the division's requirements for its fuel controls, temperature controls and propeller Synchronphasers.

Surprising in the "jet age" was the fact that Hamilton Standard's commercial propeller backlog reached an all-time high during the year. The situation, reflecting the propeller's continued strength in the air transport picture, was due mainly to continuing procurement by major airlines of piston-powered aircraft to meet the growing demands of air travel.

As a result of these demands, orders for the Douglas DC-6 and DC-7 series aircraft, as well as the Convair 440, extended into 1958. All were equipped with Hamilton Standard propellers—43E60 reversing Hydromatics for the DC-6A's, DC-6B's and the 440's; 34E60 reversing Hydromatics for the DC-7's, DC-7B's and DC-7C's. Also in production commercially were 43E60's and 43H60's for the Lockheed 1049G Super Constellation; 43H60's for the Lockheed 1649 Super Constellation; 43E60's for the Breguet 765; 22D30 feathering Hydromatics for the Beech D-18; and 3D40 Controllables for the DeHavilland Otter.

During the year the company's military propeller backlog reversed its downward trend. Propellers were in production for military versions of the Lockheed Constellation; the R6D and C-118 versions of the DC-6; the Boeing KC-97F; the Fairchild C-123; the North American T-28B and C.

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**Nickel coating of propeller blades, as developed by Hamilton Standard, is tested on Martin P5M**

and T-6; the Lockheed P2V-7; Grumman S2F-1, TF-1, UF-1 and SA-16A; Convair T-29B, C and D; Martin P5M; Beech SNB and C-45; and the L-20 version of the DeHavilland Beaver.

Production of the old 12D40 Controllable Counterweight propeller, which was resumed in 1954, continued into 1956. The 12D40 was first designed and produced in 1933 and the reorder was for replacements for Air Force and Navy trainers.

Hamilton Standard's sales of equipment for jet aircraft in 1956 exceeded its total propeller sales for 1948, the year the company entered the jet equipment field. The eighth year of this major product diversification program found the division producing air conditioning systems, fuel controls, starters, hydraulic pumps and pneumatic valves for a wide variety of military aircraft. One or more of these products were either installed in or scheduled for installation in some 40 different models, ranging from supersonic fighters and guided missiles to the largest intercontinental bombers.

Among these aircraft were the Boeing B-52, 707, K-135, B-47D and KC-97J; Canadair Sabre VI; Chance Vought F7U-3, F8U and F8U-1P; Convair F-102, F-102A, YC-131, R3Y; Douglas F4D, RB-66, A4D, A3D-1, C-133, DC-8; Grumman F11F-1, F9F-8T; Lockheed F-94C, C-130, F-104A; Martin XP, TM-61; McDonnell F-101, RF-101, F3H; North American F-86D, F-86H, FJ-2, 3 and 4; and F-100; Northrop F-89D and H; and Republic F-84H.

A significant step toward improving its position in the field of aircraft air conditioning was taken by Hamilton Standard early in the year with the purchase of the Aero-Pneumatics Division of Pacific Airmotive Corporation which manufactured air pressure equipment.

Of particular significance toward the division's future in the equipment field was the announcement in April that Hamilton Standard had an engineering team at work on the problem of providing controls for nuclear aircraft engines. The company, it was disclosed, was applying to the

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problem its six-year background of experience in designing and producing electronic and hydromechanical fuel controls for gas turbine engines. The nuclear control team had a full-time representative assigned to Pratt & Whitney Aircraft's nuclear engine group.

"Armor coating" of propeller blades with a thin layer of nickel has proved an effective way to protect against damage from stones, debris, or water spray, Hamilton Standard announced early in the year. The nickel-coating development had established its worth as a major means of reducing propeller maintenance costs in more than 2.5-million hours of commercial and military operations, it was disclosed.

During the year the CAA granted an approved type certificate to Hamilton Standard for a new hollow aluminum aircraft propeller blade. The blade, under development for the past six years, is believed to be one of the most important steps forward in propeller design in the past ten years. It has been selected for Lockheed 1649A Constellations on order by Trans-World Airlines and Lufthansa of Germany, and Lockheed propeller-turbine Electras ordered by KLM of Holland. Flight tests on the 1649A were started in October.

The new blade is significant, Hamilton Standard says, because it provides the lightest, strongest structure to do the propeller's job. Its saving in weight over conventional solid aluminum alloy blades means that the propeller's hubs can be lighter. The end result is a propeller which absorbs more horsepower per pound of weight than any other propeller in history.

The simplicity of the blade's manufacturing process affords maximum control over blade quality at every stage of its production. Contributing to the ease of control and dependability of operation is the relatively low temperature at which aluminum is extruded compared to steel. This factor provides the added advantage of inflicting little or no damage on the steel tools used for the manufacturing process and permits almost mirror-like interior and exterior finishes impossible with steel blades without extensive additional work.

Hamilton Standard's development work in the propeller-turbine field advanced on three fronts:

First, service testing of the A3470 Turbo-Hydromatic on two T-34-powered YC-121F Constellations was generally satisfactory. One aircraft logged almost 600 hours of flight time during the year while the other totaled more than 300. Both aircraft were equipped with Synchronphasing, Hamilton Standard's electronic device for providing smoother, quieter flight by keeping propellers "in step" with split-second accuracy.

Second, Hamilton Standard's huge nose-mounted Turbo-Hydromatic propeller was brought to the flight test stage after some 2,500 hours of engine operation in test cells at Hamilton Standard and at Pratt & Whitney Aircraft. Flight testing of this four-bladed propeller, which is intended for installation in large military transports using gas turbines of high power was being carried out in a Douglas C-124 flying test bed during early fall.

Finally, at the lower end of the division's turboprop power range, a

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Hydromatic adapted especially for turbine engine operation was approaching the development test stage. Designated the 54H60, this propeller was intended for installation on Lockheed Electras on order for KLM.

The drive for more manpower, which saw Hamilton Standard's total employment reach 10,000 at the year's end, was necessary to keep pace with climbing production schedules.

### SYSTEMS AND COMPONENTS

**Aeronca Manufacturing Corporation** of Middletown, Ohio, continuing its program of growth and development with the aircraft industry, during 1956 achieved a series of new objectives.

A 57,000 square foot addition to the the main plant at Middletown was opened August 10, 1956. This was used largely for production of major sub-assemblies of the Boeing KC 135 and 707 and for a beaching vehicle for the Martin P6M SeaMaster. The Boeing B-47 program having phased out, other major attention was centered on production of B-52 sub-assemblies for Boeing, C-130 assemblies for Lockheed, newly developed brazed stainless steel honeycomb for Convair, as well as projects for Arma, Ford, McDonnell, Raytheon, General Electric and other aircraft manufacturers.

To more effectively serve the corporation's customers and simplify the organization, a major regrouping of activities was undertaken about October 1. This, when completed, will result in strict control of each project from start to finish.

The Industrial Research Laboratories Division at Baltimore, Maryland, continued its work in basic and applied electro-mechanical research, broadening the scope of Aeronca's manufacturing potential by the development of a "Navigational and Bombing Radar Trainer," now under test; semi-automatic inspection equipment for the beer and soft drink bottling industry, a low cost burglar alarm system and many other products. It is also engaged in the research and development of a series of other electronic defense mechanisms.

The Aircraft Maintenance Division, organized for the maintenance of aircraft of the Army Aviation Center at Fort Rucker, Alabama, was dis-established on June 30, 1956, with the transfer of the contract for this service.

Aeronca's backlog of unfilled orders early in November stood at \$37,250,000 compared with \$32,200,000 at the end of 1955. Sales for 1956 were projected at \$22-million compared with \$20-million for 1955.

Research and development projects were greatly expanded, both at the Middletown and Baltimore plants, with principal emphasis on electronic and missile research at Baltimore, and development of new metals process at Middletown. The metal bonding process developed at Middletown was extremely successful, and the brazed stainless steel honeycomb received very favorable acceptance in the industry.

**Aluminum Company of America**, in 1956, announced: start of construction on a 150,000-ton fully integrated smelting plant in the Ohio River



Valley; plans for a \$45-million alumina plant adjacent to its Point Comfort (Texas) smelter; installation of the West Coast's first large hydraulic forging press; plans for the installation of a second 14,000-ton extrusion press; an advance in the use of the Air Force's heavy presses with production of the world's largest closed die forging for the Navy's first multijet seaplane; and production of aluminum alloy hand forgings with a previously unobtainable low level of internal stresses.

Alcoa is building its newest smelter near Evansville (Ind.) at a cost of approximately \$80-million. Power for the new potlines will be generated by a 375,000 kilowatt coal-fired steam power plant, with first production scheduled for the fall of 1957. Fully integrated operation of the smelter on its own power is expected by mid-1958, and employment of the over-all operation is expected to number about 1200. The new smelter's output will boost Alcoa's production of primary aluminum approximately 19 percent over the existing and planned installed capacity announced at the close of 1955.

At a site adjacent to its Point Comfort (Texas) works, Alcoa is proceeding with plans to build a 500,000-ton alumina plant to meet the needs of the Company's smelters at Point Comfort and Rockdale (Texas). First production from the new facilities is scheduled for early 1958, and the new plant will employ a minimum of 650 persons.

To produce large precision aircraft forgings of the close tolerance, low draft type, Alcoa has installed an 8,000-ton hydraulic forging press at the company's Vernon (Calif.) works.

A 14,000-ton extrusion press, twin to the world's largest, will be installed by Alcoa at the company's Lafayette (Ind.) works. The new unit, financed entirely by Alcoa, will provide a mate for the 14,000-ton extrusion press owned by the U. S. Air Force and operated by Alcoa since 1954 at the Lafayette works. It will be built and installed to meet an unprecedented demand for large, high-strength aluminum alloy extrusions for military and defense needs, primarily in the aircraft and missile fields.

In a further development of the capabilities of the Air Force heavy presses, Alcoa produced a massive 3,000-pound airframe member on the giant 50,000-ton press at the company's Cleveland (Ohio) works. Measuring 13 feet in length, three feet across at its widest point, and a foot in thickness, the pace-setting forging was produced for the Martin company as part of the airframe in the P6M SeaMaster, world's first multi-jet seaplane. Achievement of the king-size forging made possible a substantial weight reduction and increase in the performance level of the radically designed new plane. The Cleveland works die shop accomplished another first by sinking the world's largest dies to make the big forging possible.

Production of aluminum alloy hand forgings with a long sought, low level of internal stresses was announced in 1956 by Alcoa. The development, made possible by a new tempering process, meets a decades-old need in the aviation industry. The immediate advantages are sharply reduced machining and straightening time, with resulting economies in production

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costs. Designated T65 temper, the newly perfected treatment has been applied to hand forgings and rolled rings in Alcoa alloy X7079.

Additional facets of Alcoa's expansion program announced during 1956 included a seventh potline at Point Comfort works, adding 20,000-tons to that operation's present installed capacity. The addition will cost approximately \$11-million, and will provide jobs for about 100 men. At the company's Massena (N.Y.) works, two new potlines will be built to replace older facilities that will become inoperable with the shutdown of generating facilities of the St. Lawrence River Power Company, an Alcoa subsidiary. The new lines are scheduled to be in operation by late 1958.

During the year the **B. G. Corporation** received approval of a new series of all weather top type spark plugs for use in Pratt and Whitney Aircraft R-4360, R-2800, R-2000 and R-1830 engines. Approval was also received for this new type spark plug model BG 340 for use in United States Air Force and United States Navy aircraft.

During the year the corporation continued to manufacture ceramic terminal sleeves, spark plugs and ignition harness test sets for use in conjunction with piston engine operations.

In the gas turbine engine field, the B. G. Corporation expanded its activities in the development of thermocouples and rigid type thermocouple harnesses for all of the principal aircraft gas turbine engine manufacturers. Research was also being done for the United States Air Force on resistance-temperature measurement systems for gas turbine engines.

In the field of igniters for gas turbine engines, the B. G. Corporation concluded research work on semi-conductors and furnished this type of igniter in production quantities for use with high energy, low tension ignition systems.

During 1956 the company completed research on a metal-to-ceramic sealing process and began production on items such as hermetic seal terminals for the electronics industry.

The Cincinnati Division, **Bendix Aviation Corporation**, in September of 1956 moved into a new 30,000 square foot plant in the Hyde Park residential suburb of Cincinnati. The Division is an electronic manufacturer of instruments for aircraft as well as devices for industrial control.

An industrial model of a nuclear density gage has been modified by the Cincinnati Division to measure the vapor-liquid ratio in fuel lines. Several of these instruments were delivered during the year to Wright-Patterson Air Force Base where an investigation was under way to correlate the indicated reading on the Bendix gage with the ratio calculated from data taken on fuel pump test stands.

The gage actually measures average density of the vapor and liquid present in the fuel line, and it can be calibrated in terms of V/L ratio if density of the fuel remains sufficiently constant. The measurement relies on absorption of gamma rays by contents of the line. A 20 millicurie Cesium-137 radioisotope source is mounted on one side of the line, while an ionization type detector is mounted on the other. Installation is made

without interrupting the flow or process, and without inserting any sensing element into the stream.

At Eclipse-Pioneer Division of Bendix Aviation Corporation, 1956 was the final year of preparation for the coming of jet and turboprop aircraft to the commercial aviation scene. Much equipment, particularly in the field of integrated instrumentation and control systems for aircraft of the new era, had passed the design and development stage and was started on its way through production.

Significant among this product group was the Division's PB-20 Automatic Flight Control System. Early in the year, in an announcement that was hailed as "U.S. commercial aviation's first decision on an automatic flight control system for the turbo-prop and turbo-jet age," the PB-20 was specified for use on America's first turbo-prop airliner, the Lockheed Electra. And during August, the Boeing Airplane Company, in what was believed to have been the largest commercial order of its kind, called for \$2.5-million worth of PB-20's for their model 707 Stratoliner and Intercontinental jet transports. And then in a move that emulated the military's "systems concept" for procuring a completely integrated package of co-functioning systems, both Lockheed and Boeing specified PB-20-matching Flight Director instrumentation and Compass Systems from Eclipse-Pioneer. Even as these airplane-tailored systems were placed into production, components of PB-20 systems slated for the world's longest range commercial plane, the Lockheed 1649A, and the world's largest turbo-prop-transport, Douglas' C-133A for the USAF, were rolling off the line.

Complementing this PB-20 activity, additional versions of the system were also specified during 1956 for two of Canada's latest military aircraft.

Developed during 1956 as an alternate to Eclipse-Pioneer's much publicized Polar Path Compass was a new Continental Compass system. This utilized the same high accuracy, one-degree random drift directional gyro transmitter and small magnetic-sensing remote compass transmitter, as Polar Path. But in lieu of the Polar Path Controller which provided a means of correcting gyro drift during flight with changes in latitude, the Continental Compass gyro was factory calibrated for the mean latitude of intended operational use. The indicator developed for use with the system combined the functions of an RMI and a master direction indicator, provided "take-offs" for operating repeaters, an autopilot, or other navigational equipment, and offered integral VOR-ADF switching in lieu of the usual remote switching arrangement.

Several new Flight Director systems, based on differing operational concepts of commercial operators, were also developed during 1956. In these 2-indicator systems, the Flight Path Indicator was of the plan position type rather than a ground reference indicator similar to previous instruments. It combined compass heading, omni-bearing selection, localizer or VOR indication, glide slope indication, "TO" and "FROM" indication, and radio warning flags all in one and thereby served as a replacement for a Gyro Compass Indicator, an Omni-bearing selector and an ILS or Course Indicator.

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As new marks for operational speeds and altitudes were achieved during 1956 and even greater increases became a matter of just waiting for tomorrow's takeoffs, the ever present problem of accurate navigation presented new complexities for the biologically limited human pilot. Toward solving these, Eclipse-Pioneer devoted considerable engineering effort to the development of self-contained dead reckoning navigational computers for both military and commercial applications. Typical of these was a combined latitude-longitude and great circle computer all wrapped up in 16 self-contained pounds. From true airspeed and compass heading inputs, it automatically derived distance flown and continually indicated present position in terms of latitude and longitude as well as great circle distance and great circle bearing ( $\rho$ - $\theta$ ) to home base, destination or alternate target.

Eclipse-Pioneer's 1955-announced concept of a Central Air Data Computer System for military aircraft was brought to a production reality during 1956 in a unique and dramatic manner that shattered delivery time for production equipment from a normal two-year period to nine months after receipt of an order. The technique employed on the 2700 part, delicately precise system eliminated the usual development model or engineering prototype and all conventional steps involved therein, and enabled first draft drawings to be used for production purposes. By this process the very first model ever produced was actually the first unit of a full production run and came off the line ready for delivery to the customer. The successful accomplishment of that production innovation was a vital step in helping to solve the external problem of adequate lead time for the development and production of complex new equipment. By year end, Eclipse-Pioneer Central Air Data Computers had been specified for use on most of the Air Force's new century series of jet fighters.

In the field of radar, Eclipse-Pioneer during 1956 successfully developed and produced an airborne weather radar antenna which, at the flick of a switch, provided either a narrow pencil beam of the type required for spotting storm clouds, or a wide fan (cosecant squared) beam of the type required for terrain mapping. The design, which promised to set the style for future radars, was based on the use of a ferrite rotator and a special type of spoiler which did not require the use of moving parts. The new antenna was developed for use with the Bendix Radio Division's RDR-1 airborne weather radar system.

At Friez Instrument Division, engineering and manufacturing activity was devoted mostly to precision instruments, particularly meteorological equipment. The Division expanded its products scope to include a category called "airborne devices"—which included Vortex Thermometers, Thermistors, Pressure Switches, and Pressure Transducers.

At the Hamilton Division of Bendix Aviation Corporation the year 1956 was highlighted by an expansion of plant facilities and personnel. The Division continued and augmented its efforts toward the development of new products and in the field of manufacturing techniques. One example of this was development and production of precision bellows.

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On the Research and Development side the Division was particularly active in the development of Jet Fuel Controls for engines in the low thrust class and on Fuel and Hydraulic Pumps and Accessories for both aircraft and missile use. Delivery was made on a Dual Element Gear-Type (Model GPB2) Main Engine Fuel Pump and Fuel Control (Model HJA2) which is used on the Continental J-69 Engine.

The year saw a continued increase in the amount of design engineering the Hamilton division supplied to its contractors on engine accessory items. The contract manufacturing facilities of the Division were expanded to embrace all phases of precision machining, assembly, high-temperature brazing, test and calibration of customer-designed hydraulic and fuel system components. The installation of five large electrically-heated, controlled-atmosphere, Bell-type brazing furnaces made possible the fabrication of complex assemblies such as turbine burner rings, manifolds, etc., up to 42" in diameter.

During 1956, Bendix began manufacturing transistors and set up a research and development laboratory for work in semiconductors and other solid-state devices.

The Research Laboratories Division was actively engaged in investigation of improved methods of making rectifying junctions in germanium and silicon including the new diffusion method, modified alloy methods, and still newer techniques.

Other areas in which progress was made: (1) improvement of thermal and electrical characteristics of transistors by changes in chemical and physical steps in the fabrication of transistors and (2) metallographic procedures for evaluating semiconductor materials and processing. Several

### **Bendix Vortex Thermometer system**



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other aspects of solid-state research were actively investigated including fundamental studies of semiconductor phenomena.

The Research Laboratories was also engaged in an extensive development program concerned with automatic controls for machine tools used in the manufacture of airframe and jet engine components as well as a variety of aircraft accessories. The tape control system developed by Bendix makes it possible to control a complete and complex machining process without requiring the use of expensive and long lead time tooling. This principle was applied to a cam-milling machine which in actual plant operation enabled the manufacture of intricate three-dimensional cams in several days following engineering release as contrasted with previous lead time of several months. Accuracy of .0005 inch or less which is obtained is of course applicable to a variety of other accessory components.

A compact manifolded mounting base for a hydraulic missile guidance system package in which all external interconnected plumbing lines have been eliminated was in production at the Pacific Division of Bendix in 1956. It was designed for the Convair Terrier Missile, and has lateral passage lines which lie in three different levels.

A new accurate and inexpensive analog-to-digital converter was also announced by Pacific Division in 1956.

The purpose of the converter is for accurate long-distance transmission of data representing voltage, current and power. By converting data from analog to digital form, it is not subject to varying line conditions, and resultant inaccuracies of readings.

A new air motor, developed by the division, was of particular interest to those engaged in missile engineering and production.

Faced with the problem of locating a prime mover to operate an alternator and a hydraulic pump for an electro-hydraulic supply to power a missile control system, Bendix-Pacific made a careful evaluation of various motors. For the application at hand these motors proved to lack the desired efficiency and were excessive in weight and size. As a result, the Bendix air motor was developed, tested and produced, and offered for sale to others who are in missile work.

Pioneer-Central in 1956 developed a new true mass flow system which applies the angular momentum principle with single turbine. Its design permits its use to measure flow in either direction.

The Bendix capacitance type liquid oxygen quantity gage systems now offer dual indication—in the cockpit and at any desired point on the airplane. This was another 1956 development.

Bendix Products Division at South Bend, Indiana, continued to supply the major aircraft engine and airframe manufacturers with components and complete fuel metering engine control and landing gear systems during the year.

This equipment included Stromberg carburetors, fuel metering and engine control systems, for turbojet, turboprop, ram jet, nuclear and reciprocating engines. Airframe equipment included all sizes and types of shock absorbing struts, including electro-hydraulic nose wheel steering

of an exclusive Bendix design, wheels and brakes with Cerametalix lining and anti-skid devices.

A three-dimensional flight systems simulator for use in the development and evaluation of aircraft control equipment and missile guidance systems was developed during the year. The device features a large capacity precision d-c analog computer and a high performance, hydraulically controlled three gimballed flight table. The Computer Division of Bendix Aviation Corporation assumed the manufacturing responsibility for the device and is currently producing the third system to be constructed.

During 1956 Scintilla Division of Bendix conducted a forum on ignition systems for piston and jet type aircraft engines at its plant in Sidney, New York. This meeting was attended by approximately one hundred representatives of foreign and domestic airlines, U.S. and Canadian military services, CAA, and aircraft engine and spark plug manufacturing companies.

A sizeable plant addition was completed to permit consolidation of all engineering design, research, and experimental manufacturing facilities in one area. Also placed in operation during the year were considerably enlarged plating facilities employing the latest and best equipment available.

New ignition systems were developed for turbo-jet and turbo-prop aircraft engines and much work was done on miniaturization of ignition systems for small gas turbine engines. New ignition systems were placed in service on Pratt and Whitney J57 and J75 engines, the General Electric J79, and the Allison T56 engines. Ignition systems of smaller envelope size and less weight were developed for small gas turbine engines. Much development work was conducted on ignition leads of smaller diameter, improved firing characteristics for igniter plugs, and ignition leads and other system components to operate at higher temperatures.

A universal type jet engine ignition tester, the number 11-4700, was developed to handle the testing of jet engine ignition systems manufactured not only by Scintilla Division but by other manufacturers as well. With this tester it is possible to check the functions of each unit in the ignition system.

To meet the electrical connector requirements of miniaturized electronic equipment the Pygmy miniature connector was developed. In many instances the standard AN connector is too large and heavy for suitable usage on miniaturized electronic equipment. The Pygmy provides the same standards of performance and dependability as the regular AN connector but is approximately one third smaller in size and weight than a comparable AN connector carrying an equal number of contacts.

A new ignition analyzer, the number 11-3398-2, was developed incorporating a number of refinements such as printed circuits, edge lighted front panel, provision for rack and panel mounting, a ruggedized high intensity 5" scope cathode ray tube, a sealed transformer, selenium rectifiers, and the added features of light weight, ease of service, stable circuits, and the incorporation of all components in one unit. American Airlines has ordered a large quantity of this new analyzer to provide for installation

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as an airborne instrument on its entire fleet of DC-6's and on DC-7's presently on order.

As of November 1, 1956, ten major airlines have placed orders with Bendix Radio Division for RDR-1 Airborne Weather Radar Systems. The combined orders totaled 334 individual systems plus spares. In addition, 122 RDR-1 Systems were sold to operators of executive aircraft, making a total of 456 units sold. Of these, 400 were X-Band units.

In January, 1956—as part of a general reorganization plan in the Division—an Aviation Electronic Products Group was created, encompassing all activities concerned with the Division's commercial aviation products.

Bendix Radio delivered the first DFA-70A  $\frac{1}{2}$ -ATR Automatic Direction Finder system to Braniff Airways for installation in their new DC-7C El Dorado aircraft during the year.

Also announced in 1956 were plans for a new short  $\frac{1}{4}$ -ATR Glide Slope Receiver designated the GSA-8A. This unit will be in production in the late summer of 1957.

One of the principal tubes used in Sage early warning system was the Special Purpose Electron Tube RETMA No. 6888 developed by Bendix Red Bank division.

During the year the Division supplied power transistors for use in automotive radio, power supplies and electronic equipment. In 1957 it was expected that a production rate of 125,000 transistors per month would be realized.

The Division also initiated development of transistorized power supplies that replace standard rotary dynamotors and inverters. These transistorized power packages are completely static with no moving parts and are therefore better able to withstand severe environmental conditions associated with high performance aircraft and missiles.

**Cleveland Pneumatic Tool Company**, Cleveland, Ohio, continued during 1956 to design and manufacture aircraft landing gears and ball-bearing screw mechanisms for military and commercial use by major airframe companies.

In March, the company purchased the National Water Lift Company of Kalamazoo, Michigan, a designer and manufacturer of aircraft control systems. The addition of their product line provided Cleveland Pneumatic with valuable further diversification within the aircraft and guided missile fields.

In September, a missiles division was established to design and produce ground handling and positioning equipment for this industry.

The company's facilities were further increased by the addition of a new pressure welder and many new machine tools.

In the first half of 1956, the company received contracts to produce the landing gear for both the Douglas DC-8 and the Boeing 707. Later in the year, it received the contract for the Douglas C-132.

During 1956, **Flight Refueling, Inc.** of Baltimore, Md. continued in



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the design and production of aerial refueling equipment as well as related fuel system components.

Major production during the year was concentrated on the A-12B-1 hose reel units for installation in U. S. Air Force KB-50 aircraft which are capable of refueling three jets simultaneously by the Probe and Drogue method.

The company also continued to supply U. S. Navy jet fighters and tankers with probe installations, couplings and hose reels.

The Navy FJ-4 Fury jet fighters are to be used in a "Buddy System" developed by this company to enable an FJ-4 tanker to refuel its fighter counterpart in flight, greatly extending the range or permitting greater bomb loads to be carried.

Among the other contracts awarded the company during the year was one with the U. S. Navy for the development and manufacture of aerial refueling equipment for Marine Corps helicopters.

The **Garrett Corporation**, Los Angeles, one of the five largest aircraft accessory and components manufacturing organizations in the world, observed its twentieth anniversary in 1956 with the most successful year in its history.

Through its AiResearch Manufacturing divisions in Los Angeles and Phoenix, the corporation has stepped up its intensive research and development activities in addition to maintaining volume production of such items as cabin air compressors, cabin pressure controls, pneumatic valves and controls; air cycle, evaporative and mechanical refrigeration systems, electric actuators, electric motors and generators, heat transfer equipment, temperature controls, electronic computers and instruments, gas turbine engines, starter air and gas turbine motors.

AiResearch produced the largest stainless steel unit ever manufactured for aircraft use in its development of a new heat exchanger for a supersonic jet military plane, while also developing its smallest heat exchanger (encased in a housing 4 x 3.75 x 2.25 inches) to pressurize and cool the inside of a pilot's high altitude suit.

A significant advance in air conditioning of high flying aircraft was made with a precise temperature control system. Each of several zones throughout the plane will contain its own temperature controller for localized regulation of warming air. These operate through a master controller, which programs the entire operation. The master controller reacts to maintain a constant cabin temperature as pre-set by the flight engineer.

Expenditure of \$4,936,561 was made on additions to property, plants and equipment for the fiscal year ending June 30, largest single year's outlay for this purpose in the company's history. Enlarged shop, office and engineering space, plus new, modern production machinery acquired, did much to increase efficiency and meet demands of growing production volume.

The AiResearch Manufacturing Companies in Los Angeles and Phoenix added more than 90,000 square feet of factory and office space.

AiResearch Aviation Service Division moved into a new 100,000

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square foot hangar, with administration building adjoining, on a 25-acre plot at Los Angeles International Airport. It contains facilities for complete overhaul, maintenance, rebuilding and modification of private, commercial and military aircraft.

A dramatic development in modification of the Douglas DC-3 was unveiled by AiResearch Aviation Service. Called the "Maximizer Kit," it is designed specifically to increase speed, provide substantial and measurable margins of safety at high and low speeds and rate of climb, and also improve payload, economy and revenue with no increase in horsepower. A gain of 20 mph in speed is guaranteed on the basis of a gross weight of 25,000 pounds at 10,000 feet with 1830-92 Pratt and Whitney engine.

The Garrett organization consists of nine divisions and two subsidiaries. Newest of the divisions is Rex, activated for the purpose of conducting advanced research and development in a classified field of aviation and currently carrying out this program under Government contracts.

Sales for the entire organization attained an all-time high of \$138,981,762 for the fiscal year, a significantly notable increase of 34 percent over the previous year's record volume. The manufacturing backlog also jumped to \$145-million, amounting to 48 percent more than the 1955 figure of \$98-million. Approximately 86 percent of this backlog is for military end use, the remaining 14 percent covering contracts for products destined for commercial and foreign use. A working capital of \$21,876,701 was existent.

This forward progress by The Garrett Corporation resulted in an increase of employees to over 10,000 from the former total of 7,600.

A number of new, long-range projects into the uncharted areas of missile components, nuclear accessory studies and other classified assignments were embarked upon.

**General Laboratory Associates, Inc.**, Norwich, New York, continued the expansion of their research, engineering and production facilities of high energy ignition systems for turbojet, turbo-prop, rocket and ram-jet engines. The 1956 program brought forth a new line of lightweight, compact ignition systems for use in all types of small turbine and rocket engines. Research and development continued through the year in the high temperature, high altitude and high energy categories. Of these major improvements, several have found their way into production ignition systems. Special ignition devices for varied requirements were also engineered and produced to meet the needs of an ever expanding sphere of activity in the development of turbojet and missile engines.

In 1956, **Harvey Aluminum**, Torrance, California, announced the resumption of construction for its 54,000 ton aluminum reduction plant at The Dalles, Oregon. The plant is scheduled for completion in late 1957. Long term plans announced during the year include a 13,000 ton annual increase in primary capacity by 1958 and construction of an 130,000 ton alumina plant and a second reduction plant of 67,000 ton annual capacity during 1960-1963.

Expansion at the Torrance, California plant during the year included the completion of press installations and supporting equipment for the Air Force Heavy Press Program. Harvey put into operation the huge 8,000 ton hydraulic extrusion press; aluminum alloy extrusions from this press are being used for airframe and missile structural components. A companion 12,000 ton extrusion press, the largest ever built in this country, is in the final assembly stages at the Torrance works and is scheduled to begin extruding at the early part of 1957. Heavy press supporting equipment in operation at Harvey include 80 foot capacity vertical solution heat-treat furnaces, two hydraulic stretch-straighteners of 1,500,000 and 3,000,000 pounds capacity, new ingot casting facilities, and homogenizing furnaces.

A battery of new hydraulic forging presses, ranging in size up to 8,000 ton capacity, also went into operation in Torrance during 1956. Supporting these new forging presses are the newest pre-heating furnaces, trim presses, straightening presses, and automatic ultrasonic testing equipment. Harvey continued its leadership in the production of aluminum no-draft forgings in addition to producing conventional draft forgings and hand forgings in aluminum and titanium alloys.

In the field of aluminum impact extrusions, Harvey contributed many new design concepts and fabricating techniques in the production of larger, more complex, closer tolerance impact extrusions.

Harvey also processes titanium and zirconium.

Keynoting a very heavy emphasis on new development during 1956, **Jack & Heintz** doubled its research facilities and recorded several major firsts in the design and manufacture of electric systems and components for aircraft and missiles.

With development projects at record levels and showing every tendency toward even greater volume, Jack & Heintz purchased two plants from the Universal Wire Spring Company of Bedford Heights, Ohio. The adjacent plants, covering a floor area of more than 135,000 square feet, have been integrated and when equipped as a research facility, will double the size and capacity of the J & H Research and Development Center. Rate of new project completions (entire systems and special components), prior to this expansion, was approximately 30-35 per year.

Perhaps the most important 1956 design achievement at Jack & Heintz, in the opinion of Company engineers, was the development of oil-cooled generators to the point of placing these machines into production. Jack & Heintz thus became the first manufacturer to have on its assembly lines a complete and diversified family of "environment-free" generators. As the term implies, these generators can deliver full-rated output independent of aircraft speeds, ambients and altitudes.

In addition to the oil-cooled machines, Jack & Heintz broadened its lines and production schedules of vapor-cooled and thermal lag generators. Among the three design types, Jack & Heintz has generators ranging in ratings from 2.5 kw through 40 kva.

The environment-free capability of the generators is due, as indicated,

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to the cooling systems incorporated in their design. Briefly, these cooling techniques operate as follows:

Oil-cooled machines utilize engine or hydraulic oil from the existing systems in an aircraft. Oil enters the generator at the mounting pad, is circulated through the stator and rotor, and is returned to the mounting pad for re-entry into the original system. Heat flow characteristics of this technique are excellent, eliminating all generator hot spots.

Vapor-cooled machines use water as the coolant. Water from a reservoir is injected under pressure into the generator's hollow shaft. Centrifugal force propels the water in spray form, through four ports, scattering it on the internal surfaces of the machine. As it picks up heat from these surfaces, the water vaporizes, and the resultant steam escapes through an exhaust port.

Thermal lag machines require no cooling. They have been specially designed to deliver their full-rated outputs for specified periods of time under excessive temperature levels. Presently, these machines are particularly effective aboard missiles designed for relatively short-duration flights.

A prime significance of these J & H environment-free developments lies in their pointing the way toward a standardized approach to electric system design and procurement.

Among the other notable J & H firsts during 1956 were the G180 a-c generator, the G23-5 d-c generator and the GC150 power transformer.

Along its development of ancillary system components, J & H introduced new control panel, regulator, circuit breaker, inverter, converter, relay and special unit designs during 1956. Many of these new designs are for use with the Company's environment-free generator lines, although even these are available and adaptable separately to existing system designs.

Total sales for the year were between \$20-25-million and the backlog of unfilled orders was approximately \$19-million. Employment totalled 2,200 and production floor space exceeded 600,000 square feet.

On May 31, 1956, **Kaiser Aluminum & Chemical Corporation**, fully-integrated producer of aluminum and aluminum mill products, completed its first ten years in the aluminum industry. During that ten-year span, the company's production of primary aluminum increased from 59,802 tons (1946-47 fiscal year) to 427,267 tons. Net sales rose from \$45,418,000 to \$330,712,000, and net earnings from \$5,338,000 to \$43,293,000.

The company entered its second decade with a major construction program underway which, when completed, will enlarge its annual capacity by more than 50 percent.

Principal units in this latest expansion program include an alumina plant at Gramercy, Louisiana, and a rolling mill and aluminum reduction plant at Ravenswood, West Virginia.

The Ravenswood mill will enable the company to provide the aircraft industry with a greater supply of critically needed stress-relieved aluminum plate.

The Ravenswood plant will also include modern heat treating facilities and ultrasonic testing equipment for detection of below-surface flaws in aluminum alloy plate. Ultrasonic inspection, plus the high quality ingot resulting from degassing and metal handling techniques developed by the company's Department of Metallurgical Research, make aluminum plate ideally suited to the aircraft industry's critical requirements.

Another phase of Kaiser Aluminum's construction program of special interest to the aircraft industry is the \$6.25-million expansion of its Halethorpe, Maryland, extrusion plant. Additional equipment, including four new extrusion presses, is being installed at Halethorpe which will raise the plant's output from 24 million to 46 million pounds of extruded shapes annually.

The year 1956 saw the commencement of full-scale production from the two 8,000-ton extrusion presses at the Halethorpe heavy press plant, which Kaiser Aluminum operates for the U. S. Air Force. The presses produce hollow and solid shapes up to 17 inches in maximum cross-sectional dimension and flat sections up to 32 inches wide.

Auxiliary equipment includes one of the nation's most advanced-design billet casting stations. Developed by Kaiser Aluminum especially for the Air Force heavy press program, the units can cast billets 20 inches in diameter, 24 feet long and weighing more than 6,000 pounds each.

**Kollsman Instrument Corporation**, subsidiary of Standard Coil Products Co. Inc., entered a new phase of manufacture in 1956 and made significant strides in many facets of its operations. Marking the fruition of an intensive ten-year program in the research and development of complex automatic navigation and flight control systems, substantial production orders were received for the new instrumentation. The trend in these systems, which are presently designed for manned aircraft, is toward automation and the diminishing of human participation. They comprise sensing, measuring, and computing features, and utilize electronic, electrical, mechanical, and optical components.

In general, the activities of the Kollsman Research and Engineering Laboratories were directed to systems for rapid and accurate navigation of manned and unmanned aircraft, and to systems for flight control.

During the year production was launched on the new Kollsman automatic astrocompass. Starting with an initial \$4.5-million production order from the Air Force, subsequent contracts amounting to \$26-million were being negotiated at year's end. In the field of navigation equipment, the demand continued for such instruments as periscopic sextants, hand-held sextants, the sky compass, and other various classified navigational systems.

Furthermore, many types of flight control systems, air data computers, and special devices, which combine pressure mechanisms with electronic equipment were produced.

The Kollsman Integrated Flight Instrument System gives the commercial pilot precise and complete interrelated flight data. Designed by Kollsman engineers for all high performance transport aircraft, this sys-

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tem is a significant step toward solving of the problems of altitude separation, cruise control, and dead reckoning navigation.

Volume production continued on the Kollsman line of sensitive and high range precision altimeters, Mach airspeed indicators, sensitive airspeed indicators, true airspeed indicators, and Mach-meters. Large orders were filled for cabin pressure control systems, thrustmeters, tachometers, compasses, 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, and precision optical components. Synchrotel transmitters, pressure switches, and pressure monitors were in wide demand for guided missile application.

Motor production at Kollsman remained at approximately the 1955 level with concentration on precision induction motors and rate generators. The overall picture showed an increase in the number of motor units made for Kollsman end-items.

At the beginning of the year, the total number of Kollsman employees was 3,600. By the third quarter, the figure had risen to 4,600 employees.

The trend toward complex instrument systems was emphasized by the expansion of the Service Engineering Department which added to its functions a new group to study systems and products during the design stage in order to ascertain service requirements and techniques in advance of production. This group is the source for field service specialists thoroughly skilled and experienced in the installation, maintenance, and overhaul of each new production item. Another new engineering service section is the Technical Analysis and Reliability Group which compiles data on product reliability and performance in the field. The group maintains automatic record system reliability studies and coordinates them with the Military's Product Improvement Program and similar programs conducted by commercial aviation.

To expedite the training of Military and Commercial personnel in the operation and servicing of new instrumentation, Kollsman re-organized and expanded its Instrument School.

In the fall of the year, a new Kollsman manufacturing facility in Syosset, Long Island, was completed. Located on nineteen and a half acres of Kollsman-owned property, the new building is a one-story, fireproof, steel frame and masonry structure with an area of 157,000 square feet of manufacturing space. It has provision for assembly, machine shop, shipping, receiving, and other departments, and will accommodate an additional 1,400 employees.

Orders received during the first ten months of 1956 amounted to \$34-million. A \$50-million backlog for unfilled orders was anticipated by the end of the year, with shipments amounting to about \$36-million.

The volume of Kollsman subcontracts to small business grew in proportion to the increase in orders. To help subcontractors meet the Kollsman standard of precision, the Company gave assistance on technical manufacturing problems and provided special instrumentation and equip-

ment wherever necessary. Cooperation with subcontractors extended to the dissemination of information on quality control techniques and work scheduling.

In completing its eighth consecutive calendar year, **Lear, Inc.**, estimated shipments of about \$62-million and new business of approximately \$70-million for 1956. Backlog at October 1 was \$57,682,000. In four years since 1952, the net worth of the company has approximately doubled. Payroll is about 4,700.

The company built and equipped a 20,000 square-foot laboratory and office building at Santa Monica to house the western engineering contingent of its Grand Rapids instrument products division; also added 14,000 feet of floorspace to its Elyria, Ohio, plant. At the latter location, complete new facilities were installed for manufacture of electric motors to power the division's line of pumps and related airborne devices. Such motors previously were purchased elsewhere. At year end, architectural plans were complete for a 170,000 square-foot production facility at Grand Rapids airport, Michigan, to supplement existing engineering and manufacturing buildings at that city.

During 1956, development and manufacturing subsidiaries were established at Geneva, Switzerland, and Munich, Germany, under the respective corporate names of Lear S. A., and Lear Electronics GmbH. By year end these activities, with a combined payroll of about 100, mostly engineers, were active in development and starting production of airborne instruments and communication equipment to meet European needs.

Licenseses in France (Intertechnique, and Societe Generale des Equipements) and in Italy (Galileo) continued successful application of Lear products on many European military and commercial airplanes. The Sud Est Caravelle, commercial jet transport, equipped with a Lear automatic flight control system, went into regular service for Air France between Paris and Algiers. This was the first American autopilot applied to a European commercial jet aircraft. The production version of this autopilot is completely transistorized. Lear's Grand Rapids Division also announced application of an automatic flight control system to the Swedish SAAB delta wing supersonic J-35 fighter, and an automatic stability augmentation system on the Dassault Mystere IV supersonic fighter. Meanwhile a Lear autopilot in production for the Boeing KC-135 transport-tanker was the first American autopilot ever applied to a jet transport.

At home, the company was able to reveal a substantial increase in the number of product applications to the nation's most advanced guided missiles, and to the new "century series" of supersonic fighters. Among these products were gyro-stabilized platforms and coordinate converters; data link equipment; fuel, lube, and air pumps; rocket-engine fueling nozzles and fuel intake adaptors; and rocket-engine test stands. Also, the Lockheed X-7 ramjet test vehicle for which Lear has been producing major components for nearly seven years was disclosed by Air Force spokesmen.

Another dramatic product announcement was an automatic wings-level bombing system by which the precise and complicated maneuver

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of low-altitude nuclear weapon delivery is accomplished on virtually a hands-off basis due to a tie-in with the Lear L-10 autopilot. New automatic flight control systems and instruments for helicopters were introduced. The company's vertical gyro instruments, including advanced versions, continued to be produced for nearly all high performance aircraft. An exceptionally lightweight gyro-stabilized compass for all-latitude navigation also went into volume production, along with a new line of miniature rate gyros.

Improved new lines of automatic direction finders, flight instruments and communication radios were placed in production late in the year at the LearCal Division, Santa Monica. These include a patented technique called the Lear Self-Correcting Automatic Navigation system.

The Aircraft Engineering Division, also at Santa Monica, introduced the Mark II version of its Learstar executive transport. In this conversion program, present Lodestar owners are enabled to retain existing interiors and equipment, and buy primarily the structural and aerodynamic alterations by which Lear has greatly increased the speed and range of the original airplane. The Mark I model includes modernization and remanufacture throughout, including equipment and interior.

Contracts for systems work involved supersonic jet engine air inlets, and thrust reversers. An outstanding Lear "first" during 1956 was the application of a tubeless three-axis damping system to the sensationally fast Lockheed F-104 now entering high priority production. This was the first three-axis application of the body-axis stabilization principle which Lear pioneered with rudder-axis dampers on a large proportion of America's best known jet fighters.

The **Liquidometer Corporation** of Long Island City, N. Y., continued its development and production of liquid quantity gages and position indicating systems for aircraft during 1956.

Operations in the West Coast area were expanded as the result of a newly constructed building in Los Angeles. This new facility, besides providing sales and engineering services, has the latest equipment for the overhauing and repair of the company's line of products for aircraft and missile use.

One of several Liquidometer developments during the year was a liquid oxygen quantity gage. This new gage, highly resistant to shock and vibration, employs a capacitor-type sensing unit in the liquid oxygen container. A self-balancing bridge network measures and indicates liquid quantity. The only moving parts are those in the motor driven indicator. The amplifier section of the self-balancing bridge system can be supplied with either vacuum tubes or transistors.

Another Liquidometer development in 1956 was a miniature magnetic amplifier relay that weighs only six ounces and has extremely high sensitivity and vibration resistance. Designed for use in guided missiles, airborne computers and circuits employing photocells, transistors or thermistors, the relay fits in an envelope measuring only  $1\frac{1}{4}$  inches by  $2\frac{3}{4}$





Lear MA-1 compass system

inches. This unit has a sensitivity of 80 microwatts for a zero to 5,000 ohm resistance source, decreasing to 100 microwatts for a 15,000 ohm source.

**Minneapolis-Honeywell's** major production flight control systems during 1956 were for North American's F-100 Super Sabre and McDonnell Aircraft's F-101 Voodoo, the nation's two top-production supersonic aircraft. The division also produced systems for Canada's CF-100 fighter and the new Douglas B- and RB-66 light bomber.

Honeywell's Aeronautical Division was named as associate prime to Radio Corporation of America to develop and produce the most highly complex flight control, communications, special weapons and navigational system yet devised for a manned aircraft. The RCA-Honeywell "Integrated Electronics Weapons System" will be manufactured for Canada's new CF-105 supersonic jet fighter. The division was also developing other systems for a number of aircraft and missiles.

The Aeronautical Division hit record highs in employment and scope of physical plant and equipment. The division employed 6,000 in Minneapolis representing a fifth of the Honeywell corporation's 30,000 employees.

Several hundred types of components and systems were in production during the year. Besides the basic field of flight control, Honeywell's Aeronautical Division was producing components and systems for inertial guidance, special weapons developments, a score of gyroscopic applications and a complexity of engine control and measurement devices.

Demonstrated publicly at the 1956 Air Force gunnery meet was a new bombing system that Honeywell has been manufacturing for Air Force and Navy fighters and fighter bombers.

Gyroscopic engineers during the year put into production a new member of the HIG gyro family called the Miniature Integrating Gyroscope

## THE INDUSTRY

(MIG). The MIG is just 2½ inches long and weighs less than a half pound.

Another major field for the Aeronautical Division was the development and production of transistorized and miniaturized engine controls and instruments for military and commercial aircraft.

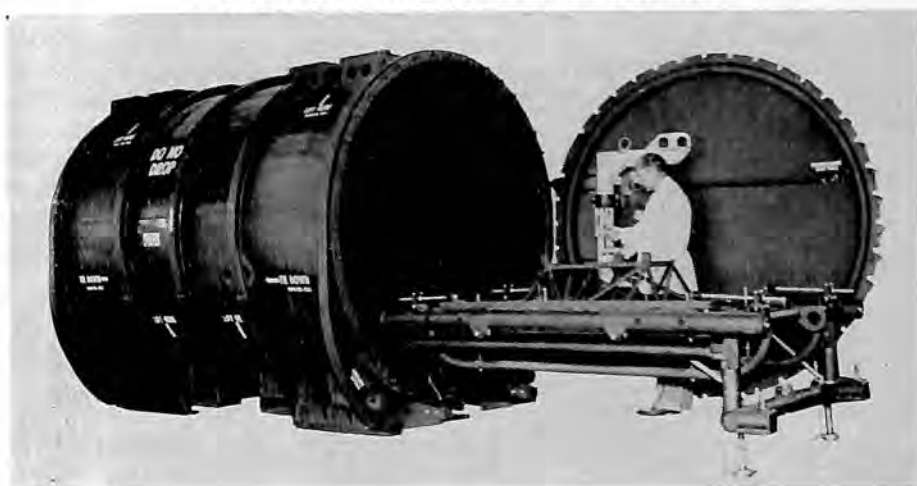
Significant progress was made during the year on several aircraft instruments, including new miniaturized versions of the Mach and altitude controllers which are used in automatic flight control systems. The division also began development work on a central air data computer which will supplant several separate devices and provide additional information to flight control systems or pilot such as true airspeed, angle of attack and others.

Instrumentation and human engineering research and design activities during the year were accelerated considerably. Results in these areas during 1956 included development of a Mach indicator and altitude-flight director. Significant studies were made in the areas of engine instrumentation, map displays and plane-engine condition status reporting.

During 1956 **Pacific Airmotive Corporation** continued to be a major factor in the modification repair and overhaul of private, commercial and military aircraft, including the rebuilding, overhaul and testing of aircraft engines, varied accessories and parts. Only private maintenance facility on the West Coast equipped to overhaul jet engine accessories and modify jet engines, PAC received its first jet aircraft overhaul contract in September.

The company's Burbank engine shop increased its workload approximately 50 percent over 1955 through long-term overhaul contracts with 11 commercial air carriers. A new Air Force contract covering the overhaul of 497 helicopter engines was awarded to PAC in September, 1956.

### **Pacific Airmotive pressurized container**



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The company's military aircraft division located at Chino, Calif., modified more than 200 F-86 Sabre jet aircraft for the Air Force, as well as working on a C-47 aircraft overhaul contract valued at approximately \$5.5-million.

The company's design and manufacture of specialized test and ground support equipment for the military services and the aircraft industry increased approximately 30 percent in volume in 1956.

Test stand design and production during 1956 included cabin pressure regulator test stands, fabric burst testers and stands to test the pilot's oxygen demand regulator. An advanced universal hydraulic accessory test stand capable of testing most aircraft hydraulic fittings, hoses and pumps were also produced.

In addition to producing test equipment such as hydraulic and fuel pump run-in test stands, specific gravity test stands and gas temperature control stands, PAC developed an electronic governor to prevent overspeed of hydraulic flow meters. Other electronic devices are being incorporated by the company into fuel flow and other test stands.

Sales for the nine months ended August 31, 1956 were \$14,759,926, compared with adjusted sales of \$14,230,118 for the same period in 1955.

Effective November 1, 1956, Pacific Airmotive purchased from Lear, Inc., all the outstanding shares of Learcraft Conversions, Inc., renamed PacAero Engineering Corporation.

With its 75,000 sq. ft. of hangar space and 170,000 sq. ft. of ramp area on Santa Monica airport, PacAero Engineering can handle any aircraft up to and including the DC-7 and Super Constellation.

The Tube & Hose Fittings Division of **Parker Appliance Company** continued to manufacture and sell tube working tools to the aircraft industry during 1956. Included were tube cutters, tube flaring machines and hand flaring tools, hand tube benders and bench mounted tube benders. A significant portion of the synthetic rubber o-rings produced by the Rubber Products Division of Parker were sold to the aircraft industry. A new product of this division—Unicellular Rubber Floats—had important applications in the aircraft industry. Both these divisions had increased production programs resulting from the increased demand for their products.

**Rohr Aircraft Corporation**, Chula Vista, California, during 1956 added 300,000 square feet to its manufacturing facilities, bringing its total space to 2,250,000 square feet. It also began construction of a 39,000 square foot assembly plant at Auburn, Washington, where jet pods for the Boeing KC-135 will be assembled.

In addition to the production of power packages and pods and other major assemblies for five commercial and ten military airplanes, Rohr also has an extensive program for the production of stainless steel honeycomb sandwich panel structures, metal bonded panels and high strength weldments.

In the commercial field Rohr is manufacturing power packages for the Boeing 707 jet Stratoliner, the Convair 440 Metropolitan, the Douglas

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DC-7 and the Seven Seas, the Lockheed Super Constellation and the propjet Electra. Military planes for which the company also builds power packages and pods include the Boeing B-52 and KC-135, Convair T-29, C-131, Lockheed P2V and C-130.

Company sales for the year ending July 31 amounted to \$90,027,159, an increase of 9.2 percent over the previous year. As of December 1 the backlog was \$195-million, of which 37 percent was for commercial production. Employment on that date was 9,200 and another 1,000 were expected to be added within six months.

**Simmonds Aerocessories, Inc.**, during 1956, substantially increased its activity in the research and development of capacitance type fuel measurement and fuel management systems. Keeping pace with industry by improvements in the transistorized circuitry of fuel gaging equipment, Simmonds engineers succeeded in increasing accuracy and reliability while at the same time reducing weight and cost.

A new plastic tank unit (or probe), type M-2, developed to reduce weight to a minimum and permit disassembly for service proved successful.

Simmonds offered to the aircraft industry, fuel measurement and fuel management systems in the following configurations:

A three unit, vacuum-tube system, consisting of light weight tank units, indicator, and amplifier-bridge; light weight tank unit, with a combined indicator and vacuum-tube type amplifier-bridge unit; and light weight tank unit and combined indicator, housing a transistorized amplifier-bridge.

Numerous installations were made of the Thermistor Liquid Level Sensing System. This system provides reliable, accurate and trouble-free indication of liquid level, independently of the gaging system. The level sensing system is capable of operating a light to indicate whether the liquid is above or below a certain level, or can provide control to start and stop pumps and operate valves to transfer liquid from one tank to another.

A True Weight Gaging System was developed which is based upon new concepts of gaging accuracy. The relationship between the dielectric constant and the density of a fuel is no longer assumed. These factors are independently determined and are constantly used in the fuel gage circuit to continuously correct the basic circuit so as to always indicate true weight.

Simmonds SU Fuel Injection System successfully passed the 150 hour CAA qualification tests on both the Lycoming GSO-480 and the Air Cooled Motors O-335-5 engines. Prototypes were installed on nine other types of aircraft engines. SU Fuel Injection is installed on the Lycoming 320 engines used on the Super "V" Bonanza conversion and continues in full scale production for ordnance vehicles for the Ordnance Department of the U. S. Army.

During the year, the company continued development on SARAH—Search And Rescue And Homing Equipment—and completed several applications.

A new line of heavy duty arctic aircraft latches was also developed.

Research and engineering continued on push-pull controls and an

## The AIRCRAFT YEAR BOOK

especially noteworthy application has been completed requiring heavy duty performance under high temperature in the control of the afterburner aperture.

**Solar Aircraft Company**, San Diego, during 1956 continued a diversified production program of small gas turbine engines, jet and reciprocating engine components, airframe structures, and missile components.

A new pod mounted version of the company's 50 hp Mars gas turbine engine was introduced. The small engine, mounted in pods beneath the wing, is being used to supply airborne auxiliary electrical power for the Convair C-131B flying test laboratory. The units are also being produced for the KC-97, Douglas C-124C Globemaster, and the Lockheed C-121C Super Constellation.

Under Air Force contracts, new air bleed compressor versions of the 500 hp Solar Jupiter gas turbine engine were embodied in multi-purpose vehicles to provide ground support for starting advanced types of jet engines, and to air condition planes. They are scheduled for use in the support of the Douglas B-66. The Air Force designation for the new compressor pack is MA-2.

The manufacture of all-metal honeycomb structures and aluminized and ceramic coated metals for high temperature and corrosion resistance continued. New highly specialized brazing techniques for the manufacture of honeycomb were accomplished through the design and installation of the Solite furnace—a bell shaped elevator type furnace capable of maintaining consistent temperatures up to 2150°F.

Production started on stainless steel nacelle barrels for the Lockheed 1649A and a number of other airframe and missile components.

The company continued production of intricate stainless steel components for the Wright-Aero J65, for the J57 for both Pratt & Whitney and the Ford Aircraft Engine Division, and for the new Allison and General Electric turboprop and jet engines.

Plant area for the San Diego engineering division was increased 27,000 sq. ft. to house the 50 percent increase in engineering personnel. A new 45,000 sq. ft. Airframe Parts plant was established one block from the main San Diego plant to accommodate expanded production in this category. To handle the increasing volume of gas turbine research and development work, a new testing laboratory containing five additional test cells was completed in San Diego.

Construction began on a 117,000 sq. ft. addition to the Des Moines, Iowa plant which, when completed, will bring the total plant area for both plants to 1,227,000 sq. ft.

Total employment on April 30, 1956 was 5,337, up from 4,653 a year earlier.

Sales for the year ended April 30, 1956, totaled \$51,645,522 and backlog more than doubled during the year.

To insure its continued ability to meet expanding commitments in an increasingly complex air world, the **Sperry Gyroscope Company** in 1956



**Pilots test Sperry Helicopter control system**

established several new, specialized organizations and divisions, both at its Great Neck, N. Y. headquarters and elsewhere in the nation.

Sunnyvale Research and Development Center, Sunnyvale, Calif.—an ultra-advanced laboratory facility, near Palo Alto, for conducting advanced research in the fields of radar, fire control, servo mechanisms and missile systems.

Sperry Utah Engineering Laboratory, Salt Lake City, Utah—an expansive engineering laboratory facility on 28 acres to provide advanced research in critical, highly-classified weapon systems.

Microwave Electronics Division, Great Neck, N. Y.—an autonomous organization, incorporating special facilities and technical “know how” for supply of vital microwave systems instrumentation and support equipment for critical weapon systems.

Electronic Tube Division, Great Neck, N. Y.—an autonomous organization with expanded facilities for the development and production of microwave tubes and special electron devices.

Sperry Gyroscope Company also coordinated for its parent company the formation of the:

Sperry Phoenix Company, Division of Sperry Rand Corp., Phoenix, Ariz.—initial construction of which provides for a \$2-million manufacturing facility and a flight research center, on some 500 acres, for development and production of advanced flight and engine control systems, and allied aviation instrumentation.

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Sperry Semiconductor Division, Division of Sperry Rand Corp., Norwalk, Conn.—a specialized production laboratory for development of highest quality transistors required in advanced weapons and supersonic flight systems.

Continued high emphasis was placed on research and development in critical aviation equipment and systems, especially in the fields of inertial guidance, countermeasures, air defense and missile guidance radars, and automatic check-out equipment for modern weapons.

Manufacturing volume remained high in (1) pulse and continuous wave radars, (2) bombing-navigation systems, (3) guided missiles, stabilization and guidance systems, (4) automatic fire control systems (5) flight and engine control systems, (6) advanced aircraft instrumentation, (7) support equipment for evaluation of weapon performance and (8) specialized electronic tubes for all types of high-powered radars (see Yearbook, 1955 edition.)

High among Sperry's major aviation contributions was development by its Aeronautical Equipment Division at Great Neck of a revolutionary electronic system, providing for "hands off" automatic, precision control of commercial jet airliners.

The system—called the SP-30—represents the first major advance in the flight control field in a decade. It incorporates many new design concepts and is expected to provide turbo-prop and turbo-jet aircraft with levels of air safety and passenger comfort, surpassing anything produced by Sperry in 40 years of automatic pilot development.

Sperry's Integrated Instrument System, currently being produced in volume for a wide variety of conventional airliners, has been integrated with the SP-30 system.

In 1956, after almost five years of research, incorporating exhaustive studies in Sperry's own helicopter, the Aeronautical Equipment Division began manufacture of a miniaturized flight control system for rotary aircraft.

The system precisely and automatically stabilizes a helicopter during all normal flight, hovering, landing and take-off maneuvers, regardless of adverse wind and weather conditions. It is adaptable to remote-controlled pilotless flight.

The lightweight, transistorized system—which features control stick steering—can be used for either full or partial automatic control. It is expected to broaden the role of helicopters in military, commercial and industrial missions because it provides these comparatively unstable aircraft with new, high levels of stability, safety and piloting ease.

Sperry's Aeronautical Equipment Division also maintained a high manufacturing volume of flight control systems for other aircraft. Chief among these were the A-12 system for a wide variety of commercial aircraft and the A-14 system, designed expressly to meet critical Air Force requirements for the B-52, for which Sperry also is producing an advanced K-Bombing navigation system.

USAF also announced that Sperry is a prime developer of a critical

## THE INDUSTRY

operational system, contributing to the increased capability of the B-58 Hustler.

The Aeronautical Equipment Division announced development of an extremely low-drift compass system to insure precise navigation on long over-water and polar flights. The all-transistorized equipment, called the C-10 Gyrosyn (R) Compass System, provides a random drift rate of less than three degrees-per-hour. The system also incorporates automatic compensation for earth rate drift of the gyro.

Sperry's large-scale entry into the critically important field of precision engine controls was announced when the Aeronautical Equipment Division developed and delivered advanced systems for turbine-powered aircraft.

Widespread adoption by the Air Force of Sperry's electronic engine analyzers for use in connection with propeller-driven aircraft signaled still another increased production effort.

Specialized efforts by various Sperry organizations enhanced the company's position as a major producer of guided missiles and varied missile systems. The supersonic Sperry Sparrow I, first air-to-air guided missile to attain operational status, was produced in volume for the U. S. Navy, which assigned the weapon for wide defense use by both the Atlantic and Pacific fleets and the Sixth Fleet in the Mediterranean.

High manufacturing schedules also were achieved in connection with other Navy weapons: stabilization systems for the Chance Vought Regulus, surface-to-surface missile, and guidance radars for the Convair Terrier, surface-to-air missile. In all, the company was engaged in 12 missile projects. Sperry also received large new contracts from USAF for the development of microwave command guidance systems for highly-specialized supersonic drones.

Continued high production of advanced airborne radars was maintained with emphasis being placed on the manufacture of Sperry-developed APN-59 and APN-69 systems for USAF, as well as various fire control and long-range search radars.

The company's pioneer efforts in the field of automatic electronic checkout equipment for complex systems were pointed up late in the year when Sperry's Microwave Electronics Division disclosed development of RACE (Rapid Automatic Checkout Equipment). First such system to bring mobile automation to tactical combat areas, RACE—within minutes—tests and troubleshoots individual components of complex missile systems, as these weapons are made ready for launching. Other versions of the computing equipment—in appearance, a simple one-man-operated console—will be used to test complete supersonic aircraft systems and fire control systems of the Air Force, Army and Navy.

Greater protection against counter-radar tactics of a prospective enemy was assured by Sperry's Electronic Tube Division through the development of a new type of traveling wave tube constructed entirely of metal and ceramics. Far superior to conventional glass predecessors in withstanding shock, vibration, and heat, the new metal components bring additional important capabilities to advanced radars and missile systems



## The AIRCRAFT YEAR BOOK

being produced at Sperry. The new metal tube is lighter, more compact in design, and achieves the greater power and versatility needed for modern electronic systems.

Sperry's Microwave Electronics Division scored another important first with the introduction of new control components, called ferrite devices. Manipulating radar energy magnetically, under precise electrical control, the new microwave components act as electronic "traffic cops" by regulating the amount of energy transmitted and received in the systems in which they are used. Smaller, more versatile and simpler in design than the many mechanical components they are replacing, ferrite devices are making possible many unusual advances in all types of radar systems.

**Sundstrand Aviation**, a Division of Sundstrand Machine Tool Company, Rockford, Illinois, successfully continued production of Constant Speed Drives in 1956. The hydro-mechanical constant speed drive is the primary product of Sundstrand Aviation. Other products related to the drives are field test stands and overhaul test stands for both the military and industry. Further diversification in aircraft accessories are special gearboxes and a newly introduced line of aircraft hydraulic motors.

In 1956, 12,000 Sundstrand Drives were in use all over the world, accumulating 2,104,000 flight hours. Aircraft with the drive included the B-36, P5M, B-47, F3H, B-66, F-101, F-102 and F-100. Other new applications now flying are the KC-135, B-57D, RB-66, B-47E, F-106A, XP6M, B-52 and B-58. Sundstrand Aviation received contractual agreements for applications on the GZ-17, C-132, Regulus II, Navaho, Snark and foreign aircraft such as the RCAF CL-28 and CF-100.

The first American jet airliners, the Boeing 707 and Douglas DC-8, selected the Sundstrand Drive for their electrical systems.

Employment increased from 1,687 employees in October 1955 to 2,053 employees in August 1956. Plant expansion was also prominent. During 1956 construction was started on a new High Temperature Laboratory costing one half million dollars. New additions brought total facilities to 438,700 square feet.

Sundstrand Aviation—Denver employee growth was from 116 employees in October of 1955 to 1,057 employees in August of 1956. The Denver plant has 161,000 square feet, of which 131,000 square feet is devoted to manufacturing constant speed drives with over \$7-million of special machinery and equipment.

Sales for 1956 reached a new high of \$36-million.

The major fields of endeavor in the Research and Development Program in 1956 were high temperature lubricants and materials to be used with the higher ambient temperatures required by modern aircraft.

**Thompson Products, Inc.**, of Cleveland, Ohio, through its staff and divisional organizations, continued in 1956 to expand its research, development and manufacturing facilities in addition to its product areas in the aircraft, missile and rocket equipment fields.

The Aircraft New Devices group of Staff Research and Engineering

## THE INDUSTRY

was actively engaged in the development and production prototype fabrication of specially designed auxiliary power units, turbo generators and hydraulic and pneumatic control systems. The company's Aircraft Fuel Systems Laboratory, located in Inglewood, California, was engaged by major aircraft companies in the study of fuel handling problems as they relate to high altitude and high temperature conditions. Much of the work of this group required the actual construction of equipment to simulate flight conditions to be encountered by the proposed missile and aircraft fuel systems.

The Gas Turbine Laboratory operated by Thompson Products' staff engineers for the U. S. Navy, was officially dedicated on June 1, 1956, although the facility was completed and shakedown tests were conducted late in 1955. Additional shakedown operations conducted in the early months of 1956 included tests on the facility's high-vacuum heated spin pit using a multiple thermocouple instrumental jet engine turbine wheel.

The Accessories Division of Thompson Products continued in 1956 to be one of the leading suppliers of aircraft fuel booster pumps. Continued improvements in pump design resulted in performance improvements in the order of 10 to 20 percent.

The division's line of air turbine water injection and afterburner pumps was improved by a development that protects the unit in event of loss of fluid at the pump inlet. This device does not affect the efficiency of the unit at normal operating speeds and does not add additional weight as compared to previous designs. Also a 20,000 rpm engine driven centrifugal type afterburner pump was developed during 1956, which does not require de-clutching for non-afterburner use. For use with the foregoing pumps and control valves, the Accessories Division of Thompson Products has developed an engine and tested a spill type main nozzle and air atomizing afterburner spray bar, both of which offer significant improvements in high-altitude combustion limits.

A continuous laboratory facility building program was carried on by Accessories Division, during 1956, at the Euclid, Ohio plant. In addition to the \$12-million laboratory facility maintained by the division, an announcement was made on October 4, 1956 that a new \$10-million facility for testing auxiliary power units and fuel systems for rockets and missiles was started on a 1,000 acre tract of land near Roanoke, Virginia. This laboratory facility is scheduled to be completed by 1961.

The Electronic Division of Thompson Products has concentrated its engineering and production efforts, during 1956, to provide magnetic amplifiers, frequency discriminators, load sensing units, modulating actuators, current transformers, tachometer and gear box used in an alternator drive. Advancement was also made in the state of the art of coaxial, waveguide, and lobing switches.

The Jet Division of Thompson continued, in 1956, to be the largest manufacturer of jet engine compressor blades and turbine buckets. Highlighting the division's activities during the year was the completion of the process development laboratory facility which is concerned only with the

"So far as we in the Navy can see today, the manned aircraft will continue to play a major role in Naval warfare. Guided missiles and other new developments are of course coming along. But they will augment our striking power. We see nothing in sight that is going to put the manned aircraft out of business."

—ARLEIGH A. BURKE,  
Admiral and Chief of Naval Operations, USN



developments of new manufacturing techniques and metallurgical process for aircraft, missile and rocket components. Also an experimental manufacturing and pre-production facility was completed to permit the company's research engineers to study advanced problems in rolling, welding, forging and other production manufacturing techniques.

Company-wide employment at December 31, 1955, stood at 21,218, compared with 21,531 at the end of 1954. On September 30, 1956, Thompson's total employment was 21,939.

Sales were up in the first nine months of 1956, running slightly ahead of \$214,478,664 for the same period of 1955. Aircraft sales continued to move higher, more than offsetting the year's lower levels of automotive shipments.

It is anticipated that the company's total sales for the year would be somewhat higher than the \$286-million of 1955, and that the earnings would also compare satisfactorily with last year's.

**Vickers Incorporated**, Detroit, Michigan, manufacturer of oil-hydraulic systems and components completed the second phase of a three-step program aimed at expanding the company's aircraft products manufacturing facilities by occupying a new 130,000 sq. ft. plant in Jackson, Mississippi. The new plant is devoted exclusively to manufacturing products for the aircraft industry. Part three of the program calls for a new facility on the west coast; plans for this are already underway. The first step, expansion of existing facilities at El Segundo, California, was reported a year ago in the 1955 Aircraft Year Book.

Additional emphasis was placed by Vickers during 1956 on use of "packaging" concept in aircraft hydraulic system design. One significant example of this was the Vickers personnel rescue hoist system. Although applicable for all airborne winch installations, its development was primarily aimed at helicopter users.

The constant gain solenoid selector valve introduced by Vickers in 1956 was another example of the package concept. This is a "seven-units-in-one" valve that results in minimum weight and envelope with a great reduction in the amount of external plumbing required.

A significant advance in the field of missile hydraulics made by Vickers

## THE INDUSTRY

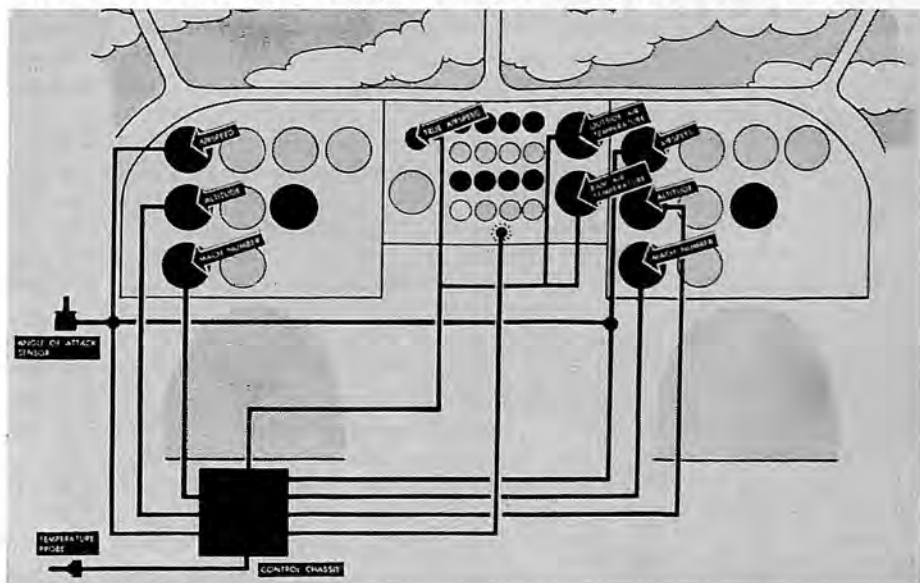
during the year was the miniaturized oil-hydraulic pump. This unit is specifically designed for limited life airborne application and achieves unusually high power/weight ratios. Under optimum conditions, certain models are capable of developing more than 6 hp per pound of total weight.

Further broadening of its product line was accomplished by Vickers with the introduction of a hydraulic-powered electrical power package and an "off-the-shelf" in-line relief valve for airborne application. The power package is lightweight, compact and provides improved efficiency when used in place of a conventional inverter. It produces a-c power for newly designed systems and for electronic equipment added to aircraft systems already loaded to capacity.

The in-line relief valve is a standard product which combines unusually accurate control and fast response with exceptionally "flat" performance characteristics. A special high-temperature design is recommended for operation in the temperature range from 550°F. to 650°F.

**Wyman-Gordon Company**, in 1956, succeeded in raising production of certain titanium forgings for plane power plants, into the volume category at USAF Plant 63 which the company operates in North Grafton, Mass. It also registered advances in forging titanium plane frame components of intricate design. It successfully forged new high-heat resistant steel alloys as well as close tolerance, no draft plane frame parts of aluminum alloy. The plant with 112,860-ton closed die forge press capacity, produces forgings for the nation's principal plane and plane engine, makers. The 50,000-ton and 35,000-ton hydraulic, closed die presses placed in operation in 1955, went on round the clock schedules in

### **Kollsman Instrument Corp.'s integrated flight instrument system**



the Spring and continued on the long-hour schedule remainder of 1956.

Highest gain in kind of metal forged in North Grafton, in 1956 over 1955, was titanium. Its production was tripled. Substantial gains were also recorded in aluminum and magnesium, but the steel total was practically unchanged.

Wyman-Gordon's Worcester plant, where jet-engine and missile power plant parts are forged, underwent an ambitious change in 1956. Involved were four buildings and eight related departments. Aim of a two-year study by the company's own engineers, was to streamline the inspection and shipping departments to enable the men to handle their work more efficiently and with greater ease as well as to further strengthen the strict quality and delivery controls demanded by the company itself, as well as its customers. The whole streamlining took place over a six month period, without loss of a minute in production time by close scheduling of machine moving and installation of new equipment to replace old. Forgings now enter one end of the inspection department and, travelling in a straight line, end up in the shipping department where they belong, without once retravelling the line.

**Zenith Plastics Company**, a subsidiary of Minnesota Mining and Manufacturing Co., during 1956 continued production of more than 50 percent of the reinforced plastics components delivered to the aircraft industry. The growth pattern established at the company's inception continued, with an increase of about 15 percent in personnel, required by a similar increase in dollar volume of product. Current employment was approximately 1200, with plant area of about 300,000 square feet.

Zenith's products include critical electronics parts, such as navigational, weather, and fire-control radomes, structural and semi-structural components, such as wings, stabilizer fins, missile parts, etc., and non-structural items (window-frames, chairs, etc.). Jettisonable fuel tanks were under development, as were parts for high-temperature use, based upon silicone, epoxy, phenolic, and ceramic compositions.

The Micronics Division of Zenith, devoted to electronics design, development, and test, more than doubled its personnel complement during the year.

Zenith also, through the 3-M association, acquired plants for aircraft plastics fabrication at London, Ontario, and Bristol, Pennsylvania. A commercial plant at Bedford Park, Illinois, was also obtained. It was planned that the first of these new facilities will be in operation during 1957, and that all of them will be producing during 1958. To improve its facilities at the Gardena plant, an additional 15 acres was purchased adjacent to the present area. On this plot, expanded administration, engineering, fabrication, and testing buildings were planned for early construction.

Supplementing their own large developmental research laboratory, Zenith has available all of the services of the 3-M Central Research Laboratory at St. Paul, employing over 1200 scientists and technical personnel devoted to basic investigations into new and improved materials and processes.

## CHAPTER TWO

### Department of Defense

**D**RAMATIC EVIDENCE of the importance of air power both at home and abroad, paralleled by equally dramatic U. S. advances in supersonic planes, convertiplanes, and a score of other fields, combined in 1956 to make U. S. military aviation headline news throughout the year. Behind the news, blanketed by security, work on even more spectacular projects went steadily forward.

Air power's vital role in defense was never more dramatically illustrated than when General Nathan F. Twining, USAF Chief of Staff, visited Russia in June and returned to report to the Congress and the nation. Russia, he reported, "is progressively narrowing" this country's lead in the air. Soviet emphasis on its air might may conceivably result in Russian advances ahead of those here, particularly in new designs. General Twining reported. The Soviets are particularly strong in training technical and engineering personnel and in research and development, he added.

Despite these warnings, General Twining was careful to point out that the Russians have not yet outdistanced us. "Nothing," he said, "is superior to the best U. S. aircraft in comparable categories."

That the U. S. aircraft industry was doing its job well and economically was confirmed a few weeks later when Rep. F. Edward Hebert (D., La.) reported on findings of his House Armed Services Subcommittee, which devoted the spring to investigating profits in the industry.

"The Subcommittee concludes, on the evidence, that there has been no showing that, on the average, the profits allowed are excessive.

"It is our opinion that the Government is getting substantial value.

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"The Subcommittee repeats its observation, often voiced by the members during the course of the hearings: This is an industry which cannot survive, on a comparable scale, without military production. The irrefutable evidence is that the moment military orders are either withdrawn or curtailed, the industry is in the doldrums.

"What we have seen, then, is a national asset in facilities and proven capabilities for production, both in plants and skills, as a weapon for defense.

"An examination of these plants and the personnel operating them is a source of confidence to the members of the Subcommittee who were able to complete such a tour. It is a plant and a force which we require 'in being' for our safety."

The Twining and the Hebert testimony helped to mold the decision of Congress early in the summer on appropriations for air power. Final figures on Congressional aviation appropriations for Fiscal 1957 were consistently ahead of the preceding year. To the Air Force went \$16.4-billion (exclusive of public works), as compared with the 1956 appropriation of \$14.7-billion. For aircraft and procurement Naval aviation got \$1.7-billion as compared to \$906-million in 1956, and the National Advisory Committee for Aeronautics appropriation was up from \$60.1-million in 1956 to \$61.9-million in Fiscal 1957.

Another investigating group, a Special Committee of the Senate Armed Services Committee, under Sen. Stuart Symington (D., Mo.), who as a former Secretary of the Air Force is a strong advocate of its expansion, also held highly-publicized hearings beginning in April. These promise to be reopened early in 1957.

Production planes, notably in the supersonic regime, continued to break speed and altitude records during the year. Experimental models gave repeated glimpses of the future, especially in the convertiplane field. Heavy buying of helicopters was also indicated by the Army and the Marines, while all four air services reported continued progress in rockets and guided missiles.

Leading in research and development was Project Vanguard, first announced by President Eisenhower in 1955. In 1956, the satellite experiment progressed to the point where experimental firings of test vehicles took place in November, with others promised during the winter in anticipation of the actual satellite launching in mid-1957.

Heavily cloaked in secrecy, another revolutionary project was reportedly progressing rapidly—an atomic-powered plane. Both the Air Force and the Navy had contracts out in this field, and the Atomic Energy Commission stated in its annual report that power-plant experiments were going forward satisfactorily.

By mid-year, the aircraft industry had reached a World War II employment peak and was the nation's largest employer, again taking the lead over the automobile industry. Peak month was August, with 814,000 aircraft workers on the payroll, more than one hundred thousand ahead of the auto figure of 702,000.

## DEPARTMENT OF DEFENSE

Thus at all points on the air defense front progress was reported, much of it promising even more dramatic stories for the year ahead.

### Air Force

With the 137-wing U. S. Air Force in sight and some of the most ambitious research and development projects of all time under way, the nation's air defenses improved all along the line during 1956.

Work on an atomic-powered plane went forward under the USAF Air Research and Development Command. Contracts for atomic planes and engines were awarded to Lockheed Aircraft Corp., for an airframe to be powered with Pratt & Whitney engines. A second pair of contracts in the same field went to Convair, a Division of General Dynamics Corporation, with powerplants by the General Electric Corporation. Reactors were also airborne for test purposes during the year.

Operation commands continued to demonstrate performances of new models. Featured among the fighters were the North American F-100 Super Sabre series, replacing North American F-86 Sabres both on this continent and abroad. It was a star for the Tactical Air Command at the Labor Day week-end National Air Show in Oklahoma City. F-100C's raced for the Bendix Trophy from George Air Force Base, Calif. Trophy winner was Capt. Manuel J. (Pete) Fernandez, assistant group operations officer, 413th Fighter Day Group, who flew the 1,120 miles at an average speed of 666.661 mph. The five other entrants from Tactical Air Command all beat the old record of 616.208 mph.

Also starring at the Oklahoma show, this time for the Strategic Air Command, were Boeing B-47 medium jet bombers. Non-stop flights came in from England and North Africa, and another flight, from Bermuda, competed for the General Electric Trophy. Winner was SAC's 22nd Bomber Wing, March Air Force Base, Riverside, Calif. A crew headed by Maj. Joseph Schrieber flew a Stratojet 1,900 miles from Kindley AFB, Bermuda, to Oklahoma City at an average speed of 601.187 mph, a new record. SAC also demonstrated aerial refueling of B-47's by KC-97 tankers at the show.

During the year, SAC began replacing Convair B-36's with Boeing B-52 long-range bombers. Ten more wings are being added to the Command, which plans to reach the 54-wing level by mid-1957. A glimpse of things to come was revealed late in the year when Convair's B-58 Hustler, powered by G-E J-79 turbojet engines and notable for its delta wings, made its first flights.

Operationally, Air Defense Command flew North American F-86 Sabres, Northrop F-89 Scorpions, and Lockheed F-94's. Convair F-102's began to go on active duty beginning mid-year.

Firepower in this command and elsewhere was increased. New missiles are being added to the ADC arsenal, and the planes themselves have improved armament, as witness General Electric's new 20-mm Vulcan aircraft cannon installed during the year in F-104's and F-105's, as well as the B-58.



"The Air Force's relationship with industry is unique in the history of armed forces. The record of arms and armament shows that industry used to lag behind the demands and progress of the armed forces. In fact, in the earliest days there was no industry at all to support armed forces. Contrast this with the development of air weapons in the air age. Our military people did not even ask for the airplane. It was developed by civilians and sold to the service over the protests of some military experts. Industry has gone far beyond merely producing weapons developed within the service. In many cases it has recognized new needs and gone ahead to provide the answer."

—NATHAN F. TWINING,  
General and Chief of Staff, United States Air Force



New transport to go into operation during the year was the Fairchild C-123. Douglas C-124 Globemasters continued to do heavy duty. In February, the Air Force rolled out the largest cargo plane ever to go into production, the turboprop-powered Douglas C-133, with four Pratt & Whitney T34-P-3 engines. Equally dramatic was introduction of the propjet Lockheed C-130, which became operational in December. This plane can carry 20 tons of equipment or 92 combat-equipped troops or a 70-litter hospital unit. Earlier in the year it made news when it dropped a single platform loaded with 27,000-lb. of iron.

That the Air Force of tomorrow was of more concern than the Air Force in being was repeatedly indicated during the year with reports from the Air Research and Development Command, working on all aspects of the air defense program. Lead project was, of course, an atomic-powered plane. The Air Force also played a leading role in the Vanguard satellite project, headed by the Office of Naval Research. But beyond these were literally hundreds of other projects, many top secret, all designed to give the nation the world's best air defense.

First in the field of research planes was the X-2. Although this work was marred by the tragic crash that killed USAF Capt. Milburn G. Apt, the Air Force reported that many significant research findings had been revealed as a result of X-2 flights.

Another ARDC project that made news during the year was the McDonnell XV-1, a convertiplane which unofficially exceeded the speed record for helicopters by going 200 mph. Pilot for the record flight was Capt. Wayne W. Eggert of the ARDC.

From stratosphere to landing runways, ARDC engineers and scientists were at work. A device for testing runway wear was developed at Wright Air Development Center, and ARDC scientists conducted a series of tests at Holloman Air Development Center, New Mexico, to develop safe bail-out equipment and procedures at altitudes ranging from 50,000 to 100,000 feet.

New equipment included a microwave relay station with a 100-ft. magnesium tower, that can be transported to a site by helicopter and put in

## DEPARTMENT OF DEFENSE

operation within two hours; a portable-type oxygen facility for use in air cargo and troop carriers; a new wheels-down warning device and a new electron tube designed to operate at extremely high frequencies with large power outputs; a research device which measures the effectiveness of the three methods used in airborne radar observation; a trainer for radar operators to help them learn how to guide a plane toward its target; a high (150,000-ft. altitude) flight simulator; a mobile control tower, a new lightweight fabric for use in air-support radar shelters, and a monstrous vehicle—called an aircraft crash pusher—capable of shoveling a 400,000-lb. crash bomber off a runway in less than 20 minutes, as contrasted with the former time for such an operation of from five to 15 hours.

Other Air Force researchers manned an expedition to Pike's Peak to make infra-red radiation measurements, observed sun spots at Sacramento Peak observatory, New Mexico, and tested meteorological research balloons over Texas.

### Naval Aviation

Significant Naval air news in 1956 centered around the Vanguard satellite project, which the Office of Naval Research spearheaded, further research and development on an airborne nuclear powerplant, and, at the operational level, the application of the angled deck to carrier aviation.

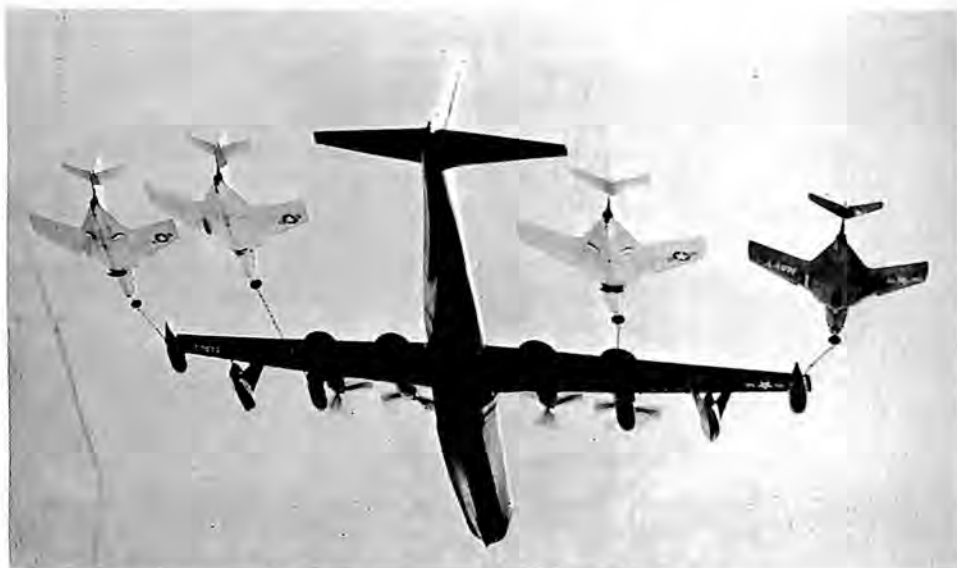
Work went steadily forward during the first half of the year on Vanguard, the pace accelerating as the deadline neared for launching the satellite during the International Geophysical Year, beginning in mid-1957. The Navy was put in charge of managing the technical aspects of the program, working in close cooperation with the Army, Air Force, National Academy of Sciences, and the National Science Foundation. Launchings of satellites were announced as scheduled for Patrick Air Force Base, Cocoa, Fla., about June, 1957.

Advanced work on Vanguard in 1956 included research by Navy Rockoons—balloon-supported rockets consisting of a 12-ft. Deacon research rocket suspended on a Skyhook balloon. The balloons take the rocket to approximately 80,000 ft., where rockets are fired. Balloons are made by Winzen Research Corporation of Minneapolis, rockets by the Allegheny Ballistic Laboratory at Cumberland, Md.

How much progress was made during the year on an airborne nuclear powerplant for Navy use is cloaked in secrecy, but it is known that work continued.

Long-heralded and much-debated, the USS air carrier Forrestal continued on active duty, teamed with six other carriers whose decks have been angled. Four additional Forrestal-type carriers are authorized, and money is requested for a fifth. All reports are that the angle deck has worked out better than anticipated and is one of the most significant developments in Naval air defense in recent years.

Four carrier-type planes made headlines at the National Air Show over Labor Day. The Chance Vought F8U Crusader, piloted by Cmdr. Robert W. (Duke) Windsor of the Naval Air Test Center, Patuxent



**Convair R3Y-2 Tradewind refuels Navy fighters**

River, Md., scored a new national speed record of 1,015.428 mph, to win the Thompson Trophy. North American's FJ-3 Fury won the North American trophy when, piloted by Lt. (j.g.) David K. Grosshuesch of Navy Fighter Squadron VF-24, Moffett Field, Calif., it flew from the carrier USS Shangri-la off the northern coast of Mexico to Oklahoma City, a distance of 1,198 miles, in two hours 13 min., 38.6 sec., for an average speed of 537.849 mph. A McDonnell F3H-2N Demon, piloted by Ralph Carson of Navy Fighter Squadron 124, NAS, Miramar, Calif., won the McDonnell trophy for a similar flight, and the Douglas Trophy went to Capt. J. T. Blackburn of Navy Heavy Attack Squadron 1, NAS, Jacksonville, Fla., flying a Douglas A3D Skywarrior. The Demon clocked an average speed of 566.007, the Skywarrior 606.557 mph.

Other carrier planes on active duty during the year include the Douglas A4D Skyhawk, powered with a Curtiss-Wright J65 engine, lightest of all U.S. jet combat planes, and the Douglas F4D Skyray. Scheduled to reach the fleet next year is the Grumman F11-1 Tiger, which made history during 1956 by being what is believed to be the first and only aircraft to overtake its own projectiles when the projectiles were following a normal trajectory.

For carrier support, Navy announced a program for 47 missile-equipped ships, to be on duty by 1961. Eight Convair Tartar equipped ships are scheduled by Fiscal 1960, and a total of 17 by 1961. Twenty-two ships armed with Terrier missiles, also a Convair product, are scheduled by 1961. There will also be eight Talos missile ships. During the year, incidentally,

## DEPARTMENT OF DEFENSE

the Talos missile scored six direct hits in succession on airborne targets, according to Adm. Arleigh Burke, Chief of Naval Operations.

Navy also continued to back the development of the Martin XP6M SeaMaster and placed quantity orders for this long-range jet bomber. Deliveries will begin next spring on the Convair R3Y-2 Tradewind, turboprop tanker-transport.

Missile production orders included the Sperry Sparrow air-to-air, the Terrier, and the Chance Vought Regulus. The Sidewinder, a Philco air-to-air missile, was in development-production stage before the end of the year.

Intensive Naval research continued in the fields of intercontinental ballistic missiles, vertical takeoff aircraft, antisubmarine warfare, and personnel equipment designed to protect pilots in the supersonic areas of flight.

### Army Aviation

Army aviation took giant strides forward in 1956. These included plans to double procurement in guided missiles, reorganization and strengthening of research and development, accelerated helicopter activities at both the experimental and operational level, transfer of Army plane and helicopter pilots' training to the Army from the Air Force, and scores of other activities, all designed to make ground units and materiel more mobile by application of air power.

Straw-in-the-wind of Army thinking was the announcement by Lieut. Gen. James M. Gavin, Chief of Army Research and Development, that "a real revolution in Army research and development" is under way. Army's guided missile budget of \$400-million in Fiscal 1955 will jump to more than \$800-million in Fiscal 1957, he reported.

This news was backed up by operational successes in the missile field, the most dramatic a demonstration of the controversial Nike at White Sands Proving Ground early in the summer. This anti-aircraft missile scored seven hits in eight tries.

Operationally, activities revolved principally around lightplanes and helicopters. Four world helicopter records were made by Army pilots during the year. The world class record of 1,199.078 miles was achieved

"Our streamlined Army has impressive mobility, both strategic and tactical, which would be a prime factor of success in any war we might be called upon to fight. Our units can be moved by air across continents and oceans if necessary. Our paratroopers can be moved into combat by tactical airlift. By means of the new assault air transports our infantry divisions can now have air mobility comparable to paratroopers. Increased use of helicopters and light, fixed-wing planes is solving difficult problems of observation and fire control, the command and resupply of dispersed units, and the rapid movement of small bodies of combat troops."

—WILBER M. BRUCKER, Secretary of the Army



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on August 11, 1956, at Robbinsville, N. J., by Lieut. Col. Harry L. Bush and Maj. William C. Dysinger, U. S. Army, flying a Vertol H-21C helicopter with Wright R-1820-103 1275-hp engines. Army Captains C. E. Hargett and E. D. Hill hung up three world records at Milford, Conn., July 12, flying a Sikorsky H-34 helicopter with a Wright 1820 1275-hp engine. The records were a speed of 141.915 mph for 62.137 miles, 136.041 mph for 310.685 miles, and 132.633 mph for 621.369 miles.

Army helicopters, including the Sikorsky H-34, appeared at the National Air Show in Oklahoma City over Labor Day. The Bell H-13 made an endurance record of 57 hrs., 50 min. Aerial refueling of helicopters was demonstrated with the Vertol H-21.

An outstanding event on the home front was the introduction of the prototype of the Martin Company's Missile Master, an electronic nerve center of an anti-aircraft defense system designed to provide near-automatic, instantaneous location and identification of missiles, followed by optimum distribution of fire-power from wide-scattered anti-aircraft batteries.

Throughout the year work went forward toward reorganizing and strengthening research and development. By early fall, basic aviation research and development was transferred from the office of the Chief of Transportation to the Transportation Research and Development Command. Personnel was then added to strengthen work in aviation.

Paralleling this change were a series of contracts toward future strengthening of Army's air arm. Typical were four for design studies in the flying crane field, let to Flettner Aircraft Corp., Kaman Aircraft Corp., Hughes Tool Co., Aircraft Division, and Hiller Helicopters. Army desires heavy-lift designs that can carry up to 16 tons of cargo.

Another development requested, this time in a contract with Vertol Aircraft Corp., was for a turbine-powered vertical take-off and landing aircraft with transport airplane cruising performance.

Army also leased 12 de Lackner Aerocycles, one-man aerial scouting vehicles, for test work with personnel, with the possibility of future orders.

"Our defense capability is not static; it is improving and will continue to improve. We will increase our long-range bombing capability with the continued introduction of the B-52 in larger numbers. We are obtaining aircraft of improved performance for our aircraft carriers and tactical air forces, capable of delivering an increasing variety of atomic weapons at greater ranges. We expect to increase our capability to deliver atomic weapons with supersonic missiles, launched from land, or from our carriers, submarines and other warships. We also expect to have in the relatively near future ballistic missiles of intercontinental range which can be launched from the United States, and ballistic missiles of intermediate range, which can be launched from ships or suitable bases."

—CHARLES E. WILSON, Secretary of Defense



## DEPARTMENT OF DEFENSE

"There are several kinds of power. Military is one. Economic is another. And moral and spiritual power is a third. It is the genius and the inspiration of Freedom-loving people. To have a secure peace, Freedom must rest on a true position of qualitative strengths—military, economic, and spiritual. In maintaining all these strengths, international aviation has its greatest role as the silver and gold wings of a secure peace."

—ADMIRAL ARTHUR RADFORD,  
Chairman of the Joint Chiefs of Staff



### Marine Corps Aviation

Further strides toward perfecting ultra-modern amphibious warfare techniques, notably by use of helicopters, all-weather air support, and highly advanced base shelters, marked Marine Corps Aviation activities during 1956.

During the year, the first HR2S Sikorsky transport helicopter was delivered. It flew non-stop from the factory in Bridgeport, Conn., to Patuxent, Md., in April. By November, the twin-engine machine had topped a speed with payload of 162 mph while carrying 11,000-lb. of payload. The record flight was made with Maj. R. L. Anderson, USMC, at the controls.

The Marine radar guidance system introduced in 1955 was improved during the current year, making it possible to give Marines in battle close air support on a round-the-clock basis, regardless of weather. The system is designed to use voice commands, can accommodate both propeller and jet aircraft, and is capable of delivering tactical nuclear weapons.

### Marine Geodesic Dome



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On the ground, Marine Aviation investigated a new concept in advanced base shelters which could result in saving millions of dollars. The dome-shaped buildings, designed by R. Buckminster Fuller, an authority in the field, promise spectacular savings also in weight and man-hours required for erection.

Other highlights of Marine Aviation during the year included participation in Continental Air Defense Command activities in cooperation with the Navy and Air Force, further field work with the Sperry Sparrow I air-to-air guided missile, and operational work-outs on the A4D Skyray.

## CHAPTER THREE

### Government Agencies in Aviation

#### Agricultural Research Service

**U**. S. DEPARTMENT OF AGRICULTURE researchers moved ahead during 1956 in research on aerial application of insecticides, fertilizers, seeds, and weed killers and other farm chemicals. They also continued development studies in aircraft design, equipment, and pest control methods. Growing use of aircraft for international transport of agricultural products called for increased vigilance by USDA plant and animal inspectors to prevent entry of foreign insects and diseases.

The important role of aircraft in the battle against insects is shown by the acreage treated from the air in 1956 under Federal-State contracts. The total area amounted to more than 8 million acres. Four insects—grasshoppers, spruce budworms, Mediterranean fruit flies, and gypsy moths—were targets from the air on more than 7.9 million of those acres.

In the grasshopper control program, some 2 million acres of rangeland in 10 western States were treated. About 1.4 million acres of forest land in Montana and Idaho were treated to control the spruce budworm. After the Mediterranean fruit fly struck orchards and vegetable gardens in a  $\frac{3}{4}$ -million-acre area in Florida, much of the infested area was sprayed by planes several times, aggregating over  $3\frac{1}{2}$  million acres of spray treatments through September. In the gypsy moth control project, about 1 million acres of forests in eight northeastern states and Michigan were treated from the air.



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Migration studies of pink bollworm moths were made during the year, using a small plane from the Aircraft and Special Equipment Center of USDA's Agricultural Research Service at Beltsville, Md. This airplane, equipped with screen-type traps, was used to check the presence of the moths at several altitudes above land in or near infested areas of the southwest.

A second plane operated by the Center was used to apply several insecticides in granular form in control experiments against the Japanese beetle and white-fringed beetle. A cooperative project was initiated between the Aircraft Research Center of Texas A & M College and USDA's Agricultural Research Service to improve distribution of aerial-applied granular insecticides for control of soil-inhabiting insects. Work is underway to develop a better spreader.

The fuselage of a transport plane donated by the U. S. Air Force arrived at the Beltsville Center from Smoky Hill Air Force Base, Salina, Kans. It will be equipped with air-conditioning and used to test new fumigants developed by USDA chemists. Tests of improved residues and aerosols will be run in the baggage compartments of the fuselage.

An extremely poisonous and costly weed came under attack from the air. The trouble-maker—halogeton—has taken a high toll of cattle and sheep in western states. An area in Nevada received experimental control treatment with the herbicide 2,4-D in various strengths, formulations and application rates.

Aerial application of 2,4-D to control sagebrush on western ranges proved successful during the past year. USDA scientists found that the herbicide could be effectively applied by airplane or helicopter, in tests over large areas in California, Wyoming, and Colorado.

During the year, an agreement permitting key agricultural aviation personnel of the Civil Aeronautics Administration to help USDA's plant pest control workers resulted in benefits to contractors and government agencies. The agreement allows the CAA to assist in inspection of aircraft and pilot qualifications and to help supervise contract spraying.

The worth of aircraft in the fight against insects also was proved in remote areas of the world. In the Near East, USDA planes, pilots, and entomologists helped control one of Libya's worst locust invasions. With funds provided by the State Department's International Cooperation Administration, the U. S. Regional Insect Control Project also helped local government agencies fight pests in Pakistan, Iran, Iraq, Lebanon, Afghanistan, Jordan, India, Egypt, and Ethiopia. Using ten small planes, the five pilots and six entomologists have trained several dozen local pilots and mechanics in these countries to operate and maintain spray planes.

Livestock exportations by air to foreign countries were heavy during the year. For the first time in history, more cattle were transported overseas by air than by ocean vessel—about 9,000 by air, 5,800 by boat. Aircraft carried 63 percent of all livestock sent overseas, with shipments to 35 countries, not including Mexico and Canada.

During the same period, USDA's animal inspection and quarantine

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personnel also inspected 277 separate importations of livestock arriving by air from overseas. The shipments totaled about 1,000 animals. Today, more than 75 percent of the horses and 90 percent of the poultry imported to the U. S. come in by air. These figures do not include livestock shipments from Canada and Mexico.

Nearly 63,000 pounds of prohibited or restricted meats were removed from foreign aircraft and from airline passenger baggage and destroyed by incineration by USDA inspectors.

USDA plant quarantine inspectors inspected almost 100,000 airplanes, 84,000 of which arrived from abroad, for compliance with plant quarantine requirements. About 37,000 airplanes were found with prohibited or restricted plants and plant products carried in passenger and crew baggage, stores, or cargo.

### **Air Coordinating Committee**

The Air Coordinating Committee, established in 1946 to coordinate Federal policy in the field of aviation, is composed of the following members of the eleven Government Agencies having an important interest in aviation: Louis S. Rothschild, Under Secretary of Commerce for Transportation, Chairman; Chan Gurney, Member of the Civil Aeronautics Board, Vice Chairman, succeeded on October 15, 1956 by James R. Durfee, Chairman of the Civil Aeronautics Board, as member; Herbert V. Prochnow, Deputy Under Secretary of State for Economic Affairs; David W. Kendall, Assistant Secretary of Treasury; E. George Siedle, Assistant Postmaster General; George H. Roderick, Assistant Secretary of the Army; Garrison Norton, Assistant Secretary of the Navy for Air; Dudley C. Sharp, Assistant Secretary of the Air Force; Robert E. Lee, Commissioner, Federal Communications Commission; Percy Rappaport, Assistant Director, Bureau of the Budget (non-voting); George A. Landry, Assistant Director for Transportation, Office of Defense Mobilization (non-voting). The Executive Secretary is William E. Neumeyer.

The Committee, during 1956, developed and coordinated the United States positions for the Tenth Session of the ICAO Assembly. The agenda for the Tenth Session of the ICAO Assembly contained items covering technical, economic, legal, and administrative matters. An agenda item proposed by the United States dealt with review of the policy and program of ICAO for the provision of air navigation facilities and service to meet the needs of the jet air age.

A major portion of the activities of the Committee, in the technical field, is concerned with the work of the International Civil Aviation Organization. United States positions for twelve meetings held under the auspices of ICAO on technical subjects were formulated and finally approved during 1956. Likewise, there were thirteen actions taken on amendments to the technical annexes to the Chicago Convention, as follows: 1, Personnel Licensing; 2, Rules of the Air; 3, Meteorological Codes; 4, Aeronautical Charts; 6, Operation of Aircraft; 10, Aeronautical Communications; 11,

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Air Traffic Services; 12, Search and Rescue; 15, Aeronautical Information Services.

Additionally, in order to improve the inadequate communications over the North Atlantic, the United States proposed to ICAO the development of a plan for the utilization of forward scatter propagation techniques. A meeting of Contracting States will be held early in 1957 to discuss the technical aspects of the forward scatter project.

Domestically, a major accomplishment of the Committee during the year was the finalization of a National Search and Rescue Plan to insure the effective utilization of all available facilities for all types of search and rescue missions. Activity in this field is continuing as the Committee is charged with the responsibility for monitoring the implementation of this Plan.

Under the auspices of the Committee, a joint industry/government committee was formed for the purpose of resolving the many conflicts between the radio/TV and aviation industries resulting from the erection of very tall antenna towers.

In the field of air traffic control and navigation planning, the most important matter approved by the Committee during 1956 was resolution of the VOR-TACAN problem. A plan for instrumentation of the Federal airways with TACAN-compatible distance measuring equipment to supplement VOR, and integration of TACAN into the Common System, was approved by the Committee on August 30, 1956. This was named the VORTAC system, to differentiate it from earlier short-range navigation systems. The Committee endorsed as necessary those items contained in the CAA F. Y. 1957 Establishment of Air Navigation Facilities Program and is presently considering the CAA F. Y. 1958 proposed EANF program. The CAA plans provide for the most ambitious modernization program ever undertaken by that agency. The report of Special Working Group 13, of the Air Traffic Control and Navigation Panel, was being considered for approval by the Committee at year-end. This report is a policy guide to implementing agencies and planning groups, and deals with far-reaching improvements and modernization of the Common System of air traffic control and navigation. A manual establishing single common standards for flight facility inspection was completed and approved by the Committee for use by the appropriate Government agencies. Several recommendations for national application resulted from the Committee-sponsored high density air traffic study conducted in the Washington, D. C. area. Appropriate rules will be promulgated by the Civil Aeronautics Board and implementation of certain features of the recommendations will be accomplished by the Civil Administration. In support of the current United States policy on electronic long distance navigation systems, an approved program was prepared.

The Committee's efforts in coordinating the use of airspace were accelerated, considerably, both in the number and the nature of the problems handled. It completed an extensive survey of present airspace utilization and has outlined the problem areas where airspace conflicts may be

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expected in the future. These were preliminary actions which precede an over-all review that will now be conducted to determine policies with respect to the use of airspace.

The Committee, in connection with its responsibility of insuring the most feasible development and utilization of the nation's airports, has, among other things, solved the problems involved in finding permanent bases for military Air Reserve training units at six different locations; also, has resolved problems in connection with the construction of eight new military and eleven new municipal airports. In addition, three public hearings and two airport inspections were conducted at the local level.

In the Economic area, the Committee has continued to advise the Export-Import Bank regarding proposals for financing the sale of aeronautical equipment exported by United States manufacturers. Coordination was effected during the year for domestic and foreign civil aviation requirements for priorities for the production of civil transport aircraft, four such programs being approved covering the start of construction of 651 multi-engine civil transport aircraft. In the nontransport category, manufacturers planned production for the year indicated construction of 6,428 aircraft which are not included under the Defense Materials System. The Committee approved the transfer, under Public Law 647, 80th Congress, of certain meteorological equipment to the Japanese Government and of four Link trainers to the Government of Germany. In the international field, the Committee reviewed the North Atlantic Ocean Stations Agreement and recommended extension of the program through June 30, 1958, in order that meteorological information, communication services, navigational aid and search and rescue capabilities required by the United States might be provided. Seven reports covering serious deficiencies in international air navigation facilities and services affecting safety and regularity of international operations in various Regions were submitted to ICAO in order that appropriate steps might be taken toward elimination of such deficiencies. The Committee considered the economic aspects of providing air navigation facilities including CONSOL, in the North Atlantic Regions and prepared the United States position for a Joint Financing Conference held at Geneva, Switzerland, during September 1956 for revision of the existing Danish and Icelandic arrangements. The Committee prepared the United States position for an international conference on airport charges held during November 1956 in Montreal, Canada. Work was continued toward achievement of greater facilitation of passenger and cargo movement in international air transport.

In the Legal field, a study was prepared for submission to the ICAO Legal Committee on jurisdiction and law to be applied to crimes aboard aircraft in international flight, and a United States position was prepared in this area for a meeting of the ICAO Legal Committee. Subcommittee on Legal Status of Aircraft convened in Geneva, Switzerland, September 3, 1956. A position was also prepared for a meeting of the ICAO Legal Committee's Subcommittee on Hire, Charter and Interchange of Aircraft held in Caracas, June 1956, to consider legal problems involved and need for

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an International Convention. In another area, The Hague Conference for Amendment of the Warsaw Convention adopted resolutions urging further study by ICAO of a system of guarantees for the payment of compensation for liability arising under the Warsaw Convention and of the question whether rules of procedure in cases arising under the Convention should be adopted. The latter resolution provides for inclusion of the question of execution of judgments. Another resolution recommended that international bodies, interested in private international air law, study problems relating to uniform interpretation of private air law conventions and international settlement of disputes under such conventions. A United States position was prepared for a meeting of an ICAO Legal Committee Subcommittee at Caracas, Venezuela, in June 1956, to consider these problems. Among other matters pursued in the legal field, the Committee also approved proposed legislation to require the painting and lighting of unused or abandoned radio and television towers.

### **Civil Aeronautics Administration**

The imminence of jet transports on the airways and the impetus given to air traffic control improvement by a disastrous mid-air collision had important effect upon the 1956 activities of the Civil Aeronautics Administration.

At the end of the year, the CAA found itself with the largest appropriation in its history and was moving ahead with its forward-looking program for modernization of the entire airways system. Before the end of the year in June 1957, the agency will have committed \$75-million for new facilities and services in the interest of air travel safety, and may know by that time whether conditions in the busy field of electronics will make possible the hoped-for completion of the five-year plan in three years.

One move in this big program was a reorganization of the CAA in which the Office of Airways was divided into the Office of Air Traffic Control and the Office of Air Navigation Facilities. Thus CAA traffic control, which began 21 years ago, attains its majority and the added importance which today's aviation and its anticipated growth justifies.

Plans of the airlines for purchase of jet transports for service beginning in 1958 and 1959 resulted in continued activity by the CAA. Following a conference with potential jet operators, manufacturers and city officials, in January, 1956, the CAA initiated a comprehensive study of the many problems the jet produces, at airports and in traffic control, to add to the information it had gathered over several recent years on the design and performance of various jet planes.

Shortly after the January conference, a Jet Age Planning Group was established within the CAA to look into all aspects of jet transports as related to U. S. airways. This group continued the study of several years' standing of jet planes abroad. It arranged for a visit of 13 CAA specialists to the Boeing factory where they flew the Boeing 707 in actual operating conditions to observe its adaptability to present air traffic control methods.

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Later, the Air Force loaned two B-57 jet bombers to the CAA for its use in practical study of the control of traffic at high altitudes.

The collision of two airliners over the Grand Canyon touched off a great wave of public interest in airways safety. While these planes were not on airways nor under CAA control at the time, there was general demand for more traffic control, and general agreement by the CAA that such control was desirable as soon as necessary facilities and personnel were available. Congress responded to the demands with a \$75-million appropriation as the beginning of a previously submitted five-year CAA program estimated to cost upwards of \$246-million. Radar was the principal item in the new equipment. CAA experts had learned that conversation between pilot and controller could not match the speed of future planes, and long-range radar, capable of "seeing" enroute planes, was needed.

Solution of the conflict between two systems of air navigation, the VOR-DME originated by the CAA as a common system of air navigation, and TACAN, originated by the military, was reached by the Air Coordinating Committee during the year in a compromise. The common system for military and civil air navigation will be known as VORTAC, and the CAA began planning facilities for that system for equipping the airways.

Long range radar was installed at New York where CAA officials hoped to increase by 50 percent the instrument landings during the winter. The Air Force and the CAA cooperated in radar studies at the Technical Development Center at Indianapolis, using the complex of nearby military and civilian fields for study and development of better air traffic control methods and equipment. At Indianapolis also the CAA continued its study of conditions at various airports through use of an air traffic simulator. It operated an Airport Operations Evaluation Center there, and continued work on further automation for air traffic control, the use of automatic equipment for storing data, transferring it and displaying it to the controller. An important evaluation project of TDC was the radar beacon, which makes possible quick identification of a plane shown only as a blip of light on the radar screen. The CAA maintained a small staff at Lexington, Mass., to study the military SAGE system for its value in civil use.

Purchase of better performing planes for use in checking airway aids at altitudes where new transports will be flying was made by the CAA late in the year. At the same time, a new system of checking airway aids by flying a north-south, east-west grid system all over the country was developed. Using special computers, this system will make possible checking every airway aid on the airways at least once a month, a major improvement.

While the CAA was making records in its modernization of the airways and other services to the industry, the airlines were breaking previous records by carrying 41,868,000 passengers on domestic lines as against 38,026,000 in 1955; 3,992,000 in international travel, against 3,415,000 in 1955. A CAA pilot on a routine flight observation ride across the Atlantic reported that throughout the night he could see position lights of other

planes along the route, and the airlines reported an average of 86 civil flights a day during July and August. Landings and takeoffs at airports where the CAA operates the control towers numbered 20,384,000, an increase of 1,583,000 over fiscal 1955.

Other aspects of aviation continued to grow. The annual aerial blitz against bugs and pests that attack forests, crops and ranges used 20,000 tons of insecticide to treat 2,600,000 acres. Fix postings, that is, reports by pilots in flight over designated points, continued to increase in number, and the CAA reported that 43 percent of the total were military flights.

Washington National Airport became 15 years old, and in the midst of plans for a second airport for Washington, piled up new records of passengers handled. The airport is operating to capacity, but still more schedules are sought by airlines, of which four started new services to Washington during the year adding eight schedules. Another "finger" was under construction to add four more gate positions, a new baggage room was put into operation and the airport fuel "farm" was enlarged to care for the burgeoning business. The airport continued to earn for the treasury more than it asked Congress to appropriate for its operation.

Other cities reported record use of their airports also. Excluding purely local use, the ten with the highest volume of air carrier and itinerant operations for fiscal 1956, were Chicago (Midway), New York (La Guardia), Washington, Los Angeles, Dallas, Atlanta, Miami, Albuquerque, St. Louis and Cleveland in that order.

The CAA was in the second year of its four-year Federal Aid Airport Program. Federal money totalling \$51.8-million was available for the second year of the period covered by the amendment to the Federal Airport Act which made \$63-million available for each of four years. The CAA planned to have a firm airport program ready for announcement early in 1957 for the fiscal year beginning July 1, 1957. This was the culmination of its aim to give local sponsors as much advance notice as possible, so that they could start actual construction as soon as the fiscal year began and the money became available.

Business flying continued its growth in 1956, and the trend noted before toward more multi-engined planes for executive travel continued. The CAA advised special caution on pilots flying the new, light twin-engined planes because of the flying characteristics of these unusually "clean," high-speed planes, and because many pilots with private licenses and moderate experience are flying them in the transaction of their business affairs.

Training of foreign nationals and technical assistance to friendly governments was an important CAA program during 1956. In Fiscal 1956 the number of foreign trainees coming here for special aviation instruction was 167. In addition, the CAA operated ten permanent international field offices and a number of special aviation missions.

Again for the fifth year the air carriers of the United States produced an amazing safety record—fewer than one passenger fatality per 100-million passenger miles. Despite the loss of two planeloads of passengers in the presumed collision over Grand Canyon, the rate for domestic air carriers

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in 1956 is estimated by the Civil Aeronautics Board to be 0.62 to compare with the 1955 rate of .76 per 100-million passenger miles.

On foreign and overseas lines there was a perfect record, no passengers killed throughout the year. The combined accident rate was 0.5.

Fred B. Lee, resigned as Administrator of the Civil Aeronautics Administration in December 1955. He was succeeded by Charles J. Lowen, who had been his deputy since May 1955. Mr. Lowen's appointment as Administrator was confirmed June 6, 1956. He died in Denver September 5 and was succeeded by James T. Pyle as Administrator. In his brief tenure, Mr. Lowen pushed into action a number of CAA plans which greatly increased public attention as a result of the crowded condition of the federal airways.

### Civil Aeronautics Board

The Civil Aeronautics Board, in carrying out its route activities under the Civil Aeronautics Act, has as its primary goals economically sound routes, subsidy-free operations, and adequate service to the public. During the past year the Board has made substantial progress in this area.

Since July 1, 1955, the Board decided 15 proceedings changing the operating authority of every domestic trunkline carrier, adding more than 21,000 new route miles and numerous new or additional links between communities.

In addition to the three major route cases in 1955 (New York-Chicago Case, Denver Service Case and Southwest-Northeast Service Case) the Board decided the New York-Florida case in 1956. In this proceeding Northeast Airlines was authorized to operate the third airline route between Boston-New York and Florida points, furnishing additional service on this heavily traveled route to meet more fully the needs of the traveling public. The Board also made adjustments and additions to the routes of other airlines operating in the area.

As a result of these major route cases the Board has increased competition on the trunkline routes. Today only four of the 50 top U. S. markets and 12 of the second 50 markets remain noncompetitive, and proposals are pending for competitive service for these markets. The route grants have established better balance among the trunkline carriers, and will make possible the decrease or elimination of subsidy to the few carriers requiring subsidy.

In the local service airline field the Board began a series of "area cases" involving applications for new service filed by local service carriers and cities in the various areas. A comprehensive review of local airline needs throughout the country will be accomplished at the completion of these area reviews. Five proceedings are now in progress, and three more are contemplated.

The local service carriers, in a strikingly expanding market, require less, year by year, in subsidy support in relation to the volume of service offered and traffic carried. The goal of the Board, and the local service carriers, continues to be the provision of local air services throughout the country



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in response to the public need, accompanied by an absolute decrease in requirements for federal support.

At present more than two-thirds of the several hundred local service points are permanently authorized. The carriers since 1950 have increased their revenue plane-miles flown by approximately 80 percent, and their revenue passenger-miles by somewhat more than 200 percent. The average load on board has almost doubled from 5.6 passengers to nearly 11.

In the field of airline passenger rates, the Board initiated an investigation into the over-all passenger fare level of the domestic trunkline carriers. The purposes of this proceeding are, in general (1) to develop appropriate and well-defined standards as to the earnings which are required by the 12 domestic trunkline carriers for proper development consistent with the public interest; and (2) based on such standards, to require or permit such overall decreases or increases in domestic fares as circumstances may warrant. The Board's decision, which will be reached after full hearings, will, of course, be guided by the objectives of the Civil Aeronautics Act which envisage earnings adequate to assure a sound national air transportation system offering maximum and safe service to the public at the lowest economical fares.

It is the goal of all concerned—the Congress, the Board, the carriers and the public—that as each segment of the air transport industry moves beyond the developmental stage and can reasonably support itself, the prop of subsidy will be removed. Steady progress in that direction is being made.

By the close of fiscal 1956 only one domestic trunkline carrier required subsidy for trunkline services. It is expected that in 1957 even this carrier will become self-sufficient as the result of route improvements authorized by the Board. Domestically, only the 13 local service carriers and the three helicopter carriers are expected to need federal governmental assistance. Only three of the seven U. S. carriers providing service abroad require subsidy; and their subsidy has declined from more than \$30-million in 1951 to about \$7-million in 1956. The decline in total subsidy, from about \$70-million in 1951 to an estimated \$44,590,000 in 1956, has been due in general to continuing improvement in operations, and a vigorous effort on the part of the Board to improve carrier route systems and to maintain a current docket in subsidy rate cases.

In November 1956, the Board members and top staff officials began a series of discussions on the safety, economic and operational development of large turbine-powered passenger transport aircraft with each of the five U. S. manufacturers now designing or building such aircraft. CAB Chairman James R. Durfee said that the airlines have made the largest financial investment ever made in world aviation for civil transport aircraft, and that the Board is vitally interested in surveying the current development of this new equipment in order to assist itself in preparing new jet safety and economic regulations as required of the Board under the Civil Aeronautics Act.

Accident fatality rates, surveyed over the ten years since World War II, showed a drop of almost 75 percent, while passenger-miles nearly quad-

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rupted. The rate was 0.6 passenger fatalities per 100-million passenger miles in calendar 1955 and shows every indication of being less than 1 again in 1956, for the fifth straight year.

### **Federal Communications Commission**

In the aviation field, the Federal Communications Commission is responsible for the regulation and licensing of all non-Government radio facilities. These include aeronautical enroute, 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. In addition, the Commission authorizes and regulates non-Government aeronautical fixed communication circuits between the United States and overseas terminals.

As of July 30, 1956 there were 49,639 aviation radio authorizations collectively—34,463 aircraft; 2,471 aeronautical and fixed; 319 aviation radionavigation land; 190 aviation auxiliary, and 12,196 Civil Air Patrol.

The Commission participated in the work of various interagency coordinating and policy groups during the year as a part of its continuing effort to find solutions to the many new problems created by the expanding needs of the user-public, and in order to accommodate its rules and policies to the rapid technological advances taking place in the field of aviation. The Air Coordinating Committee (ACC), the International Civil Aviation Organization (ICAO), and the Radio Technical Commission for Aeronautics (RTCA) are examples of these interagency groups.

### **Fish and Wildlife Service**

The Fish and Wildlife Service uses aircraft both in Alaska and the United States on wildlife and fishery enforcement patrols; waterfowl nesting and population surveys; big game and fur animal inventory surveys; predator control operations; waterfowl depredation control activities; as well as agricultural operations on national wildlife refuges which include spraying for the control of noxious vegetation and the seeding of waterfowl foods.

During fiscal year 1956 the Service owned and operated 52 aircraft. The fleet was composed of: 30 Pipers (Supercubs, Pacers, and J3C's); 13 Grumman Gooses; five Grumman Widgeons; one Stinson V77; two Cessnas (180 and 170); and one Twin Beechcraft.

Sixty-eight personnel held letters of flight authority during the fiscal year. These pilots flew more than 12,000 hours, and the territory covered included Alaska, Canada, Mexico, Cuba, Puerto Rico, Haiti, and the Dominican Republic, as well as the United States.

The maintenance and repair of Service aircraft operating in the United States are handled through commercial shops. In the Territory of Alaska, however, where 34 Service aircraft were used during the fiscal year, the Service maintains overhaul and repair shops of its own.

### Forest Service

The Forest Service uses aircraft in connection with the protection and management of 149 national forests, located in 39 states, Alaska, and Puerto Rico. Chief uses include the transportation of men and supplies during forest fire emergencies, fire detection and aerial reconnaissance of going fires, supplying remote and inaccessible stations, aerial survey, re-seeding or revegetation of burned-over and denuded areas, surveying and spraying for insect control, and search and rescue.

In May and June of 1956, national forests in New Mexico and Arizona had their worst fire season on record. More than a score of big, damaging fires burned over nearly 200,000 acres in California national forests in the summer of 1955. In the full calendar year of 1955, the Forest Service fought 8,173 fires in the national forests. A total of 373,918 acres was burned. (Annual averages for the preceding five year period: 10,977 fires, 287,140 acres burned.)

Aircraft figured prominently both as cause and in the control of one of the worst forest fires of the 1956 season. The crash of an Air Force Super Sabre Jet on a rough, inaccessible mountain slope in the San Bernardino National Forest in California on September 21 started a forest fire which raged for five days before being brought under control, burned 10,250 acres (16 square miles) of high value watershed, timber lands and recreation area. Several communities in the vicinity of Lake Arrowhead and Running Springs narrowly escaped destruction. The Forest Service and cooperating state and local agencies quickly mobilized 1,400 men, including trained "hot shot" crews and fire fighting experts from 16 other National Forests, 250 Indians in organized fire crews flown from Arizona and New Mexico, employees made available by local citrus fruit growers, and military personnel from Air Force and Marine bases nearby. Fire fighting equipment assembled included 150 pumper-tankers and water-hauling trucks, 25 tractors, 8 air tankers, and 3 helicopters.

One of the actions that helped to control the fire was the use of air tankers to make water-chemical drops. A converted Torpedo Bomber and seven Stearman air tankers were used in a low-level bombing type of attack to retard rapid spread of the fire at key points until ground forces could establish a control line. During four days of operation, the aerial tankers made a total of 458 flights, dropping 43,260 gallons of water and water-borate mixture on the fire. Some 25 tons of sodium calcium borate were used. Aerial chemical bombing of forest fires is still in an experimental stage of development. This was the first large-scale use on a going fire of the experimental techniques so far developed.

The Forest Service in 1956 owned and operated 22 aircraft—14 single-engine airplanes, 7 twin-engine planes, and 1 helicopter. These planes all have been equipped for transporting personnel, cargo parachuting, and smokejumper work. Some of them are also equipped for seeding and spraying.

Latest yearly figures (1955) show use of fixed-wing aircraft by the Forest Service totaled 18,743 hours. This included 3,755 flights, totaling

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3,943 hours, by Forest Service airplanes; 10,261 flights, 14,047 hours, by commercial planes under charter contract; and 21 flights for 173 hours flown by the armed services for the Forest Service. Use of helicopters (commercially operated under contract) amounted to 1,256 hours. (Not included in the above figures is certain contract flying for aerial photography and insect control work.)

A total of 18,012 fire-fighters and other passengers were transported by air during 1955. Cargo transported totaled 1,569,907 pounds, of which 768,480 was air freight (delivered at nearest airport), and 801,427 pounds was para-cargo dropped by parachute to Forest Service fire camps or back-country stations.

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 304 men. Smokejumper units were stationed during the fire-danger season at Missoula, Mont.; Grangeville, Idaho City, and McCall, Idaho; Silver City, N. M.; Illinois Valley, Ore.; and Winthrop, Wash. During the year, the smokejumpers made 1,031 jumps to 284 fires. They worked a total of 3,723 man-days on "jumper" fires, plus 1,032 man-days as ground crews on other forest fires. The Forest Service estimated that they saved a total of some 25,700 acres of forest that would probably have been lost to fire except for the quick arrival of the parachute-jumping fire-fighters.

Forest Service planes and rental aircraft were used extensively to locate and map the occurrence of incipient outbreaks of forest insects and tree diseases during the year. Approximately 1,500 hours of flying time were devoted to aerial insect surveys and an additional 300 hours were used for the scouting of oak wilt and other tree diseases. These aerial pest surveys covered an estimated 150,000 square miles of forest lands in various parts of the country.

Research was continued to improve aerial insect survey techniques and to improve methods for use in aerial insect spraying. The research work on detection and appraisal surveys included an evaluation of visual estimates, tree counts, viz strip sampling, and photographic interpretation of infestation areas. The spray-swath characteristics and height of multi-engined planes were studied in research on aerial spraying. Approximately 350 hours of flight time were used in both research activities.

During the 1956 season, insecticide was applied by aircraft on control projects to some 1,372,000 acres of forest lands in Montana, Idaho, New Mexico, and Colorado to protect and preserve forest resources from destructive insects. The work was conducted under provisions of the Forest Pest Control Act of 1947, and included several projects in which State agencies and private land owners cooperated with the Forest Service, contributing part of the cost as well as furnishing certain services and facilities. The control projects required an estimated 4,200 hours of flight time, supplied almost wholly by rental planes.

Approximately 20,000 acres of range lands in national forests were treated by aerial spraying of herbicides, during fiscal year 1956, to eliminate

undesirable plants such as sagebrush and wyethia. About 50 hours of rental flying time was involved in these projects.

### **National Advisory Committee for Aeronautics**

The major research effort by the National Advisory Committee for Aeronautics in 1956 was focused upon acquiring information at the earliest possible moment of information necessary for achievement of two goals:— (1) airplanes speedy enough to shrink the globe until any two points will be within a short, day's journey, and (2) long-range ballistic missiles that can travel the required distances at the desired velocities without being destroyed by aerodynamic heating.

The urgency of these needs is so compelling that the NACA effort was planned to produce information that would be directly useful to the men in industry charged with the task of designing airplanes and missiles that would perform the desired missions.

In a time when the Navy was readying a 1,000-mph airplane for carrier service, and the Air Force was buying fighters to operate in the M-2 range (1,320 mph at altitude) the aerodynamic heating problem was something immediate. At sustained flight at these speeds, a temperature rise of as much as 300° Fahrenheit (about that used by the housewife to roast the Thanksgiving turkey) was being experienced.

Keeping the pilot, the complex electronic gear, the weapons system, and the fuel cool under such conditions is difficult enough. Fully as serious is the parallel problem of learning how to maintain the structural strength of the airplane. An indication of how the problems grow in size may be seen from the fact that the temperature due to aerodynamic heating rises as the square of the velocity.

Before design of aircraft and missiles capable of tomorrow's high speeds can be undertaken on a rational basis, a much better understanding of the mechanics of aerodynamic heating must be gained. The task of designing equipment that will be useful in conducting the necessary fundamental research has been formidable. The great difficulty has been in learning how to duplicate in the laboratory the extremely high temperatures and other conditions of future flight. Only recently have ways been learned how to design and build the small pilot models with which to demonstrate the practicability of constructing the radical new tools so necessary for the rapid expansion of the limits of our knowledge.

Already, NACA scientists have learned much about the processes of aerodynamic heating at the relatively low speeds envisioned for conventional airplanes (less than M-5, or 3,300 mph). Even here, more information is urgently needed, and great effort is being exerted on the problems. Respecting aerodynamic heating at the still higher speeds at which intercontinental ballistic missiles and such new man-carrying vehicles as hypersonic (above M-5) gliders may fly, our understanding is still imperfect, to say the least.

In essence, aerodynamic heating is the conversion into heat energy of the kinetic energy of the air through which the airplane or missile is

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flying. The heat energy first appears in the thin, stationary boundary layer of air surrounding the surface of the aircraft. Then it is transferred through the boundary layer into the aircraft structure. At the same time that heat energy is being absorbed by the aircraft structure, radiation is dissipating some of it. If steady flight is maintained, a balance between heat



**Aerial view of NACA Lewis Unitary Plan Wind Tunnel**

input and outgo will be reached. The desired goal, of course, is a temperature balance low enough so the aircraft structure will not be destroyed.

Aerodynamic problems affecting flight at speeds below that of sound (below 660 mph at high altitude) the atmosphere can be considered to be composed of stable molecules of the various elements in air, but at the higher velocities where aerodynamic heating becomes a serious problem, the molecules in the air no longer behave in an orderly way according to the "ideal gas" laws. It is essential, therefore, to determine the thermodynamic properties of air at high temperatures. How high may be seen from the following:— At M-3, about 2,000 mph., the temperature would be about 660°F; at M-20, about 13,000 mph, the temperature would be above 20,000°F, far hotter than the surface temperature of the sun.

At relatively low temperatures, molecules move about in three-dimensional space; the higher the temperature, the faster their straightline movement. At temperatures above 500°F, the molecules begin to vibrate. At temperatures exceeding 5,000°F, a part of the heat energy within the molecules is changed into chemical energy; some of the molecules dissociate or split apart into free atoms, and new molecular combinations appear, notably nitric oxide.

When the temperature rise approaches 20,000°F, ionization or electronic excitation of the atoms and molecules occurs. In the thermodynamic studies already made, some 40 reactions have been noted as taking place. Although only a dozen or so of these reactions are believed to be of great significance, accounting for even these is an enormously complex problem and useful solutions will require the efforts of many talented workers, using both theoretical and experimental techniques.

In developing ways of studying heat problems at which airplanes and short-range missiles may be expected to reach soon—below a Mach number of 5—NACA scientists have found it desirable to employ two general techniques:— (1) Equipment incorporating radiant-heat sources, an approach especially useful in the study of basic structural heating problems, and (2) facilities in which both the actual aerodynamic heating and loading experienced by a structure at a specific velocity can be duplicated.

For several years, the NACA has been employing both methods intensively, but the need has become apparent for a much larger supersonic air jet that will enable extending the second technique to laboratory investigations on full-scale structural parts. Such a facility was nearing completion at the NACA's Langley Aeronautical Laboratory at the end of 1956. It will have a test section 8¾ feet by 6 feet, and its test range will be up to M-3. A heat accumulator holding 600,000 pounds of stainless steel sheet is required, and temperatures up to 660°F will be provided at the test section.

When it comes to study of the aerodynamic problems encountered at the much higher speeds of the ballistic missile, learning how to duplicate in the laboratory the enormously high temperatures that will be generated in flight is a task hardly less difficult than solving the heat problem. Only recently, techniques have been devised sufficiently promising to warrant construction of small, pilot models to prove their worth.

One approach is to build apparatus in which aerodynamic heating can be generated to match that experienced at the high-speed conditions. Such equipment includes shock tubes, special compressors, and light-gas guns. In the shock-tube, for example, a shock wave heated to many thousands of degrees Fahrenheit passes over a model, but the desired condition can be maintained for only a very small fraction of a second.

At somewhat lower speeds, combustion-products tunnels are proving useful. They are essentially ram-jet or rocket engines exhausting their hot jets through supersonic nozzles. Although the chemical composition of the exhaust gases differs from that of air, these jets are valuable because they can be used to duplicate the temperatures, velocities, and pressures of airstreams at speeds up to M-8 (5,000 mph) or higher.

Still another technique, proven only recently in a small, pilot model, provides both air flow and temperatures that match closely conditions experienced in actual flight. The vital part of the apparatus is a heat apparatus made of ceramic material—because it would be virtually impossible to build it from even the most heat-resistant of metals—in which temperatures above 4,000°F can be maintained. The pilot model has been

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so successful that a larger version, with greater capacity, is being constructed at the NACA's Langley Aeronautical Laboratory.

Still another technique calls for use of small, rocket-propelled models and also of full-size research airplanes. In 1956, the NACA announced it had fired one of the rocket-powered models to a speed of M-10.4, nearly 7,000 mph. Because aerodynamic heating becomes most serious in the denser air near the earth, use of an "over-the-top" trajectory is being made. Models fired in this manner are propelled by four rockets, fired in sequence. The first two are shot off while the model is still climbing, while firing of the two remaining rockets is delayed until after the model has begun to descend. Announcement was also made that a new research airplane was built as a part of the joint military services-industry-NACA program. The X-15 is being constructed by North American under Air Force sponsorship.

In 1956, the three large, supersonic wind tunnels constructed at NACA research centers under the Unitary Wind Tunnel Plan came into full use. These tunnels are especially valuable in providing the large-scale information essential for design of supersonic airplanes.

One of the major problems faced by designers of supersonic fighters, which can be studied in these tunnels, is the decrease in directional stability that occurs as speed increases. What happens is that conventional surfaces such as the vertical tail tend to lose their effectiveness as the Mach number increases. The positive directional stability of an airplane may be diminished until it becomes unacceptably low, and by moving the tunnel speed upward, the advent and seriousness of this phenomenon as it affects a particular design can be studied in detail.

With 1,000-mph tactical airplanes now going into military service, thoughts of man-carrying aircraft—perhaps rocket gliders—that travel at speeds five times the velocity of sound appear within the realm of relatively early attainment. As in other areas of research, those engaged in full-scale flight studies must look far ahead. They must recognize the fundamental problems requiring solution before the greater performance desired for the future can become available.

In considering what difficulties the pilot will face in flight into the high reaches of the atmosphere at speeds of 3,000 mph and faster, it becomes apparent that many of his problems will result from the fact that his airplane must be capable of maneuverable flight from sea-level take-off to altitudes where the density of the air has thinned sufficiently to make possible the desired speed without destructive aerodynamic heating.

Such airplanes will have very thin wings of low aspect ratio. Because the low-aspect ratio wings are incapable of producing the high lift needed during landing. It is likely that variable geometry of the lifting surfaces may be required. During cruise at high altitude, the inertia of the airplane will be high and the response to the controls will be sluggish. Any disturbance of the airplane will result in oscillations that will be very difficult to control.

For preliminary studies of the control problems of such very high-



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speed flight, the NACA has constructed a simulator that is capable of duplicating the vertical motion and pitching motion of almost any possible airplane. By a preprogramming technique, the pilot can be confronted with the control problems respecting these two motions that he would face in a flight from low speed at low altitude to high speed at high altitude and then return. Work now in progress with such simple research tools has given valuable information about what piloting problems will be most serious, and how they may be solved.

In addition to work on high-speed-flight problems, the NACA continued its research on problems of low-speed flight. Stability and control programs peculiar to the STOL and VTOL type of aircraft are but a part of the work in these areas.

The national security demands that the military services, the aircraft industry, and the NACA, working as partners, accomplish the rapid improvement of the performance capabilities of our airplanes and missiles. The magnitude of the national effort is very great for progress can be no faster than the acquisition of new knowledge about aerodynamics, structures, and propulsion.

### **Post Office Department**

There was a continued increase in the use of the domestic airmail service during the fiscal year which ended June 30, 1956. Use of the Air Parcel Post Service increased considerably faster than the letter service.

The Post Office Department paid the airline carriers \$32,459,000 for hauling domestic airmail during the fiscal year as compared to \$31,304,000 the previous year. This does not include any subsidy payments made by the Civil Aeronautics Board. During the year 1956 the United States Certificated air carriers carried 145,293,000 ton miles of airmail as compared to 131,536,000 ton miles the previous year.

Fifty-eight air routes were operated by air carriers over 236,560 route miles.

Use of the airlift service also increased during 1956. Twenty-four carriers served 205 cities in 31 States and the District of Columbia. Airlines carried 15,114,000 ton miles of 3 cent mail in 1956 as compared to 13,362,000 ton miles the previous year.

Volume of foreign airmail from the United States, to and from U. S. possessions and territories (except Alaska) and to and from U. S. Military Post Offices in foreign countries, increased 13.7 percent over the previous fiscal year's volume for 1955. Total weight for fiscal year 1956 was 30,480,020 pounds.

United States flag carriers carried 9,341,216 pounds of airmail, an increase of 14 percent over the previous year. Foreign flag airlines carried 1,273,416 pounds;—an increase of 12.6 percent over the previous year. Mail carried to Canada by all carriers increased 33.5 percent—total of 1,649,742 pounds.

Mail to and from U. S. Military post offices increased 28.1 percent

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during the past year over the previous year. Mail poundage for 1956 was 11,457,157 as compared to 8,940,557 pounds a year ago.

U. S. territory and possessions mail increased 9.5 percent from 6,171,107 pounds in 1955 to 6,758,489 pounds in 1956.

On May 14, 1956, three Cargo freight airlines were authorized by the Civil Aeronautics Board to carry airmail in addition to first class mail. These three carriers actually began carrying airmail on May 28, 1956.

### **Radio Technical Commission for Aeronautics**

The RTCA is a permanent Government-industry advisory body composed of more than 100 aeronautical telecommunications agencies. Illustrative of the problems referred to the RTCA for study are: high altitude grid plan for VOR/DME frequency pairing; minimum performance standards for airborne electronic equipment for the transition period "common system;" re-evaluation of VOR lateral separation procedures; helicopter air navigation, communication and traffic control; and continuing evaluation of frequency utilization in the VHF band.

A matter of particular interest to the flying public during fiscal 1956 was the announcement by the CAA that messages such as those requesting ground transportation and meals from pilots of aircraft in flight would no longer be accepted by CAA facilities. This action resulted in a strong public demand for air-to-ground telephone service beyond that presently available through Aeronautical Public Service radio stations licensed by the FCC. The problem received consideration by a special committee, established within the RTCA.

### **Weather Bureau**

The continuous broadcast of recorded aviation weather and NOTAMS on the Arcola, Virginia, L/MF radio range (reported in the 1954 YEAR BOOK) received the endorsement of aviation groups and continued in operation during 1956. A similar broadcast was activated on the L/MF range at Los Angeles. This is a joint CAA and Weather Bureau project and plans call for 36 additional installations by the end of 1957.

A series of 18 aviation weather articles for pilot consumption was issued on a monthly basis through 1955 and 1956. Each article is illustrated and gives a brief discussion of a particular weather topic. Through the cooperation of the CAA, a copy of each article printed in poster form is posted at about 2,500 public airports. The articles are also available in pamphlet form from the Superintendent of Documents, U. S. Government Printing Office. Twenty airports are now equipped with remote reading cloud height and visibility measuring instruments in the approach zone to the major instrument landing runway. Plans for the next two years provide for similar installations at an additional 95 airports.

The operation of 23 rawinsonde stations was transferred from the military services.

Additional radar storm detection equipment was placed in operation, increasing the total number of stations to 55.

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Four automatic weather stations were activated, bringing the total now in operation to eight. Plans have been made to install twelve additional stations within the next 18 months. Components of this equipment can measure and transmit runway visibility, temperature, dewpoint, wind, altimeter setting and precipitation. Field tests of equipment to report cloud height are now in progress.

The National Hurricane Research Project, started in 1955 under the sponsorship of the Weather Bureau, progressed according to plan but encountered some delays in the installation of the special weather-recording equipment on the three project aircraft. These three planes, two B-50's and a B-47, being provided by the Air Weather Service, reconnoitered hurricanes and other tropical weather phenomena from their flight bases in Florida. Much of the information on weather phenomena encountered on these missions is automatically recorded by digital recording systems and placed on punch cards in flight. This permits the immediate processing of the data by electronic computer when the planes return to base. Other phases of this program include a greatly expanded rawinsonde network in the West Indies which is rapidly nearing completion; development of a constant level balloon that will remain in the eye of a hurricane and permit the tracking of the storm by electronic means; photographic reconnaissance of hurricanes by rockets and high altitude balloons; and special observing and recording equipment, including water level recorders at coastal locations along the Gulf and Atlantic coasts. This project, which was just getting into full swing at the end of the 1956 hurricane season, will probably continue for several more years.

A research program was being conducted for the investigation of tornadoes and other severe local storms. The program includes detailed studies of tornado damage to obtain information of the structure and behavior of tornadoes, continued investigation of the structure and prediction of squall lines using data from a special severe local storm network in the Midwest and measurements with a tornado research airplane. The first flight of the specially instrumented Weather Bureau tornado, research airplane, an F-51, was made on April 26, 1956. Operating mainly in the Midwest, this contracted, privately piloted plane is equipped with a vortex thermometer, an infra-red hygrometer, a velocity-gust-height recorder, a recording altimeter, an electric field meter, several cameras, a voice recorder and necessary associated gear. The objectives of this program are to obtain observations of the various meteorological elements, particularly those of temperature and humidity gradients in the vertical and horizontal, in the vicinity of tornado activity or conditions. As of the end of August some 100 missions had been made, including test, calibration and reconnaissance flights. Data from these flights are being processed, analyzed and evaluated.

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## LEGISLATIVE AND GOVERNMENT EVENTS

Jan. 5

Senator A. S. Mike Monroney (D., Okla.) accuses Commerce Secretary Weeks and Transportation Under Secretary Rothschild of assuming "Presidential powers" in demanding the resignation of former CAA Administrator Fred B. Lee.

Jan. 10

Pentagon lifts ban which blocked release of information on new aircraft for a year after their entry into tactical units.

President Eisenhower forwards the Federal tion of new Civil Aeronautics Board member, G. Joseph Minetti, to the Senate.

Jan. 11

Pentagon announces wide changes in its policies for creating and maintaining a reservoir of machine tools and production equipment for emergency use.

Jan. 17

President Eisenhower in his annual budget message requests a total of \$7,537,900,000 for aircraft and related equipment by the Navy and Air Force.

Supreme Court refuses to review a lower court decision in National Airlines fight to overturn a CAB order limiting issues in the Eastern-Colonial merger case.

President asks Congress for a record \$202,-618,000 appropriation for the Civil Aeronautics Administration.

Jan. 19

President Eisenhower accepts recommendation made to the Bureau of Budget by the Harding Committee for a long-range study of aviation facilities.

Jan. 23

CAA announces appointment of William B. Davis as director of the Office of Aviation Safety.

Jan. 27

President Eisenhower refuses to make a decision on National Airlines petition to him charging legal error by the CAB in the Eastern-Colonial merger case.

Jan. 30

Senator Warren G. Magnuson (D., Wash.) reveals he will introduce legislation providing for permanent certification for the intra-Alaska, U.S.-Alaska and Hawaiian airlines.

Representative Daniel J. Flood (D., Pa.) discloses that the Pentagon promises reforms in MATS which may save up to \$49.5-million annually.

Jan. 31

President Eisenhower makes the Federal Communications Commission a full voting member of the Air Coordinating Committee.

Feb. 2

Defense Secretary Charles Wilson announces he will appoint a special assistant to concentrate on guided missiles.

Feb. 9

Assistant Air Force Secretary Trevor Gardner submits resignation in protest over the Administration's research policies.

Feb. 10

CAA discloses that a total of 319 new Federal-aid-to-airports projects totaling \$38,932,-065 are included in the fiscal 1956 portion of the Monroney Act.

Feb. 14

Edward P. Curtis accepts President Eisen-

hower's invitation to be his special assistant for aviation facilities.

The Senate passes by voice vote death penalty for persons convicted of aircraft sabotage.

Feb. 15

The House Armed Services Committee approves NACA atmosphere entry simulator to cost \$169,000.

Feb. 17

Former Assistant Air Force Secretary Trevor Gardner charges that the appropriation requested for the Air Force for fiscal 1957 is \$3.5-billion short of the amount needed.

Feb. 24

Representative Wright Patman (D., Tex.) tells the House his Small Business Committee has started investigations of the aircraft manufacturing industry and the Civil Aeronautics Board.

Feb. 27

President Eisenhower in a letter urges Defense Secretary Charles E. Wilson to name a guided missile czar quickly to accelerate ballistic missile program.

Feb. 29

McDonnell Aircraft Corp. offers Hebert Subcommittee the alternatives of permitting industry to make "reasonable earnings," or face socialization with Government-furnished facilities.

Mar. 1

Douglas Aircraft Corp. tells the Hebert Subcommittee it probably has the largest capital investment in company-owned property in the airframe industry.

Mar. 2

Senate approves the nomination of CAB Chairman Ross Rixley as Federal Judge for the western district of Oklahoma.

Mar. 16

Commerce Secretary Sinclair Weeks calls for a two-year extension of the Defense Production Act, and asks Congress to strike out a section requiring persons who serve the government without compensation to report on their financial interests.

Mar. 21

Assistant Air Force Secretary Dudley C. Sharp tells Hebert Subcommittee that aircraft industry profits are "reasonable and adequate now," and "no new techniques are needed" to boost the industry's profits for future growth and stability.

Mar. 23

President Eisenhower nominates James R. Durfee to replace Ross Rixley on the Civil Aeronautics Board.

Admiral Arleigh Burke, Chief of Naval Operations, tells the Senate Armed Services Committee the Navy is working on a supersonic seaplane, an advanced version of the Martin P6M Seamaster.

Mar. 26

House Appropriations Committee releases 400-page report, describing major military procurement as rife with "waste," "delay," "duplication," and "chaos."

Mar. 27

Senator Warren Magnuson (D., Wash.) indicates his Interstate and Foreign Commerce Committee would act promptly on legislation authorizing permanent certification of intra-Alaskan and intra-Hawaiian airlines.

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President Eisenhower names Thomas Coggeshall chairman of the Renegotiation Board.

Defense Secretary Charles E. Wilson announces the appointment of Eger V. Murphee, president of Esso Research and Engineering Co., as his missile czar to coordinate the nation's guided missile program.

Mar. 28

Representative Carl Hinshaw (R., Calif.) introduces legislation authorizing Federal participation in the design and development of prototype aircraft for local service airline needs.

Mar. 29

J. Gordon Bennett takes oath as executive assistant to Edward P. Curtis, Special Presidential Assistant for Aviation Facilities.

Mar. 30

Air Force Secretary Quarles and Chief of Staff General Nathan F. Twining warn Congress that the fiscal 1958 budget will have to be raised over 1957's.

Ramsay D. Potts, Jr., president and general counsel of the Independent Military Air Transport Association, announces his resignation to become associate counsel of the special Senate Armed Services Subcommittee to investigate U. S. airpower.

The Senate passes legislation repealing transportation taxes on travel between the U.S. and much of North and Central America.

Apr. 30

Possibility that guided missiles, which account for 20.3 percent of the Air Force's fiscal 1957 request for aircraft and related procurement, will climb to 35 percent by fiscal 1959 is voiced before a House subcommittee.

May 7

CAA policy prohibiting the use of Federal aid to airport buildings having segregated facilities is revealed.

May 8

President Eisenhower reports that the U.S. has shipped more than \$12.4-billion in military equipment to free world countries during the past six years.

House passes legislation authorizing severe new penalties for aircraft sabotage.

May 11

House rejects efforts to boost Air Force appropriations for more B-52's by \$1-billion.

May 16

Senate Commerce Committee concludes hearings on the nomination of CAA Administrator Charles J. Lowen.

May 17

CAB endorses a low-cost transatlantic air service proposed by Pan American World Airways.

May 23

Representative F. Edward Hebert (D., La.) states the aircraft industry is doing "a hell of a good job."

National Advisory Committee for Aeronautics unveils a new \$32,856,000 unitary plan wind tunnel at Lewis Flight Propulsion Laboratories, Cleveland.

May 24

Senate Commerce Committee approves the nominations of G. Joseph Minetti as CAB Member and Charles J. Lowen as CAA Administrator.

Special Presidential Aide Edward P. Curtis retains J. L. Anast as his full-time systems planning advisor.

May 29

President Eisenhower accepts the resignation

of James Smith, Assistant Secretary of the Navy for Air, and nominates Garrison Norton, former Assistant Secretary of State, to replace him.

June 4

CAB Chairman James R. Durfee discloses that the Board's Office of Compliance is investigating charges of "overbooking" by airlines and faulty flight information to the public.

The Senate passes a bill appropriating \$1.4-billion to run the Commerce Department and its related agencies, including CAA and CAB.

June 5

A joint Senate-House Committee recommends a two-year extension of the Renegotiation Act—with liberalized provisions.

June 7

Acting Administrator Charles J. Lowen, Jr., is confirmed on June 6 by the Senate.

June 8

The Senate Armed Services Committee approves Garrison Norton as the Navy's Assistant Secretary for Air.

June 11

CAB grants Helicopter Air Service a seven-year certificate to fly passengers by helicopter in the general Chicago area.

June 11

G. Joseph Minetti is sworn in as a CAB member in ceremony at the White House.

June 12

CAB orders an investigation of the proposal Hughes Tool Co. to build and sell jet transports to Trans World Airlines and other carriers.

The Commerce Department announces the second installment of the four-year \$252-million airport program.

Air Coordinating Committee's policy guaranteeing the use of VOR at least through 1965 is upheld.

June 15

Congress approves a compromise \$1,416,732,000 appropriation to finance the Commerce Department for the fiscal year beginning July 1.

June 25

Garrison Norton is confirmed by the Senate as the new Assistant Navy Secretary for Air.

June 27

The Senate votes to increase fiscal 1957 Air Force budget by more than \$900-million over Administration requests.

The Senate Armed Services Committee rejects Air Force requests for funds to set up four Talos-equipped anti-aircraft bases and approves Army plans for expanding its Nike anti-aircraft missile system.

Clarence N. Sayen, president of the Air Line Pilots Association, advocates abolishing the Air Coordinating Committee and calls for creation of an independent CAA to solve aviation facilities problems.

July 2

The House and Senate approve a compromise Defense Appropriation Bill providing about \$900-million in Air Force funds over Administration requests.

President Eisenhower signs the fiscal 1957 Defense Appropriations Act, allocating \$34,656,727,000, about a half a billion more than the Administration asked for.

July 9

Senator Warren Magnuson (D., Wash.), chairman of the Senate Commerce Committee, predicts his group will recommend that radar be installed in all commercial passenger aircraft.

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The House Appropriations Committee urges Defense Secretary Wilson to end disputes between the Air Force and Army over the merits of the Talos and Nike air defense missiles.

July 11

CAA reports it expects to take delivery this month of an Air Force B-57 as part of its air traffic control study program for the jet age.

July 13

Commerce Under Secretary Louis S. Rothschild says he will resign if AAC, of which he is chairman, fails to arrive at a clear-cut decision on the short-range navigation controversy after receiving the NAV Panel reports.

July 16

Former Air Force Assistant Secretary Trevor Gardner tells a House Subcommittee that overclassification of scientific and technical information by the Defense Department and the AEC is seriously holding back U.S. progress in weapons development.

July 17

The House passes and sends to the Senate a two-year extension of the Renegotiation Act.

General Nathan Twining in testimony to the Senate Armed Services Committee says the twin-jet Blowlamp supersonic light bomber is the most important aircraft he observed on his recent visit to Russia.

J. H. Carmichael, president of Capital Airlines, is named chairman of the Commerce Department's newly-appointed Transportation and Communications Committee for 1956-57.

July 18

President Eisenhower signs legislation increasing penalties for aircraft sabotage. New law will permit death sentence in cases where loss of life resulted from damage to an airplane.

Commerce Department census of the Aircraft Propeller Industry shows 16 companies in 1954 grossed \$108.4-million.

July 20

The Senate passes by voice vote legislation extending the Renegotiation Act of 1951 for two more years.

July 23

President Eisenhower signs a bill (S. 3163), authorizing permanent certification of air carriers operating within Alaska and Hawaii and legislation (S. 3412) extending the provisions of the Civil Aeronautics Act relating to war risk insurance.

House Armed Services Investigations Subcommittee, headed by F. Edward Hebert (D., La.), asserts that "the Government is getting substantial value" from "its investment in military airframes."

July 25

The Senate approves and sends to the President legislation (S. 3149) authorizing all airlines to offer free or reduced rate air transportation to clergymen on a space-available basis.

July 26

The Senate Appropriation Committee recommends granting of the full Administration request for \$68,043,000 for CAA expansion of the Federal Airways System.

The House passes a bill to prohibit alcoholic drinks aboard airliners.

July 30

The House kills the Airline Capital Gains Bill (H.R. 8902) after angry debate, led by one

of the bill's chief opponents, Representative John Heslton (R., Mass.).

Aug. 1

Admiral Arthur Radford, Chairman of the Joint Chiefs of Staff, in testimony before Senator Stuart Symington's Airpower Subcommittee, urges the Air Force to perfect a new and better bomber.

Aug. 2

The President signs bills (H.R. 119471), extending the Renegotiation Act for two more years; (S. 3149), authorizing airlines to provide free or reduced rate air transportation to ministers on a space-available basis, and (H.R. 5738), authorizing the Army, Navy and Air Force to contract for flight instruction up to 35 hours per cadet at institutions with ROTC units.

Aug. 3

Special Presidential Aide Edward P. Curtis appoints an eight-man systems engineering team to develop a master plan for the future air traffic control system.

Aug. 7

Representative Carl Hinshaw (R., Calif.), aviation policy leader in the House of Representatives, dies.

Aug. 8

House-Senate conferees reduce the Administration's request for a supplemental appropriation of \$68,043,000 to \$45-million for new air navigation facilities and CAA operating expenses in connection with expansion of the Federal Airways system.

Aug. 10

New CAB procedure, designed to eliminate "leaks," will announce decisions through press releases, followed up by official board orders.

Aug. 15

Defense Secretary Charles Wilson sets up a special Pentagon committee to study the problem of protecting military information.

Aug. 29

A special House Armed Services Subcommittee announces changes in Defense Department rules, making it mandatory to notify any contractor placed under investigation on suspicion of fraud.

The National Business Aircraft Association officially notifies the Air Coordinating Committee that it "cannot accept" recommendations of the NAV Panel, calling for a TACAN/compatible DME system.

Aug. 30

CAA safety director W. B. Davis goes on record opposing CAB's proposed economic regulation requiring 75 percent on-time scheduling by airlines.

Aug. 31

The ACC reaches a unanimous decision on the new common short range navigation system which calls for eliminating the civil DME, retaining VOR, and implementing TACAN/DME into an azimuth-distance system to be called VORTAC.

Sept. 5

CAA announces a reorganization encompassing three principal changes: establishment of six program offices; streamlining of the Administrator's office; and establishment of "readily identifiable" counterparts of the program offices in the regions.

CAA Administrator Charles J. Lowen, 41, dies of cancer.

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Sept. 6

Aircraft Owners & Pilots Association gives qualified endorsement to the ACC VORTAC plan.

Sept. 11

The Atomic Energy Commission discloses that two of its laboratories are studying the possibilities of nuclear propulsion for rocket engines.

Sept. 20

The first of two B-57's being loaned to CAA by the Air Force is accepted by acting administrator James Pyle.

Oct. 1

ODM Director Arthur S. Flemming establishes a special committee to handle the problems of titanium production and utilization.

A new two-stage high-altitude research rocket called the "Terrapin" soars to a height of 80 miles from the NACA proving ground at Wallops Island, Va.

NACA awards its Distinguished Service Medal to Richard T. Whitecomb, developer of the area rule concept for supersonic aircraft.

Oct. 3

The State Department announces it will hold a top-level international aviation meeting in Washington in November.

Oct. 8

Representative John E. Moss (D., Calif.), chairman of the House Government Operations Subcommittee, asks Defense Secretary Wilson for a report on the functions of a committee Wilson set up to plug "leaks" of military information.

Oct. 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.

Oct. 15

Defense Secretary Charles Wilson asserts that military spending next year will rise probably "something like" four percent to six percent.

Commerce Department announces three more contract awards totaling \$750,000 for CAA's fiscal 1957 airway program.

Oct. 18

James H. Doolittle is named chairman of NACA, succeeding Dr. Jerome C. Hunsaker.

Defense Department cancels its quota system for controlling consumption of critical materials in jet engine manufacture.

Oct. 19

CAB estimates the U.S. airline industry's subsidy bill for the current fiscal year will be the highest of the four-year period 1955 through 1958.

NACA awards Distinguished Service Medals to John W. Moise and Charles W. Littleton for "outstanding bravery beyond the call of duty" following a high-altitude explosion in the

rocket-propelled X-1A research plane in August, 1955.

Oct. 25

Senator Harry Byrd (D., Va.) urges the Government to hold up action on all industry bids to become eligible for fast writeoffs until a Congressional study of the program is completed.

Commerce Under Secretary Louis Rothschild reports that CAA obligated \$15-million in the first quarter of fiscal 1957 for new airway equipment.

Oct. 26

CAA control towers report a total of 20,384,000 aircraft operations in the year ended June 30.

Nov. 5

Sen. George A. Smathers (D., Fla.) urges ratification of the Hague Protocol to the Warsaw Convention by the U. S. and other leading air transport nations.

Nov. 8

Sen. A. S. Mike Monroney (D., Okla.) renews call for a "declaration of independence" for CAA, breaking it away from "domination" by the Commerce Department.

Nov. 9

Harold A. Jones resigns as U.S. representative on the Council of the International Civil Aviation Organization.

Nov. 15

Defense Secretary Charles Wilson designates three-man committee to review and implement the Coolidge recommendations for protecting classified information.

Nov. 19

Branding the proposal as "shocking," Rep. John E. Moss (D., Calif.) urges Defense Secretary Wilson to reject a recommendation of the Coolidge committee that newsmen refusing to disclose sources of "leaks" be taken before grand juries.

CAA announces it will conduct a major evaluation of three experimental runway lighting systems, in anticipation of developing new U.S. civil/military standards for an improved system.

Nov. 27

Defense Secretary Charles Wilson issues document giving Air Force sole responsibility for all land-based Intermediate Range Ballistic Missiles, and Navy the responsibility for ship-launched IRBM, dashing Army's hopes for major role in military aviation and long-range missiles.

Dec. 4

Bureau of Labor reports that aircraft employment in September reached new peacetime peak of 825,000.

Dec. 13

Atomic Energy Commission confirms reports that it more than doubled expenditures for the atomic-powered aircraft project in fiscal 1956.

## CHAPTER FOUR

### Manpower

**L**ONG BEFORE Chief of Staff of the Air Force General Nathan F. Twining returned from Russia to report that training of technical personnel in the Soviet was gaining alarmingly over parallel U. S. efforts, plans and programs were in operation in this country to offset the Russian gains, streamline recruitment and training, and coordinate activities between the services and industry.

Leading in this work was the aircraft industry, leaders of which in May met with Carter L. Burgess, Assistant Secretary of Defense for Manpower and Reserves, to go over mutual problems. Result was a comprehensive survey and report by the Aircraft Industries Association's Industrial Relations Advisory Committee. This report revealed for the first time the widespread training and educational work done by the aircraft industry and projected efforts to be made in the future toward winning the technological cold war.

It showed that aviation is, and has for some time been offering assistants to the nation's school structure at all levels, has perhaps the most advanced training program in industry, and is tailoring its recruiting practices to accommodate recruiting and personnel problems of the military.

The survey showed that during the academic year 1955-56, representative companies in the aircraft industry spent more than \$280,000 in scholarships for more than four hundred students at the undergraduate level, including 218 for engineers, 10 in physics and chemistry, 61 in business



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administration, and 115 open. Plans call for virtually doubling this program during the 1956-57 school year. Additional funds are being budgeted for graduate scholarships, also. Last year, the average grant to graduate students was more than \$2,300 annually, some 891 scholarships were awarded, and total expenditures reached \$1.6-million.

During the year, aviation concerns also participated widely in sponsoring interest in scientific subjects, giving field trips to plants, providing teaching aids in technical courses, and giving summer employment to high school seniors. Community work toward fostering interest in the technological needs of the nation was expanded.

A summer employment program also expanded throughout the industry for teachers, backed by a concerted effort to place the instructors in occupations specifically related to their field of teaching. Conversely, hundreds of company employes served as instructors in schools after their normal working hours, others getting leave to take classes during company time.

Within plants, paid-time training, tuition refund plans, and company-sponsored after-hour training programs expanded. In five companies surveyed, some 1,500 courses were given, taken by more than 200,000 employees representing more than 6.3-million manhours of training, or an average of approximately 32 hours of technical per employe-student. Cost of the courses is estimated by AIA at \$13-million.

Commenting on the report and the programs, Assistant Secretary Burgess stated:

"I was truly impressed with the wide range of measures being taken by various firms in the industry to motivate, encourage, and in many cases finance young people of talent to pursue higher education in engineering and the sciences; by the ways in which assistance is being furnished to teachers and educational institutions; and by the extensive in-plant training programs. The report puts together for the first time a listing of the various constructive measures in very specific and concrete terms, and it indicates the degree to which they are being used throughout the industry."

Meantime, figures indicated during the year that the shortages of technical talent at all levels would continue and become aggravated with the increase in demands. Burgeoning of the industry to national leadership, with upwards of 800,000 workers on the payrolls, plus increased demands for a higher number of trained personnel, especially at the engineering level, gave promise of further difficulties during the coming year.

Accelerated recruitment and training at all levels seemed the only answer to the problem, and there was every indication at year-end that the aircraft industry would go into the new year with greatly expanded programs.

## RESEARCH AND DEVELOPMENT

### CHAPTER FIVE

#### Research and Development

**F**ISCAL YEAR 1957 (July 1, 1956—June 30, 1957) saw Congress appropriating \$1.6-billion to the military services for research and development activities. This money, which will be painting the picture of weapons that will be under test in the early 1960's and that will be in combat inventories within the decade, is largely devoted to top priority projects, which are in part being financed by the aircraft industry—work on intercontinental and intermediate range ballistic missiles and nuclear powered aircraft, studies of advanced propulsion systems and new types of aircraft, solutions to the thermal and consequent metallurgical problems induced by supersonic and expected hypersonic speeds of aircraft and missiles, and development of advanced electronic and analog computing systems.

#### Military R&D Expenditures (In Millions of Dollars)

	1954	1955	1956	1957
	Actual	Actual	Estimated	Estimated
Air Force .....	\$ 513	\$ 524	\$ 632	\$ 650
Army .....	396	400	410	420
Navy .....	476	467	449	485
Total	\$1,385	\$1,391	\$1,491	\$1,555

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During the height of the World War II period, 1940-4, annual military expenditures averaged about \$245-million. At this time, research and development suffered in favor of an all-out production of the weapons needed for victory. It was fortunate that the United States required only several radically new weapon systems for this event. Despite almost complete military demobilization of the United States at the end of World War II, the grave need for accelerated research and development was recognized: the average expenditure level for the next five years, through 1949, more than doubled over the preceding period, reaching about \$549-million annually. Another technical spurt came with the Korean War, which carried in its wake a tremendous increase in appropriations by Congress for research and development along the entire technical perimeter. In this area, defense expenditures in fiscal 1956 were more than double the \$650-million in 1950.

The government is planning to allocate 49 percent of its fiscal 1957 research and development funds to industrial contractors. That such funds are vital to keep this country's technological advantages is patent: performance requirements for modern military fighter aircraft demand designing more than 3½ times as many parts as did World War II fighters. Preliminary design studies of the less complex World War II bomber took only about a year; preliminary design studies of one of today's heavy bombers (for example) took over five years. It is held that the vastly superior performance demanded for modern aircraft will continue to call for design studies whose cost and lead time will be correspondingly high.

### **Army**

The research and development work for the Army is accomplished through its seven Technical Services: Chemical, Engineers, Ordnance, Quartermaster, Signal, Transportation and Medical. These services have assigned spheres of interest, compatible with their roles in support of the combat forces. They are responsible for research and development projects falling within their assigned spheres of interest. Through their agencies they solicit and receive proposals from individuals or organizations who wish to participate in research and development. The agencies' activities cover all phases of research and development, from the initial steps of basic or applied research through to the production of a prototype model suitable for user test by the component of the Army concerned. They negotiate and award contracts for such work whether it is performed in a military or civilian agency.

About 30 percent, or \$108-million, of Army expenditures for research and development is devoted to missiles, either the surface-to-surface type or the surface-to-air type. In the field of surface-to-surface missiles, Army developments are emphasizing the ballistic rather than the more vulnerable cruise-type air-supported missiles. Efforts are aimed towards weapons required by the Army commander in the field. In the category of surface-to-air, the Army is concerned with its basic responsibilities for air defense, which include not only the field army and vital installations overseas but

## RESEARCH AND DEVELOPMENT

also the provision for Army antiaircraft units for defense of the United States.

Research and development for novel types of aircraft increased during 1956 as a result of the Army's demands for mobility and agility within the battle area, which has made aircraft an integral part of Army equipment. Aircraft that can move troops and critical combat supplies within the battle area, that can provide the battlefield surveillance essential to the effective use of the new long-range weapons are said to be vital. Primary emphasis was directed towards the helicopter, which proved itself as an Army battlefield item in Korea, and the short or vertical takeoff and landing aircraft that can move key personnel or supplies about the battlefield. The scope of the Army's current research and development work may be seen in terms of the following projects:

Early in Spring, 1956, the Army announced development of the *Missile Master*, the country's first electronic system designed specifically for controlling and coordinating the use of *Nike* antiaircraft missile batteries. Martin Company of Baltimore was named principal contractor, aided by the Airborne Instruments Laboratory, Mineola, New York, and the American Machine & Foundry Company, New York. The systems will be located at key antiaircraft installations in the United States. Each system operates independently, and can also operate in conjunction with units of the Air Force's semi-automatic ground-environment area defense system, known as *Sage*. The *Missile Master* collects information about the location of aircraft and their identity, presents this information on electronic displays, and distributes these data to the missile firing batteries. In this way, each *Nike* battery receives a continuous flow of fresh data about all aircraft within the defense area, as well as about the activities of the other batteries; and each *Nike* battery commander is provided with all the information needed to enable him to make a proper selection of a target.

A television system using an aerial drone as its vehicle and designed to aid combat commanders obtain immediate ground evaluation was demonstrated by the Army at Bolling Air Force Base on May 19 and 20, 1956. The pilotless system consists of an L-17 modified for drone operation, an autopilot which provides effective remote control by on-off type radio signals, and a ground control station that can be carried in a jeep. Signals transmitted from the ground station to the airplane's 42-pound autopilot regulate stability, altitude and air speed. Complying with remote commands, the aircraft can maneuver, climb or glide. Special control provisions prevent stalls, over speeding, excessive loss of altitude, and other hazardous conditions. Upon completion of the drone's mission, the ground controller flicks an "approach" switch, which automatically positions landing gear, flaps, propeller pitch, and power in proper sequence for landing run.

The Army is awarding almost \$2-million to Melpar, Inc., Falls Church, Virginia, to develop a helicopter flight simulator. Scheduled for 1958 completion, the new flight simulator will incorporate the cockpit of Sikorsky's H-37A. The device is to be used to train Army helicopter pilots in all phases of operation including engine starting, take-off, hovering, transi-

tion to forward flight, blade stall, autorotation and flare-out for landing. Other simulations are cockpit motion and effects of rough air. Development of the simulator is expected to reduce substantially the cost of training cargo helicopter pilots and provide a device that will aid materially in advancing helicopter instrument flying.

The Office of Naval Research is administrating a \$700,000 Army contract awarded to the Ryan Aeronautical Company, San Diego, for the design and development of a flying test-bed, deflected slipstream, turbine-powered aircraft. (Flying test beds are flying "mock ups" intended to simulate the essential design and performance characteristics of new design concepts.) The new craft is called the *Vertiplane*, and has mounted large propellers and double retractable flaps located in a manner that the propeller slipstream is deflected 90 degrees downward during take-off, hovering and landing. For transition into horizontal flight, the flaps are retracted as the craft picks up forward speed. Using the flying test-bed approach in designing VTOL and STOL aircraft permits the characteristics of an aircraft to be explored with relatively inexpensive models in a matter of months rather than years.

A rapid-firing 20-mm weapon, one of the first specifically designed for present supersonic jet aircraft, was unveiled on August 28, 1956 at Aberdeen Proving Ground, Maryland, by the Army and Air Force. Named after *Vulcan*, ancient Roman God of Fire, the new weapon was developed by General Electric's Aeronautics and Ordnance Department under the sponsorship of Army Ordnance. Development of the new cannon was prompted by the tremendous increase in speed of modern jet aircraft. Two design features from the original *Gatling* gun, patented in 1862, were "borrowed." Each gun has a rotating multi-barreled cluster, and each is externally driven. External power for the *Gatling* gun comes from human energy as the operator turns the crank. The *Vulcan* gun is externally powered, either electrically or hydraulically. According to its designers, the *Vulcan* gun is simple to operate and maintain, and can be field stripped and re-assembled in less than 30 minutes.

### Air Force

The Air Research and Development Command (ARDC) went full steam ahead on its Weapon Systems concept established in the fall of 1955. First order of business pursued during 1956 was to let industry in on some of ARDC's trade secrets and thinking. The Command increased the flow of technical data to qualified contractors, sketched the Systems concept so contractors would know what technical avenues are likely to be followed, encouraged contractors to invest their own money in research and development, and were open to advice in terms of hardware as a result of contractors' studies.

In its less than six years of being, the Command has pulled together the scattered research and development facilities of the Air Force into a sturdy cohesive body under Lt. Gen. T. S. Power. Located today in downtown Baltimore, ARDC will soon be moving to Washington, D. C.



**Air Force's new missile-research wind tunnel**

The Command oversees for the government and its contractors 11 centers and \$2½-billion worth of research and development facilities. Current Air Force research and development projects include the following:

A giant computing machine that could save up to two years in the development of advanced-design jet engines has been built for the ARDC by the General Electric Company, Schenectady, New York. One of the largest ever built, this unique analog computer will enable engineers to "fly" jet engines before they are constructed and to forecast, in actual control tests, the performance characteristics of jet engines that are still on the drawing boards. The computer will become the "brain" for a jet-engine simulator that will reduce wind-tunnel testing time and cut down the expense of flight testing.

A new magnetic material that promises to yield powerful permanent magnets is under study by the Westinghouse Electric Corporation for the ARDC. The material was discovered through an improved method for preparing almost pure manganese-bismuth in powder form. Perhaps the greatest advantage from the new manganese-bismuth magnets is their un-

usual resistance to demagnetization. The magnets are said to be at least ten times better in this respect than most commercial magnets. This resistance suggests many advantages: such magnets would not be affected adversely by external magnetic fields; this would make the magnets especially promising for use in electric meters, where "stray" magnetism from large electrical equipment is likely to be met. The high coercive force of pure manganese-bismuth could also result in a new assortment of permanent magnets having novel shapes and uses.

With plans completed and construction scheduled for spring, 1957, the ARDC will be supervising a special multi-million dollar facility for testing electronic components that will comprise the super high-power radar systems of the future. The facility will be located at the Rome Air Development Center and will be used by Air Force engineers and industrial contractors engaged in developing radar components such as transmitters, tubes, deplexers, and wave guides. The need for super high-powered detection systems is critical in the ground environment of a defense against intercontinental ballistic missiles. The special facility, serving as a proving ground for radar components, may help achieve the desired powers under controlled laboratory conditions. The facility will look like the combination of a large commercial power plant and a TV station, with its complex of transmitters and other electronic equipment. Building specifications call for about 40,000 square feet of floor space.

A breakthrough made in releasing some of the sun's energy may lead to more effective communications on earth. An *Aerobee* rocket equipped to exhaust nitric oxide gas under high pressure was sent to an altitude of 60 miles above the desert sands of Holloman Air Development Center, New Mexico, on March 14, 1956, and effected a phenomenon that has been the subject of speculation by geophysicists for the past ten years—releasing the energy chemically stored by the sun in the upper atmosphere. When the nitric oxide gas was automatically released, observers saw what first appeared to be the formation of a new star, nearly twice the brightness of the planet Venus. The light was reported seen by observers more than 60 miles away from the ARDC launching site. In less than ten minutes the "star" had grown to a size that appeared to a ground observer to be about four times the moon's diameter. By increasing the natural amount of nitric oxide in the atmosphere by a factor of several billion, the rocket-released gas was able to unlock chemically-stored sunlight in vast quantities. This action produced the spot of light in the upper atmosphere which spread to a width of about three miles before the gas thinned out and reduced the light's brightness. During the experiment, scientists "bounced" radio signals from the charged cloud in the same way that light is reflected from a mirror. They feel that man-made ionspheric clouds produced in a series may pave the way for increasingly effective long-range communications.

The Fairchild Camera and Instrument Corporation, Syosett, New York, developed a motion-picture gun camera which automatically adjusts itself to varying light conditions much like the human eye. Known as the KB-5 camera, it will be used to record the effects of gunfire and the maneuvers

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"You might consider the wonderfully refreshing outlook expressed by the White Queen in Alice in Wonderland. I quote:

"I can't believe *that!*" said Alice.

"Can't you?" the White Queen said in a pitying tone. "Try again; draw a long breath and shut your eyes."

"Alice laughed. "There's no use trying," she said, "one can't believe impossible things."

"I dare say you haven't had much practice," said the Queen. "When I was your age, I always did it for half an hour a day. Why, sometimes I've believed as many as six impossible things before breakfast." "

—JAMES M. GAVIN,

Lieutenant General and Chief of Research and Development, Department of the Army



of enemy airplanes in aerial combat. Present test results indicate that the new camera with its automatic light control will yield a high percentage of properly exposed aerial film.

The world's fastest ground vehicle, developed by the Convair Division of General Dynamics Corporation for the Materials Laboratory of the Wright Air Development Center, was recently put into operation to test rain erosion on exposed aircraft and missile parts. Using a pusher and sled, the test vehicle embodies 12 rockets, each developing 11,000 pounds of thrust. Five rockets are on the pusher, which gives the vehicle a speed of 620 miles per hour in the first 950 feet; seven other rockets on the sled then boost the speed to Mach 2 within 3800 feet.

A new altimeter, announced by the Wright Air Development Center, is claimed to permit the Air Force to safely reduce from 2000 to 1000 feet the vertical distance between aircraft in flight. Eventually, it is hoped that the development will enable military and domestic airplanes to be compressed into less vertical air space, thereby helping alleviate the problem of increasingly crowded skies. Called the MA-1 altimeter, and currently being installed in many Air Force aircraft, the instrument was developed by WADC in conjunction with the Kollsman Instrument Corporation, Elmhurst, New York.

A test range to provide the Air Force with a central location to study the effects of radomes on aircraft radar performance was completed by late summer, 1956, at Wright Air Development Center. Said to be the most complete such facility in the U.S., the installation will help the WADC Electronics Components Laboratory solve problems in transmission-reflection, beam pattern distortion, and bore sight error. The latter two problems could not be satisfactorily studied at WADC before construction of this new \$500,000 facility. The test range consists of three different and independent units. Each unit mounts a radome, which tilts and rotates around a radar test antenna. This permits the microwaves to pass through all portions of the radome. In this way, the new facility enables the Air Force to study all types of airborne radome designs.



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Additional facilities for use in the Air Force's Aircraft Nuclear Propulsion Program were made available in late summer through a contract between the USAF and the Atomic Energy Commission. The contract made the nuclear shielding facility at the AEC's Brookhaven National Laboratory in Long Island available for a long-term research program. Other nuclear developments included plans to build a nuclear reactor facility at the Wright Air Development Center. This 10-megawatt facility, to be known as the Air Force Nuclear Engineering Test Facility, will be used to test aircraft materials, components, and systems under development for the Air Force's nuclear-powered aircraft.

*Tunnel Hotshot*, styled by the Arnold Engineering and Development Center, Tullahoma, Tennessee, for the ARDC, took its place during the year as one of the newest instruments for simulating hypersonic flight of ballistic missiles. Especially useful for helping solve the re-entry problems of missiles as they glide in from the higher altitudes into the denser atmosphere, *Tunnel Hotshot* can develop speeds up to 11,000 miles per hour and temperatures up to 15,000° F. Because it is a blowdown-type tunnel, a single run can last up to one-hundredth of a second. This is unlike the shock-tube tunnels where testing time for hypersonic runs lasts only a few millionths of a second. Researchers say that they expect to achieve still greater than the announced speeds and temperatures with this new tunnel.

To aid manufacturers of navigational equipment for aircraft, missiles, and possibly satellites, a world-circling Air Force scientific expedition took off in a Boeing KC-97 from Hanscom Field, Massachusetts, late in September to survey the shape of the earth's magnetic field. Joining in the undertaking with the ARDC was the Strategic Air Command (SAC), and the University of Chicago. Used in the survey was a 1500-pound cosmic ray meter which the KC-97 airlifted on a 90,000-mile world trip.

At a site at about the 9000-foot level in the Sacramento Mountains near the Holloman Air Development Center in New Mexico, the Air Force is planning to design and construct a large solar furnace. Design proposals were received from qualified contractors during the latter part of 1956. This solar furnace—which is a system of mirrors capable of concentrating the sun's energy on a single spot—may, under ideal conditions, attain radiation temperatures of 7000° F. to 8000° F. over a substantially larger area than any furnace known to exist in the world today. The furnace will be used by the ARDC for high-temperature research and for testing materials and weapon components; for duplicating, insofar as possible, the thermal effects of nuclear weapons on various materials; and for high-temperature research in chemical reactions.

A research rocket that reaches several times the speed of sound in just two seconds was developed by Curtiss-Wright's Aerophysics Development Corporation, Santa Monica, California, in conjunction with the ARDC. Called the Hypersonic Test Vehicle (HTV), it was designed as a free-flight research tool to gather data at hypersonic speeds. Twenty experimental models were fired and tested by late 1956 at Holloman Air Development Center, Alamogordo, New Mexico. The HTV is a two-stage solid-

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propellant rocket vehicle. The first stage is a booster which raises the second stage to supersonic velocity. When the first stage burns out, it falls away and the second stage ignites and reaches the maximum velocity. It is with this stage that the hypersonic data are gathered. These data include information on aerodynamic heating, aerodynamic shapes, and air pressures and densities.

At what point the research and development efforts of the United States can be relaxed has not been set, chiefly because there is no way to know when scientific breakthroughs will occur. All that is known is that such a breakthrough will not occur unless a vigorous research and development program is pursued. "Through such a program," reasons the Department of Defense and the aircraft industry, "the technological lead of the United States can be maintained; and this lead is the decisive factor in the future security of the nation."

### Navy

The "Weapon Systems Concept" lay in back of the August 15, 1956 reorganization of the Research and Development department of the Navy's Bureau of Aeronautics.

This concept, which treats weapons only as parts of overall systems, was evolved through the Bureau's past struggles with the enormous complexities of today's aircraft. Because of the stepped-up interdependence of component parts in a given system, the design is approached as an integrated whole, starting from the initial concept. According to the Department of Defense, "It is no longer possible to design component parts of an air weapon separately and then fit them into a completely satisfactory system."

The new system places greater emphasis on the research and development planning phases, strengthens project management for air weapon systems, and provides more efficiency and economy through centralization. Realignment of functions and talent resulting from the reorganization remains under the direction of the Assistant Chief of the Bureau for Research and Development.

The department structure now comprises line and staff divisions reporting directly to the Assistant Chief through special officers for groups of related divisions. The line engineering divisions, covering individual product areas, are: Guided Missiles, and Aircraft and Aircraft Nuclear Propulsion, under a Weapon Systems Officer; Power Plants, Avionics, and Airborne Equipment, under a Component Development Officer; and Ship Installations, under a Support Equipment Officer.

Rounding out the department are staff divisions for Research, Evaluation, and Airframe Design, all under a Research and Analysis Officer. Managerial functions such as planning and progress reporting, program planning and budgeting, and administrative services, are under their respective senior officers.

In developing an air weapon system, from planning to delivery, each

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division contributes the developmental engineering necessary for its assigned part of the system; and the whole is coordinated and phased together by the Weapons System Officer.

Significant changes under the new arrangement include realigning the functions of some of the previous research and development divisions, consolidating or eliminating others, and grouping homogeneous functions in order to eliminate parallel functions or responsibilities.

One major change was combining the Electronics and Armaments Divisions with the Navigation Branch of the Airborne Equipment Division, out of which emerged the new Avionics Division. Through centralization, this division has more effective control of responsibilities in developing radar fire-control systems, and infrared and electronic weapon release systems. It will operate on a budget of about \$50-million for fiscal 1957. Changes such as this are examples of the strong effort the Navy is making to conform with the "Weapon Systems Concept," whose outline can be seen in the following list of research and development projects that involved the Navy during 1956:

The Office of Naval Research (ONR) directed Douglas Aircraft Company in the development of a standard ejectable cockpit capsule. Able to be produced in either one- or two-place units, this new capsule is said to provide a recoverable escape device for the pilot and for the plane's electronic equipment as well as being interchangeable in other aircraft. Through standardizing the cockpit, the designers are able to use a large number of identical parts with a resulting lowering of the basic cost of manufacture and repair. Cockpit design-time for various types of new aircraft can also be reduced. For atomic-powered aircraft, a strong advantage for this capsule arises because cockpits may be removed and stored separately from the powerplant to avoid contamination. Jettisoning of the capsule is by manual or automatic means. Stabilizing fins extend when separation occurs, and a drag chute is used. Upon reaching the proper speed, the main parachute system is activated by the drag chute. It is believed by ONR that this cockpit capsule "will standardize the modern aircraft cockpit to meet basic requirement for efficient operation, escape and survival, and provide wide mission capabilities and economy."

The Navy was allowed \$15-million in its fiscal 1956 budget to establish a new facility for testing and evaluating aircraft-carrier launching and recovery systems at the Naval Air Station, Lakehurst, New Jersey. Construction began in February, 1956, and is to be completed in two years. The facility will be used by contractors to test catapult and arresting gear equipment; and by engineers in the Bureau of Aeronautics to evaluate these developments. Conditions will closely simulate those aboard an aircraft carrier, with the latest high-performance jet aircraft being used.

Development of a remotely controlled helicopter that can perform a wide range of military missions was announced on June 28, 1956 by the Navy, the Army, and Kaman Aircraft Corporation, Bloomfield, Connecticut. Uses for such helicopters are claimed to include battlefield surveillance, mine and wire laying, cargo carrying, and use as an offensive vehicle against

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land weapons such as tanks. The first remotely controlled flights were made in May, 1953, and the vehicle had its first demonstration before Navy personnel in September of that year. This first machine was flown from the ground-control station by a helicopter pilot. It is said that today this helicopter can be "flown" from a ground station by men with no flight training at all. Control can also be switched back and forth between airborne and ground-control stations. It is also possible to have the helicopter fly a memory course fed into the control station. By this method, one ground control station can operate simultaneously a number of remotely controlled helicopters. The Department of Defense says that "The significance of remotely controlled helicopters, in addition to eliminating personnel from hazardous operations, lies in simplicity and light weight. All the safety devices and a structural strength necessary in manned helicopters to provide the utmost in safety for crewmen can be eliminated in remotely controlled helicopters." The Department also points out that "compact remotely controlled rotary-wing units carrying the special equipment required for any particular mission can be more easily produced than can man-carrying helicopters."

A new-type early-warning research airplane completed a one-hour flight test on August 8, 1956 at Edwards Air Force Base, Muroc, California. Developed by Lockheed Aircraft, the airplane was designed as a flying laboratory for testing Navy early-warning devices. It comprises a Navy WV-2 type *Super Constellation* airplane and a 30-foot, disc-shaped, radar-containing structure, which spreads over the airplane like a parasol.

At the 1956 mid-summer point, two naval observers completed a high-altitude meteorological experiment while on a *Skyhook* plastic-balloon flight. The research involved short-range photography of vapor trails produced by jet aircraft. This is Phase One under Project *Stratolab*, aimed to conduct research from a manned high-altitude laboratory. The observers rose to an altitude of 40,000 feet in an open fibreglas gondola suspended by the balloon built and launched by General Mills, Inc., Minneapolis, Minn. For flights to higher altitudes, observers will use a pressurized aluminum gondola. The *Stratolab* system affords a unique opportunity to make physical measurements of the atmosphere, and to conduct astronomical observations not possible by ground observers. In addition, the system provides a laboratory for obtaining basic data in aeromedicine, upper atmosphere physics, and many other scientific areas.

The world's first seaplane tanker capable of simultaneously refueling four fighter aircraft, the Convair R3Y-2 *Tradewind*, successfully accomplished this operation in a September, 1956 flight off the coast of Southern California. Four Grumman F9F-8 *Cougar* jet fighters were refueled in less than five minutes from the R3Y's four wing tanks. The aircraft rendezvoused off La Jolla, California, and were refueled ten miles off the coast at 10,000 feet altitude. The four-engine turboprop *Tradewind* can carry enough fuel to service eight fighter planes. It was designed as a dual purpose tanker-transport, and is one of eleven such aircraft built by Convair for the Navy.

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The first controlled release of atomic energy in the nation's capital was achieved September 17, 1956 when scientists started the Naval Research Laboratory's new atomic reactor. Calibration and checkout of the reactor continued until the end of the year at which time the unit was officially placed into regular operation. In addition to being in the Washington area, this nuclear reactor is the first research reactor to be constructed, owned, and operated by an agency of the Department of Defense. The reactor, which is of the "pool" type, is being used as a new research facility for the laboratory's investigations in physics, chemistry, metallurgy, and other scientific fields, including problems in reactor technology. The reactor and its associated facilities for research are unclassified.

A tiny transmitter, developed by scientists at the Naval Research Laboratory for use in sending signals from the scientific earth satellite to radio tracking stations located on the ground, weighs only 13 ounces. Called *Minitrack*, the transmitter has a 10-milliwatt output and operates on a fixed frequency of 108 megacycles. Quartz-crystal controlled, the *Minitrack* oscillator is fully transistorized. It is powered by seven 1.2-volt Mallory mercury batteries. The transistors used in the little satellite broadcasting station were developed by the Western Electric Company and the Philco Corporation.

## CHAPTER SIX

### Guided Missiles

**A** SUMMARY FACT SHEET on guided missiles was issued at midyear by the Department of Defense. Although missiles additional to the ones announced were known to be in research and development stages, the Department's official release recognized only the following ones, grouped according to service.

The Army released information on four guided missiles, the first two of which are operational:

NIKE .....	Surface to Air
COPORAL .....	Surface to Surface
REDSTONE .....	Surface to Surface
JUPITER .....	Surface to Surface

The Navy released information on six guided missiles, the first four of which are operational:

PETREL .....	Air to Surface
SPARROW .....	Air to Air
REGULUS .....	Surface to Surface
TERRIER .....	Surface to Air
TALOS .....	Surface to Air
TARTAR .....	Surface to Air

The Air Force released information on nine guided missiles, the first two of which are operational:

MATADOR .....	Surface to Surface
FALCON .....	Air to Air
SNARK .....	Surface to Surface
NAVAHO .....	Surface to Surface
RASCAL .....	Air to Surface
BOMARC .....	Surface to Air
ATLAS ICBM .....	Surface to Surface
TITAN ICBM .....	Surface to Surface
THOR ICBM .....	Surface to Surface

## Army

When the war against Hitler Germany was drawing to a close, the United States Army raced the Soviet Union for possession of Germany's rocket and missile laboratories. Although the Soviet is said to have come out ahead in this trial, the American troops rounded up 120 German scientists and 100 V-2 rockets for evacuation to the United States. On April 16, 1946, the first American-fired V-2 rocket roared into the sky above the New Mexico desert at the Army's White Sands Proving Ground. This flight initiated the practical phases of an intensive Army program in the field of rockets and guided missiles.

NIKE named after the Greek goddess of victory, is the Army's first supersonic anti-aircraft guided missile designed to intercept and destroy the enemy target regardless of evasive action. Developed by Douglas Aircraft Co., liquid-fueled, and bearing two sets of fins for guidance and steering, the missile is about 20 feet long and one foot in diameter. Missile and booster weigh more than one ton. Speed, range, altitude and lethality of NIKE are classified. Fired from an almost vertical position, NIKE can meet an attack from any direction and its kill potential is reported to exceed design expectations. There are eight launchers in each NIKE battery, which is operated by approximately 100 officers and men. Personnel are trained at the Anti-aircraft and Guided Missile School, Fort Bliss, Texas.

NIKE guided missile installations are now deployed throughout the United States as an inner ring of defense for industrial, highly populated, and strategic areas. When sufficient NIKE missiles are available it is expected that they will replace many of the conventional guns, and that some of the batteries will be manned by National Guard units. Newest site for a NIKE installation is Okinawa. In improving NIKE, the Army is anticipating the capabilities of higher performance aircraft. A new version may carry a nuclear warhead. If it does, then one missile will be able to destroy an entire attacking air fleet, according to the Army. Coordinating the work of NIKE batteries will be the Missile Master System, developed by the Army and the Martin Company of Baltimore. The system, described in the Research & Development chapter, collects information about approaching aircraft and presents these data on electronic displays.

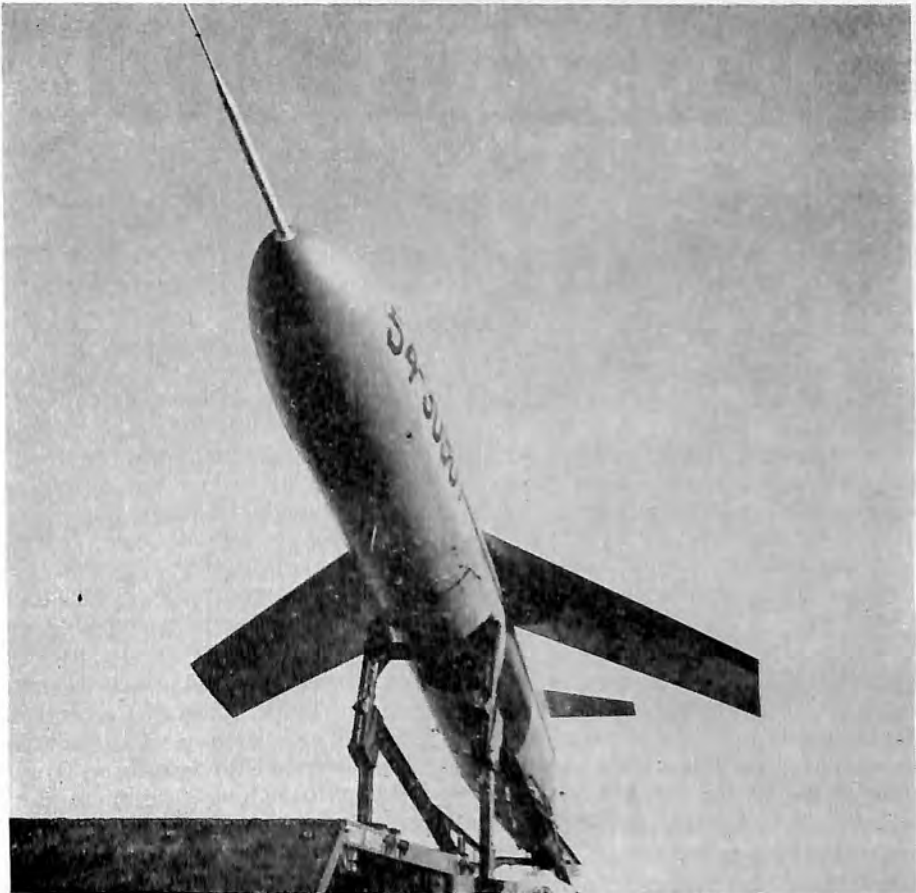
The CORPORAL, designed by the Firestone Tire & Rubber Co., is able to engage tactical targets far beyond the range of artillery or the new 280-mm gun. The missile can be equipped with either a nuclear or conventional type warhead. In this way, the field commander is given great fire-power, enabling him to strike hard at selected targets deep in enemy territory. The missile follows a ballistic trajectory in its flight to target. Its range of 50-75 miles and its ability to be used despite weather or visibility conditions, makes the CORPORAL a highly lethal weapon. Powered by a high-thrust rocket motor, the missile travels through the atmosphere at a speed several times that of sound. The CORPORAL is 46 feet long, 2.5 feet in diameter, and has about a 5-ton take-off weight. A CORPORAL battalion comprises three launchers and 250 men. Each battalion has two

## GUIDED MISSILES

batteries—a firing battery and a service battery. Six CORPORAL Field Artillery Battalions have been deployed to Europe.

The REDSTONE is the largest surface-to-surface ballistic guided missile successfully fired in this country. Its range is reported to be between 200 and 400 miles, with a possible extension to 500-700 miles. Five to six feet in diameter, and 60-65 feet long, the single-stage rocket missile is powered by a North American liquid-propellant engine developing about 70,000 pounds thrust; a speed of 4000 mph is attained. Named for the place of its development, the Army's Redstone Arsenal in Huntsville, Alabama, the missile has been flight-tested at Cocoa, Florida, and is ready for production at Chrysler's missile plant at Warren, Michigan. The REDSTONE was developed under the supervision of Dr. Wernher von Braun, developer of the German V-2 rocket. Activation of the first U.S. Army unit to fire

### **Martin Matador tactical missile**





## *The* AIRCRAFT YEAR BOOK

the missile was announced by the Secretary of the Army on March 14, 1956. Designated the 217th Field Artillery Missile Battalion, the unit was formed at Redstone Arsenal.

The JUPITER missile, an intermediate range ballistic missile capable of being launched from land or ship, is being developed under the new Army Ballistic Missile Agency, which was set up under high priority for such work early in 1956. Designed for a 1500-mile range, JUPITER is being developed under a \$3-million engineering and production contract by Chrysler Corporation. Able to be ground-launched by the Army, and ship and submarine launched by the Navy, JUPITER is an outgrowth of the shorter range REDSTONE. In a recent change-around of names, JUPITER A has been given to the REDSTONE missile, JUPITER C to the 1500-mile IRBM and JUPITER B may be the name of a solid-propellant version of JUPITER C.

### **Navy**

PETREL was developed by the National Bureau of Standards under the technical direction of the Bureau of Ordnance. Launched by patrol aircraft well outside the range of the target's air defense, the missile attacks at high speed, saving the plane pilot from the antiaircraft hazards experienced during World War II. Produced by the Guided Missiles Division of Fairchild Engine & Airplane Corp., the PETREL consists essentially of a winged Mark 13 torpedo powered by a J-44 turbojet engine, which delivers 1000 pounds thrust. The missile is about 24 feet long, 2 feet in diameter, and has a wing span of 13 feet; launching weight is 3800 pounds. A number of patrol-type aircraft are equipped with PETREL including the Navy's P2V-6B, manufactured by Lockheed Aircraft.

SPARROW I, a supersonic air-to-air missile, was developed by the Bureau of Aeronautics and the Sperry Gyroscope Company. Described as a powerful deterrent against attack by jet bombers and fighters, it is about 12 feet long, weighs about 300 pounds, and is powered by an Aerojet-General solid propellant rocket motor. Speed is estimated at more than 1500 mph. Guidance signals from launching aircraft deflect the missile's wings, and direct the missile to its target, even though the target may use evasive actions. The SPARROW I weapons system is versatile, permitting effective attacks against high and low altitude targets, flying singly or in groups. The missile is in production at the Sperry Farragut Co. in Bristol, Tennessee. SPARROW I is operational in the Fleet and in shore-based aircraft.

REGULUS I, which resembles a conventional swept-wing jet fighter about 30 feet long, was developed by the Chance Vought Aircraft Co. under the sponsorship of the Bureau of Aeronautics. The missile tracks at sonic speed and has about a 500-mile range. It was designed for launching from submarines, surface ships and shore bases. The launching equipment can be installed in a short period of time at relatively low cost, with only slight modification to the ship itself. Tactically, REGULUS I can be used against appropriate land targets. In amphibious warfare, the missile will be used

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**McDonnell F3H-2N Demon carries Sparrow missiles**

by the Marine Corps and the Navy. Although the assault missile and some of its variations will use a drone version of the REGULUS, tactical employment will also include techniques and guidance systems associated with the operation of all-weather, distantly controlled guided missiles. Such plans make it possible to use the missile in various ways without the expense and effort of designing and procuring a separate missile for each function. The program was started in 1947. The missile was initially developed in 1948, and first flown at Edwards Air Force Base in 1950. A \$12-million production contract was awarded by the Navy to Chance Vought for construction of REGULUS II, a bigger and faster missile than REGULUS I and with an increased range. Ships able to launch the parent missile will also be able to launch its offspring.

The TERRIER was fired experimentally in fleet operations in November 1954 from the Navy's oldest battleship, the USS MISSISSIPPI, which was converted into a test ship for this purpose. A slim, needle-nosed supersonic weapon, the TERRIER is designed to intercept aircraft at longer range and higher altitudes than conventional antiaircraft guns, and under any weather conditions. A two-stage rocket, the TERRIER has a present range of about 20 miles and a speed of about Mach 2.5. Its total length is 27 feet; its solid propellant booster length is 14 feet, and its diameter is 8 inches. Its sustainer rocket is also solid. Developed by the Bureau of Ordnance under the technical direction of the Johns Hopkins University Applied Physics Laboratory, the TERRIER is being produced in quantity at the Naval Industrial Reserve Ordnance Plant in Pomona, California, which is operated by Convair. Recently, the USS BOSTON fired the missiles against target planes. Hits at 6 miles' range and 15,000 feet altitude were recorded.

TALOS, a ramjet-propelled surface-to-air supersonic guided missile, was developed by the Applied Physics Laboratory of Johns Hopkins University and is being produced by Bendix Aviation (prime contractor), McDonnell Aircraft (airframe), and Farnsworth Div. of IT&T (guidance). The missile will be used by the Navy aboard ship and by the Continental Air Defense Command. An outgrowth of the 1944 BUMBLEBEE project, TALOS is accelerated by a solid propellant booster rocket. During ramjet operation, the missile's speed exceeds Mach 2. TALOS, though similar to TERRIER, is larger and has a longer range. It will soon be installed on the USS GALVESTON and other light cruisers.

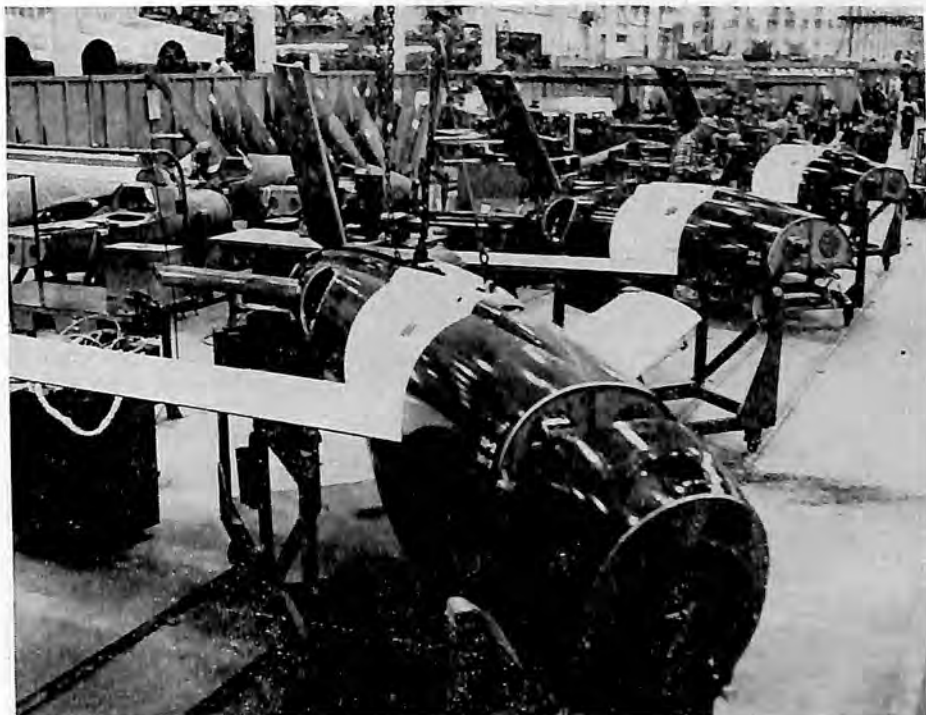
The TARTAR, a surface-to-air missile powered by a solid-propellant single-stage rocket, is being developed by Convair to replace five-inch naval gun batteries. It is smaller than TERRIER but has a similar design. During a press conference on March 13, 1956, aboard the guided missile cruiser USS BOSTON, Rear Admiral John H. Sides, answering direct press queries, said: "TARTAR will be small enough to go into destroyers and (into) the secondary batteries of large ships, (and) yet have more performance than the original TERRIER." Admiral A. A. Burke, Chief of Naval Operations, said: "TARTAR should be cheaper than TERRIER." No other information has been released.

#### **Air Force**

The MATADOR (TM-61A), tactical missile of subsonic speed, is manufactured by the Martin Company of Baltimore. It received its first flight in December 1950 and was operational March 1954. It has a wingspan of 28.7 feet, length of 39.6 feet, and diameter of 54 inches. The MATADOR can exceed 650 mph and an altitude of 35,000 feet. Ground launched from a roadable launcher by a T50 solid propellant booster, the missile is powered by an Allison jet engine (J-33-A-37), controlled electronically in flight by ground personnel, and is capable of delivering conventional or nuclear weapons several hundred miles. MATADOR squadrons are already stationed in Germany and Orlando, Florida. A later version, the TM-61B, is longer and faster than the TM-61A and has greater range and improved guidance. It has been tested in successful launchings at Holloman Air Development Center, New Mexico.

The FALCON (GAR-1) is a guided aircraft rocket of supersonic speed, manufactured by Hughes Aircraft Company. Under development since 1947, the missile was test fired in 1950. Production was ordered in 1955, and the FALCON became operational in March 1956. The missile weighs slightly over 100 pounds and is about six feet long. Electronically fired and guided, it is powered by a solid-propellant rocket. The missile can be carried in quantity by interceptor aircraft, which mount the FALCONS under wing or in pod installations. The FALCON is launched miles from target, upon which it automatically homes. During tests, destructive hits by unarmed FALCONS were made on target aircraft. The GAR-1's are operational on SCORPION F-89H's, which carry the missiles in wing tip pods. Soon, FALCONS will be installed in McDonnell's F-101 jet interceptors.

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**Ryan's jet Firebee drone missile**

The surface-to-surface SNARK (SM-62), long-range strategic missile, is manufactured by Northrop Aircraft, and is under test at the Air Force Missile Test Center, Patrick AFB, Florida. A winged pilotless bomber able to carry a nuclear warhead, the SNARK is a subsonic cruise-type missile that travels at about Mach 0.9. The first U.S. intercontinental range missile to be test flown (range estimated to be 5000 miles), the SNARK is launched by rocket and powered by an Allison turbojet engine. Its specifications include: length, about 60 feet; span, about 50 feet; diameter, about 5 feet. Its range, accuracy, and load-carrying capabilities are said to compare favorably with those of ballistic-type missiles. To increase the range, tip tanks may be installed under the missile's wings. Early in 1956, a 2000-mile test flight of the SNARK was run at Patrick AFB.

The NAVAHO (SM-104A, formerly SM-64), long-range strategic missile, is manufactured by Northrop Aircraft under a \$5-million government contract, and is under test at Patrick AFB. Rocket launched and air breathing, the missile is considered to have range, accuracy, and load-carrying capabilities equal to those of ballistic missile types. At present, the NAVAHO is using J-40 turbojets. Later, it will be using two Wright ramjets.

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RASCAL (TAM-63), long-range guided missile under development by Bell Aircraft, is a rocket-powered pilotless bomber designed to be carried by strategic bombers and released miles from objective to proceed at high speed to target. Its guidance system is being developed by the Federal Telecommunications Lab, Nutley, New Jersey.

BOMARC (IM-99), long-range interceptor guided missile of supersonic speed, is under development by Boeing Airplane Company. Reports indicate that the missile is now in its "production ready" stage. Successful experimental launchings at Patrick AFB were a regular part of the development program. A pilotless guided missile powered by a Marquardt ramjet engine, the BOMARC is launched from the ground. The missile is designed to seek out and destroy enemy aircraft at great distances from its launching site. The BOMARC's present range of 200 miles is expected to be boosted to 300 miles. Boeing Seattle will initiate production, which later will be taken over by Boeing Wichita.

Intercontinental ballistic missiles include the ATLAS ICBM (SM-65) and the TITAN ICBM. Convair holds a development contract for airframe and airframe components for the ATLAS. A second development contract for airframe and airframe components for the TITAN (two-stage rocket) is held by Martin of Denver. Separate contracts were awarded to prime contractors for sub-components such as guidance system, propulsion, and other sub-systems. Many of the major components and sub-systems will be identical for the ICBM-IRBM. Such standardization is expected to accelerate development of the missiles and to reduce greatly the overall cost of the program.

The intermediate range ballistic missile THOR (WS-315A), scheduled for first firing in 1957, is a single-stage weapon being developed under contract by Douglas Aircraft. Subcontractors are: General Electric, warhead; North American, rocket motor; and AC Sparkplug, Guidance.

### **Other Missiles**

Still more missiles made news in 1956:

On June 29, Aerojet-General's AEROBEE-HI climbed to 163 miles above the White Sands, New Mexico desert, to set a new altitude record for an American-built, boosted rocket.

The Navy's solid-propellant research rocket ASP attained an altitude of 30 miles. Reaching a speed of 3500 mph, the single-stage rocket used the same propellant combination as will Stage 3 of the VANGUARD projectile. ASP measures 12 feet by 6½ inches.

Radioplane's CROSSBOW, an air-to-surface subsonic missile, is undergoing flight tests.

The antitank missile DART, designed by Aerophysics (Studebaker-Packard subsidiary), was revealed as a wire-controlled, solid-propellant rocket launched from land vehicles. About six feet long, the DART will be manufactured under a \$16-million contract by another Studebaker-Packard subsidiary, the Utica-Bend Corp.

Designed to hold a nuclear warhead, the new missile DING DONG is

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being developed by Douglas Aircraft with guidance furnished by Hughes Aircraft. It is propelled by a North American rocket engine.

Eastman Kodak is making the DOVE, an air-to-surface and air-to-underwater missile. No other details are given.

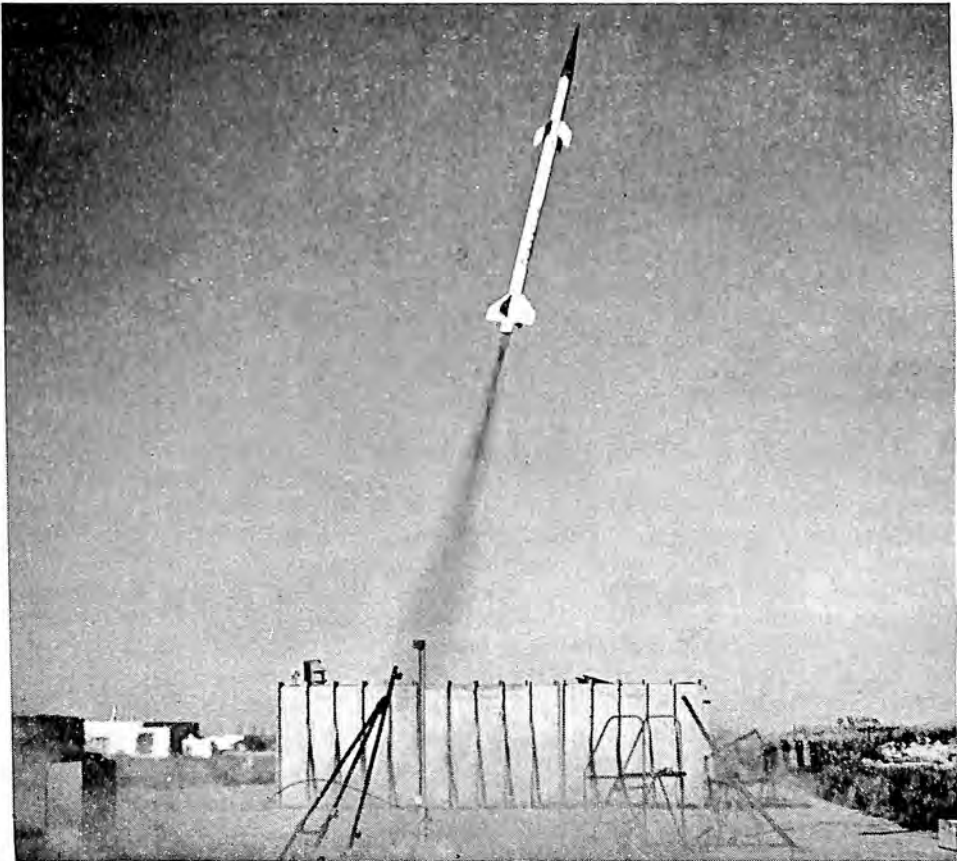
A long-range missile called the GOOSE is under development for the USAF by Fairchild. No other details are given.

Raytheon's HAWK may be an Army Ordnance surface-to-air missile designed to supplement the NIKE for low-altitude defensive work.

Curtiss-Wright Corp. and the Wright Air Development Center revealed their HYPERSONIC TEST VEHICLE (HTV) late in the year. A two-stage solid propellant vehicle, the missile measures 5 feet by 9 inches. Reaching Mach 7, the missile is to be used to gather hypersonic data for the USAF.

Developed at the Cornell Laboratories for Army Ordnance, and in pro-

### **Republic's Terrapin on first flight**



duction at Martin, Baltimore, the new surface-to-surface guided missile LACROSSE will be used for close support operations on the battlefield.

The University of Maryland and Republic Aviation Corp. announced on September 30 the first flight of a lightweight, high-altitude research missile, which reached 80 miles' altitude. Here it relayed measurements of primary cosmic radiation, temperatures and spin of the rocket, and accelerations experienced by the internal equipment. Dubbed TERRAPIN after the University of Maryland's mascot, the two-stage rocket is less than 15 feet long, 6¼ inches in diameter, and weighs 224 pounds.

The 10-ton TRITON missile, developed by the Applied Physics Laboratory of Johns Hopkins University for the Navy, measures 45 feet by 5 feet, and is designed for Mach 2.5.

### **Project Vanguard**

The VANGUARD vehicle, the first three-stage rocket to be developed in the United States, is about 72 feet long with a diameter of 45 inches for the first stage, and 32 inches for the second stage. When fueled for take-off, the VANGUARD vehicle will weigh about 11 tons. Protected by the streamlining of the second-stage rocket will be the 20-inch 21½-pound scientific earth-satellite being developed by the Naval Research Laboratory for PROJECT VANGUARD, a part of the United States participation in the International Geophysical Year, from July 1, 1957, to the end of 1958.

Martin Company, Baltimore, is the prime contractor for PROJECT VANGUARD, a Department of Defense responsibility, under the over-all management of the Chief of Naval Operations.

The first-stage vehicle is slightly longer than the Martin VIKING rocket, but will have a much simpler structure. First-stage propulsion is provided by a newly developed General Electric liquid-propellant rocket engine, which produces 27,000 pounds of thrust at sea level.

A portion of the second stage, including the engine thrust chamber, the tanks and associated plumbing, is being designed and manufactured by Aerojet-General Corp.

The third stage is a solid-propellant rocket, to be furnished through a parallel development by the Grand Central Rocket Company and the Allegheny Ballistics Laboratory. The spherical hollow magnesium satellite is attached by a release mechanism to the forward end of this third stage rocket. The satellite fabricator is the Detroit concern Brooks & Perkins. The third-stage rocket carries no guidance system, has no autopilot or any other means of control. It will be set upon its course by the second stage at the end of its coasting flight, at an altitude of 300 miles.

The Controls System uses a three-axis gyro reference system being designed and built by the Minneapolis-Honeywell Regulator Company. This reference system continuously indicates the VANGUARD vehicle's position with respect to pitch, yaw and roll.

## CHAPTER SEVEN

### The Airlines

**I**N JULY OF 1956, the scheduled airlines of the United States carried their 300,000,000th passenger. It was a statistic that illustrated graphically the increased usefulness to—and use by—the American people of the scheduled airlines.

It also brought out the fact that it required 24 years to count the first 100-million scheduled airline passengers, four years to count the second 100-million and two years to count the third 100-million.

The airlines started the 24-year period—in 1926—with only the nucleus of a fleet of airplanes. (In 1928—the first year for which figures are available—the airlines had 268 airplanes, many of which were single-engine mailplanes.) They started the four-year period with about 960 airplanes, and they started the two-year period with about 1100 airplanes. Today, the total scheduled airline fleet comes to about 1500 airplanes.

Regulated competition, inaugurated in 1938 when the Civil Aeronautics Act brought regulation to the scheduled airlines, has played a great part in this growth for during the first 17 years of the Act the industry showed an almost 4,000 percent increase in the service performed. During the same period no other major industry in the nation came even close to matching the growth of the scheduled airline industry.

In terms of revenue ton-miles, the domestic scheduled airlines increased their service from the 1938 figure of 58,112,000 to 1,903,183,000 in 1954, an almost phenomenal rise of 3,175 percent. In terms of passenger miles, the domestic and international scheduled airlines increased from 533,052,000 in 1938 to 20,512,894,000 in 1954 for a rise of 3,748 percent.



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Next to the 3,175 percent increase in the revenue ton-miles flown by domestic scheduled airlines is the 462 percent increase in ton-miles run by the trucking industry.

To go down the line through the growth of some other industries since 1938, freight ton-miles on the railroads went up 88 percent; passenger miles on the railroads went up 35 percent; passenger miles on intercity buses went up 116 percent; registration of privately owned automobiles, trucks, and buses went up 97 percent; tons of cast and ingot steel went up 82 percent; and the number of telephones in service went up 165 percent.

In the decade that followed World War II the scheduled airlines had two equipment revolutions and are now starting a third one which is ushering in the age of jet transportation. For the scheduled airline industry placed its first turbo-prop airliners in service in 1955 and ordered other new and advanced types of equipment to the amount of well over a billion and a half dollars. And by October of 1956, the industry had on order 441 jet air transports. Of these 279 were turbine-powered gaint air transports with a range of as much as 4,000 miles, cruising altitude of between 30,000 and 40,000 feet and cruising speeds of 550 to 610 miles per hour. Seating capacity will range from 80 in one first class configuration to as much as 145 in tourist versions. The remaining 162 were medium-range turbine-powered air transports.

The value of these planes is well over \$2-billion and there were indications that in the next decade the total expenditures of this equipment revolution might top three and a half billion dollars.

The year 1956 saw the Russians fly their jetliner, Tupolev 104, to London where for the first time people of the free world could see it. In pointing out that the question "Who will pay for the Russian jet transports?" was of interest to Americans Milton W. Arnold, Vice President-Operations and Engineering, of the Air Transport Association said, "And the fact that Russia is in a program of civil jet transports is a demonstration of the foresight and the necessity of the American air transport industry's action in moving boldly and on its own initiative into the jet age.

"There are probably few Russian people," said Mr. Arnold, "who can afford the luxury or who will be permitted the privilege of flying in a Tu-104. This only serves to emphasize the difference in how the two countries are to be provided with their civil jet fleets, for the charge of creating Russia's expensive new fleet will be borne by the Soviet taxpayer.

"But in our country, as far as the taxpayer is concerned, this new airpower will be provided free. The domestic trunklines as a group have not only made themselves free of subsidy, but are going to use private capital to equip this country with jet airliners. In the case of the U. S. international carriers, the proportion of subsidy of their total revenues is becoming so small—less than two per cent projected for fiscal 1956—that every prospect is that the operators through private financing will pay the whole bill for the jetliners that will carry the American flag from continent to continent."

During 1956 the final report of the Air Transport Association's commit-

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tee on Rotorcraft was issued. The report outlined recommendations and operational procedures for two types of multi-engine transport rotorcraft to meet the anticipated requirements of scheduled air transportation. It also contained a section on heliport design and location.

One of the types of rotorcraft needed, according to the report, would be for serving large metropolitan centers to supplement present ground means of transportation. This rotorcraft, with a capacity of 25 passengers plus baggage, would serve a radial route system, generally less than 75 miles, from a large central city to surrounding communities.

The second type of rotorcraft, with a 35 to 50 passenger and baggage capacity, would be for scheduled air transportation or intercity or local service routes, which require such service but do not have the facilities to permit safe operation of fixed wing aircraft.

During the year the scheduled airlines began negotiations with Collins Radio for an aircraft proximity warning indicator. Towards the end of the year contracts were being signed by individual airlines with Collins.

In 1956 a "No-show" control program designed to improve the service rendered the traveling public was instituted by the scheduled airlines. The plan calls for a passenger who makes an advance registration to pick up his confirmed ticket, indicating positive reservation of a seat, at a time that is agreed to by the passenger and the airline. If the passenger fails to comply his reservation is cancelled.

### Allegheny Airlines

Allegheny Airlines traffic during the first 9 months of 1956 continued to establish new records. For the period January through September, Allegheny flew 49-million passenger miles for an increase of 16 percent over the corresponding period of 1955.

Express and mail loads similarly increased substantially. In addition, at the beginning of 1956, Allegheny began air freight service on its system. During the first nine months, freight traffic totalled 600-thousand pounds.

The Company increased its equipment to a total of 5 Martin Executive 40-passenger aircraft and 14 DC-3's (24-26 passengers), with an additional DC-3 on lease.

The Civil Aeronautics Board granted Allegheny permanent certification over its present route system. This action marked a milestone in the development of the carrier.

During the summer season, non-stop flights were again operated between Pittsburgh and Atlantic City with Martin Executive aircraft. Local traffic between these points, combined with connecting travel from western points, was sufficient to warrant two daily round trips.

Allegheny was granted permission by the Civil Aeronautics Board to operate direct services to Detroit, Michigan, by way of Erie, Pennsylvania, and eight other industrial centers in New York and Pennsylvania. The Company thereby added service to another strong western terminal having an important community of interest with other points on the existing system. Service was begun on December 1, 1956.

French hostesses were added in the spring of 1956 to Allegheny's

Executive service. By special arrangement with Air France 15 girls are providing a continental touch to Allegheny's service in the Middle Atlantic area.

The company was again awarded the Aviation Safety Award of the National Safety Council. Through September 1956, Allegheny has flown 268-thousand passenger miles without an accident.

### **American Airlines**

American Airlines expected to fly more than 7.5 million passengers in 1956. In 1955, American became the first airline in the world to carry more than seven million passengers in a single year. The 7,300,000 passengers carried was more than twice the total carried in 1950. The total represented an increase over 1954 of 24.3 per cent.

In June, 1956, the company set another record by flying a total of 489,668,000 passenger miles in the 30-day period. A third record was established on August 31, 1956, when American flew 26,750 passengers a total of 18,282,000 passenger miles.

On August 18, 1956, the company transferred the world's largest airline reservations office from LaGuardia Airport to Manhattan's West Side Terminal.

Establishment of the new facility represented more than three years of planning, the shift of 500 reservations personnel, and the installation of enough communications wire to stretch from New York to Los Angeles and halfway back. The facility occupies 30,000 square feet of space, has the largest private telephone system used by any airline, an improved Magnetronic Reservisor that reduces reservations handling time to less than a second, and provides airline supervisory personnel with an instant up-to-the-minute view of the volume of traffic.

American announced during the year it had placed an order with Boeing Aircraft Company for the delivery of 30 model 707 turbo-jet aircraft.

The first 707 jet will be delivered to the company in early 1959. American plans to place the 550-mile-an-hour plane in service in June, making it the first airline to fly jets in transcontinental service. The first flights of the 707 have been completely reserved. AA also has an order for 1958 delivery 35 Lockheed Electra turbo-prop airplanes.

Demand created by the announcement of the introduction of "The Royal Coachman," a nonstop, coast-to-coast DC-7 aircoach flight, was so great prior to the inaugural flight on May 20 that American had to schedule two roundtrip flights daily, instead of the one originally planned.

In conjunction with 18 other major and local service airlines in the United States and South America, American Airlines introduced a simplified, single form, world-wide "Go-Now-Pay-Later" credit plan for air travel on August 27, 1956. It was designed specifically for travel agents. Features of the new plan were: only one form, snap-out form, quick reference chart, "high credit" approval, faster service, broad coverage, and automatic insurance.

Last July the company announced it would build a \$1-million school at

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Fort Worth to train 1,000 stewardesses yearly to be ready for occupancy by August, 1957.

In June, American introduced "To-Your-Door-Baggage" service at New York and Los Angeles. For a modest charge passengers may check their baggage prior to departure and have it delivered to the designated address at destination, or they can make the arrangements when they arrive at destination airport.

American Airlines now has more than 200 modern planes in scheduled service from coast to coast. All but 74 of the planes are of the four-engined, long range type.

On October 22, 1956, American Airlines reported net earnings of \$15,761,000, exclusive of profit on sale of aircraft, for the nine months ended September 30, 1956. This is equivalent, after preferred dividends, to \$1.98 per share on the average number of shares of common stock outstanding during the period. In addition, there was a profit (net of tax) of \$1,317,000 from sale of aircraft. Total earnings, including profit on the sale of aircraft, aggregated \$17,078,000, or \$2.15 per share of common stock.

Net earnings for like period of 1955 were \$14,337,000 which was equivalent, after preferred dividends, to \$1.88 per share of common stock.

Revenues for the first nine months of 1956 were \$217,281,000, an increase of 11.5 percent over the \$194,895,000 reported for the like period of 1955.

During the first nine months of 1956, American Airlines carried 5,856,721 passengers—a total of 3,697,054,000 revenue passenger miles. This represents an increase of about 13.1 percent over the 3,267,465,000 revenue passenger miles flown for the same period last year.

American Airlines carried 51,787,000 ton miles of airfreight for the first nine months of 1956—an increase of 4.3 percent over the same period last year.

### **Braniff International Airways**

The inauguration of Braniff International Airways' service between Texas points, the Mid-South, Washington and New York on February 15, culminating twelve years of effort by the airline to extend its domestic routes to the East Coast, highlighted the activities of Braniff during 1956, a year which also witnessed the Texas-based airline engaging in the greatest expansion program in its 28-year history.

The year also marked the initial implementation of Braniff's extensive new equipment program. The first of Braniff's El Dorado DC-7C aircraft, purchased under an \$83-million new aircraft program authorized in 1955, was delivered to the airline in September and placed on schedules late in October.

On February 15, Braniff began DC-6 service on its newly awarded 1,050-mile route segment between San Antonio, Fort Worth, Dallas, Nashville, Tenn., Washington and New York, and in October an additional round-trip daily DC-6 flight between Texas and New York via Memphis and Chattanooga, Tenn., was initiated.

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Coincident with the start of the New York service, Braniff also inaugurated its "Silver Service", a new concept of luxurious in-flight service including deluxe cuisine and special passenger comfort appointments.

The schedule pattern on the new route segment was further improved in October as Braniff placed the first of its new El Dorado aircraft in service between Texas cities and New York as well as Texas and Chicago. Special cabin arrangements of the 73-passenger, 360-mile-an-hour El Dorado provide both first class and tourist service on the same schedule.

Braniff has ordered a fleet of seven of the new DC-7Cs, four of which were delivered during 1956 and the balance to follow in the spring of 1957.

Another step in Braniff's fleet expansion program was taken early in 1956 when the airline ordered five Convair 440 Metropolitan airliners at a cost of approximately \$4-million. Delivery of the 44-passenger transports began in November and will be completed during January, 1957.

Modification of Braniff's Douglas DC-6 fleet continued during 1956 and it was contemplated that the entire \$1.2-million program will be completed by mid-summer of 1957. More powerful water-injection engines, increasing the plane's speed to 325 miles per hour, were installed, and passenger cabin interiors completely refurbished. In addition, gross take-off and landing weights were increased, with a resultant increase in passenger-carrying capacity of approximately 2,000 pounds.

Additional moves to improve the airline's ground facilities were made in 1956, including the announcement in January of plans for a new ten-story Braniff Airways building in Dallas. Plans call for occupancy of the new administrative offices in July, 1957, and it was anticipated that the maintenance and operations facilities will be completed early in 1958.

To house its rapidly expanding staff in Washington, D. C., resulting from the extension of its routes to the East Coast, Braniff also opened new sales and administrative offices in June.

During 1956 work progressed on the installation of Braniff's new electronic reservations system which is expected to be in operation by February, 1957. The electronics unit will be tied in with Braniff's entire communications facilities and will keep track of all seats on all flights throughout the airline's complete system 31 days in advance and automatically notify all Braniff stations and sales offices of seat availabilities.

During the year, Braniff management completed a financing plan to support the aircraft, equipment and facilities improvements planned for the airline through 1960, including the purchase of nine Lockheed Electra turbo-prop and five Boeing 707 jet aircraft, deliveries of which will commence in 1959. The financing plan includes additional equity capital and long-term loans to supplement its cash estimated to result from depreciation and retained earnings.

Route development and modification activities during 1956 included the Dallas to the West Coast Case, in which Braniff has an application to provide air service between major cities in Texas and the co-terminals of San Francisco and Oakland via Albuquerque, Phoenix and Los Angeles. Texas cities included are Lubbock, Wichita Falls, Fort Worth, Dallas;

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Austin, Waco, San Antonio, Houston, Corpus Christi and Brownsville.

Traffic-wise, Braniff continued to show increases in virtually every category of its operations during 1956. Operating revenues reached an all-time high of \$39,043,450 in the first nine months of the year, an increase of 12 percent over the same period in 1955. Net profit for the period was \$1,496,700, also a 12 percent increase over the 1955 period.

For the first nine months of the year, revenue passengers carried increased eight percent over the first three quarters of 1955, from 1,248,600 to 1,352,570, and revenue passenger miles flown increased 14 percent, from 510,587,000 to 581,551,000. Air freight ton miles flown and express ton miles flown both showed a 13 percent increase in the first nine months of 1956 over the corresponding 1955 period.

As of December 10, 1956, Braniff was operating a fleet of 67 aircraft, including 4 Douglas DC-7Cs, 9 Douglas DC-6s, 2 Lockheed Constellations, 2 Convair 440s, 25 Convair 340s, 22 Douglas DC-3s, and 3 all-cargo planes. On order and yet to be delivered are 3 additional DC-7Cs, 3 additional Convair 440s, 9 Lockheed Electra turbo-prop planes and 5 Boeing 707 jet transports.

Braniff's 16,422 certificated route miles extend from Minnesota to the Gulf of Mexico through 17 states in the U. S. and the District of Columbia and eight Latin American countries, serving 53 U. S. and 9 Latin American cities. Braniff employees totaled approximately 4,400 at the end of 1956.

### Capital Airlines

The phenomenal success of the jet-prop Viscount, along with a decision to purchase 14 Comet jetliners, combined to make 1956 an outstanding year for Capital Airlines.

### Capital Airlines' new Viscount



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July 26th marked the first anniversary of Viscount service which was inaugurated on the highly competitive Washington-Chicago market. Today Viscounts cover better than 50 percent of the Capital system connecting such major cities as Washington, New York, Detroit, Minneapolis, Cleveland, Buffalo, Rochester, Philadelphia, Norfolk, Atlanta, Birmingham, Mobile, New Orleans and countless smaller cities between.

A quick check of traffic and operations figures revealed that the jet-prop planes had increased load factors on the Washington-Chicago market by 199 percent at the end of a full year of operation. A similar rise was noted for several other large market areas.

The rugged dependability of the Viscount's four Dart 510 engines, which now have a total fleet engine time of nearly 100,000 hours without a single engine failure in the air, exceeded the company's best estimates.

With an ear to the public demand for more jet-prop service and an eye on the outstanding operational figures Capital promptly increased its original Viscount order to a total of 75. The airline now has a total of 50 Viscounts in service and at the current delivery rate of four a month expects to have its full Viscount fleet by mid-summer of 1957.

The first airline to offer jet type flight in this country, Capital was quick to consolidate the competitive lead provided by the Viscount, by announcing the purchase of 14 Comet jetliners on July 24th. The \$53-million decision was based on an exhaustive study of the Comet similar to that employed prior to the Viscount purchase.

Four of the Comets, manufactured by the DeHavilland Co., will be the Model 4, while the remaining 10 will be Model 4A. Delivery is expected to begin in the last half of 1958, with scheduled service planned for early 1959.

Powered by four Avon R.29 jet engines, manufactured by Rolls-Royce, which also builds the jet-prop engines for the Viscount, the Comet will carry 76 passengers at altitudes up to 42,000 feet at a cruising speed of 550 miles per hour.

Capital's present fleet consists of 12 Constellations: 19 DC-3s: 14 DC-4s and 48 Viscounts.

The company's advertising program has been intensified to further educate the traveling public to jet-prop Viscount flight. Full use was made of all news media such as newspapers, radio, television, magazines, trade journals, films on Viscount flight and Capital's operations and a particularly effective direct mail campaign which has won the company a total of seven national awards.

An unusual part of this educational program is a 45-foot tractor-trailer housing a Viscount display with a cut-away model of a Rolls-Royce engine, which is still touring the country.

Several new safety modifications are now being installed on the Viscount fleet, the most important of which are weather radar, air-stair doors and special fuel dump chutes.

Bendix RDR-1 Airborne Weather Radar sets were ordered and will be installed in special nose housings of all Viscounts, enabling pilots to

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locate "corridors" or relatively calm air through storms at ranges of up to 150 miles.

The air-stair doorways consist of a three part stairway which folds into the front of the aircraft. These hydraulic units are push button controlled from the plane's interior by the hostess and will eventually replace the old type mobile loading ramps.

Greater safety in event of emergency landings is provided by new fuel dump chutes located on the trailing edges of the Viscount's wings.

Operating revenue for the first nine months of 1956 was \$45,514,822 as compared to \$38,043,463 for the small period of one year. However, the worst first quarter flying weather experienced in eight years, along with the July steel strike and the depressed air traffic following the Grand Canyon disaster, combined with additional expansion costs, had a direct bearing on the \$1,571,215 operational loss recorded by Capital for the first nine months of 1956.

A total of 2,180,588 passengers were carried during the first three quarters as compared to 1,946,229 for the nine month period of 1955. Passenger miles flown for the same period last year totaled 731,988,926 as compared to 605,116,431 for the same period in 1955.

### Continental Air Lines

Continental Air Lines of Denver received delivery early in 1956 of three Convair 440 aircraft and on April 1 scheduled these aircraft on flights along its system. The addition of these aircraft to its six Convair 340s enabled the scheduling of Convair service along major routes in Texas and New Mexico, formerly a part of Pioneer Air Lines before that airline was purchased by Continental. Continental's entire fleet of Convairs have been equipped with R. C. A. electronic weather avoidance radar.

The addition of the Convair 440s replaced certain DC-3 flights and gave the airline a total of 29 aircraft; 3 Douglas DC-6Bs, 3 Convair 440s, 6 Convair 340s and 15 DC-3s. One DC-6 is leased from American Airlines and one from United Air Lines in connection with Continental interchanges from Houston-San Antonio-El Paso-West Coast and from Tulsa-Wichita-Denver-Pacific Northwest.

Late in 1955, Continental announced a new equipment program for the purchase of 5 Douglas DC-7Bs, 15 Viscount S10D-840s turbo-prop and 4 Boeing 707 jet airliners at a cost of more than \$63-million including ground equipment, spare parts and preoperating expenses. The DC-7B aircraft will be used to inaugurate service on April 28, 1957 to Chicago and Los Angeles along the Chicago-Kansas City-Denver-Los Angeles routes. Continental was awarded the extensions to Chicago and Los Angeles late in 1955 in the "Service to Denver" case.

In April, 1956, Continental joined Trans-World Airlines, United Air Lines, American Airlines, and other private industry in the underwriting of a \$150-thousand program for solar-terrestrial research by Dr. Walter Orr Roberts at the University of Colorado.

Also in April, 1956, Continental announced plans for the construction



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at Los Angeles of a \$2.5-million jet maintenance base at Los Angeles International Airport. It is expected that construction will begin sometime in the autumn of 1956. Continental was actively pushing new route cases, chiefly a new route nonstop Denver-Phoenix also with service to Palm Springs and San Diego as part of its new Chicago-Los Angeles route; and for new routes between Dallas-Fort Worth and Los Angeles and San Francisco both on a nonstop basis and via major cities.

From June through November, 1956, Continental was actively promoting its future Viscount turbo-prop fleet with a large \$75-thousand mobile display. This display visited 23 cities and traveled over 6,000 miles along the Continental system and was a feature at major shows and important events.

During the first six months of 1956, Continental Air Lines through substantial increases in passenger and cargo revenues, along with reduced operating costs made a net profit of \$493,218, equal to \$1.04 per share and a 212 percent increase over net income for the first six months of 1955 of \$157,869, which was equal to 33 cents per share on a slightly lesser number of shares outstanding.

Passenger revenue for the first six months of 1956 was \$7,767,575, a 23 percent increase over the \$6,327,123 for the first six months, 1955. Mail revenue was \$204,207, a 19 percent increase over the \$172,286 mail revenue for the first six months of 1955. Freight was \$212,830, a 13 percent increase over the \$188,924 revenue for the first six months of 1955. Express revenue was \$71,914, a 16 percent increase over the \$61,752 for the first six months of 1955.

The airline celebrated its 22nd birthday on July 15, 1956, together with a record of safe flight throughout its history. On that date the airline had carried approximately 3,600,000 passengers 1,345,000,000 passenger miles without fatality, and the record continues.

For the first time in its history, Continental Air Lines' passenger revenue for a single month passed the \$1.5 million mark in August, 1956.

### **Delta Air Lines**

Passengers carried by Delta during the first ten months of the year totaled 2,244,607 (estimated), a 15 percent increase over the 1,933,559 passengers carried during the first ten months of 1955. Revenue passenger miles also increased 15 percent over 1955, from 850,216,154 to 983,423,889 (estimated). Through October 1956 the airline transported 12,040,568 pounds of air express (estimated), an 11 percent increase over the 10,749,204 pounds carried during the corresponding period in 1955. For the first 10 months of 1956 airfreight totalled 23,393,460 pounds (estimated), a 3 percent increase over the 22,640,184 pounds carried during the first ten months of 1955.

Shortly after Delta inaugurated service to New York the airline announced that free helicopter transfer service between Newark Airport and La Guardia or Idlewild Airports would be available for connecting air passengers using Delta's first-class service between New York-Atlanta or

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points beyond. The service is via New York Airways, a scheduled helicopter airline.

Luxury on a budget in Miami Beach and the Caribbean was offered in Delta's low-cost all-expense vacations which were available this year for the tenth consecutive summer. Delta, who pioneered the packaged vacations in 1947, offered a new theater tour this year to New York and planned additional package vacations to Washington, New York, Mexico, Ft. Lauderdale, New Orleans, etc. A convenient easy-pay installment plan was available.

### Eastern Air Lines

The completion of the \$422-million equipment program, which got underway in the fall of 1955 and will continue through 1960, and the merger and integration of Eastern's routes with those of smaller Colonial Airlines were the highlights of Eastern Air Lines operations in 1956.

Eastern's equipment programs include two fleets of piston-driven aircraft in its "pre-jet stage" and two fleets of jet transports including both turbo-prop and straight jet.

Deliveries commencing in late summer and ending early December added 18 more luxurious Golden Falcons to the Eastern fleet—Douglas DC-7B's and 10 Super G Constellations, all equipped with radar and newest fully automatic flight control systems.

These airliners along with the 12 DC-7B's delivered in 1955 put Eastern into a position to handle what all forecasters predicted would be the greatest fall and winter vacation travel between the north and Florida.

In addition to the Golden Falcons, Eastern contracted for 20 Convair Metropolitan 440 Silver Falcons to supplement its fleet of 60 Martin 404's and to enable the retirement of DC-3 and DC-4 aircraft over Colonial's former routes.

Jet plans call for the delivery of 40 Lockheed Electras commencing in August 1958 and running through August 1959. The third and final step in the jet transition program entails the purchase of 20 giant Douglas DC-8 straight jet airliners at a cost of \$135 million. Deliveries of these jets are slated to commence in November 1959 and continue through 1961. Eastern decided after extensive study and research to equip all of its DC-8's with the larger and more powerful J-75 engines which will do away with the necessity of water injection used on take-off.

Following authorization of both the President and the Civil Aeronautics Board, Eastern formally acquired the routes and assets of Colonial Airlines on June 1st by swapping one share of its common stock for each two shares of Colonial outstanding.

Constellation service was added to schedules between Montreal and New York and New York and Bermuda by October, and the company planned to retire the obsolescent DC-3 and DC-4 aircraft over all the routes in favor of modern pressurized airliners by the spring of 1957.

With the acquisition of some 800 former Colonial employees and a normal increase system wide, the company's employment figure rose from

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nearly 12,000 employees at the end of 1955 to some 14,000 at year's end in 1956.

The airline continued to progress in its long range program to overcome the traditional summer slump in travel to Florida and other summer resorts. By mid-October Eastern had sold over 60,000 of its Happy Holidays all expense vacations, an increase of nearly 34 percent over those sold for the same period in 1955.

Both traffic and earnings reached new records at the end of the third quarter of 1956. Eastern had boarded 5,754,687 passengers, an increase of 14.1 percent over the 5,042,907 carried during the first 9 months of 1955. Passenger miles were up 15.8% to 3,224,471,490 over 2,783,672,915 in 1955. Seat miles increased approximately 15% to 5,159,195,905 from 4,485,038,556. The load factor at the end of the 9 months period was 62.4 percent as compared with the 9 months load factor of 62.0 percent during the corresponding period in 1955.

For the first 9 months of 1956, Eastern Air Lines recorded a net profit of \$8,135,000 or \$2.92 a share as compared with \$4,748,000 or \$1.90 a share for the corresponding period in 1955. Gross operating revenues for the 9 months totaled \$172,485,000 compared with \$148,483,000; operating expenses were \$151,128,000 against \$129,685,000.

### **Lake Central Airlines**

Lake Central Airlines, the world's only employee-owned airline, during 1956 continued to increase its operating efficiency to levels beyond even the records the airline established in 1955.

Lake Central in 1955 carried a total of 113,352 revenue passengers, and flew 16,733,000 revenue passenger miles. During the first nine months of 1956, traffic was substantially ahead of last year for the same period. Through September, 1956 Lake Central carried 102,074 revenue passengers and revenue passenger miles totaled 15,520,000.

On September 28, 1956, Lake Central realized a new peak day in passenger sales when 619 passengers were boarded over the airline's five-state system. System-wide load factor, or the percentage of seats occupied on all flights, reached an all time high of 48.26 percent in June, 1956.

Lake Central employs a staff of over 300 stationed in 27 cities in the five states of Indiana, Ohio, Illinois, Michigan and Pennsylvania. Route mileage has been extended to more than 1500 miles with the addition of Marion, Indiana on September 1, 1956. Thirty-five new cities were applied for during 1956 by Lake Central in the Great Lakes Local Service Investigation to be held by the Civil Aeronautics Board. These new cities are located in the states of: Indiana, Ohio, Michigan, West Virginia, District of Columbia, New York, Pennsylvania, Kentucky, Missouri and Wisconsin. These routes, if granted to Lake Central, would more than double the airline's mileage and points of service.

Since the employees took over the airline in 1955, the line's operating results have shown steady improvement. Lake Central has been able to

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increase non-mail revenue and substantially reduce total operating expenses and breakeven mail pay need.

The company has a fleet of 10 DC-3's and is presently fitting each aircraft with a new interior that includes seating for 26 persons and a carry-on baggage rack. A \$104-thousand electrical and radio conversion of the present Lake Central fleet is nearly completed.

### Mohawk Airlines

In 1956 Mohawk Airlines reached a milestone in passenger traffic, added substantial flight equipment, embarked on an ambitious building program, and received important route extensions.

Early in the year Mohawk achieved a passenger milestone by boarding its one millionth passenger.

After the worst operating winter in the history of the company had prevented substantial traffic gains early in the year, revenue boardings surged upward to carry Mohawk to the best year in its history. At the end of nine months, Mohawk was experiencing an increase of 24.3 percent over the corresponding period of 1955, by having carried 256,000 passengers.

The company established a new monthly record in October, highlighted by a daily record of 2,201, and expected to carry a total of 350,000 by year's end.

Again this year, Mohawk received the National Safety Council's 1955 Award of Honor for the operation of 158,636,000 passenger miles without fatality to passenger or crew member. Mohawk flew approximately 60,000,000 passenger miles in 1956, a figure 20 percent above that recorded in 1955.

On March 12, 1956, Mohawk entered into an agreement with Swissair to purchase its fleet of seven Convair 240s and a large spare parts inventory. The equipment purchase increased the size of the Mohawk fleet to 11 Convairs and 11 DC-3s and more than doubled the company's investment in flight equipment.

Late this year, Mohawk began a program to modify the Convairs to 46-seat transports, first by the installation of a two-seat lounge in the rear of the cabin, then by the installation of a row of four seats in the forward portion of the cabin.

Mohawk this year also instituted a maintenance training program whereby all maintenance personnel first receive a three-week training course including both Convair and DC-3 operation, then receive monthly follow-ups and tests to record their proficiency. The program is divided into units comprising all aircraft and engine systems and includes both theoretical and practical experience.

On September 5, Mohawk inaugurated first east-west service to Glens Falls, N. Y. Just prior to that, the CAB announced its decision to extend the Mohawk route system beyond Buffalo to Erie, Pa., and Detroit, Mich., thus providing the airline with its most important extension since Boston and other New England points were added in 1953.

During 1956 the airline announced plans for the construction of a new

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headquarters and maintenance facility, and on August 3 the Mohawk board of directors announced the relocation of the airline headquarters from Ithaca, N. Y., to Oneida County Airport midway between Utica and Rome, N. Y. Construction of the building, to cost approximately \$2.5-million began this year.

Another step forward to improve passenger service was taken early this year when a completely automatic telephone was put into operation at the West Side Airlines Terminal in New York in the Mohawk-Allegheny joint operation there. Marking the first use of the unit in the airline industry, the system provides for the automatic routing of incoming calls without the need for switchboard operators.

In electronics, Mohawk currently leases one DC-3 to the General Electric Company and another to General Precision Laboratories, Inc., for use as flying test beds in experiments with electronic equipment.

### **National Airlines**

In 1956 National Airlines not only set a new high in net profit equal to \$4.14 per share but it also embarked on an expansion program of over \$112-million in an effort to continue bringing the finest in air travel to Florida residents and visitors.

With over \$108-million of the expansion program total earmarked for new aircraft, National has placed orders with various aircraft companies for the delivery of six Convair 440's which were received this summer; four Douglas DC-7B's, scheduled for delivery in 1957; four Lockheed Super H Constellations, also scheduled to be received in 1957; twenty-three Lockheed Electra 400-mile-an-hour turbo-prop airliners and six Douglas DC-8 jet aircraft, which will fly at 600 miles an hour. These aircraft are all scheduled for delivery to the Florida based airline in 1959 and 1960.

All of NAL's new aircraft on order, including the Convair 440's delivered in 1956, will be equipped with airborne radar for inflight weather detection. This device is currently installed on National's entire four-engine fleet.

Current plans call for operating the Lockheed Electra's on NAL's routes between New York, Philadelphia, Washington, New Orleans, Houston and practically all the cities in Florida and Havana, Cuba.

When the first DC-8 jet airliner is scheduled between Miami and New York the flying time between these two cities will be cut to two hours and 20 minutes and each flight will carry as many as 130 passengers at 600 miles hour.

National is also increasing its investment in Florida with a construction program in excess of \$3.5-million. This program, currently under construction, and scheduled for completion in the Fall of 1957, includes a \$1.5-million general office at Miami International Airport and a nose and maintenance hangar to cost over \$2-million.

The general office building, scheduled for completion in the Spring of

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1957, will be completely air-conditioned and heated and will contain more than 88,000 square feet.

New ideas in construction design are being incorporated in the nose and maintenance hangar, also under construction at Miami's International Airport. Featuring a self-supporting cantilever design made of thin-shelled corrugated concrete slabs, the structure measures 450 feet in length and the width of 260 feet includes 105-foot cantilevers on each side of a 50-foot center section.

Planned for the fast approaching jet age, this hangar will enable NAL mechanics and engineers to service six DC-8 jet aircraft at the same time. These aircraft have a wingspan of 139 feet and are 148 feet long.

Recent Civil Aeronautics Board decisions have enabled National to broaden its service with awards of service to Houston, Boston, Providence, Fayetteville, Winston/Salem and Greensboro/High Point.

Houston service was inaugurated November 20 when NAL scheduled three flights daily from Miami, two flights a day from both Tampa and Jacksonville and five flights from New Orleans to Houston. Daily service to the Texas metropolis is also provided from Tallahassee, Pensacola, Panama City and Mobile.

Direct service between Boston and Providence and South Florida was inaugurated December 14 when National's winter schedules went into effect. At that time NAL also started service to Fayetteville, N. C.

### New York Airways

As of November 1, 1956, New York Airways had flown 43,000 passengers; air express amounted to 2,008,000 lbs; mail poundage totaled 1,079,000 and air freight transportation reached the 588,000 lbs. figure. The 1956 figures represent a growth of 75 percent in passenger transportation over 1955.

New York Airways was the recipient of the National Safety Council Award of Honor "in recognition of its contribution to safe air transportation, having operated two years, and, as of December 1955, 737,000 passenger miles without a passenger or crew fatality in scheduled passenger carrying operation." This is the first time a helicopter airline was so recognized by the National Safety Council. Up until November 1, 1956, New York Airways has flown 441,000 scheduled miles and maintained its laudable record.

New York Airways announced joint fare agreements with all major national and international airlines, which means 'all the way by air' between passenger points on New York Airways' routes and those of participating fixed-wing carriers.

The addition of three Sikorsky S-58's, plus a Bell 47-H Bellairus swelled New York Airways fleet to nine aircraft. The equipment now consists of five S-55's, three S-58's and the Bellairus. The latter is used extensively for charter duty and during the recent elections was used by members of both parties seeking office.

The purchase represents an investment of more than \$2-million and will be advantageous in these ways:

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Increased passenger capacity from five to twelve;  
Increased cruising speed from 85 miles per hour to 105 miles per hour;  
Increased lifting power from 1,200 pounds to 3,600 pounds;  
Increased the engine power from the S-55 Pratt and Whitney R-1340 600 horsepower to a Wright R-1820 1525 horsepower engine.

As a direct result inter-airport service schedules were changed from hourly to a three-quarter hourly basis.

The joint fare agreements arranged with major national and international airlines also marked a big step in the growth and development of New York Airways. Such growth and development and the increased faith in helicopter transportation has been demonstrated by the construction of heliports in and near the metropolitan area, the most recent at Stamford, Connecticut.

### Northwest Orient Airlines

Northwest Orient Airlines, which began operations the same year Congress passed the Air Commerce Act creating the aeronautical branch of the Department of Commerce, celebrated its 30th Anniversary this fall.

As 1956 closed, Northwest was arranging the final steps in another long range flight equipment program which would take it well into the jet era. Early in 1956 Northwest purchased a number of J-75 jet engines to power its jet fleet. Evaluation of the available jet aircraft was nearing completion and orders were expected in the near future.

Northwest also increased its order for new piston-engined equipment during the year. The company had on order 26 new type DC-6B and DC-7C aircraft and parts valued at over \$63-million. Delivery of this equipment began late in 1956 and continued through 1957 and 1958.

The year also marked another milestone in Northwest's history with the completion of arrangements with the Minneapolis/St. Paul Metropolitan Airports Commission for the construction of a \$15-million over-haul base and general office.

Northwest increased its Orient operation, providing a sixth transpacific passenger frequently during 1956. In addition, Constellation equipment was introduced in its local intra-Orient operations.

The year's total passenger business, based on actual figures up to September and projection to the end of the year, was 1,420,000 passengers compared to 1,343,000 in 1955.

Domestic revenue passenger miles were 894-million compared to 823-million in 1955. On the domestic system freight ton miles were 7,950,000 compared with 6,582,000 during 1955.

On the international route, Northwest carried 108,000 passengers in 1956 compared to 98,000 passengers in 1955. Mail ton miles in 1956 were 10,000,000 compared to 6,900,000 in 1955.

In addition to its fleet expansion program, Northwest is installing airborne radar equipment in all of its DC-6B, DC-7C, and Boeing Strato-cruisers.

Northwest currently operates 6 DC-3's, DC-4's, 10 DC-6B's, 9 B-377's and 4 1049-G aircraft, giving a total of 47 aircraft.

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### Ozark Air Lines

During the past fiscal year Ozark Air Lines increased its passenger traffic by 49 percent, carrying 288,578 passengers compared to 193,876 passengers in the preceding year. Air Express volume increased 66 percent to 188,751 ton miles. Air mail volume increased by 53 percent to 99,290 ton miles. Revenue passenger miles flown increased 41 percent or by 12.5 million passenger miles, while revenue plane miles flown were expanded 1.5 million or 43.6 percent. The revenue passenger load factor for the year averaged 43.21 percent, approximately the same level as the prior year, but actually representing a large increase due to the substantial additional revenue plane miles flown.

In the latter part of the fiscal year Ozark inaugurated air freight service to all the cities Ozark serves. The air freight volume grew from about 3,900 ton miles in April, 1956 to over 9,000 ton miles in the month ended June 30, 1956.

During the year Ozark inaugurated service over several new routes. Ozark's present system has 3756 route miles and serves 45 cities in eight states. Applications are now pending before the Civil Aeronautics Board for a number of additional routes.

Ozark was awarded the National Safety Council's Merit Award for the fifth consecutive year, having had a perfect record of safety since the beginning of its operations on September 26, 1950.

Ozark owns 17 DC-3 aircraft and acquired three additional DC-3 aircraft from the United States Navy on long-term leases. Ozark is the first scheduled airline in the United States to adopt Hi-Per Ozark DC-3's. During 1956, Ozark and Pan American Airways developed a modernization program of the DC-3 aircraft by installing stream-lined wheel-well doors, new oil coolers; utilizing flush-mounted automatic direction-finder loops and a new type exhaust stack; fairing-in the ailerion gap and replacing the present wing fillets with fillets that fit closer to the aircraft fuselage.

Ozark constructed additional office facilities at its general headquarters in St. Louis and enlarged the apron adjacent to its hanger to provide greater aircraft parking and working areas.

### Pan American-Grace Airways

A general step-up in its operations marked Panagra's performance in 1956, as flight frequencies were increased, facilities expanded, services improved and traffic continued to rise.

One of the reasons for the rise in traffic was the new group excursion fares, which went into effect on April 23rd and have since been extended through March 1958. These lower fares reduce by 30 percent the cost of a round trip fare on all tourist or first class flights from any city in the United States and Canada to Lima or points south with stopover privileges during a 30 day period.

To keep pace with the increased demand for space generated by the new fares, the company provided more than 46,000 tourist and first class



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seats to South America on its fourteen weekly DC-6B and DC-7B flights from New York.

Reflecting the general increase in the company's operations, inter-continental air cargo shipments between the United States and South America continued the fast upward trend in the first half of 1956, with an increase of 45 percent over the same period in 1955.

The airline flew 1,006,620 ton miles between the United States and South American points during the first three months as compared with 645,488 ton miles carried in the first quarter of 1955. To keep pace with the rapid expansion of the cargo business, Panagra equipped two DC-4's with special double doors to facilitate loading bulky cargo. Panagra also replaced DC-3's with bigger and faster four-engine DC-4's on the route from Lima, Peru to La Paz, Bolivia, and the free port of Arica, Chile.

Following a thorough evaluation of jet transport equipment, Panagra ordered four DC-8 jet airliners from the Douglas Aircraft Company with an option to purchase two more. The Panagra DC-8's will be powered with the J-75 Pratt and Whitney jet turbine engines and will be able to carry more than 100 passengers. Delivery of the planes will begin in early 1960.

In preparation for the coming jet age and to meet the demands of the increasing number of tourists and travelers to that continent, Panagra has undertaken a program to assist local governments in the expansion and improvement of the airport facilities in South America.

An electronic system to reduce noise and vibration aboard multi-engine aircraft was installed and tested by Panagra on one of its DC-7B's in regular operation between New York and Buenos Aires, Argentina. Manufactured by the Hamilton Standard Propeller Co., the device, known as the Synchrophaser, was designed to keep the propellers in step with split-second accuracy and thus reduce the noise level caused by the propellers coming in and out of synchronization. The Synchrophaser is equivalent to 800 pounds of additional sound-proofing material.

First U. S. airline to use airborne radar in regular operation on a DC-6B in April of 1954, Panagra, which had equipped its new fleet of DC-7B's with X-band radar last year, ordered installation of similar electronic equipment on the rest of its fleet of DC-6B's in tourist service.

New flight records were established all along the Panagra routes in South America as DC-7B flights were added to the schedule. Typical of these was the record established when a Panagra DC-7B, aided by strong tail winds, crossed the Andes between Santiago, Chile, and Buenos Aires, Argentina, in one hour and 55 minutes, cutting 35 minutes from the schedule. This was the 22,976th crossing of the Andes by Panagra since it began operating 27 years ago.

For its perfect safety record in 1955, Panagra was presented the Inter American Safety Council Aviation Award and the National Safety Council Award of Honor. It was the 12th consecutive year that the airline, which operates a network of more than 8,000 miles of routes to seven Latin American countries, has received these awards. During the twelve years

## THE AIRLINES

covered by the awards, Panagra has flown a total of 1,500,268,000 passenger miles without a passenger or crew fatality in scheduled passenger carrying operations.

### Pan American World Airways

Passenger and cargo totals for Pan American World Airways in 1956 reached the highest marks in the company's history. Revenue passenger miles flown increased 17 percent, while cargo ton-miles rose 22 percent, according to totals for the first nine months and an estimate for the final quarter.

Indicating increased business and tourist travel over Pan American's Atlantic, Pacific and Latin American routes, the revenue passenger mile figure climbed to 3,303,850,000, compared to 2,818,993,000 for 1955.

Cargo ton-miles flown added up to 83,848,000, contrasted with 68,876,990 for 1955.



**Pan American World Airways Super-7 Clipper**

Contributing to the record carriage of passengers and cargo was Pan American's new fleet of 33 DC-7Cs. By the end of the year, Pan American had 17 of them in service. The remainder will be delivered by May, 1957.

The first of the DC-7Cs was introduced May 25 with a press flight of 4,570 miles from Miami to Paris non-stop, the longest ever scheduled by an airline. Upon arrival in Paris it still had a fuel reserve for an additional 900 miles. The new plane, which is in operation on transatlantic and Pacific routes, permits two-way non-stop trans-ocean service for the first time.

As an aid to crew training in the new equipment, a Curtiss-Wright electronic flight simulator for the DC-7C was installed by Pan American in its training section at La Guardia Field, New York.

## *The* AIRCRAFT YEAR BOOK

Pan American also intensified its preparations for the receipt of its jet transport fleet of 48 Douglas DC-8s and Boeing 707s, the first of which is scheduled to be received in December, 1958.

An order was placed with Curtiss-Wright for two flight simulators, one each for the DC-8 and 707, and an option taken on two additional DC-8 simulators and three more 707 trainers. The first two simulators will be delivered 6 months in advance of the delivery date of the jets, thus enabling Pan American to train crews in advance.

Pan American introduced to Puerto Rico on June 20 the first three-class air service. The new program provides a third fare which cuts previous tourist fares by about 20 percent.

Pan American also proposed to operate three classes of service over the Atlantic, including a new class of service priced 15 to 20 percent below present tourist fares. The International Air Transport Association traffic conference, held last summer, voted to accept the Pan American proposal effective April, 1958.

During the year Pan American began a technical aid program with Thailand to help expand and develop its air transport system. Twenty-five airline technicians were sent to help Thai Airways. The three-year project, worked out with the International Cooperation Administration, is similar to programs already underway in Turkey and Pakistan.

Pan American instituted two programs to facilitate arrangements for air travel.

To speed up its reservations procedures, the airline installed an electronic system in its ticket offices in the New York area and will extend it nation-wide.

In a move designed to reduce the paper work in its installment-plan system for purchasing tickets, Pan American, first airline to put in a Pay Later Plan, joined with 17 other national and international airlines in an arrangement known as the "World-Wide Plan—Go Now Pay Later."

### **Southern Airways, Inc.**

From a small route serving only eighteen cities in 1949, Southern Airways has extended its service to include thirty cities in eight southeastern states, and flies over 10,000 plane miles per day. In 1956, Southern expected to fly in excess of 30-thousand passenger miles and attain a load factor of 45 percent.

Several new records were set during this year: During the month of April, the carrier attained an all-time high load factor of 47.8 percent. In August, a new high of over 17,000 passengers for one month was reached, and a new record of 818 passengers in a single day was recorded on August 31.

During the first six months of 1956, Southern's revenue from excess baggage reached an all-time high of \$7,605, up 80 percent over the same period in 1955. First class mail revenues topped all previous records with a total of \$1,184 for the same period, and air express revenues were up 15 percent over the first six months of 1955.

## THE AIRLINES

On June 29, 1956, Southern started service over its new route between Atlanta, Georgia, and Panama City, Florida, with stops in Columbus, Georgia, and Dothan, Alabama.

During the year, Southern Airways purchased two additional DC-3 airplanes, bringing the total fleet to thirteen such aircraft. All aircraft were completely modernized during 1956, and now include twenty-six new-type seats and carry-on baggage racks.

During 1956, the Airways, through use of its sales department personnel and its stewardesses, assisted in Telethons sponsored by the local Cerebral Palsy chapters in the cities it serves.

Southern Airways concentrates a great deal of selling effort on its charter operations, which are an excellent source of supplemental revenue. Through October 15, Southern had completed over 66,000 miles of flying in connection with these operations and expected to fly in excess of 75,000 miles during the year.

### TPA Aloha Airline

TPA Aloha Airline, an Hawaiian corporation with 2,800 stockholders, celebrated the completion of its first decade of operations July 26, 1956. The month also marked a decade of perfect safety, TPA Aloha Airline never having had a passenger or crew fatality in its history.

In the same month of July, TPA Aloha Airline received its permanent Certificate of Public Convenience and Necessity as a scheduled airline. The airline had previously been operating as a scheduled air carrier under a five-year temporary Certificate.

TPA Aloha Airline operates eight Douglas DC3 aircraft in daily flights to all of the major Hawaiian Islands.

The airline's aircraft were being converted in 1956 to luxury VISTALINERS with 32 seats, a facing-seat arrangement opposite five-foot wide panoramic windows and a forward Aloha Lounge. All eight aircraft feature specially-designed camera windows for photography enthusiasts.

### Trans World Airlines

Record-breaking passenger volumes coupled with great technological advances highlighted 1956 for Trans World Airlines. For 1957, the global airline predicts an even greater year of passenger volume with the introduction of its new, long-range Lockheed 1649A. With this huge aircraft, 24 of which have been ordered, TWA will have a luxury airliner capable of flying 6,400 miles non-stop at speeds of more than 300 miles per hour.

In line with the ever-growing passenger volume, TWA in 1956 inaugurated a new Passenger Service Department. The department is responsible for every service to the airline passenger from first phone call to final destination.

TWA, which has been in the forefront of inexpensive, mass air travel for many years, took two more steps in this direction in 1956. First, TWA's proposal for reduced tourist fares across the Atlantic was accepted by IATA, and Oct. 1 saw the first group of passengers leave for Europe

under the new 17-day discount fare, a fare \$97 lower than the regular Sky Tourist fare on trans-oceanic flights.

On Oct. 15, TWA in conjunction with American Export Lines, started a unique new travel service called Sea Air Cruises. These travel packages of 2, 3 and 5 weeks combine the leisure of a ship cruise, sightseeing in Europe and fast flights back to the U.S. aboard TWA Constellations for very low cost.

In Kansas City, Mo., a huge new \$5-million office building, topped by a 30-foot red and white rocket model, was dedicated. By the year's end nearly 700 executives and clerical employees had moved into the modern, air-conditioned structure, consolidating a great part of TWA's administrative operation in that mid-west city.

Important progress was made at the \$25-million Maintenance and Overhaul Base outside Kansas City. At this base 5 engine test cells costing \$1.5-million went into operation. The major technological advance was the fact that for the first time in the history of American aviation, dynamometers were used for engine testing. This marked the end of wooden propellers in test cells. Noise outside the test cells is cut to conversation level by the 11-inch-thick walls, massive double doors and an intriguing series of scientifically designed and spaced mufflers in the cell stacks.

Another TWA "first" in 1956 was the direct flights offered between Egypt and Spain and Portugal. Also, in response to an increasing demand for travel space to the Iberian Peninsula, TWA expanded its frequencies on the south Atlantic route segment to the Azores, Lisbon and Madrid from four to seven in each direction. Over 88 percent of these were low fare Sky Tourist seats.

Domestic route expansion in 1956 saw inauguration of flights to Denver, Tulsa, Oklahoma City and Tucson. CAB approval for service to Boston and Hartford was also given during the year.

The year was marked also by an increase in non-stop flights from New York to the West Coast and Washington to San Francisco.

In the United States, TWA's coast-to-coast routes in 1956 accounted for an estimated 3,357,835,000 passenger miles, an increase of 17.1 percent over 1955. On the international runs, passenger miles were up 11.5 percent at 680,833,000.

Sky Tourist service by TWA again showed great gains during 1956. This service was up 23.9 percent on domestic flights and 13.3 percent on international flights. Domestic air express and freight also recorded gains during 1956. Express was up to 9,300,000 ton miles, an increase of 10.6 percent over 1955, and international air cargo was up 2.1 percent.

Another TWA development in the Air Cargo field was the airlines' inauguration of clearing house service for its air freight customers. The first clearing house TWA joined was in Los Angeles. Throughout the year TWA joined groups in nearly all the major cities in the country.

Also in 1956 TWA began installation of its coast-to-coast electronic reservations network called the Magnetric Reservisor. This system will

## THE AIRLINES

slash the time needed to make a plane seat reservation as well as eliminate much of the duplicate paper work now involved in this system.

TWA prepared for the jet age with preliminary orders of 8 Boeing 707's and 30 Convair 880's. The first Convair 880 will be delivered to TWA in November of 1959. TWA on its international and domestic routes operated the following aircraft: 28 Super-G Constellations, nine 1049 Constellations, twenty-seven 749A Constellations, twelve 749 Constellations, thirty-two 032 Constellations, 38 Martin 404s, 11 Martin 202s, 8 DC-4 Cargo, 2 DC-4 passenger, 5 DC-3s, one Fairchild C-82 for a fleet total of 173.

### United Air Lines

United Air Lines, approaching the jet age, topped all previous years' operations in 1956, flying an estimated 4,575,000,000 revenue passenger miles and carrying 6,300,000 passengers. The figures, quoted on nine months' actual operation and an estimate of fourth quarter activity, are respectively 15 and 13 percent higher than 1955 passenger volume.

Air cargo transportation produced an estimated 93,300,000 revenue ton miles, up 17 percent from the previous year. The cargo total was comprised of 51,200,000 ton miles of air freight, up 27 percent; 28,700,000 ton miles of air mail, an increase of 8 percent, and 13,400,000 ton miles of air express, a gain of 6 percent.

The peak travel day was reached on June 21, when 23,190 passengers were carried, and the company's fleet flew 17,542,000 revenue passenger miles.

Approximately 98,000 flights were operated during the year, according to estimated figures. During the summer United flew more than 20,000,000 seat miles daily—a capacity sufficient to carry 100 persons coast-to-coast every 18 minutes day and night. The fleet flew more than 375,000 miles every 24 hours during the summer season.

United added 18 planes in 1956. The fleet near year's end included 26 DC-7s, 30 DC-6Bs, 42 DC-6s, five DC-6As, 55 Convairs and 12 DC-4s. The company has 27 aircraft on order for 1957.

Five new DC-6A all-cargo aircraft began scheduled service in April between New York, Chicago and San Francisco, to significantly reduce shipping time coast-to-coast on the Mainliner system. The DC-6A, carrying more than 30,000 pounds of air mail, express and freight, crosses the country in less than half a day at a speed of 300 miles an hour, with an en route stop. The five DC-6As cost a total of \$5.5-million.

Preparing for future jet service, United was the first airline to order a DC-8 electronic flight simulator. It will be manufactured by Link Aviation, Inc.

The DC-8 simulator, to cost \$800,000, will be installed at the company's flight training center at Denver in 1958, a year before delivery begins on 30 DC-8 jet aircraft. Two Curtiss-Wright simulators were added at Denver during the year, supplementing two in service there, and two operating at Chicago.

## *The* AIRCRAFT YEAR BOOK

The airline completed installation of C-band radar on all of its Convair aircraft during the year, and continued the project to place similar equipment aboard DC-7s, DC-6Bs and DC-6s. Fleet-wide installation, to be completed in 1957, will cost \$4.9-million.

To further increase safety in the air, United ordered 250 airborne proximity indicators for installation on every plane in the fleet. Under development and manufacture by a leading producer in the field, deliveries of the device will begin early in 1958.

A new cabin design created for United by Raymond Loewy Associates made its debut early in the year.

Mainliner service to Pittsburgh and Kansas City was inaugurated in 1956 by United, bringing the total of cities linked by the company's 14,000-mile system to 80.

The Civil Aeronautics Board on September 28, 1956, granted authority for United to operate flights between Washington and Baltimore, New York-Newark and Boston, via the intermediate cities of Philadelphia and Hartford-Springfield. The flights must originate or terminate at or west of Toledo.

Coach service on DC-6B Mainliners between California and Hawaii, instituted in February, set new standards for budget travel. In the over-water coach version, the four-engine DC-6B carries 75 passengers.

United's 20,000th crossing of the Pacific between California and Hawaii occurred before mid-year. The company has completed 50,000,000 miles of transpacific flying since its military contract operations began in 1942, and has carried about 435,000 passengers on Pacific flights since starting commercial service in 1947.

Transportation history was made in the fall with announcement of a plan enabling the Southern Pacific to sell United Air Lines tickets, first such cooperative arrangement between an airline and a railway firm.

Many other improvements in passenger service were made in the year.

Interline agreements were signed by United with B.K.S. Air Transport, South Pacific Air Lines, Braathens South American & Far East Airtransport, Cambrian Air Services, Union of Burma Airways, Gibraltar Airways, Chicago Helicopter Airways, Mackey Airlines, Kuwait Airways, Syrian Airways, Maritime Central Airways, Sudan Airways, Eagle Airways, and Aero Transportes. More than 150 such agreements providing for passenger and cargo transport on both airlines upon issuance of a single ticket are now in force.

United Air Lines now has almost 19,500 employees.

## UTILITY AIRCRAFT

# CHAPTER EIGHT

## Utility Aircraft

**L**IGHTPLANE MANUFACTURERS burst the bounds of previous conservative estimates and achieved record sales totaling close to \$125-million in 1956, delivering over 6,000 new single and light twin-engine aircraft. Sales showed the sharpest increase in history by topping 1955's record by over \$30-million and 2,000 units delivered.

As 1956 drew to a close, the business fleet was estimated at about 25,000 aircraft, logging about 4.8-million hours.

Cessna, Aero Design, Beech and Piper manufactured 1,000 new twins during the year, bringing the total number in service in the U.S. to over 1,800. The growing popularity of the small twin reflected business' growing dependence on the airplane and the subsequent desire for greater speed, range and all-weather flying capability.

Single-engine aircraft delivered during the year were in the main tricycle gear, higher speed than the old out-pat of the immediate postwar years. Sales emphasis and engineering design provided a large segment of the flying public with simplicity of flying.



## *The* AIRCRAFT YEAR BOOK

New developments announced during the year were aimed at providing general aviation with new plane types to fill every need from the high-speed single engine type to larger multi-engine types:

Cessna Aircraft Co. flew the prototype of its Model 620, a four-engine, 8-10 place pressurized executive transport and announced 1957 production plans. The 620 will give Cessna a complete range of aircraft, being added to its Models 172 and 182, single engine tricycle gear aircraft featuring the patented "Land O Matic" gear, introduced earlier in 1956. The conventional Model 180 continued in production, offering a complete line of four-place utility aircraft. Rounding out the line was the Cessna Model 310, high speed twin-engine five-place executive transport.

Beech announced the first flight of a low-cost twin-engine four-place executive, dubbed the Beechcraft Travel Air, to be added to its high-performance single-engine four-place Bonanza; four-five place, 200 mph Twin Bonanza and Super Beechcraft, larger eight place twin-engine executive.

Piper was readying its new all-metal, high-performance Comanche for early 1957 deliveries to round out its line which continues the Super Cub, four-place single-engine Pacer and Tri-Pacer series and its twin-engine, four-five place Apache.

Aero Design and Engineering Co. continued to offer its standard Model 560 A Aero Commander and its newest supercharged twin engine Model 680 which has a top speed of close to 230 mph.

The tremendous impact of business flying on the lightplane manufacturer's new prosperity seemed to rub off on the larger transport manufacturers. Large corporations, long dependent on the old workhorse, the DC-3 and converted bombers to meet their particular requirements for airline-type transports, were becoming good customers for the airline transport manufacturers. While still the backbone of the used and surplus aircraft market and the conversion and modification bases, the corporations were also looking to the new aircraft.

Operating an estimated 2200 multi-engine transports, the business and industrial corporation executives wanted more speed and pressurization. There was a growing acknowledgment that to achieve most effective use of business aircraft, this specialized group must keep pace with the airlines.

Convair in 1956 had orders or made delivery on over 30 of its transports: seven Convair 240's; about 14 Convair 340's and 11 Convair 440's. The first 440 off the line was delivered to Cities Service for executive travel. At year-end, Convair was showing a new interest in a turboprop conversion engineered by Napier with its Eland engine based particularly on business flying requests.

Turboprops were starting to make their bow and Fairchild, expecting to make deliveries on the U.S. built Fokker F-27 turboprop, was actively courting the corporate user along with the local service carriers. It was reported that the company had orders for sixty of the aircraft from corporations early in its sales campaign.

## UTILITY AIRCRAFT



**Piper PA-24 Comanche will go into production April 1957**

The British Vickers Viscount turboprop was purchased by U.S. Steel, and more corporate orders were expected.

Also as 1956 drew to a close the business aircraft operator had the first glimpse of his entry into the jet age. Long associated with the airlines and military, the jet suddenly was emerging as a definite product for U.S. business. Hastening the day was the U.S. Air Force when it announced a unique competition for two jet configurations: (1) a twin-jet four-place "jet readiness" utility aircraft; and (2) a four-jet 8-10 place light transport. Objective was to provide speedier transportation for its officers while these same commanders obtain and maintain jet proficiency. Obviously not tactical in nature, the development of such aircraft could not be financed by military money, so the Air Force asked the manufacturers to develop and produce such configurations on their own and the Air Force would buy them off-the-shelf.

To further encourage the utility aircraft manufacturers, the Air Force expected to be able to guarantee the manufacturers that it would, over a four to five year purchase period, buy 1,100-1,200 of the twin-jet type and 200-300 of the four-jet. It was willing to waive any military requirement that would interfere with CAA certification and declassify the two-jet engine types it developed for such aircraft ahead of its usual schedule.

The partnership, if successful, would make executive jets available to civil users in 1960 at a cost which would not be possible to achieve under commercial markets. About five manufacturers reportedly had entered the competition by year-end, and one estimated that it would be able to deliver a four-engine jet to the combined military-civil market at about \$500,000 compared to \$800,000 for civil only.

## *The* AIRCRAFT YEAR BOOK

Continental Can Company jumped the gun on the jet age by placing an order for the Fairchild M-185, four-engine jet transport expected to fly early in 1958 for the first time. The competition further sparked such corporations as Lockheed, heretofore disinterested in business aviation market. Lockheed told the Air Force it would fly a prototype light jet transport in late 1957. Beech Aircraft Company, with an option to build the French Morane Saulnier MS-760 four-place twin-jet executive, was given a new outlook on its sales market.

The growth of business flying during the year had the prognosticators revising predictions for the future. Commerce Department envisioned a fleet of 80,000 aircraft by 1965 which will log close to 10-million hours.

This too may be conservative but portends a tremendous future for all of general aviation (private flying, agricultural aviation, charter, air taxi, as well as business flying) which already claims a total of 80,000 certificated aircraft logging nine-million hours annually.

While business aviation accounted for the really spectacular increases, other segments of general aviation were moving ahead, although at a slower pace:

Air taxi operators flew about 3-million passenger revenue miles, representing a 23 percent increase over 1955.

Agricultural flying, representing dusting, spraying and similar activities, totaled about 800,000 hours throughout the country.

Pleasure flying also was on an upsurge and crept close to passing the 2-million hour mark, about a 10 percent increase over the previous year.

Riding on the coattails of the business aircraft industry's prosperity were the accessory and parts manufacturers. Electronic and radio equipment manufacturers sold a total of about \$10-million worth of new radio and nav aids to the business aircraft operators, classed by CAA as the best equipped of all air transport, above the airlines and the military.

## HELICOPTERS

### CHAPTER NINE

#### Helicopters

**W**HILE THE EXPERTS were predicting mass use of helicopters starting in 1960, a demand for commercial helicopters was developing in 1956. The demand was faced with a shortage. Loaded down with military orders, the helicopter manufacturers found themselves chided by commercial helicopter operators for not "raising their sights above purely military use of helicopters."

New York Airways, one of the three certificated scheduled helicopter carriers in the country, was threatening to go abroad for appropriate equipment for its operations. Cleveland Air Taxi, which handles about 1,000 helicopter passengers a month, found that it "can never hope to be financially successful until new, more economical equipment substantially reduces the per-seat mile cost. We are all aware," one of its executives stated, "that the present economy of a helicopter passenger operation cannot justify its existence logically until a low-price, cheaper-to-operate helicopter comes on the commercial market."

More demands for commercially applicable helicopters seemed certain in the next couple of years. Chicago Helicopter Service began passenger operations between O'Hare and Midway airports; Los Angeles Airways passenger and mail service were stepped up as it increased its mail fleet to six S-55's. New York Airways was getting set to start passenger service to downtown Manhattan to mark the debut of such service eventually expected to be commonplace.

While the demand grew for commercial equipment, the airlines were assimilating their requirements. The Air Transport Association rotorcraft

## *The* AIRCRAFT YEAR BOOK

committee made design recommendations, including a request for carry-on baggage arrangements; external noise level not to exceed 75 decibels; fuselage width of about 108 inches at inside window level to provide four-abreast seating and a minimum aisle width of 18 inches.

The International Air Transport Association came up with a requirement for two configurations, both multi-engine: a 25-passenger machine, and a 40-50 passenger craft. The smaller helicopter should have a cruising speed of 100-125 mph and a 100 mile range, and both types should be able to operate safely and economically from a landing area of 200 by 400 feet in city centers.

Civil developments actually were not at a standstill. Bell Helicopters was concentrating on civil markets with two utility models, one two-place and one-four place, aimed at business flying, ambulance service, cargo and other general aviation requirements.

CAA records showed about 140 helicopters certificated for general aviation, flying about 45,000 hours, primarily for patrol and survey work.

But generally the industry was marking time and planning for that magic 1960 date. One study, undertaken by Stanford Research Institute for Bendix Aviation to determine navigation requirements, found that: (1) The helicopter will not come into its own until 1960 when multi-engine equipment is available in production quantities; (2) total national air traffic potential will require about 560 multi-engine rotary wing aircraft in the next decade. The study further estimated that helicopter carrier operations would probably be limited to altitudes of less than 2,500 feet and that minimum enroute altitudes would be at least 300 to 500 feet above terrain.

The Civil Aeronautics Administration and Civil Aeronautics Board were moving toward establishing regulations. Draft releases were under consideration to create a new CAR Part 46 to cover pilot requirements, but it was the general opinion of industry that some of the proposals were premature.

CAA toward the end of the year was hoping to work with the Navy on an educational test program to study nav aids, communications and traffic control problems for intercity operations, based on Navy helicopter experience. To be studied were (1) peculiar problems which may be encountered in helicopter traffic control; (2) effectiveness of present airway aids; (3) need for developing new aids; (4) adequacy of present communication system; (5) additional heliport requirements for instrument flight; and (6) pilot standards for helicopter instrument ratings.

Obviously the main efforts of commercial helicopters were aimed at development of the large multi-engine type. But there appeared a clear requirement for smaller equipment for air taxi, agricultural, and similar operations. Production was not keeping up with demand. Whether or not the manufacturers would be able to meet this requirement as well as the heavy military orders was indeterminate at year-end.

## CHAPTER TEN

### Planes in Production

**D**OLLARWISE, MILITARY AIRCRAFT and missiles continued to account for 80 to 90 percent of the industry's production, but signs of a partial future shift in emphasis were evident in 1956. The industry's total backlog of unfilled orders, which had been \$13.9-billion at the end of the third quarter of 1955, had risen to \$18.4-billion a year later. But the military portion rose from \$11.1-billion to \$12.8-billion, while the civil component climbed more rapidly from \$1.3-billion to \$3.5-billion during the same period.

Output of utility aircraft again reached an all-time high in 1956. Production of these types, many of them twin-engine models, rose from 3,071 valued at \$58-million in 1954 to 4,434 worth \$58-million in 1955 and again to about 6,500 units valued at \$125-million in 1956.

Deliveries of piston-powered air transport planes to airlines continued at a high level during 1956, but manufacturers invested substantial sums in the continued research and tooling necessary to insure production of the first jet and turboprop transports in 1958 and 1959.

AERO DESIGN AND ENGINEERING CO.

Oklahoma City, Okla.



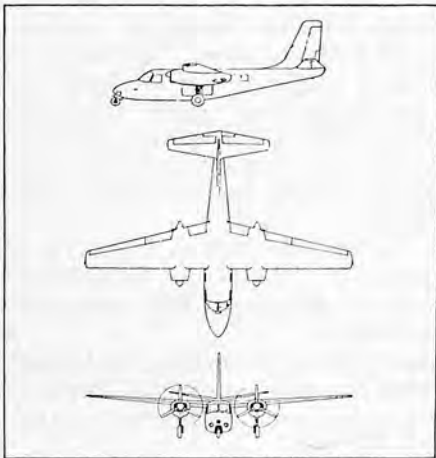
Aero Commander 560A

**TYPE** • Five-Seven place

**DESIGNATION** • Model 560-A  
(L-26B)

**SPECIFICATIONS** • Span 44 ft.; Length 35 ft. 5 in.; Height 14 ft. 9 in.; Empty Weight 4181 lb.; Gross Weight 6000 lb.; Overload Gross Weight 6000 lb.; Wing Loading 24.7 lb. per sq. ft.; Power Loading 10.9 lb.

per bhp; Engines (2) Lycoming GO-480-D1A 260 ea. hp normal rated or, 275 ea. hp at 3400 rpm takeoff; Fuel Capacity 156 gal.; Propeller Hartzell 3-blade; Main Tire 8.50 x 10; Nose Tire 6.00 x 6; 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 206 mph at 275 hp ea. at 3400 rpm at S. L.; Cruise Speed 197 mph at 70 percent hp at 10,000 ft.; Stall Speed 68 mph.; Rate of climb 1400 fpm at S. L.; Service Ceiling 21,900 ft.; Range with Maximum Payload 1050 mi. with 30 min. reserve; Range with Maximum Fuel Load 1650 mi. with optional long range tanks.

**REMARKS**

Several structural changes have been made between the 560 and the 560A. The most noticeable: a 10 in. section inserted in the fuselage forward of the wing to provide a 10 in. longer cabin and larger more streamlined nacelles. The 560A (HC) uses more powerful, high compression engines and has an 84-inch propeller.

## PLANES IN PRODUCTION



Aero Commander 680 Super

**TYPE** • Five-Seven place

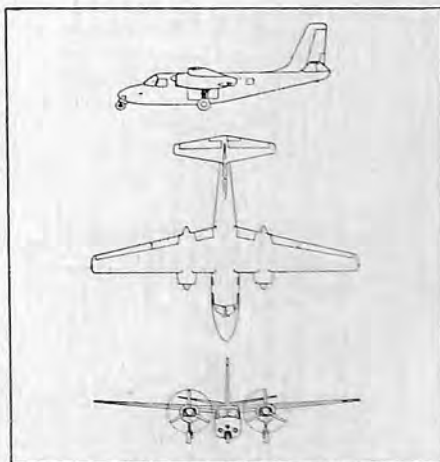
**DESIGNATION** • Model 680 Super

**SPECIFICATIONS** • Span 44 ft.; Length 35 ft. 5 in.; Height 14 ft. 9 in.; Empty Weight 4340 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 (2) GSO-480-A1A-6, 320 hp normal rated, or 340 hp at 3400 rpm takeoff; Fuel Capacity 223 gal.; Propeller 3-blade Hartzell HC-83X20-2A/9333C; Main Tire 8.50 x 10; Nose Tire 6.00 x 6; 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 1600 fpm at S. L.; Service Ceiling 24,200 ft.; Range with Maximum Payload 1600 mi.; Range with Maximum Fuel Load 1600 mi.

### REMARKS

The fastest aircraft produced exclusively for business in the United States today. Basically the same structure as the 560A. First in its category to use supercharged engines. 15,000 ft. single engine ceiling. Convertible to cargo in 30 minutes. Oxygen system and three blade propellers standard equipment.





BEECH AIRCRAFT CORP.

Wichita, Kans.



Beechcraft D50 Twin-Bonanza

**TYPE** • Six place

**DESIGNATION** • D50

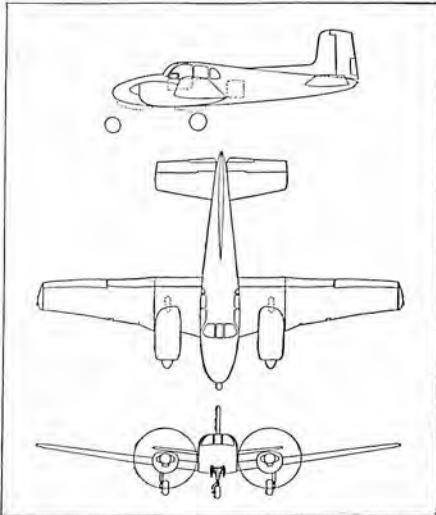
**SPECIFICATIONS** • Span 45 ft. 3 $\frac{3}{8}$  in.; Length 31 ft. 6 $\frac{1}{2}$  in.; Height 11 ft. 4 in.; Empty Weight 3956 lb.; Gross Weight 6300 lb.; Wing Loading 22.74 lb. per sq. ft.; Power Loading 11.05 lb. per bhp.; Engines (2) Ly-

coming GO-480-C2C6 295 hp. at 3400 rpm at S. L.; Fuel Capacity 134 gal. plus 46 gal. in optional auxiliary wing tanks; Propeller Hartzell 3-blade, full feathering constant speed hydraulically controlled; Gear tricycle retractable; Wing Area 277.06 sq. ft.; Aileron Area 13.89 sq. ft.; Flap Area 37.30 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 214 mph. at 285 hp at 3100 rpm at 2500 ft.; Cruise Speed 203 mph at 199 hp at 2750 rpm at 7,000 ft.; Landing Speed 71 mph; Rate of Climb 1450 fpm at S. L.; Service Ceiling 20,000 ft.; Range with Maximum Payload 1650 mi.

**REMARKS**

First flown on Nov. 15, 1949, this executive transport is the commercial version of the U. S. Army L-23B, which serves the U. S. Army Ground Forces as a light personnel transport and is easily modified into a twin-engine trainer, photographic, ambulance, or cargo airplane. Noted for its economy in initial cost, maintenance and operation, this airplane has been structure-tested to an 8G flight load factor.



## PLANES IN PRODUCTION



Beech T-34 Mentor

**TYPE** • Trainer

**DESIGNATION** • T-34A (Air Force)  
T-34B (Navy)

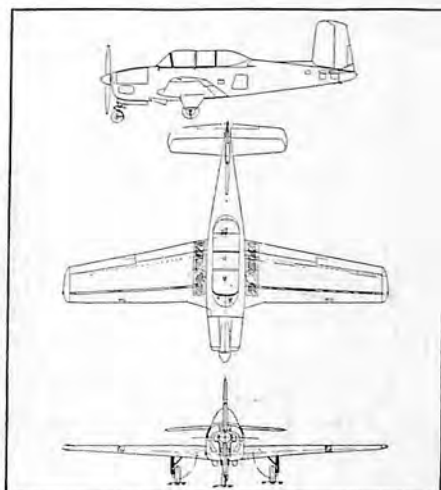
**SPECIFICATIONS** • Span 32 ft. 10 in.; Length 25 ft. 11 in.; Height 9 ft. 7 in.; Empty Weight 2246 lb.; Gross Weight 2975 lb.; Wing Loading 1675 lb. per sq. ft.; Power Loading 13.2 lb. per bhp; Engine Continental O-470-13, 225 hp at 2600 rpm; Fuel Capacity 50 gal.; Propeller Beech constant speed; Gear 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 S. L.; Cruise speed 170 mph at 135 hp at 2300 rpm at 10,000 ft.; Landing Speed 54 mph; Rate of Climb 1160 fpm at S. L.; Service Ceiling 19,500 ft.; Range with Maximum Payload 727 mi. at 10,000 ft. 60 percent power.

### 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. It has won every evaluation contest in which it has participated since the first prototype flight, Dec. 2, 1948. 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 five foreign nations. First production aircraft deliveries to the Navy commenced in December, 1954.



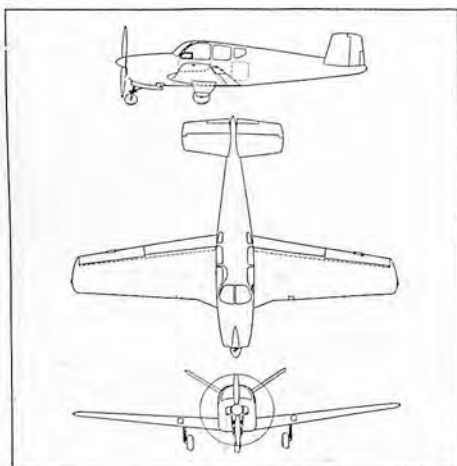


Beechcraft G35 Bonanza

**TYPE** • Four place

**DESIGNATION** • G35

**SPECIFICATIONS** • Span 32 ft. 10 in.; Length 25 ft. 2 in.; Height 6 ft.



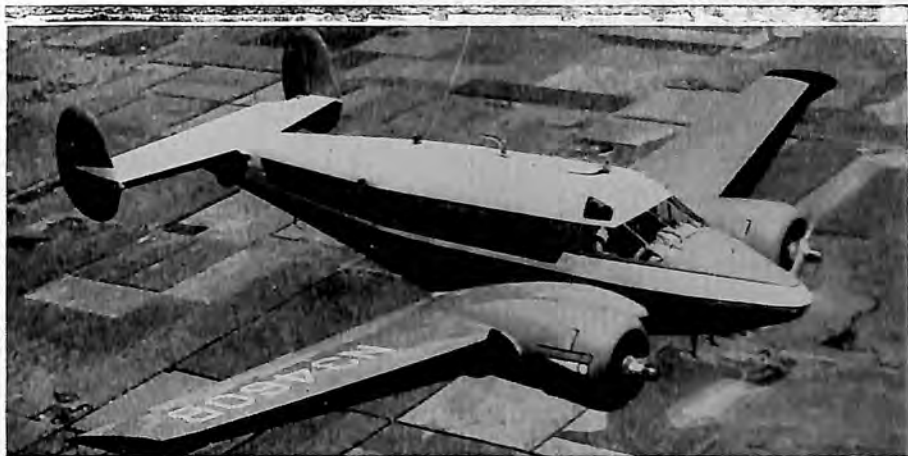
6½ in.; Empty Weight 1722 lb.; Gross Weight 2775 lb.; Wing Loading 15.6 lb. per sq. ft.; Power Loading 12.3 lb. per bhp; Engine (standard) Continental E-225-8, 225 hp takeoff; Fuel Capacity 39 gal. (59 gal. with auxiliary tank); Propeller Beech electrically controlled; Gear tricycle, fully retractable. Wing Area 177.6 sq. ft.; Fin-Stabilizer Area 23.8 sq. ft.; Rudder-Elevator Area 12 sq. ft.

**PERFORMANCE** • Maximum Speed 194 mph at 185 hp at 2300 rpm at sea level; Cruise Speed 184 mph at 146 hp at 2300 rpm at 8000 ft.; Landing Speed 55 mph; Rate of Climb 1300 fpm at S. L.; Service Ceiling 19,000 ft.; Maximum Range 1170 mi. at 10,000 ft. at 140 mph.

#### REMARKS

The Bonanza was first flown Dec. 22, 1945. It holds the lightplane non-stop world's distance record of 4,957.240 mi. (see RECORDS). Popular with the business executive, the Bonanza has also had a successful feederline operational history.

## PLANES IN PRODUCTION



Beechcraft Super 18

**TYPE** • Eight place

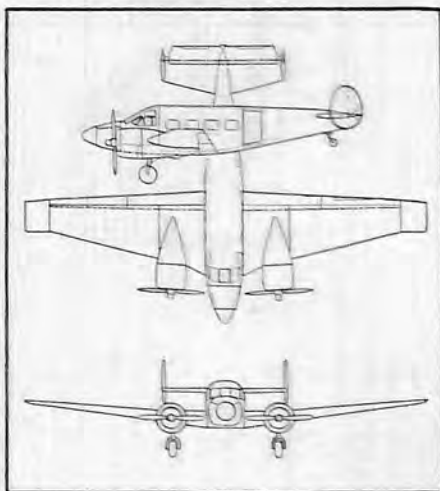
**DESIGNATION** • Super 18 (Model E18S)

**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 (2) Pratt and 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 S. L. at 8750 lb. gross; Range with Maximum Payload 1460 mi. at 10,000 ft., 44.5 percent power. 45 min. reserve.

### REMARKS

The 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 7000 of the military version were built as transports and trainers. The current model features external drag reduction plus many interior improvements.



BELL AIRCRAFT CORP.

HELICOPTER DIVISION

Fort Worth, Tex.



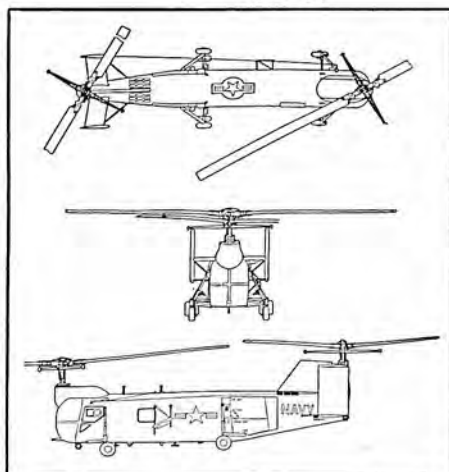
Bell 61 Twin Tandem

Combat

TYPE • Anti - Submarine

DESIGNATION • Model 61 (HSL-1)  
(Navy)

SPECIFICATIONS • Main Rotor Diameter 51 ft. 6 in.; Length 40 ft.; Height 14 ft. 6 in.; Engine Pratt and Whitney R-2800-50, 1900 hp normal rated; Fuel Capacity 425 gal.



PERFORMANCE • Maximum Speed 115 mph; Range 4 hr. endurance.

REMARKS

This is the first helicopter specifically designed for anti-submarine warfare, and marks Bell's first departure from the single main rotor configuration. Navy HSL-1 rotor system has the standard Bell rigid two-blade rotor and automatic stabilizer system. The engine is mounted in conventional position in the aft section of the fuselage. The rotors can be folded rearward, the rear blades folding forward for compact carrier stowage. Stabilizing fins are provided for directional stability in high speed flight.

## PLANES IN PRODUCTION



Bell 47H-1

**TYPE** • Three place

**DESIGNATION** • 47H

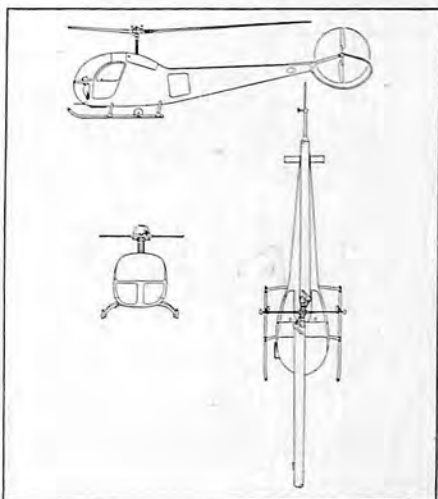
**SPECIFICATIONS** • Main Rotor Diameter 35 ft. 1½ in.; Anti-Torque Rotor Diameter 5 ft. 8 in.; Length 31 ft. 4 in.; Height 9 ft. 3 in.; Empty Weight 1465 lb.; Gross Weight 2350 lb.; Engine Franklin 6V4-1200-C32, 200 hp.; Fuel Capacity 35 gal.

**PERFORMANCE** • Maximum Speed 100 mph; Cruise Speed 90 mph; Rate of Climb 950 fpm at S. L.; Maximum Range 207 mi.

### REMARKS

Streamlined fuselage including semi-monocoque tail boom, arched skid gear, faired gas tanks and other refinements give this new model a substantial range and cruise advantage over previous models. Later model of 47G (Army-AF H-13G; Navy

HTL-6) and model 47G-2 (Army-AF H-13H). Model 47J which adapts proved model 47 dynamic components is now in production.



BOEING AIRPLANE CO.

Seattle, Wash.



Boeing KC-97G Stratofreighter

**TYPE** • Tanker transport

**DESIGNATION** • KC-97G (Air Force)

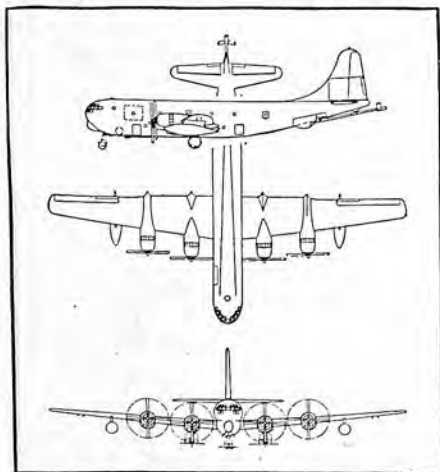
**SPECIFICATIONS** • Span 141 ft. 3 in.; Length 110 ft. 4 in.; Height 38 ft. 3 in. (foldable tail); Gross Weight 153,000 lb.; Maximum Weight 175,-

000 lb.; Engine (4) Pratt and Whitney R-4360-59 Wasp Major, 3500 hp at takeoff; Fuel capacity, 9190 gals.; 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 43000 mi.

**REMARKS**

Flying boom controls and boom operator's station are mounted 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 lb. of heavy cargo such as jeeps, trucks and artillery. Passenger version carries 130 men, ambulance model up to 79 litter patients and attendants.



## PLANES IN PRODUCTION



Boeing B-52 Stratofortress

**TYPE** • Heavy bomber

**DESIGNATION** • B-52 (Air Force)

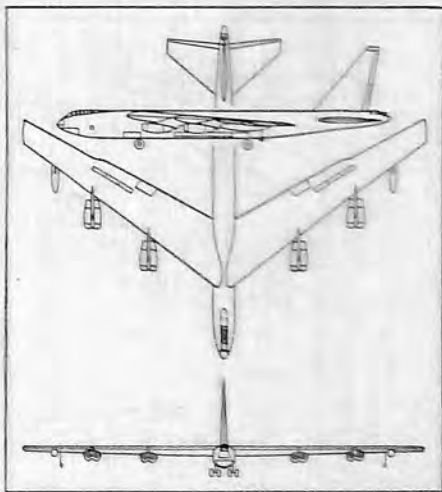
**SPECIFICATIONS** • Span 185 ft.; Sweepback 35 deg.; Length 156 ft.; Height 48 ft.; Gross weight more than 350,000 lb.; Engine (8) Pratt and Whitney J57 turbojet, 10,000 lb. thrust class; Gear eight main wheels in tandem with single outrigger wheels near wing tips.

**PERFORMANCE** • Can be described only as "a very-high speed, long-range heavy bomber with a service ceiling over 50,000 ft. and speed more than 650 mph."

### 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 and B's at Seattle, Wash. It is now build-

ing B-52C's there. B-52D's are in production at Wichita, Kans. 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.





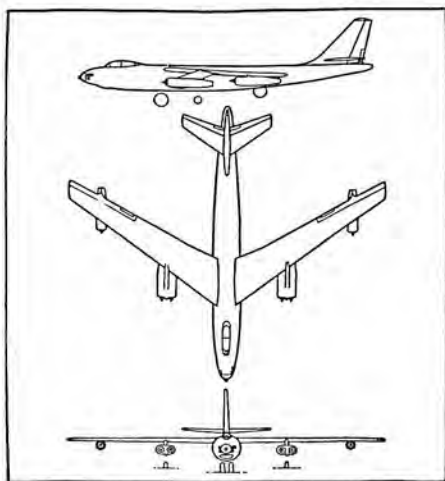


Boeing RB-47E Stratojet (foreground) and B-47E

**TYPE** • Medium Bomber

**DESIGNATION** • B-47E (Air Force)

**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.; Engine (6) 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

The B-47 is the fastest operational medium bomber in the world. The first XB-47 flight took place Dec., 1947 and more than 1200 have been built. Another model, 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, co-pilot riding in tandem and observer-photographer. Among the features of the B-47 are the thin flexible wings which have a drooped 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 mi. flight in 47 hours and 35 minutes with the aid of aerial refueling. Crew: 3.

## PLANES IN PRODUCTION



**Boeing 707 Tanker-Transport Prototype**

**TYPE** • Tanker Transport

**DESIGNATION** • KC-135 (Air Force) this is the advanced version of the 707 transport, details of which are not released.

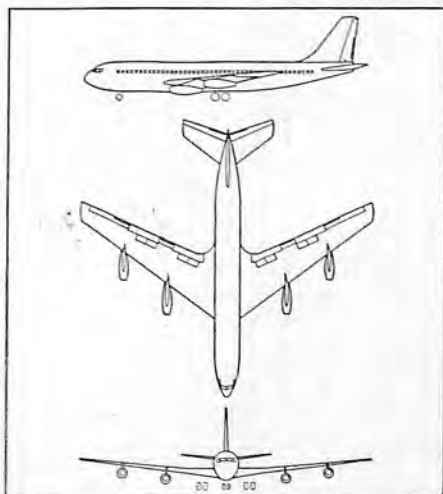
**SPECIFICATIONS** • Span 130 ft.; Sweepback 35 deg.; Length 128 ft.; Height 38 ft. 3 in.; Gross Weight 190,000 lb.; Engine (4) Pratt and Whitney J-57 turbojet, 10,000 lb. thrust class; Gear tricycle, main undercarriage units, four-wheel trucks, dual nose wheels.

**PERFORMANCE** • Cruising Speed 550 mph; Service Ceiling over 42,000 ft.

### REMARKS

America's first jet tanker-transport was rolled from Renton, Wash. plant May 14, 1954, and made its maiden flight July 15, 1954. It was flown at altitudes of more than 42,000 ft. and speeds of over 550 mph in early flight tests. It was ordered into production Sept. 1, 1954. Three-view drawing below is 707. The three other 707's are the -120, the -220 and the -320. The Boeing -120 Jet Stratoliner weighs more than 230,000 pounds and is principally intended for continental use. Its four Pratt & Whitney J57 turbojet engines give it a

high cruise speed of 590 miles per hour. Deliveries of this airplane will start in 1958. The 220 is identical in airframe and body size to the 120, but will be powered by an advanced turbojet engine, larger and of greater thrust than the J57, and will weigh 245,000 pounds, fully loaded. The 320 weighs more than 280,000 pounds, is 12 feet, 2 inches longer overall than the 120 and 220, has 10 feet, 8 inches more in wing span and 500 square feet of additional wing area.



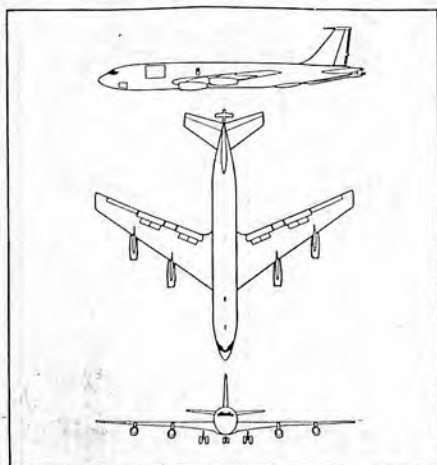


Boeing KC-135

**TYPE** • Tanker-transport  
**DESIGNATION** • KC-135  
**SPECIFICATIONS** • Span 130 ft. 10 in.; Length 136 ft. 3 in.; Sweepback

35 deg.; Height 38 ft. 5 in.; Engines 4 Pratt & Whitney J57 turbojet, 10,000 lb. thrust class; Gear tricycle, main undercarriage units, four-wheel trucks, dual nose wheels.

**PERFORMANCE** • All data classified.



**REMARKS**

The first production model of the KC-135 Stratotanker was rolled from the Renton, Wash., plant July 18, 1956, and made its maiden flight Aug. 31, 1956, spending an hour and 19 minutes in the air before landing at Boeing Field in Seattle. The KC-135 will supplant the KC-97 as the U.S. Air Force's standard aerial refueling tanker. 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, America's first jet transport.

PLANES IN PRODUCTION  
CESSNA AIRCRAFT CO.  
Wichita, Kans.



Cessna Model 180

**TYPE** • Four place

**DESIGNATION** • 180

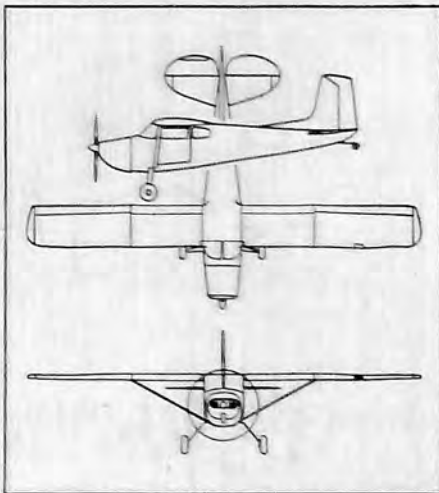
**SPECIFICATIONS** • Span 36 ft.; Length 26 ft.; Height 7 ft. 6 in.; Empty Weight 1490 lb.; Gross Weight 2550 lb.; Wing Loading 14.6 lb. per sq. ft.; Power Loading 11.1 lb. per bhp; Engine Continental 0470-K, 230 hp at 2600 rpm; Fuel Capacity 60 gal.; Propeller All-Metal constant speed; Wing Area 175 sq. ft.

**PERFORMANCE** • Maximum Speed over 165 mph; Cruise Speed over 150 mph; Rate of Climb 1150 ft. at S. L.; Cruising Range over 4½ hrs.; Service Ceiling 19,800 ft.

**REMARKS**

Design improvements on the reliable Continental engine, the new 0470-K, allows lower power settings with the same cruising speeds. New "Hush-Flight" features, such as a re-located muffler exhaust feeding out of a single stack with new engine mounts, give a much quieter cabin ride.

Trim operates full horizontal stabilizer. Equipped with Cessna "Para-Lift" flaps with 20-30-40 deg. This model is available on floats.

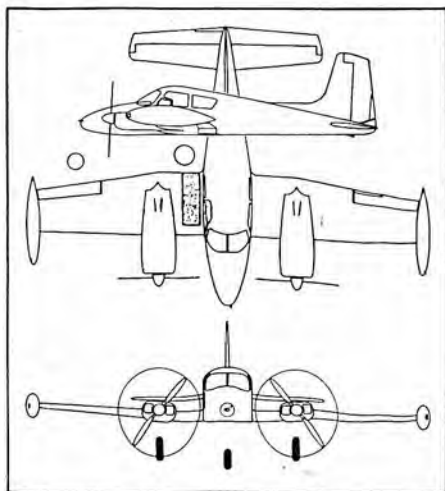




Cessna 310

**TYPE** • Five place

**DESIGNATION** • 310



**SPECIFICATIONS** • Span 36 ft.; Length 27 ft.; Height 10.5 ft.; Empty Weight 2900 lb.; Gross Weight 4600 lb.; Wing Loading 26.2 lb. per sq. ft.; Power Loading 9.6 lb. per bhp; Engine (2) 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 over 220 mph; Cruise Speed over 205 mph; Rate of Climb 1700 fpm; Service ceiling 20,000 ft.; Range with Maximum Payload 875 mi.

**REMARKS**

Outstanding performance and over 205 mph cruise is standard on this model. Wing tip tanks, augments exhaust tubes, and fully-enclosed retractable gear plus internal antennae. Oxygen and 30-gallon auxiliary fuel system available as optional equipment.

## PLANES IN PRODUCTION



Cessna 182

**TYPE • Four place**

**DESIGNATION • 182**

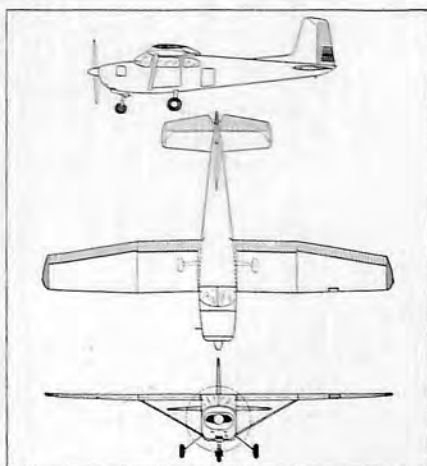
**SPECIFICATIONS • Span 36 ft.; Length 26 ft.; Height 9 ft. 4 in.; Empty Weight 1,510 lb.; Gross Weight 2,550 lb.; Wing Loading 14.6 lb. per sq. ft.; Power Loading 11.1 lb. per bhp; Engines Continental O-470-L, 230 hp @ 2,600 rpm; Fuel Capacity 60 U. S. gal.; Propeller all metal constant speed; Wing Area 175 sq. ft.**

**PERFORMANCE • Maximum Speed Over 160 mph; Cruise Speed Over 150 mph; Rate of Climb 1,100 fpm at sea level; Service Ceiling 19,000 ft.; Range Over 4½ hours at gross weight.**

### REMARKS

Model 182 with "Land-O-Matic" gear was first introduced to the U. S. market in March, 1956. Airplane designed primarily for businessmen pilots learning to fly. New "Hush Flight" features, such as re-located muffler exhaust feeding out of a single stack with new engine mounts, gives a

quieter cabin ride. Equipped with Cessna "Para-Lift" flaps with 20-30-40 deg. Rear seat can be removed for cargo weighing more than a quarter of a ton. Airplane has excellent ground handling characteristics.





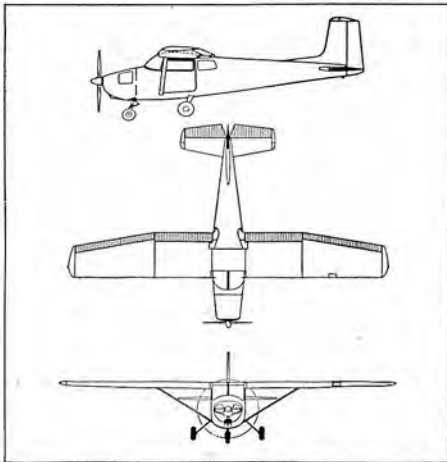
Cessna 172

**TYPE** • Four place  
**DESIGNATION** • 172

**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; Engines Continental O-300-A (6-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. @ 70% 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.



#### REMARKS

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 take-off runs and slow, easy descent when landing.

## PLANES IN PRODUCTION



Cessna T-37A

**TYPE** • Two-place jet trainer

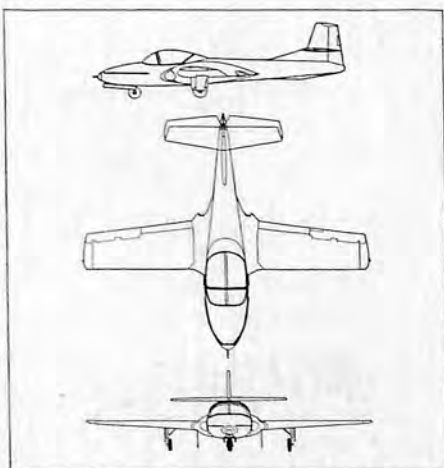
**DESIGNATION** • T-37A

**SPECIFICATIONS** • Span 33 ft. 10 in.; Length 27 ft. 7 in.; Height 9 ft. 4 in.; Empty weight 3910 lb.; Gross weight 6450 lb.; Engines (2) J69-T9 Continental, 920 lb. thrust maximum at 22,700 rpm.; Fuel capacity 317 U. S. gals.; Main tire 20 x 4.4; Nose tire 600 x 6; Wing Area 183.9 sq. ft.; Aileron area 11.39 sq. ft.; Flap Area 15.10 sq. ft.; Fin Area 12.41 sq. ft.; Rudder Area 6.24 sq. ft.; Stabilizer Area 31.45 sq. ft.; Elevator Area 11.64 sq. ft.; Vertical Tail Area 17.78 sq. ft.

**PERFORMANCE** • Maximum Speed 339 knots military power  $\frac{1}{2}$  fuel at 35,000 ft.; Cruise Speed 301 knots normal fuel at normal rated power at 35,000 ft.; Landing Speed 88 knots. Service ceiling 33,000 ft. at 6100 lb. gross weight and normal power; Range at 273 knots cruise at 35,000 ft., 705 nautical miles. Cruise ceiling at half fuel 35,400 ft.

### REMARKS

The Cessna T-37A twin-jet trainer was developed to fit the needs of the U. S. Air Force for a twin-jet 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.





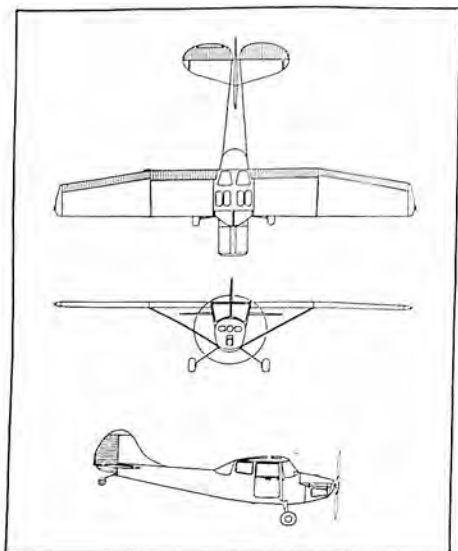


Cessna TL-19D

**TYPE** • Instrument trainer

**DESIGNATION** • TL-19D

**SPECIFICATIONS** • Span 36 ft.;  
Length 25 ft. 9 in.; Height 7 ft. 6 in.;



Empty Weight 1700 lb.; Gross Weight 2400 lb.; Wing Loading 13.79 lb. per sq. ft.; Power Loading 11.2 lb. per bhp; Engines Continental O-470-15, 190 hp normal rated, or 213 hp at 2600 rpm takeoff; Fuel Capacity 42 gal.; Propeller all-metal constant speed; Main Tire 700 x 6; 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** • Cruise Speed 122 knots at 149 hp at 5000 ft.; Stalling Speed 45 knots with flaps; Rate of climb 1100 fpm at sea level; Service Ceiling 18,500 ft.; Range at cruising speed with 40 gal. fuel 380 nautical miles.

#### REMARKS

TL-19D 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 U. S. Army where airplane will serve as instrument trainer.

PLANES IN PRODUCTION

CHANCE VOUGHT AIRCRAFT, INC.

Dallas, Tex.



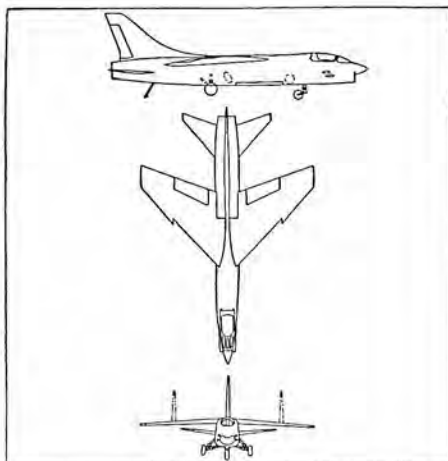
Chance Vought F8U-1 Crusader

**TYPE** • Carrier based  
Navy fighter

**DESIGNATION** • F8U-1 (Navy)

**REMARKS**

In production at Chance Vought during the year was the F8U-1 powered by a Pratt and Whitney J57 engine. The Crusader is the Navy's newest medium-size day fighter capable of flying faster than 1000 miles per hour in level flight. This high-winged aircraft is designed for carrier operations. The air scoop is located underneath a cone-shaped nose, a feature that makes the Crusader easily recognizable. It carries 20 mm. firing cannon as well as other armament. Specifications and performance data have not been released.

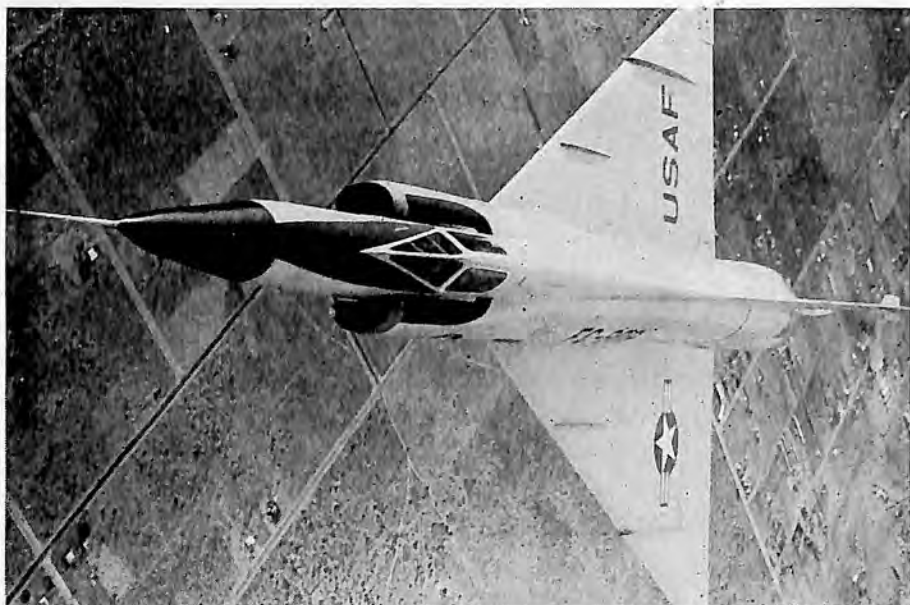


The F8U-1 *Crusader*, established as the world's fastest Navy fighter and holder of the Thompson Trophy national speed record of 1,015.428 miles per hour, was delivered to the Navy in December, 1956, for a fleet indoctrination program.

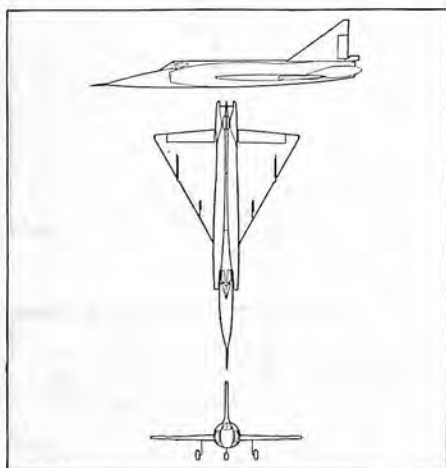
CONVAIR

A DIVISION OF GENERAL DYNAMICS CORPORATION

San Diego, Calif.



Convair F-102A Delta Wing Interceptor



**TYPE** • Interceptor

**DESIGNATION** • F-102A (Air Force)

**SPECIFICATIONS** • Span 38 ft. 1.6 in.; Length 68 ft. 3 in.; Height 21 ft. 3 in.; Gross Weight 25,600 lb.; Engine Pratt & Whitney J57.

**PERFORMANCE** • All data are classified.

**REMARKS**

The F-102A is a large delta wing interceptor designed for either piloted or pilotless flight. It uses the Hughes guidance equipment and mounts the Hughes Falcon missile. The first production model was completed in March, 1954. First all-weather supersonic interceptor for the Air Force, the F-102A electronic and armament improvements make it a lethal weapon in any kind of weather. Entered Air Defense Command operational service in 1956.

## PLANES IN PRODUCTION



Convair 440 Metropolitan

**TYPE** • Transport

**DESIGNATION** • 440

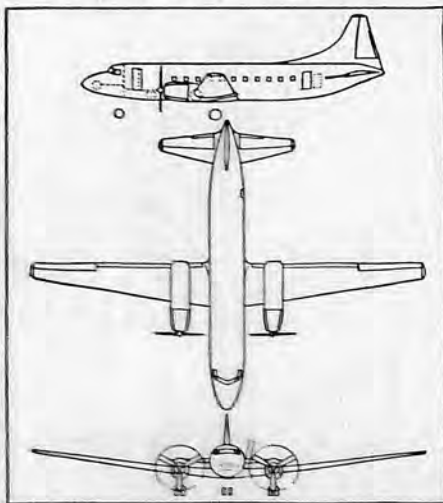
**SPECIFICATIONS** • Span 105 ft. 4 in.; Length 79 ft. 2 in.; Height 28 ft. 1 in.; Empty Weight 31,305 lb.; Gross Weight 49,100 lb.; Wing Loading 53.3 lb. per sq. ft.; Power loading 9.82 lb. per bhp; Engines (2) Pratt and Whitney R-2800-CB-17, 2500 hp normal rated; Fuel Capacity 1730 gal.; Propeller Hamilton-Standard, hydromatic; Main Tire 12.5 x 16; Nose Tire 7.5 x 14; 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 S. L.; Service Ceiling 25,000 ft.; Range with Maximum Payload 400 mi.; Range with Maximum Fuel Load 2450 mi.

### 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 pur-

chased 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.





Convair R3Y-2 Tradewind

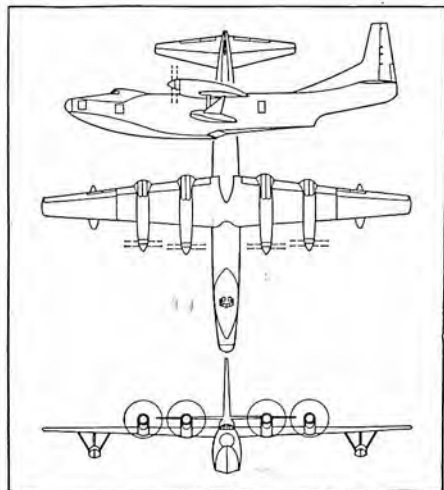
**TYPE** • Tanker Transport  
**DESIGNATION** • R3Y-2 (Navy)  
**SPECIFICATIONS** • Span 145 ft. 9 in.; Length 139 ft. 8 in.; Height 51

ft. 5 in.; Empty Weight 80,000 lb.; Maximum Gross Weight 175,000 lb.; Design Gross Weight 145,000 lb.; Engine (4) Allison T40A-10, 5500 hp takeoff; Propeller Aeroproducts three blade.

**PERFORMANCE** • Maximum Speed 386 mph at 25,000 ft.; Cruise Speed 300 mph; Rate of Climb 2500 fpm; Range with Maximum Payload 2300 mi.

#### REMARKS

The new production version of the XP5Y-1 features extensive redesign with completely refaired bow, new high aspect ratio vertical tail, new engine installations, modified float support structure. The R3Y-2 loads from the bow and is the assault transport version. The original model was the first multi-engine turboprop airplane. It made its initial flight April, 1950. Design features high length-beam ratio hull for low drag in flight and improved water handling characteristics. Seaplane tanker-transport.



## PLANES IN PRODUCTION



Convair R4Y-1 Transport

**TYPE** • Transport

**DESIGNATION** • R4Y-1 (Navy)

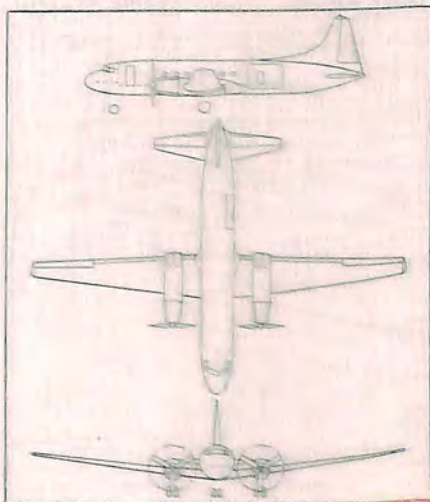
**SPECIFICATIONS** • Span 105 ft. 4 in.; Length 79 ft. 2 in.; Height 28 ft. 2 in.; Empty Weight 30,684 lb.; Gross Weight 47,000 lb.; Wing Loading 51.1 lb. per sq. ft.; Power Loading 9.8 lb. per bhp; Engines (2) Pratt and Whitney R-2800-52W, 2400 hp normal rated; Fuel Capacity 1730 gal.; Propeller Hamilton-Standard, hydromatic; Main Tire 12.5 x 16; Nose Tire 7.5 x 14; 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** • Maximum Speed 221 mph at 1570 hp at 2600 rpm at 16,000 ft.; Cruise Speed 203 mph at 1200 hp at 2300 rpm at 16,000 ft.; Stalling Speed 65 mph; Rate of climb 1220 fpm at S. L.; Service Ceiling 23,400 ft.; Range with Maximum Payload 390 mi.; Range with Maximum Fuel Load 1370 mi.

### REMARKS

Navy cargo version of the Convair-Liner 340. The R4Y-1, which is being built in

volume at Convair-San Diego for the Navy, can be used as a personnel transport with rearward facing seats, an evacuation plane equipped with litters or as a cargo carrier. Seats and litters may be removed or installed quickly. The plane also is equipped with a 120-inch wide cargo door on the left side, largest ever installed in this type of Convair plane.



DOUGLAS AIRCRAFT CO., INC.

Santa Monica, Calif.



Douglas F4D-1 Skyray

**TYPE** • Fighter

**DESIGNATION** • F4D-1 (Navy)

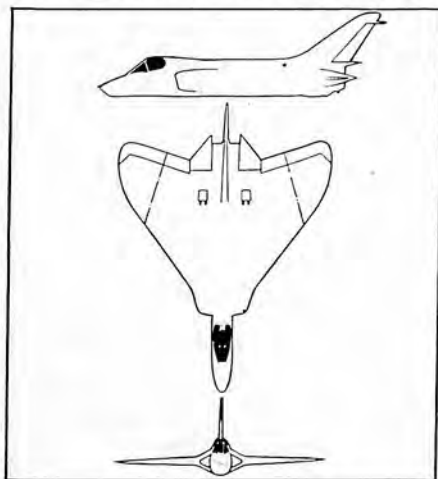
**SPECIFICATIONS** • Span 33 ft. 6 in.;  
Length 45 ft. 8.5 in.; Height 13 ft.;  
Gross Weight about 20,000 lb.; En-

gine Pratt and Whitney J57 with after-  
burner.

**PERFORMANCE** • All data are clas-  
sified.

**REMARKS**

One of three Douglas aircraft to go into fleet service during 1956, the F4D Skyray joined the U.S. fleet in April, 1956. The Skyray was designed for all-weather operations. Its light weight and extremely high rate of climb make it a potent weapon to intercept modern bombers at high altitudes. Although basically designed for interception missions with guns and rockets, the F4D can be used effectively as a general purpose fighter. It also is capable of performing ground support missions using bombs and missiles. It is the first carrier-based airplane ever to hold the world's speed record. On Oct. 3, 1953, the F4D set the world's official speed record over a three kilometer (1.863 mi.) course averaging 752.9 mph in four passes. On Oct. 16, 1953, the same plane averaged 728.110 mph for a 100 kilometer (62.1 mi.) course record.



## PLANES IN PRODUCTION



Douglas DC-7

**TYPE** • Transport

**DESIGNATION** • DC-7

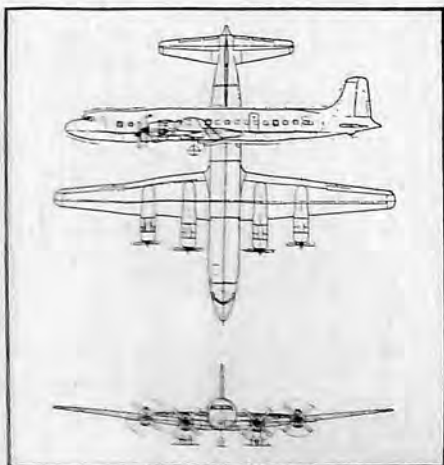
**SPECIFICATIONS** • Span 117 ft. 6 in.; Length 108 ft. 11 in.; Height 28 ft. 7 in.; Gross Weight 126,000 lb.; Wing Loading 86.2 lb. per sq. ft.; Power Loading 9.7 lb. per bhp; Engine (4) Wright R-3350 turbo compound, 3250 hp at takeoff; Fuel Capacity 6478 gal.; Propeller Hamilton Standard, four blade; 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 1800 hp at 2400 rpm at 23,000 ft.; Landing Speed 122 mph; Rate of Climb 1673 fpm at S. L.; Service Ceiling 23,300 ft.; Absolute Ceiling 24,400 ft.; Range with Maximum Payload 3565 mi.; Range with Maximum Fuel Load 5155 statute miles.

### 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 non-stop transcontinental flights. The DC-7B is equipped with saddle tanks for greater range. Third model is the DC-7C with a ten ft. greater wing span, 40 in. longer fuselage. Added fuel carried in the extended wing root increases operating range to 5000 mi. with reserves. Engine modifications provide a total of 400 greater climb hp. Carries 64 to 95 passengers.

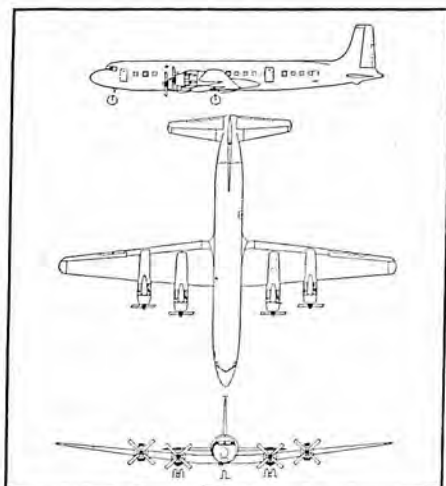






Douglas DC-7C Seven Seas

**TYPE** • Transport  
**DESIGNATION** • DC-7C  
**SPECIFICATIONS** • Span 127 ft. 6



in.; Length 112 ft. 3in.; 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 EAI; Takeoff 3400 BHP each; Propeller Hamilton Standard 4-bladed.

**PERFORMANCE** • Maximum speed 405 mph with rated power; Cruise speed 357 mph; Landing speed 116 mph at S. L.; Rate of Climb 1050 fpm at S. L.; Service ceiling 21,600 ft.

#### REMARKS

Success of earlier DC-7 models in domestic U.S. operations led to development of a larger version especially designed for long-range, intercontinental airline service. This version is capable of flying non-stop 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.

## PLANES IN PRODUCTION



Douglas DC-8

**TYPE** • Transport

**DESIGNATION** • Douglas DC-8

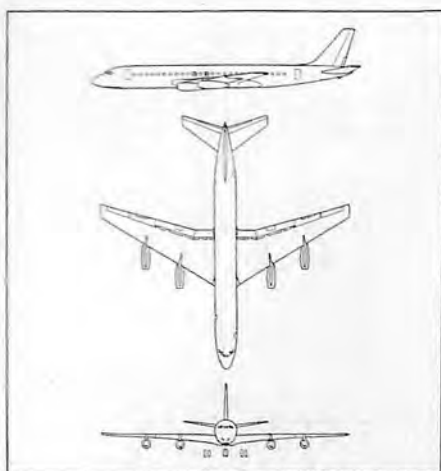
**SPECIFICATIONS** • Span 139 ft. 8.5 in.; Length 150 ft. 6.3 in. Height 42 ft. 4.2 in.; Empty Weight 115,839 lb.; T.O. Gross Weight 265,000 lb.; Wing Loading 96.2 lb. per sq. ft.; Engines (4) P & W JT3C-6-Turbojet; Fuel Capacity 17,600 gal.; Main Tire Dual Tandem 15.50-18.; Nose Tire Dual 11.00-14; 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 max. continuous thrust at 25,000 ft.; Cruise Speed 566 mph at max. cruise thrust at 30,000 ft.; Landing Stall Speed 116 mph.; Rate of Climb at max. gross wt. 1670 fpm at SL; Service Ceiling at max. gross wt. 35,500 ft.; Range with Maximum Payload 4660 mi.; Absolute Range with Maximum Fuel Load 6050 mi.

### REMARKS

All models of the DC-8 have identical dimensions, differing only in weight, result-

ing from more fuel capacity and structural accommodations for the added fuel on intercontinental models. Three power plants may be selected: Pratt & Whitney JT-3C and JT-4A for domestic models, and JT-4A and Rolls Royce Conway for the intercontinental versions. First flight is scheduled for March, 1958; first delivery in November, 1959.





Douglas DC-6B

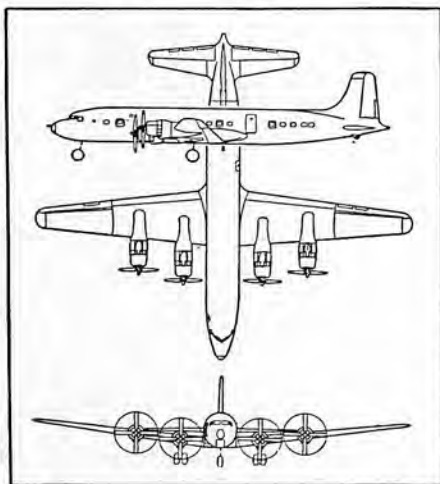
**TYPE** • Transport

**DESIGNATION** • DC-6B

**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; Engine (4) Pratt and Whitney R-2800-CB17, 2500 hp normal rated; Fuel Capacity 5512 gal.; Propeller Hamilton Standard full feathering reversible pitch; Gear tri-

cycle, 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.

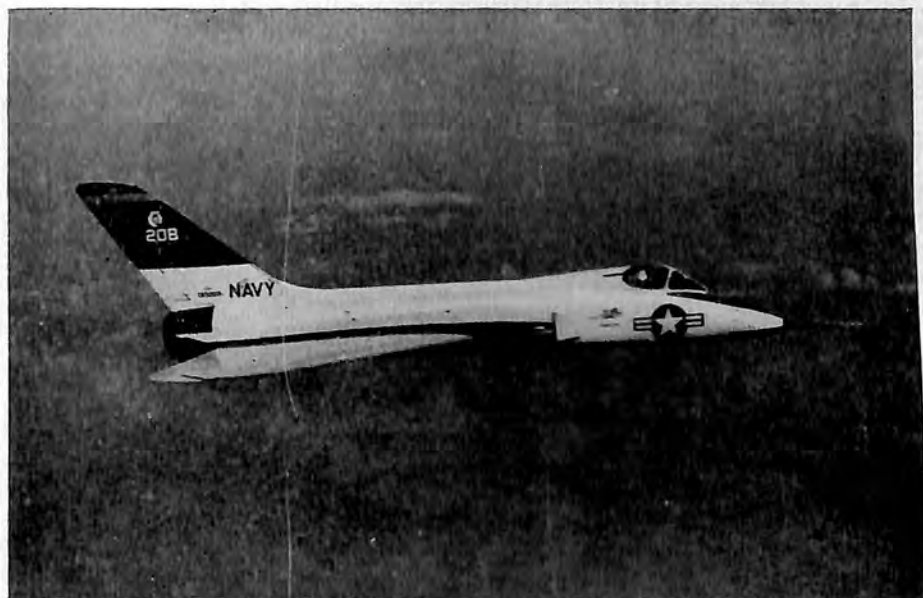
**PERFORMANCE** • Maximum Speed 360 mph at 1750 hp at 2300 rpm at 18,700 ft.; Cruise Speed 315 mph at 1200 hp at 2300 rpm at 22,400 ft.; Landing Speed 106 mph; Rate of Climb 1100 fpm at S. L.; Service Ceiling 21,900 ft.; Range with Maximum Payload 3393 mi.; Range with Maximum Fuel Load 4968 mi.



**REMARKS**

The DC-6A and DC-6B transports are enlarged versions of the DC-6s which first flew Feb. 15, 1946. First step in the evolution was the DC-6A Liftmaster first flown on Sept. 29, 1949. This was followed by the DC-6B, first flown Feb. 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.

## PLANES IN PRODUCTION



Douglas F5D Skylancer

**TYPE** • Fighter

**DESIGNATION** • F5D (Air Force)

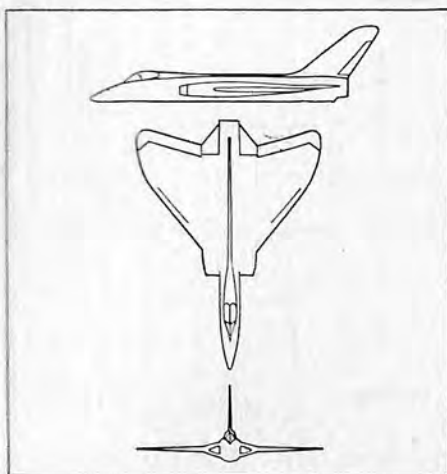
**SPECIFICATIONS** • Engine Pratt & Whitney J57 with afterburner. All other data classified.

**PERFORMANCE** • All data classified.

### REMARKS

First flown April 21, 1956 by Douglas test pilot Bob Rahn. Rated faster than any American jets now in squadron service. 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 wind-

shield. 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 slier like fuselage also contains a fuel cell.





Douglas AD-7 Skyraider

**TYPE** • Carrier-based attack bomber

Propeller Aeroproducts, 4 blades;  
Gear conventional retractable.

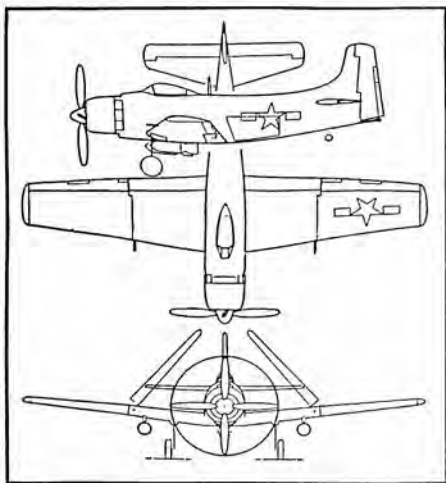
**DESIGNATION** • AD-7 (Navy)

**REMARKS**

**SPECIFICATIONS** • Span 50 ft.; Length 39 ft.; Height 15 ft. 8 in.; Empty weight 12,094 lb.; Gross weight 18,000 lb.; Powerplant Wright R3350, 2700 hp at take-off and 2900 rpm. Fuel capacity 380 gal. with provisions for two 150 gal. drop wing-tip tanks;

Over 3000 AD Skyraiders have been produced by Douglas. The AD-7 is the 50th version of the popular AD Skyraider series built since the prototype took to the air in March 1945. Among basic differences, compared with the AD-6, are an improved Wright R-3350 engine that provides added power, and "beefed up" wings to prolong service life under higher tactical loads. Although current Skyraiders outwardly resemble those of a decade ago, their equipment, speed and performance are considerably improved. The airplane was originally designed to carry 1000-pound bomb loads, but later versions have carried bomb arrangements of over 10,000 pounds, a world record for single-engine airplanes. The AD-7 is a single place dive bomber capable of carrying a variety of weapons at a single loading on its fifteen bomb racks.

An AD-4 set a new world record for loads carried by a single-engine aircraft on May 21, 1953, when it carried a bomb load of 10,500 lb. and a useful load of 14,941 lb. Its basic weight was 11,798 lb. On July 10, 1953, in San Francisco, it was revealed that AD-4B Skyraiders are equipped to carry atomic bombs and had been in operation aboard Navy carriers for nearly a year.



## PLANES IN PRODUCTION



Douglas A3D-1 Skywarrior

**TYPE** • Attack bomber

**DESIGNATION** • A3D-1 (Navy)

**SPECIFICATIONS** • Span 72 ft. 6 in.; Length 74 ft. 5 in.; Height 22 ft. 9 in.; Engines Pratt & Whitney J57. All other data are classified.

### REMARKS

The Douglas A3D Skywarrior is a powerful Navy carrier-based bomber. Rated in the 600-700 mph class, it is capable of flying long-range missions at altitudes above 40,000 feet. The swept wing twin jet has an internal bomb bay which can carry all types of bombs, torpedoes, or munitions utilized on Navy carriers. The Skywarrior, which is swifter than many jet fighters, was designed as an atom-bomber but it is so versatile that it can be used for many other missions. Now in accelerated production at the El Segundo, Calif., Division of Douglas Aircraft Company, Inc., Skywarriors are equipped with two Pratt and Whitney J57 turbojet engines and can carry a crew of three—pilot, co-pilot-bombardier and gunner-navigator. Douglas test pilot George Jansen flew the experimental A3D on its maiden flight Oct. 28, 1952, and the first production model, with different engines, was flown Sept. 16, 1953. The

A3D joined the fleet on March 30, 1956. It was designed not only for operation off Navy supercarriers of the Forrestal class, but also from many carriers currently in use by the fleet. The A3D's basic design formed the pattern for the Air Force's Douglas-built B-66 and RB-66.





Douglas A4D-1 Skyhawk

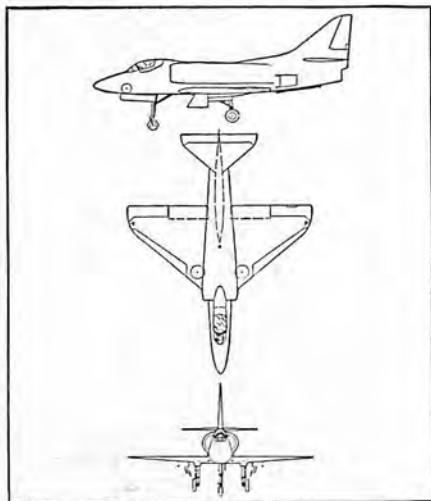
**TYPE** • Attack bomber

**DESIGNATION** • A4D (Navy)

**SPECIFICATIONS** • Span 27 ft. 6 in.; Length 39 ft. 1 in.; Gross Weight 15,000 lb.; Engine Wright J65. All other specifications classified.

#### REMARKS

The A4D Skyhawk, smallest and lightest U. S. jet combat plane ever built, was developed by the Douglas El Segundo Division. It required only 18 months to design and build the first model, and the first flight on June 22, 1954, took place two weeks after the tiny plane came off the production line. First fleet deliveries made in the fall of 1956. One of three Douglas aircraft to enter fleet service during 1956. Although designed for carrier operations, the Skyhawk is small enough to omit the traditional folding wings of that type. Nevertheless, the A4D is capable of carrying atom bombs, rockets, guided missiles, machine guns and other weapons in a wide variety of missions of attack type sea-planes. On Oct. 15, 1955, the A4D set a new speed record for the 500-kilometer closed circuit course, of 695.163 mph, at Edwards Air Force Base, Calif. The airplane was piloted by U. S. Navy Lieutenant Gordon Gray of La Jolla, Calif.



## PLANES IN PRODUCTION



Douglas B-66B Destroyer

**TYPE** • Light bomber

**DESIGNATION** • B-66B (Air Force)

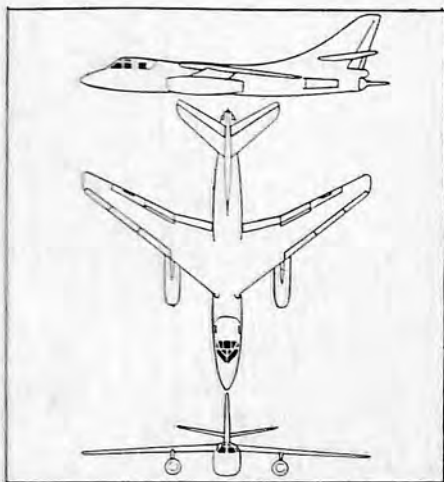
**SPECIFICATIONS** • Span 72 ft. 6 in.; Length 75 ft. 2 in.; Height 23 ft. 7 in.; Empty Weight 40,549 lb.; Design Gross Weight 78,000 lb.; Overload Gross Weight 83,000 lb.; Wing Loading 100 lb. per sq. ft.; Power Loading 4.24 lb. per lb. thrust (takeoff); Engines (2) Allison J-71-A-11, 8090 lb. thrust at 5950 rpm normal rated, or 9200 lb. thrust at 6100 rpm takeoff; Fuel Capacity 4650 gal.; Main Tire 49 x 17 extra high-pressure; Nose Tire 36 x 11 extra high pressure; 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

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 effi-

cient power-to-weight ratio gives ample range for travel far over enemy territory and return. Equipped for probe-and-drogue method of in-flight refueling, range of the aircraft is extended indefinitely. First flight made Jan. 4, 1955; first aircraft delivered to Air Force on March 16, 1956. The B-66B is produced at the Douglas Long Beach Division.







Douglas RB-66 Destroyer

**TYPE** • Reconnaissance

**DESIGNATION** • RB-66 A, B, C  
(Air Force)

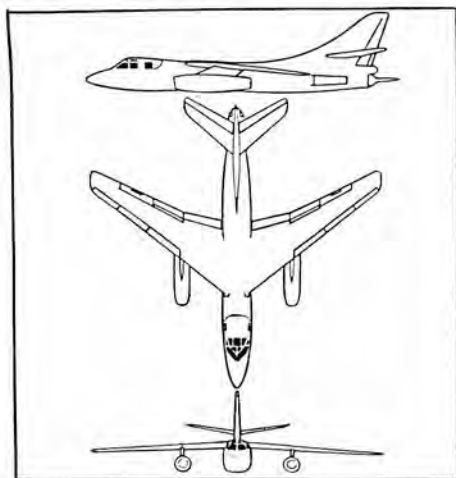
**SPECIFICATIONS** • Span 72 ft. 6 in.;  
Length 75 ft. 2 in.; Height 23 ft. 7  
in.; Empty Weight 42,368 lb.; Gross

Weight 70,000 lb.; Overload Gross  
Weight 83,000 lb.; Wing Loading 90  
lb. per sq. ft.; Engine (2) Allison  
YJ71-A-11; 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.; Ele-  
vator Area 52.2 sq. ft.

**PERFORMANCE** • All data are clas-  
sified.

#### 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 mph 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 in-flight refueling. The RB-66B is manufactured at Douglas Long Beach Division; first flight made June 28, 1954; first aircraft delivered to Air Force on Feb. 1, 1956. The RB-66C is produced at the Douglas Tulsa Division; first flight made Oct. 29, 1955; first aircraft delivered to Air Force on May 11, 1956.



## PLANES IN PRODUCTION



Douglas C-133A

**TYPE** • Heavy cargo transport

**DESIGNATION** • C-133A

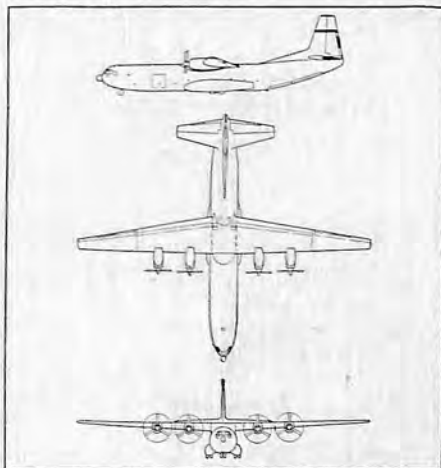
**SPECIFICATIONS** • Span 179 ft. 8½ in.; Length 152 ft. 7½ in. Height 48 ft. 3 in.; Empty Weight 111,235 lb.; Gross Weight 255,000 lb.; Overload Gross Weight 282,000 lb.; Engines (4) T34P-7W Turboprop, 5200 equivalent shaft hp normal rated, or 6000 equivalent shaft hp at 11,000 rpm takeoff; Fuel Capacity 16,000 U.S. gal.; Propeller Curtiss-Wright Corporation CT735S-B108; Main Tire 20.00-20; Nose Tire 15.00-16; Wing Area 2673.1 sq. ft.; Aileron Area 143.3 sq. ft.; Flap Area 496.5 sq. ft.; Fin Area 353.7 sq. ft.; Rudder Area 183.0 sq. ft.; Stabilizer Area 459.2 sq. ft.; Elevator Area 341.5 sq. ft.

**PERFORMANCE** • All data classified.

### REMARKS

The C-133A turboprop cargo transport has the ability to haul a 50,000-pound payload 3500 nautical miles, or a 50-ton load for distances up to 1200 miles. Ninety-six per cent 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 cu. ft. 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.



FAIRCHILD AIRCRAFT DIVISION  
FAIRCHILD ENGINE & AIRPLANE CORP.  
Hagerstown, Md.



Fairchild F-27

**TYPE** • Passenger transport

**DESIGNATION** • F-27

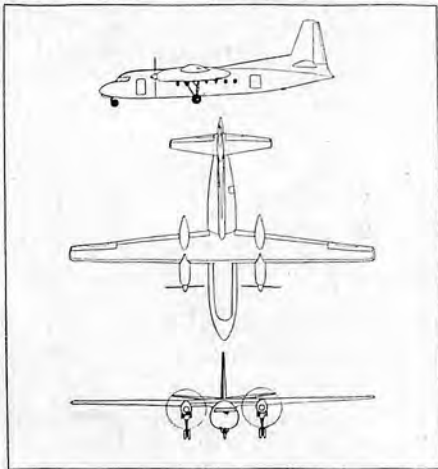
**SPECIFICATIONS** • Span 95 ft. Length 76 ft.; Height 27 ft. 6 in.; Empty Weight 21,645 lb.; Gross Weight 34,520 lb.; Wing Loading 43.3 lb. per

sq. ft.; Power Loading 10.8 lb. per shp; Engines (2) Model 506 Mark 511 Rolls Royce Dart propjets, 1600 hp normal rated; Wing Area 754 sq. ft.

**PERFORMANCE** • Cruise Speed 280 mph; Rate of climb 1500 fpm at SL; Range with Maximum Payload 2250 mi.

**REMARKS**

The basic configuration of the F-27, a high-wing, tricycle gear aircraft, was proved by exhaustive wind tunnel tests at the National Aeronautical Laboratory in Amsterdam in 1951. The high wing, of stressed skin construction, was chosen because it provides inherent stability, and because it permits faster ground loading and off-loading and makes possible unobstructed visibility for passengers. Block-to-block flight times of the F-27 will be superior to those of any other twin piston-engine transport. On the basis of "route time" studies, cost projections indicate the F-27's operating costs will be lower than those of comparable twin-engine aircraft. The performance of the F-27, coupled with greatly improved servicing and ground handling, will enable operators to meet any schedule with unmatched on-time dependability.



## PLANES IN PRODUCTION



Fairchild C-123B

**TYPE** • Transport

**DESIGNATION** • C-123B (Air Force)

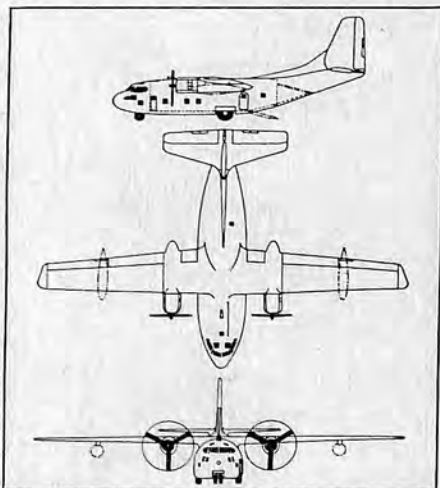
**SPECIFICATIONS** • Span 110 ft.; Length 76 ft. 3 in.; Height 34 ft. 1 in.; Empty Weight 30,812 lb.; Gross Weight 56,500 lb.; Overload Gross Weight 60,000 lb. (estimate); Wing Loading 44 lb. per sq. ft.; Power Loading 10.8 lb. per bhp; Engine (2) Pratt and Whitney R-2800, 1900 hp normal rated 2500 hp takeoff; Fuel Capacity 2414 gal. (includes auxiliary wing tanks); Propeller Hamilton Standard three blade; Gear tricycle dual wheels; Wing Area 1223.2 sq. ft.; Aileron Area 83.3 sq. ft.; Flap Area 128 sq. ft.; Fin Area 186.7 sq. ft.; Rudder Area 59.2 sq. ft.; Stabilizer Area 217.7 sq. ft.; Rudder Area 59.2 sq. ft.; Elevator Area 127.9 sq. ft.

**PERFORMANCE** • Maximum Speed 208 mi. at 1800 hp at 2600 rpm at 13,000 ft.; Cruise Speed 186 mi. at 1150 hp at 2150 rpm at S. L.; Landing Speed 85 mi.; Rate of Climb 1100 fpm at S. L.; Service Ceiling 29,000 ft.; Absolute Ceiling 30,000; Range with 18,000 lb. Payload 1000 mi.;

Range with Maximum Fuel Load 2990 mi.

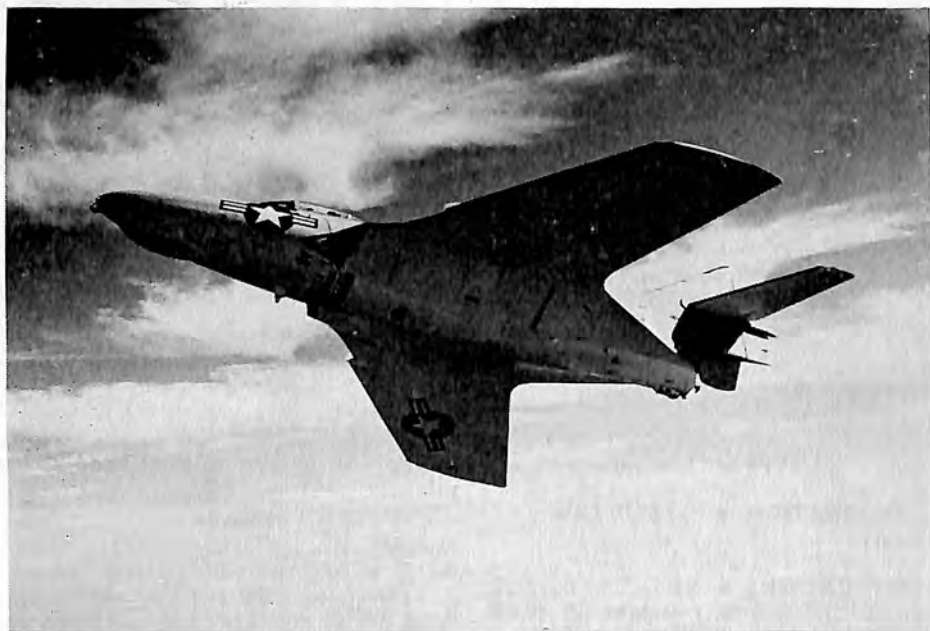
### REMARKS

Normal cargo load of the C-123B is 16,000 lb. It is equipped with integral hydraulically operated ramp and cargo door. Tie down fittings are stressed for 10,000 lb. in any direction and are spaced on the cargo compartment floor on a 20-in. grid pattern. The C-123B was designed specifically as a cargo plane and can carry 60 fully-equipped troops, and 50 litter patients.



GRUMMAN AIRCRAFT ENGINEERING CORP.

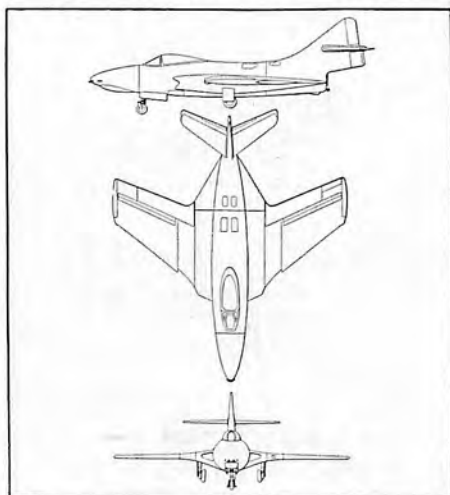
Bethpage, L. I., N. Y.



Grumman F9F-8 Cougar

**TYPE** • Fighter  
**DESIGNATION** • F9F-8 (Navy)

**SPECIFICATIONS** • Span 34 ft. 6 in.; Length 41 ft. 7 in.; Height 12 ft. 3 in.; Engine Pratt and Whitney J48-P-8, 7250 lb. thrust.



**PERFORMANCE** • All data are classified.

**REMARKS**

The F9F-8 has greater range, speed and is more maneuverable than the earlier F9F-6. Changes included replacing the movable wing slats with fixed cambered leading edges, extending the trailing edges, and lengthening the fuselage eight inches. The Cougar, the Navy's first operational swept-wing fighter, carries a wide variety of external stores and has four 20 mm cannons mounted in its nose. An F9F-8P photo reconnaissance version and an F9F-8T two-seat fighter-trainer model are also in production.

## PLANES IN PRODUCTION



Grumman F11F-1 Tiger

**TYPE** • Fighter

**DESIGNATION** • F11F-1 (Navy)

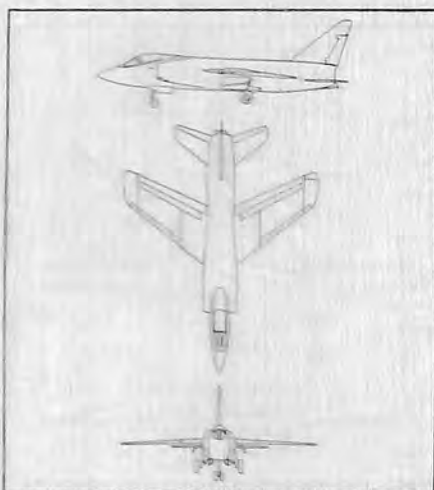
**SPECIFICATIONS** • Span 31 ft. 7 in.; Length 40 ft. 10 in.; Height 12 ft. 8 in.; Engine Wright J65-W-6 with afterburner.

**PERFORMANCE** • All data are classified.

### REMARKS

The F11F-1 Tiger 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 mis-

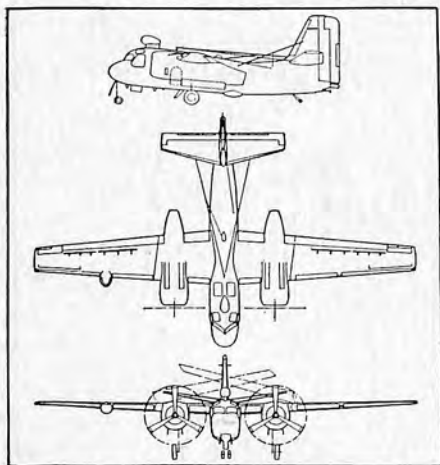
siles. A faster version, the F11F-1F, powered by a General Electric J-79 engine and afterburner, was developed and flown successfully at Edwards Air Force Base, California, in May 1956.





Grumman S2F-1 Tracker

**TYPE** • Anti-submarine  
**DESIGNATION** • S2F-1 (Navy)



**SPECIFICATIONS** • Span 69 ft. 8 in.; Length 42 ft. 3 in.; Height 16 ft. 3 in.; Engine (2) Wright R-1820-82, 1525 hp takeoff.

**PERFORMANCE** • All data are classified.

#### REMARKS

First carrier aircraft combining search and attack elements in one plane. Carries crew of four. Exceptional single-engine performance. Can land and takeoff from smallest carriers. Two modifications of S2F-1 also in production: S2F-2 features enlarged torpedo bay, while TF-1 is a passenger-cargo trainer-utility version.

## PLANES IN PRODUCTION



Grumman SA-16A Albatross

### TYPE • Utility

**DESIGNATION • SA-16A (Air Force), UF-1 (Navy), UF-1G (Coast Guard)**

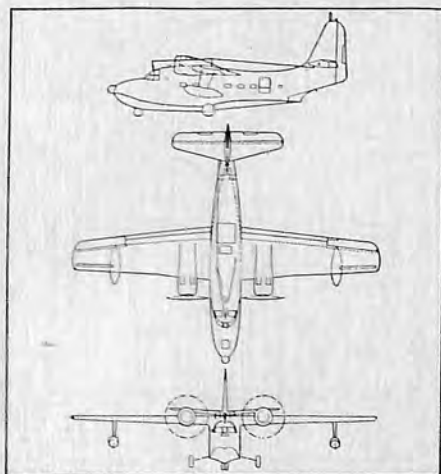
**SPECIFICATIONS • Span 80 ft.; Length 61 ft. 4 in.; Height 24 ft. 5 in.; Engine (2) Wright R-1820-76, 1425 hp takeoff.**

**PERFORMANCE • Maximum Speed 277 mph; Cruise Speed 230 mph.**

### REMARKS

The Albatross, Grumman's largest amphibian, was the first aircraft adopted by the unified Naval-Air Force command. It 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. It carries the widest variety of communication and navigation equipment found in the air today. On active service with every Air Force, Air Rescue

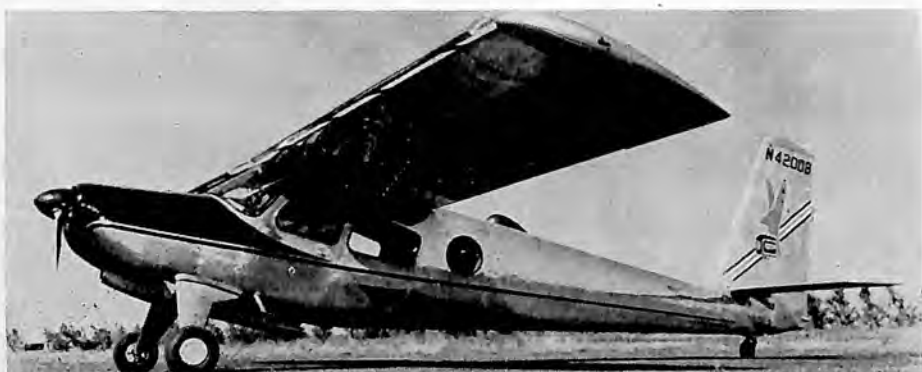
Squadron throughout the world. Crew: 6. The SA-16B, a longer-range, faster version, was evaluated by the U. S. Air Force at Orlando AFB, Florida, early this year. The redesigned aircraft has a greater wingspan and larger horizontal and vertical surfaces than the SA-16A.





HELIO AIRCRAFT CORP.

Norwood, Mass.



Helio All-metal Courier

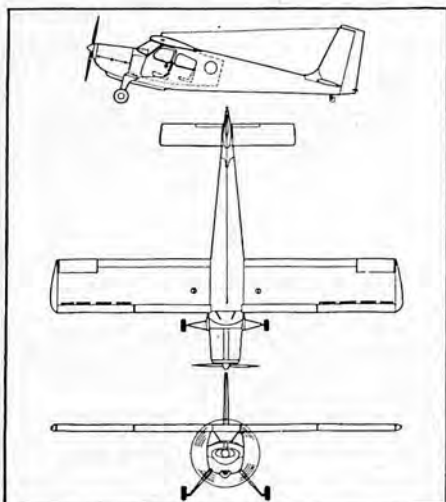
**TYPE** • Four place

**DESIGNATION** • Courier

**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); Engines Lycoming G0435C2B, 240 hp normal rated, or

260 hp at 3400 rpm takeoff; Fuel Capacity 60 gal.; Propeller constant speed; Main Tire 6.50 x 8 Crosswind; Wing Area 231 sq. ft.; Flap Area 74 percent span.

**PERFORMANCE** • Cruise Speed 142 mph at 69 percent hp at S. L. Cruise Speed 169 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.



**REMARKS**

This all-metal "helioplane" combines high speed and long range economy with stall-proof, slow flight and ultra short field utility. Take-off and landing distance over 50 ft. obstacle, no wind, at sea level, at gross weight, is 165 yards. The plane has full controllability down to speeds of 30 mph. 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.

PLANES IN PRODUCTION

HILLER HELICOPTERS

Palo Alto, Calif.



Army H-23C (Hiller 12-C)

**TYPE** • Utility

**DESIGNATION** • H-23C (Army);  
12-C (Commercial)

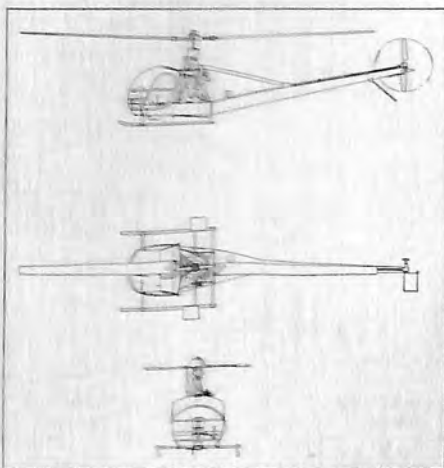
**SPECIFICATIONS** • Main Rotor Diameter 35 ft.; Anti-Torque Rotor Diameter 5.5 ft.; Length 38.7 ft.; Height 9.8 ft.; Empty Weight 1747 lb.; Useful Load 753 lb.

**PERFORMANCE** • Maximum Speed 84 mph at S. L.; Cruise Speed 71 mph at S. L.; Rate of Climb 770 fpm at S. L.; Service Ceiling 9600 ft.; Range 135 mi.

**REMARKS**

The 12-C is the three-place commercial version of this model. Accessories are available for agricultural spraying and dusting, evacuation work, night flying and

executive use. The H-23C is used as a helicopter trainer. A number are also in service with many foreign governments.



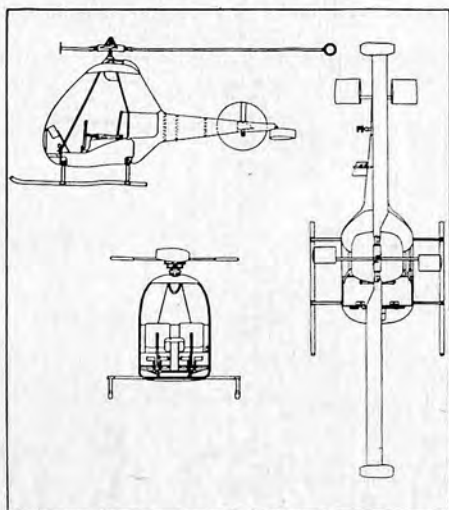


Army YH-32 Hiller-Hornet

**TYPE** • Trainer

**DESIGNATION** • YH-32 (Army)  
HOE-1 (Navy)

**SPECIFICATIONS** • Main Rotor Diameter 23 ft.; Tail Rotor Diameter 2 ft. 8 in.; Length 23 ft.; Height 7 ft. 10 in.; Empty weight 544 lb.; Useful load 536 lb.



**PERFORMANCE** • Maximum Speed 68 mph; Cruise Speed 60 mph; Rate of Climb 680 ft.; Range 26 mi.

**REMARKS**

Army and Navy have ordered several Hornets for evaluation and study of the ramjet helicopter principle and performance in actual service. Both H-32 and HOE-1 are now in service to determine suitability of the two-place jet machine for lightweight reconnaissance and liaison work. Small anti-torque rotor is belt-driven from main rotor.

PLANES IN PRODUCTION

KAMAN AIRCRAFT CORP.

Bloomfield, Conn.



Kaman HOK-1

**TYPE** • Utility

**DESIGNATION** • HOK-1 (Navy)

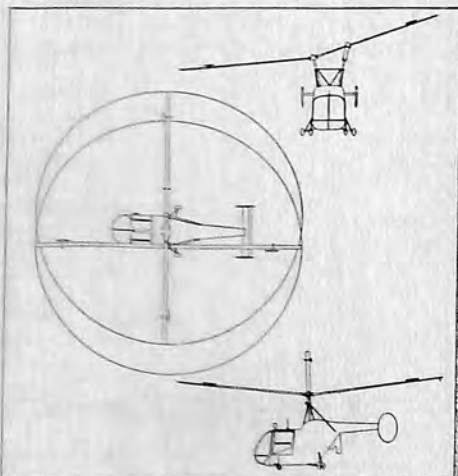
**SPECIFICATIONS** • Rotor Diameter 47 ft.; Length 25 ft.; Height 11 ft. 10 in.; Engine Pratt and Whitney R-1340, 600 hp at 2700 rpm.

**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.

**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 twin vertical fins provide direc-

tional stability in high speed flight. Stabilizer controllable from collective pitch control.



LOCKHEED AIRCRAFT CORP.

Burbank, Calif.



Lockheed 1649A Super Constellation

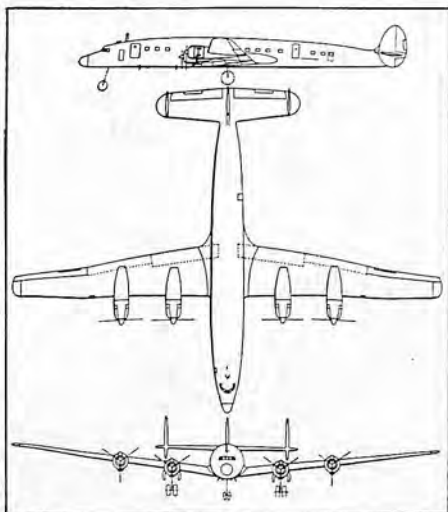
**TYPE** • Transport

**DESIGNATION** • 1649A

**SPECIFICATIONS** • Span 150 ft.; Length 116 ft. 2 in.; Height 23 ft. 4.8 in.; Gross Weight 156,000 lb.; Engines (4) 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 350 mph at 22,600 ft.; Landing Speed 101 mph.; Rate of climb 1660 fpm at S. L.; Service Ceiling 29,500 ft.; Range with Space Limit 5000 mi.; Range with Maximum Fuel Load 6320 mi. plus reserve.



**REMARKS**

The model 1649A represents a major change over previous Super Constellations by having a completely new wing. It embodies the most modern aerodynamic principles for added speed and range and is of significantly different construction. For added range, the 1649A holds 9600 gallons of fuel, 46.5 percent more than previous models. Featuring four separate passenger compartments, the transport will carry 42 passengers in intercontinental siesta arrangement; 58-62 in luxury configuration; and 92 in tourist style. Passenger capacities are slightly higher in domestic operations. Lockheed's 1649A is designed for the installation of weather surveillance/navigation radar—RCA C-band or Bendix X-band—which makes it possible for the pilot to "see" storms and thus avoid turbulence.

## PLANES IN PRODUCTION



Lockheed F-104A Starfighter

**TYPE** • Fighter  
**DESIGNATION** • F-104A  
Air Force

**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.

### REMARKS

World's fastest fighter. Can climb as fast as flies straight and level. First downward ejection seat for a production jet fighter. Two-seat fighter (F-104B) also in production and a photo-reconnaissance version is being readied.

The razor-wings of the Lockheed F-104A *Starfighter* are thinner even than those on rocket research planes. They are so sharp that sheaths are fitted onto wing edges to protect ground crewmen. The wings' down-droop is an aerodynamic design technique enhancing precision control of the high tail. The T-shaped tail's horizontal stabilizer has no elevator and moves as a whole unit.



Lockheed C-130A Hercules

**TYPE** • Medium Combat transport

**DESIGNATION** • C-130A Hercules (Air Force)

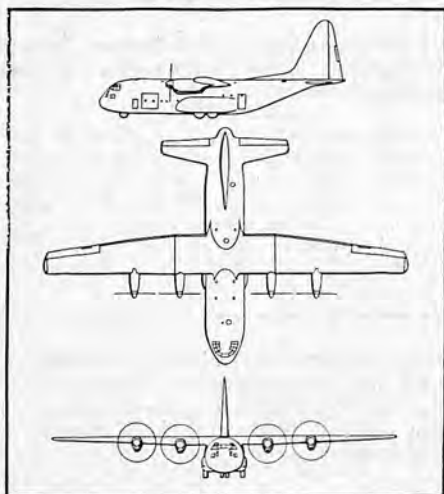
**SPECIFICATIONS** • Span 132.6 ft. Length 97.7 ft. Height 38.1 ft. Empty Weight 58,707 lb. Design Gross Weight 120,000 lb. Transport Gross Weight 124,200 lb. Maximum Wing

Loading 71.2 lb. per sq. ft. Maximum Power Loading 8.27 lb. per eshp. Engines (4) T56-A-1 Allison prop-jet, 3375 eshp normal rated, or 3750 eshp at 13,820 rpm takeoff. Propeller AeroProducts. Main Tire 20:00-20 (20 ply). Nose Tire 12:50-16 (10 ply).

**PERFORMANCE** • Cruise Speed (Combat) 330 mph with payload of 25,800 lb.; Rate of climb 2500 fpm at S. L.; Range (Combat) 2880 mi.

#### REMARKS

First production aircraft were delivered to the Tactical Air Command in 1956. The first prototype flew at Burbank, Calif., in 1954 and the first C-130A, the production version, flew at Marietta, Ga., in April, 1955. The first American transport designed from the beginning as an aerial freighter, utilizing prop-jet power plants, 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 20 tons gross in a cargo compartment which has a clear cubage 41 ft. by 10 ft. by 9 ft. 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, co-pilot, systems manager and navigator.



## PLANES IN PRODUCTION



Lockheed 1049H

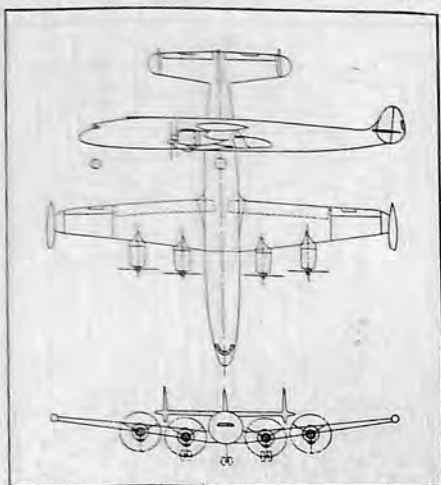
**TYPE** • Cargo/passenger  
**DESIGNATION** • 1049H  
**SPECIFICATIONS** • Span 123 ft.; Length 113 ft. 7 in.; Height 24 ft. 9 in.; Empty Weight 69,326 lb.; Domestic Cargo Gross Weight 131,500 lb.; Wing Loading 33.3 lb. per sq. ft.; Power Loading 10.6 lb. per bhp; Engines (4) Wright 988TC18EA3, 2800 bhp normal rated @ SL, or 3400 hp at 2900 rpm takeoff @ SL; Fuel Capacity 6550 gal.; Propeller Hamilton Standard 43H60-305; Main Tire Dual 17.00 x 20.00; Nose Tire Dual 33 in. wheels; 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 106.3 sq. ft.

**PERFORMANCE** • Maximum Speed 366 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 1670 fpm at SL; Service Ceiling 28,100 ft. @ 113,000 lbs.; Range with Maximum Payload 2587 mi.; Range with Maximum Fuel Load 4197 mi.

### REMARKS

Model 1049H is a cargo-convertible-to-passenger version of the 1049C 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. Its cargo-carrying capacity is one-third greater than any other commercial transport. It is the largest, fastest and most economical cargo transport in world aviation.







Lockheed T-33A Shooting Star

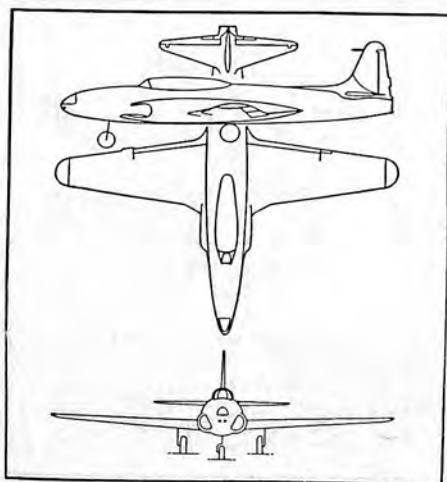
**TYPE** • Jet Trainer

**DESIGNATION** • T-33A (Air Force)  
TV-2 (Navy)

**SPECIFICATIONS** • Span 38 ft. 10½ 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 S. L.; 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 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-33s are also being produced by Canadair Ltd., Montreal for the Royal Canadian Air Force. In addition to being the standard jet trainer in this country, T-33s 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.

## PLANES IN PRODUCTION



Lockheed P2V-7 Neptune

**TYPE** • Patrol-ASW

**DESIGNATION** • P2V-7 (Navy)

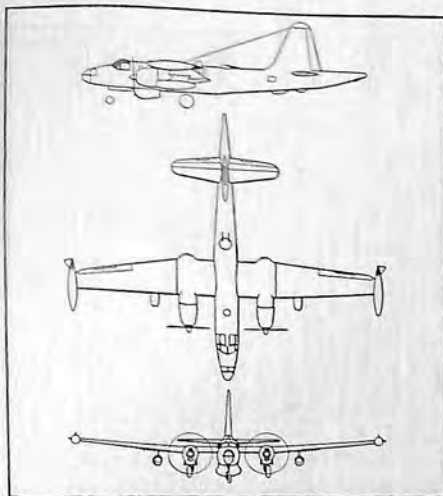
**SPECIFICATIONS** • Span 103 ft. (includes tip tanks); Length 91 ft. 5 in.; Height 29 ft. 4 in.; Empty Weight 43,950, with jet pod engines 47,450 lb.; Gross Weight 72,000 lb., with jet pod engines 75,500 lb.; Engine (2) Wright R3350-32W turbo-compound, 3250 hp and (2) Westinghouse J34 engines in pods, 3400 lb. thrust; Propeller Hamilton Standard three blade; Wing Area 1000 sq. ft.

**PERFORMANCE** • Maximum Speed 300 mph (without pods); Service Ceiling 22,000 ft. (without pods).

### REMARKS

The P2V-7 is the latest in the Neptune anti-submarine warfare series. Identifying features are double-bubble pilot canopy, jet pod engines supplementing its turbo-compound powerplants and elongated tail housing MAD gear (magnetic airborne detector) for locating underwater submarines. Like previous Neptunes, the P2V-7 is a versatile plane which can be converted for patrol, mine laying or torpedo

bomber duty. The J34 pod installations can be cut in for extra power in over-target maneuvers and takeoffs from short runways. The Westinghouse J34s require only three bolts to hold them in place under the wing's leading edge. Lockheed is modifying the P2V-5 and P2V-6 by installing jet pod engines on all aircraft of these series. Crew: 7.





Lockheed RC-121 Super Constellation

**TYPE** • Airborne Early Warning Radar Reconnaissance

**DESIGNATION** • EC-121 (Air Force) WV-2 (Navy) WV-3 (Navy)

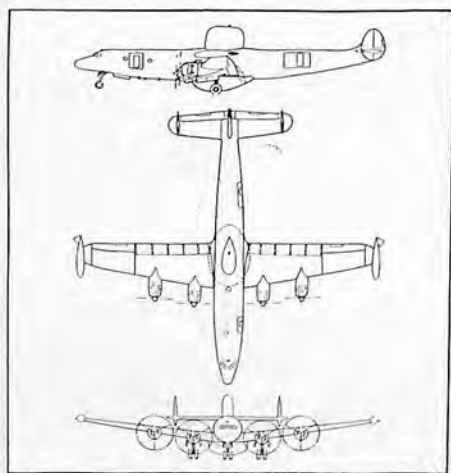
**SPECIFICATIONS** • Span 123 ft.; Length 116 ft.; Height 26 ft.; Empty Weight 81,000 lbs.; Gross Weight 145,000 lbs. (based on claim with two wing tip tanks); Wing Loading 87 lb. per sq. ft.; Engine (4) Wright R3350-34; 3250 hp takeoff, 2600 hp cruise; Fuel Capacity 8,000 plus gal.; Propeller Hamilton 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.

**REMARKS**

Lockheed has also announced the RC-121D, new series which 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 altitude reconnaissance aircraft bulge with more than 6 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 will be used to give air-defense forces extra-early warning of approaching targets. The WV-2's will be used by the Navy primarily to screen U. S. fleets. 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.



## PLANES IN PRODUCTION



Lockheed Electra

**TYPE** • Transport

**DESIGNATION** • Electra

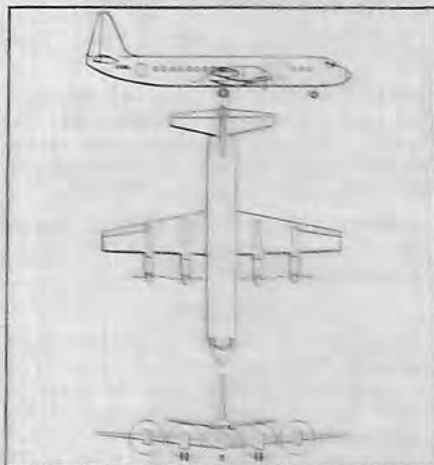
**SPECIFICATIONS** • Span 99 ft.; Length 104 ft. 6.5 in.; Height 32 ft. 11 in.; Empty Weight 56,000 lb.; Gross Weight 113,000 lb.; Engines (4) Allison 501-D13 prop-jet, 3750 hp normal rated; Fuel Capacity 5360 gal.; Wing Area 1300 sq. ft.

**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.

### REMARKS

The Electra was designed with a wide variety of operational capabilities. Among major advancements in its design progression are: extension of range capabilities to include transcontinental nonstop operation; growth of the wing to 1300 square feet of lift area; and increase of its total fuel capacity to 5360 gallons. This is the first all-new four-engine transport ordered by U. S. airlines in a decade. It carries from 66 to 91 passengers. The four Allison 501 turboprop engines pictured on the model above generate 3750 hp each. They operate on the turbine principle, with their turbine wheels linked to propellers. The plane can fly over the highest mountains in the U. S.

on only two engines. Its powerplants are half the weight of comparable piston engines and fit into nacelles only half as wide as for reciprocating units. It is more than 100 feet long, with a wingspread of nearly 100 feet. Its windows measure 16 by 18 inches. Now in production at Lockheed, the Electra is scheduled to start test flights in late 1957 and enter service on American Airlines and Eastern Air Lines in 1958. Braniff International, National Airlines, Western Airlines, and KLM Royal Dutch Airlines have also purchased the Electra.





Lockheed T2V-1 Sea Star

**TYPE** • Jet trainer

**DESIGNATION** • T2V-1 Sea Star (Navy)

**SPECIFICATIONS** • Span 42 ft. incl. 230 gal. tiptanks; Length 38 ft.; Height 13 ft.; Approximate gross takeoff weight 16,400 lb.; Engines Allison J33; Fuel Capacity 760 gal.

**PERFORMANCE** • Maximum Speed 600 mph; Landing Speed 97 mph; Approximate range 900 mi.

**REMARKS**

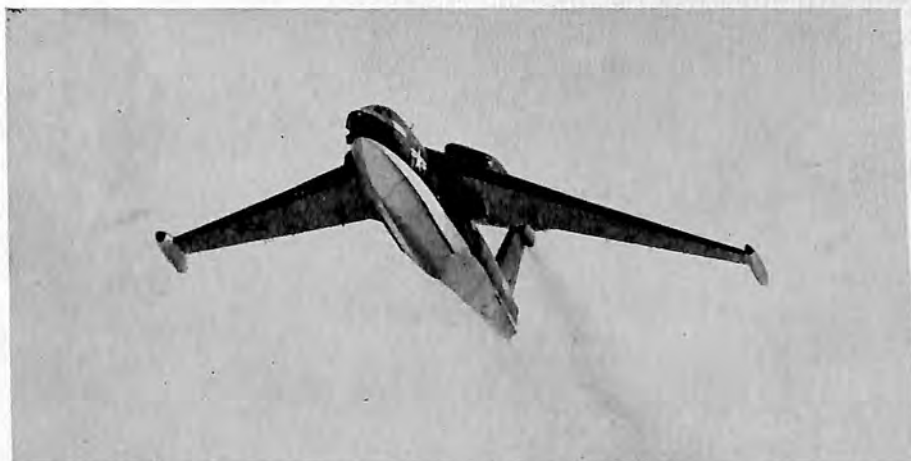
The T2V-1 is the first U. S. production airplane with boundary layer control as standard equipment, and the first two-place jet trainer for pilot training on seagoing aircraft carriers. The sea-going T2V-1, which flies its student-instructor crew at a 600

mph clip but lands at only 97 mph, 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 wing's 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-1s are now in production at Lockheed's California Division, Burbank, Calif.

## PLANES IN PRODUCTION

### MARTIN CO.

Baltimore, Md.



**Martin P6M-1 SeaMaster**

**TYPE** • Attack seaplane

Hinged panels extending the full length and width of engine nacelles permit engine changes while afloat.

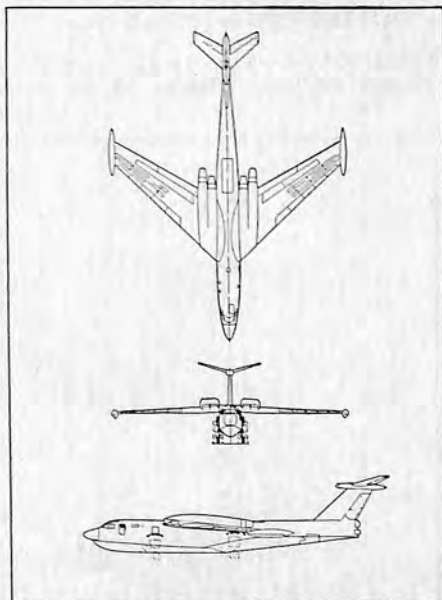
**DESIGNATION** • P6M-1 (Navy)

**SPECIFICATIONS** • Span 100 ft.; Length 134 ft.; Height 31 ft.; Payload 30,000 lb.; Engines (4) 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.

#### REMARKS

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.





Martin P5M-2 Marlin

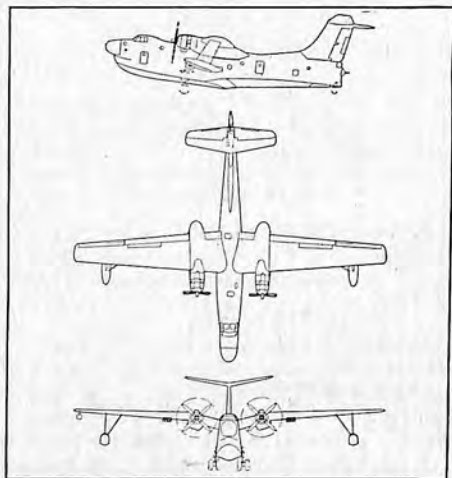
**TYPE** • Patrol

**DESIGNATION** • P5M-2 (Navy)

**SPECIFICATIONS** • Span 118 ft.;  
Length 98.9 ft.; Height 33 ft.; Hull

Width 10 ft.; Gross Weight over 73,000 lb.; Engine (2) Wright R-3350-32W; Propeller Hamilton Standard 4-blade reversible.

**PERFORMANCE** • Maximum Speed 250 mph; Landing Speed 97 mph; Range 2500 nautical miles; Fuel capacity 3635 gals.; Take-off Power 3400 bhp.



The Marlin is an advanced anti-submarine warfare seaplane in service with Navy patrol squadrons in both Atlantic and Pacific fleets. Plane carries the newest 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.

## PLANES IN PRODUCTION



Martin B-57B

**TYPE** • Light bomber

**DESIGNATION** • B-57B (Air Force)

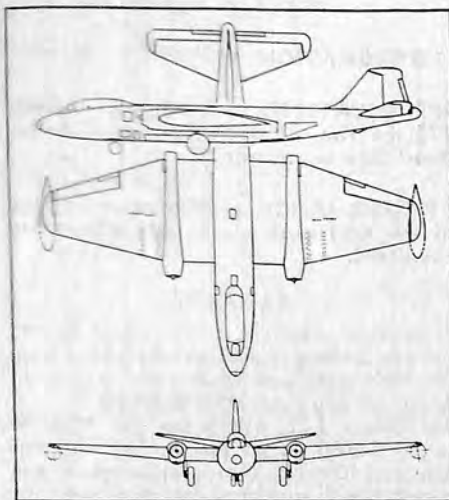
**SPECIFICATIONS** • Span 64 ft.;  
Length 65 ft. 5 in.; Height 16 ft.;  
Gross Weight more than 50,000 lb.;  
Engine (2) Wright J65-W-1, 7220 lb.  
thrust.

**PERFORMANCE** • Maximum Speed  
more than 600 mph; Service Ceiling  
more than 45,000 ft.; Range more  
than 2,000 nautical mi.

### REMARKS

The B-57B 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. Bombs 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, rockets and 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.





McDONNELL AIRCRAFT CORP.

St. Louis, Mo.



McDonnell F3H-2N Demon

**TYPE • Fighter**

**DESIGNATION • F3H-2N (Navy)**

**SPECIFICATIONS • Engine Allison J71 in the 10,000 lb. class; Armament 20mm cannon.**

**PERFORMANCE • Maximum Speed in the 600 mph class. All other data classified.**

**REMARKS**

A powerful single-jet carrier-based fighter, the new Demon is the first airplane to have the Navy gray and white color treatment. A newer, more powerful turbo-jet engine, the Allison J-71, will power the F3H-2N. In the 10,000 pound thrust class, this engine was developed to provide good fuel economy with maximum thrust output. An

afterburner installation augments the engine thrust considerably. Like its predecessor, the F3H-1N, the new Demon is an all-weather, high-performance fighter combining interceptor speed and fighter maneuverability with the pay-load of an attack bomber. Thin wings and tail surfaces are swept sharply back to place the big fighter in the 600-mph speed class. The large internal fuel capacity provides the Demon with the range necessary for fighter-bomber missions. Rapid firing, high velocity 20 mm cannon as well as a large number of rockets and combinations of external stores make the Demon a formidable aerial weapon. Improved radar and latest developments in computing and fire control equipment enable the fighter to operate under all weather conditions. Now under production at the McDonnell plant, the new Demon series is scheduled for delivery to Navy operational units through 1958.

## PLANES IN PRODUCTION



McDonnell F-101A Voodoo

**TYPE • Fighter**

**DESIGNATION • F-101A (Air Force)**

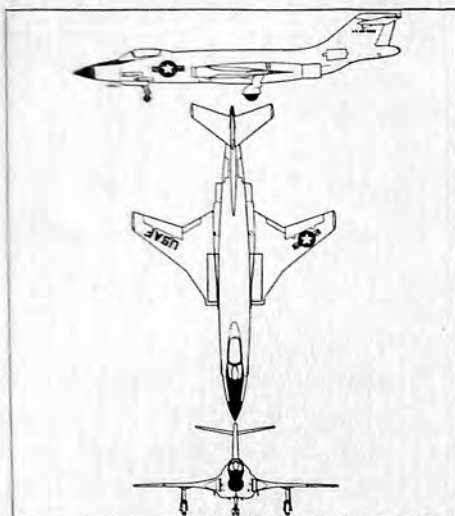
**SPECIFICATIONS • Span 39.7 ft.; Length 67.4 ft.; Height 18 ft.; Engine (2) Pratt & Whitney J57, 10,000 lb. thrust.**

**PERFORMANCE • All data are classified.**

### REMARKS

The F-101A is a long range, strategic fighter. Designed to have versatile combat capabilities enabling it to perform a variety of missions, the Voodoo is in the supersonic class and is capable of carrying atomic weapons. Wings are swept 35 deg. A photo reconnaissance version, the RF-101A, is now in production. On Sept. 30, 1955, McDonnell announced an initial quantity order for F-101B long-range interceptor fighters. Although details of this airplane are classified, it can be stated that the new F-101B is designed for duty with the Air

Defense Command. In this defensive role, it will operate under all weather conditions to execute two primary missions—the identification of unknown aircraft, and their destruction if they prove hostile.



MOONEY AIRCRAFT, INC.

Kerrville, Tex.

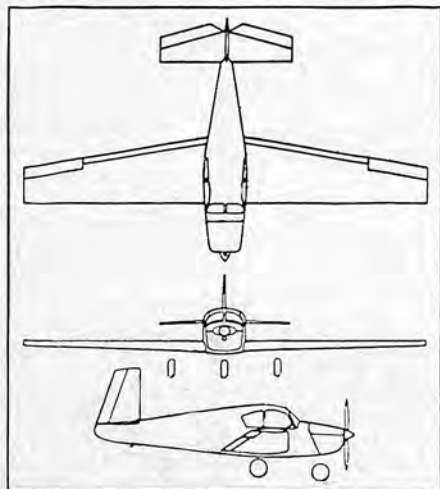


Mooney Mark 20

**TYPE** • Four place

**DESIGNATION** • Mark 20

**SPECIFICATIONS** • Span 35 ft.; Length 23 ft. 2 in.; Height 8 ft. 4½ in.; Empty Weight 1400 lb.; Gross Weight 2450 lb.; Wing Loading 14.7 lb. per sq. ft.; Power Loading 16.3 lb.



per bhp; Engine Lycoming O-320, 150 hp normal rated, or 150 hp at 2700 rpm takeoff; Fuel Capacity 50 gal.; Propeller Constant Speed Hartzell; Main Tire 6.00 x 6, 6 ply; Nose Tire 5.00 x 5, 4 ply; Wing Area 167 sq. ft.; Aileron Area 11.1 sq. ft.; Flap Area 17.2 sq. ft.; Fin Area 7.9 sq. ft.; Rudder Area 5.0 sq. ft.; Stabilizer Area 21.5 sq. ft.; Elevator Area 12.0 sq. ft.

**PERFORMANCE** • Maximum Speed 170 mph at 150 hp at 2700 rpm at S. L.; Cruise Speed 165 mph at (75%) 112.5 hp at 2450 rpm at 4900 ft.; Landing Speed 57 mph; Rate of climb 900 fmh at S. L.; Service Ceiling over 18,000 ft.; Absolute Ceiling over 20,000 ft.; Range with Maximum Payload 900 mi.; Range with Maximum Fuel Load 900 mi.

**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 hp Lycoming engine, which is noted for its low operating cost and low fuel consumption. It has the advantages of speed, comfort and economy.

PLANES IN PRODUCTION

NORTH AMERICAN AVIATION, INC.

Los Angeles, Calif.



North American T-28C Trainer

**TYPE** • Trainer

**DESIGNATION** • T-28C (Navy)

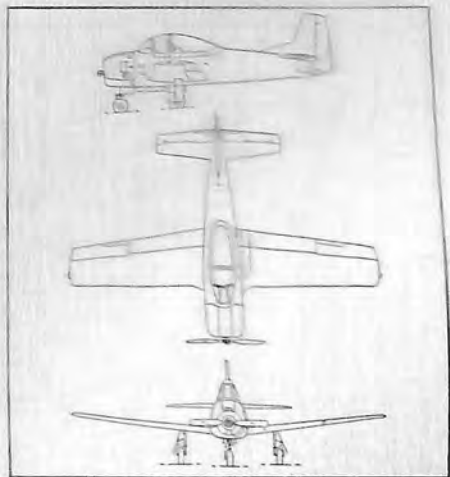
**SPECIFICATIONS** • Span 40 ft. 6 in.; Length 34 ft. 3 in.; Height 12 ft. 6 in.; Gross Weight 8247 lb.; Engine Wright R-1820, 1425 hp; Gear tricycle.

**PERFORMANCE** • Maximum Speed 346 mph; Cruise Speed 190 mph; Stalling Speed 72 mph; Rate of Climb 2800 fpm; Service Ceiling 35,000 ft.; Range with Maximum Payload 860 mi.

**REMARKS**

An improvement over the T-28B, the T-28C now enables the U. S. Navy to extend the training of pilots to shipboard work by addition of a tailhook. Carrier training can be added to the various other tasks assigned to it by the Navy: basic, advanced, instrument, tactical transition, and gunnery flight training. Armament for the T-28C, like the T-28B, provides accessory kit for bombs, 2.25 in. SCA rockets, 50 cal. ma-

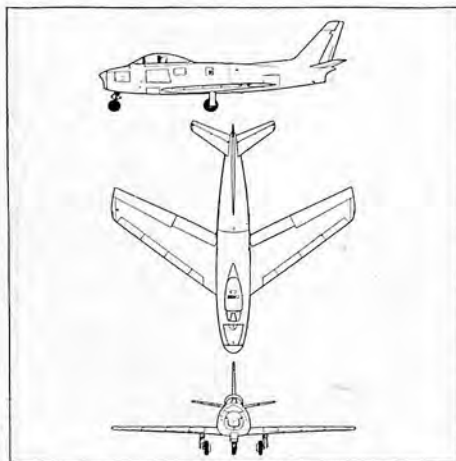
chine guns. The first flight of the T-28C was September 19, 1955. It is now in production at North American's Columbus, Ohio, plant.





North American F-86F

**TYPE** • F-86F  
**DESIGNATION** • Sabre Jet  
**SPECIFICATIONS** • Span 39 ft.;  
Length 37 ft.; Height 14 ft.; Gross  
Weight 18,000 lb.; Engine GE J47-  
GE-27, 5970 lb. thrust.



**PERFORMANCE** • Maximum Speed  
650 mph; Service Ceiling 45,000 ft.;  
Range with Maximum Payload 1000  
mi.

#### REMARKS

The F-86F Sabre Jet is a low-level fighter bomber or high-level fighter; original production was completed in 1954, but production was resumed in 1955 and carried through 1956. Other recent versions are the -K model, an all-weather interceptor armed with rockets and currently produced by Fiat in Italy, and the -H, powered by the GE J73-GE-3 engine. The F-86D interceptor version of the Sabre Jet contains search radar in the nose, and carries the intake under the fuselage rather than in the nose of the aircraft. Navy versions of the F-86 are the FJ-3, powered by the Wright J65 Sapphire, and the FJ-4, with the Wright J65-W4 engine. Both are carrier-based aircraft, with swept, folding wings, and both are produced at North American's Columbus, Ohio, division. All F-86 and FJ models have the all-flying tail in which elevator and stabilizer are a single controllable unit.

## PLANES IN PRODUCTION



North American F-100D Super Sabre

**TYPE** • Fighter

**DESIGNATION** • F-100D (Air Force)

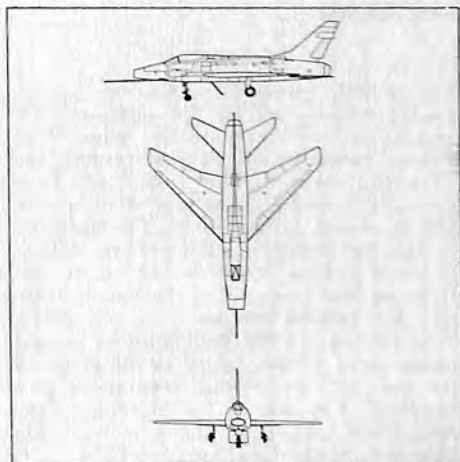
**SPECIFICATIONS** • Span 38 ft.; Length 47 ft.; Height 16 ft.; Engine Pratt & Whitney J57-P21.

**PERFORMANCE** • Maximum Speed supersonic, in level flight; Service Ceiling 50,000 ft.; Range with Maximum Fuel Load 1000 statute mi.

### REMARKS

Latest operational version of the Super Sabre series, 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. An F-100C established official world's speed record of 822.135 mph at

Palmdale, Calif., on August 20, 1955, with Col. Horace A. Hanes, USAF, at controls. F-100C and F-100D in production at both Los Angeles and Columbus plants. Two-place version, F-100F, is designed for dual-duty as fighter or as trainer.



NORTHROP AIRCRAFT, INC.

Hawthorne, Calif.



Northrop F-89D Scorpion

**TYPE** • Interceptor  
fighter

**DESIGNATION** • F-89H (Air Force)

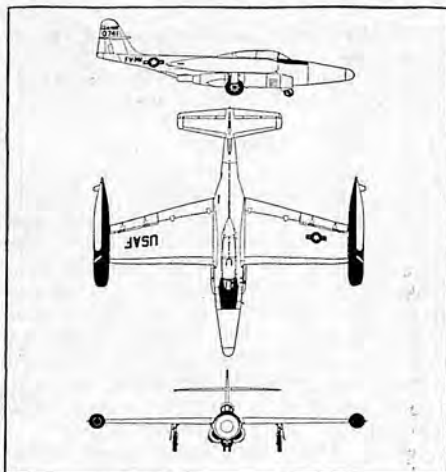
**SPECIFICATIONS** • Span 56 ft.;  
Length 53 ft.; Height 17 ft.; Gross  
Weight over 40,000 lb.; Engine (2)  
Allison J35-A-35 with afterburners;  
Wing Area over 600 sq. ft.

**PERFORMANCE** • Maximum Speed  
more than 600 mph; Service Ceiling  
over 45,000 ft.

**REMARKS**

The F-89H carries six Hughes Falcon guided missiles and 42 2.75-inch air-to-air rockets in its big wing tip pods. The Falcon missiles are carried within the wing tip pods until ready to be fired. Then they are extended from the sides of the pod as shown in this view. The air-to-air rockets are installed in the pods in clusters of seven behind frangible fairings at the front of the pods. The Falcon missiles and the rockets can be fired selectively. This enables the Scorpion to make several passes at a single target or to move in for the kill on several separate enemy bombers. Any one of the Falcons or the rockets are capable of knocking down the biggest bomber. Combination of the Scor-

pion with the Falcon provides new advantages in U. S. Air Defense. The Falcon, with a range measured in miles, can be launched from considerably below the altitude of an attacking bomber, climbing at bullet speed and using its electronic eyes and brain to strike the target, even though the bomber may be going through elusive maneuvers. F-89H Scorpions are now operational with units of the Air Defense Command.



PLANES IN PRODUCTION  
PIPER AIRCRAFT CORP.

Lock Haven, Penn.



Piper PA-18-A

**TYPE** • Two place

**DESIGNATION** • PA-18; PA-18-A

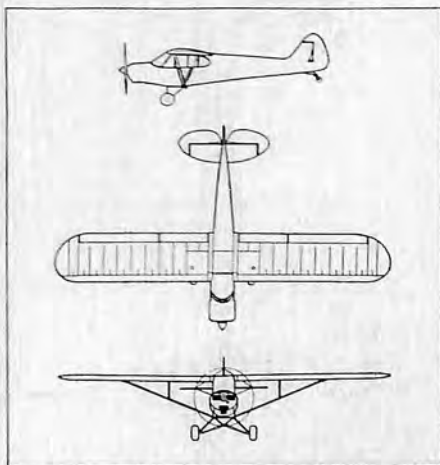
**SPECIFICATIONS** • Span 35 ft. 4 in.; Length 22 ft. 6 in.; Height 6 ft. 8 in.; Empty Weight 930 lb.; Gross Weight 1750 lb.; Overload Gross Weight 2070 lb.; Wing Loading 10 lb. per sq. ft.; Power Loading 11.6 lb. per bhp; Engines PA-18 "150" Lycoming O-320, (PA-18 "95" Continental C90), 150 (90) hp 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% power at 7,000 ft.; Landing Speed 43 mph with flaps; Rate of climb 960 fpm at SL; Service Ceiling 19,000 ft.; Absolute Ceiling 21,300 ft.; Range with Maximum Payload 460 mi.

**REMARKS**

This series includes the 150 hp PA-18 "150," the 90 hp PA-18 "95" and also in-

cludes the PA-18-A agricultural model, available as sprayer, duster or combination. With gross of 2070 lbs., PA-18-A is equipped with hopper with capacity of 110 gallons of liquid or 18 cubic feet of dust.







Piper PA-23 Twin Apache

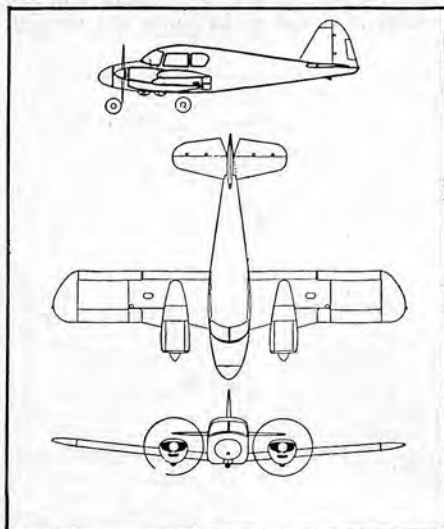
**TYPE** • Four or five-place

**DESIGNATION** • PA-23

**SPECIFICATIONS** • Span 37 ft.; Length 27.1 ft.; Height 9.5 ft.; Engine (2) Lycoming O-320, 150 hp at

2700 rpm; Gross Weight 3500 lb.; Empty Weight 2180 lb.; Useful Load 1320 lb.; Wing Loading 17.2 lb. per sq. ft.; Power Loading 11.6 lb. per hp; Wing Area 204 sq. ft.; Baggage 196 lb.; Fuel capacity 108 gal. with auxiliary tanks.

**PERFORMANCE** • Cruise Speed 170 mph at 7000 ft.; Range up to 1200 mi.



**REMARKS**

This new 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 cu. ft. 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 airfoil and wheel respective for positive identification. Optional Apache configurations include a 5-passenger version or installation of 2 reclining airline type seats in the rear.

## PLANES IN PRODUCTION



Piper PA-22 Tri-Pacer

**TYPE • Four-place**

As optional equipment. Production continued heavy on the Tri-Pacer during 1955.

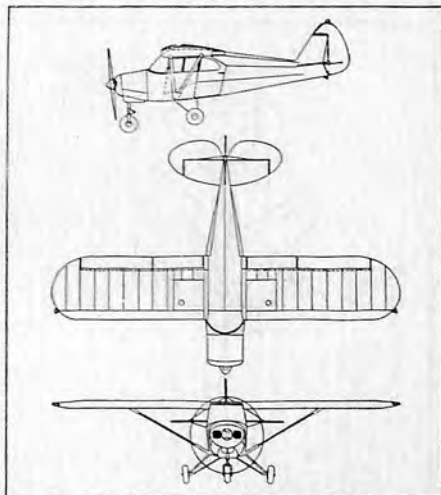
**DESIGNATION • PA-22**

**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 13.3 lb. per bhp; Engine Lycoming O-320, 150 hp at 2700 rpm takeoff; Fuel Capacity 36 gal.; Propeller Sensenich controllable pitch; Gear tricycle.**

**PERFORMANCE • Maximum Speed 139 mph; Cruise Speed 132 mph at 75 percent power at 7000 ft.; Landing Speed 49 mph; Rate of Climb 725 fpm at S. L.; Service Ceiling 15,000 ft.**

### REMARKS

Tri-Pacer offers auxiliary gas tank 8 gals.



REPUBLIC AVIATION CORP.

Farmingdale, L. I., N. Y.



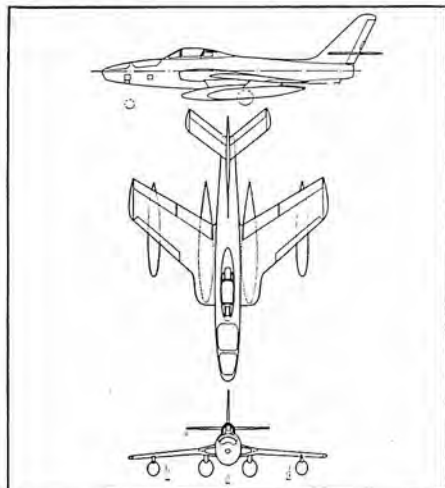
Republic RF-84F Thunderflash

**TYPE** • Reconnaissance  
**DESIGNATION** • RF-84F (Air Force)  
**SPECIFICATIONS** • Span 33 ft. 6 in.; Length 47 ft. 6½ 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.

**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. Teamed with the Convair B-36 carrier plane in the composite known as FICON, it joins the 10,000-mile range of the bomber with its own 2,000-mile range, speed and maneuverability. It can take off and land from the mother plane in mid-air. The Thunderflash serves in the U. S. Air Force and the air forces of NATO nations.



## PLANES IN PRODUCTION



Republic F-84F Thunderstreak

**TYPE** • Fighter bomber

**DESIGNATION** • F-84F (Air Force)

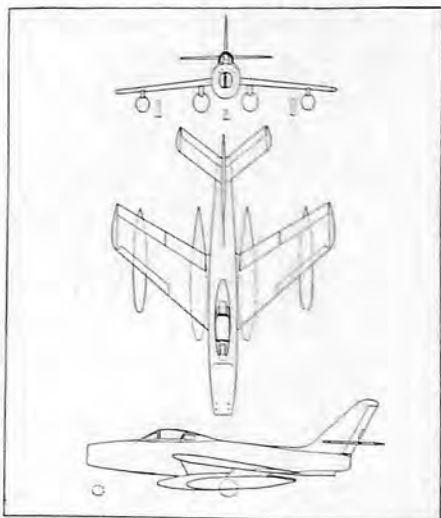
**SPECIFICATIONS** • Span 33 ft. 6 in.; Length 43 ft. 4 in.; Height 14 ft. 4 in.; Gross Weight 25,000 lb.; Engine Wright J65-W-3, 7200 lb. thrust.

**PERFORMANCE** • Maximum Speed more than 650 mph; Service Ceiling 45,000 ft.; Range with Maximum Payload over 2000 mi.

### REMARKS

The 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 lb. of bombs, rockets and napalm. In addition, it is listed as capable of carrying the atomic bomb. It is in service with six USAF commands and the air forces of NATO nations. Holder of the official U. S. transcontinental speed record

(652 mph), the Thunderstreak also holds the world's non-stop jet fighter distance record (5118 miles, England to Texas). 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 in-flight refueling.



SIKORSKY AIRCRAFT DIVISION

UNITED AIRCRAFT CORP.

Bridgeport, Conn.



Sikorsky S-55

**TYPE** • Helicopter

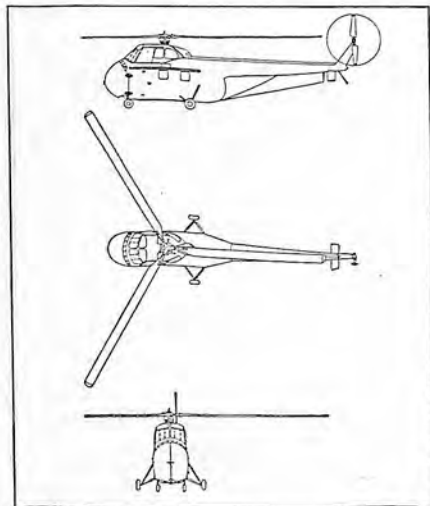
**DESIGNATION** • S-55A (Commercial); H-19 (Air Force, Army); HRS (Marines); HO4S (Navy, Coast Guard)

**SPECIFICATIONS** • Main Rotor Diameter 53 ft.; Tail Rotor Diameter 8 ft. 9 in.; Length 42 ft. 2 in.; Height 13 ft. 4 in. Empty Weight 5188 lb.; Gross Weight 7500 lb.; Engine Wright R-1300 with 600 bhp; Fuel Capacity 185 gal.

**PERFORMANCE** • Maximum Speed 112 mph; Cruise Speed 91 mph; Maximum Rate of Climb at Sea Level 1020 fpm; Range 405 st.mi. Service Ceiling 10,000 ft.

**REMARKS**

The S-55 has a seating capacity of crew (pilot and copilot) passengers (military—10 (commercial)—7, with alternate cargo capacity of 340 cubic feet. Military models have Wright R-1300 engine, which is now being offered commercially.



## PLANES IN PRODUCTION



Sikorsky XH-39

**TYPE** • Helicopter

**DESIGNATION** • S-59  
XH-39 (Army)

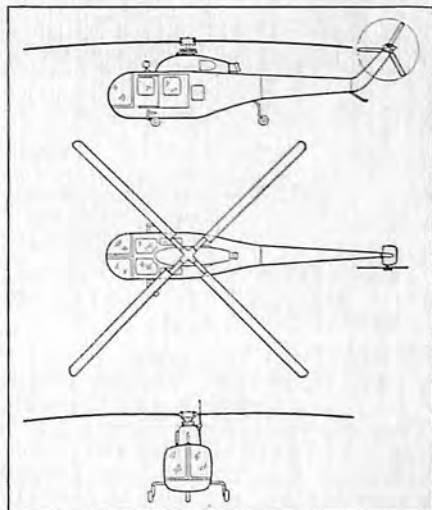
**SPECIFICATIONS** • Main Rotor Diameter 35 ft.; Tail Rotor Diameter 6 ft. 4 in.; Length 30 ft. 3 in.; Height 9 ft. 8 in.; Empty Weight 2,200 lb.; Gross Weight 3625 lb.; Engine Turbomeca Artouste II with maximum power rating 425 hp at 35,000 rpm, continuous power rating 323 hp at 35,000 rpm.

**PERFORMANCE** • High speed at sea level 127 knots, cruising 120 knots; Maximum rate of climb 2300 fpm; Cruising range 290 miles.

### REMARKS

The XH-39 set the world's speed record for helicopters when it flew at 156.005 mph over the 3 kilometer course at Windsor

Locks, Conn. The 81-cubic feet of payload space offers adequate accommodations for three passengers and 100 lbs. of baggage, or two litter patients and a medical attendant, or 800 lbs. of cargo.





Sikorsky HR2S-1

**TYPE** • Transport

**DESIGNATION** • S-56, H-37A (Army; HR2S-1 (Navy)

**SPECIFICATIONS** • Rotor diameter 72 ft.; Length 60 ft.; Gross Weight 28,500 lb.; Engine (2) Pratt and Whitney R-2800, derated to 1900 hp.

**PERFORMANCE** • All data are classified.

**REMARKS**

This new Sikorsky model is designated the

S-56 commercially. The HR2S-1 carries two Marine squads (26 men) or three jeeps plus crew. Commercial version, projected for 1958-59, will carry 34 passengers in airline service. Semi-automatic rotor blade and tail fold for carrier stowage. Autopilot and anti-icing equipment are standard. Clam-shell nose doors permit cargo and troop loading with greater ease than in previous side door loading models. Retractable main landing gear is the first on production helicopter. Five bladed main rotor and four bladed tail rotor are all-metal.



Sikorsky S-58C

**TYPE** • Cargo and Transport Helicopter  
Anti-Submarine

**DESIGNATION** • S-58 (Commercial & Navy); HSS-1 (Navy); H-34 (Army); HUS (Marines)

**SPECIFICATIONS** • Length 47 ft. 2 in. (Tail Pylon not Folded); Height 14 ft. 2 in.; Empty Weight 7560 lb. (With Standard Equipment); Gross Weight 12,700 lb.; Useful Load 4741 lb.; Engine Wright Cyclone C-9, 1275 hp normal rated at 2500 rpm or 1525

hp at 2800 rpm takeoff; Fuel Capacity 290 gal.; Main Rotor Diameter 56 ft.; Main Tires 11.00 x 12; Tail Wheel 6.00 x 6.

**PERFORMANCE** • Maximum Speed 117 mph at 1275 hp at 2500 rpm at S. L. Cruise Speed 88 mph at 2500 rpm; Maximum Rate of climb 1300 fpm at S. L.

**REMARKS**

Specifications and performance data of the HSS-1, Navy version using a Wright R-1820 engine are classified.

## PLANES IN PRODUCTION

### STROUKOFF AIRCRAFT CORP.

West Trenton, N. J.



Stroukoff YC-134 Boundary Layer Control-Pantobase

**TYPE** • Assault Transport

**DESIGNATION** • MS-8-1, YC-134A

**SPECIFICATIONS** • Span 112 ft.; Length 83 ft.; Height 43 ft. 8.45 in.; Gross Weight 66,600 lb.; Engines (2) Wright R-3350 Turbo-Compound; AeroProducts propellers; Wing Area 1234.89 sq. ft.

**PERFORMANCE** • Cruise Speed: 250 mph at extended range.

#### REMARKS

The USAF YC-134A series represents the latest contribution by Stroukoff to the air support operation of the Air Force. The Boundary Layer Control System permits this 66,600-pound aircraft to take off and land in less than half the time distance of ordinary assault transport aircraft. On the

19th of December, 1956, at the West Trenton Airport, the YC-134 took off in 418 feet and landed in less than 400 feet. The Pantobase, developed last year by Stroukoff, enables the YC-134A to operate from any unprepared surface as well as ice, snow, water, sand, swamp or tundra. It can land or take off from virtually anywhere. The huge cargo compartment terminates with a high and wide tailgate door of truck height. In addition there is a huge forward cargo door in the YC-134A which permits fast loading and unloading of air freight without disturbing the main cargo. An entirely new Stroukoff developed landing gear of four wheels distributes the gross weight of the aircraft over a wide surface. The design useful payload is 26,175 and is carried upon a specially constructed floor that needs no reinforcing for heavy loads that might have a concentrated weight point distribution.



TAYLORCRAFT, INC.

Conway, Pa.



Taylorcraft Model 20

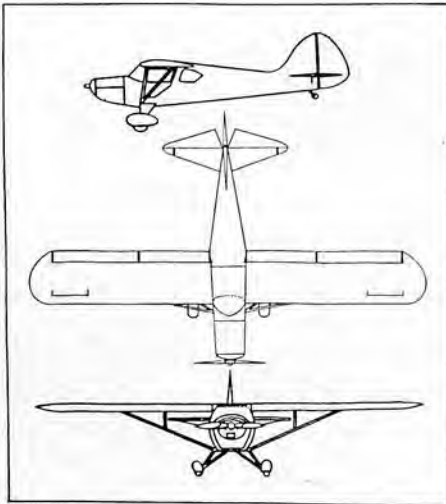
**TYPE** • Four place

**DESIGNATION** • Model 20

**SPECIFICATIONS** • Span 34 ft. 8 in.; Length 24 ft. 4 in.; Height 7 ft. 1-11/16 in.; Empty Weight 1625 lb.; Gross Weight 2750 lb.; Wing Loading 15.4 lb. per sq. ft.; Power Loading 12.2 lb. per bhp; Engine Continental O-470-J, 225 hp normal rated; Fuel

Capacity 66 gal.; Propeller McCauley, fixed; Main Tire 7.00 x 6 Cleveland C2000H; 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 S. L.; Cruise Speed 150 mph at 70 percent hp at 2450 rpm at S. L.; Landing Speed 60 mph; Rate of climb 1000 fpm at S. L.; Service Ceiling 15,000 ft.; Absolute Ceiling 16,000 ft.; Range with Maximum Payload 300 mi.; Range with Maximum Fuel Load 675 mi.



**REMARKS**

This advanced structural achievement 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.

## PLANES IN PRODUCTION

### TEMCO AIRCRAFT CORP.

Dallas, Tex.



Temco D-16A

**TYPE** • Four place

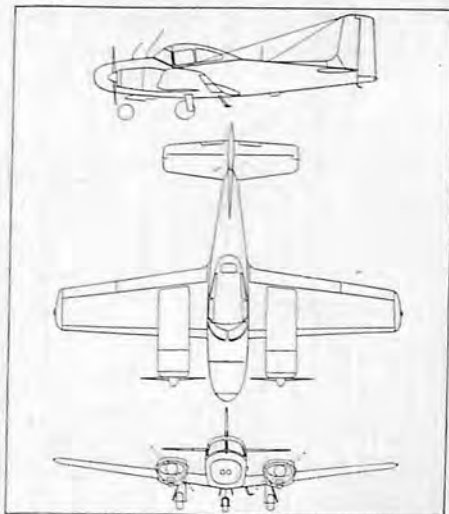
**DESIGNATION** • D-16A

**SPECIFICATIONS** • Span 33 ft. 10½ in.; Length 27 ft. 2 in.; Height 9 ft. 6½ in.; Empty Weight 2350 lb.; Gross Weight 3600 lb.; Wing Loading 20.2 lb. per sq. ft.; Power Loading 10.6 lb. per bhp; Engines (2) O-340-A1A Lycoming, 170 hp (each) normal rated, or 170 hp at 2700 rpm takeoff; Fuel Capacity 146 gal.; Propeller Hartzell HC82X6 full feather constant speed; Main Tire 7.00 x 6, 6 ply; Nose Tire 6.00 x 6, 6 ply; Wing Area 178.3 sq. ft.

**PERFORMANCE** • Maximum Speed 180 mph at 340 hp at 2700 rpm at S. L.; Cruise Speed 170 mph at 238 hp at 70 percent power at 7000 ft.; Landing Speed 60 mph (flaps down/stall with 2 engines); Rate of climb 1400 fpm at S. L.; Service Ceiling 20,000 ft.; Absolute Ceiling 21,000 ft.; Range with Maximum Payload 900 miles with 106 gal. fuel system; Range with Maximum Fuel Load 1200 mi. with 146 gal. fuel system.

#### REMARKS

A more powerful and versatile version of the Riley twin-engine conversion of the Ryan Navion. 146-gallon fuel system incorporates wingtip fuel tanks. Has been licensed by CAA. In production at Temco's Greenville center.





Temco Model 51

**TYPE** • Primary jet trainer

**DESIGNATION** • Model 51 (Navy TT-1)

**SPECIFICATIONS** • Span 29 ft. 6.9 in.; Length 30 ft.; Height 10 ft. 6.65 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 lb.; Engine Continental J69-T-9 920 lb. thrust; Fuel Capacity 124 gal.;

Main Tire 18 x 5.5 8PR Type 7; Nose Tire 5.00 x 5 4PR Type 3; Wing Area 150 sq. ft.; Aileron Area 10.04 sq. ft.; Flap Area 15.65 sq. ft.; Fin Area 23.5 sq. ft.; Rudder Area 5.15 sq. ft.; Stabilizer Area 39 sq. ft.; Elevator Area 11.6 sq. ft.

**PERFORMANCE** • Maximum Speed 294 Kts. at 100% rpm at 15,000 ft.; Average Cruise Speed 234 Knots at 100% rpm at 22,350 (avg) ft.; Landing Speed 70 to 75 Kts. 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.

#### REMARKS

The Temco TT-1 primary jet trainer was accepted by the U.S. Navy on June 29, 1956, after competitive evaluation tests were completed at the Naval Air Test Center, Patuxent River, Md. It will be the Navy's first primary jet trainer. First production models are scheduled for delivery to the Navy in July of 1957. Built and flight tested by Temco, the TT-1 fulfills the growing need for commencing a student's flight training in jet-powered aircraft. The TT-1 is also being evaluated by the USAF, the RCAF, and other foreign countries for possible use in their flight training programs.



PLANES IN PRODUCTION

VERTOL AIRCRAFT CORP.

Morton, Pa.



Vertol H-21C Workhorse

**TYPE** • Transport

**DESIGNATION** • H-21C (Army)  
H-21B (Air Force)  
H-21B (RCAF)

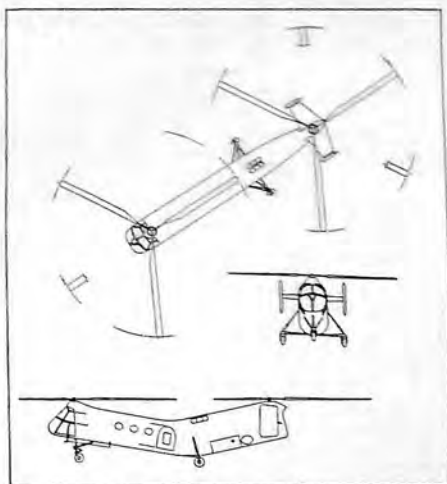
**SPECIFICATIONS** • Rotor Diameter 44 ft.; Length 52 ft. 6 in.; Height 16 ft.; Empty Weight 8500 lb.; Gross Weight 13,300 lb.; Overload Gross Weight 15,000 lb.; Engine Wright R-1820-103, 1425 hp takeoff; Fuel Capacity 300 gal.; Gear fixed tricycle.

**PERFORMANCE** • Maximum Speed 135 mph at S. L.; Cruise Speed 98 mph at S. L.; Rate of Climb 960 fpm; Service Ceiling 10,000 ft.; Range over 450 mi.

**REMARKS**

The H-21B is the Air Force model in this series, and is similar to the 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. In

addition, the H-21B has an autopilot. 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 is currently being developed.



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CHAPTER ELEVEN

Engines in Production

The following list of aircraft engines includes only those in production during the year. Unless otherwise noted the specifications are the manufacturers'.

AEROJET-GENERAL CORP.  
Azusa, Calif.

**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: 1,000 lb. thrust, or 400 horsepower, for 15 seconds.

**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 certificated by the CAA.

**MODEL: 5KS-4500 Jet-Assisted Takeoff (JATO) Unit Motor.**

**DATA**  
TYPE: Solid-propellant rocket.  
**SPECS**  
DIAMETER: 9.38 in. LENGTH: 54.31 in.  
EMPTY WEIGHT: 111 lb. LOADED WEIGHT: 225 lb.

**PERFORMANCE**  
RATING: 4,500 lb. thrust for 5 seconds.

**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: 27 in. overall.  
EMPTY WEIGHT: 24 lb. LOADED WEIGHT: 44 lb.

**PERFORMANCE**  
RATING: 250 lb. thrust for a duration of 15 seconds.

**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 15-NS-250 "Junior JATO" aircraft rocket engine is currently under development specifically for use as standby power on light aircraft. CAA certification tests are scheduled to be completed early in March 1957.

## ENGINES IN PRODUCTION

### 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: 14.88 in. LENGTH: 109.50 in. over-all. EMPTY WEIGHT: 426 lb. LOADED WEIGHT: 838 lb.

#### PERFORMANCE

RATING: 33,000 lb. thrust for a duration of 2.2 seconds.

#### 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 over-all. EMPTY WEIGHT: 1382 lb. LOADED WEIGHT: 2380 lb.

#### PERFORMANCE

RATING: 4500 lb. thrust for a duration of 40 seconds.

#### 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.

## AIRCOOLED MOTORS, INC.

Syracuse, N. Y.

### MODEL: Franklin 6AG4-185-B12.

#### DATA

TYPE: 6 cylinder, air-cooled, horizontally opposed. CAA TYPE CERTIFICATE: 238.

#### SPECS

LENGTH: 40 19/32 in. FUEL GRADE: 80 octane. BORE: 4.5 in. STROKE: 3.5 in. DISPLACEMENT: 335 cu. in. COMPRESSION RATIO: 7:1. DRY WEIGHT: 360 lbs. with hub and accessories. WEIGHT PER HP: 1.86 lbs.

#### PERFORMANCE

TAKE-OFF POWER: 185 hp at 3,100 rpm  
CRUISE: 135 hp. FUEL CONSUMPTION: .51 lbs. per hp hr. OIL CONSUMPTION: .002 lbs.

#### EQUIPMENT

CARBURETOR: Marvel-Schebler MA4-5 or Bendix PS5-C. IGNITION: Dual Scintilla. STARTER: Delco-Remy. GENERATOR: Delco-Remy. FUEL PUMP: A. C.

### MODEL: Franklin 6A4-165-B3.

#### DATA

TYPE: 6 cylinder, air-cooled, horizontally opposed. CAA TYPE CERTIFICATE: 238.

#### SPECS

LENGTH: 27 13/32 in. FUEL GRADE: 80 octane. BORE: 4.5 in. Stroke: 3.5 in. DISPLACEMENT: 335 cu. in. COMPRESSION RATIO: 7:1. DRY WEIGHT: 324 lb. with hub and accessories. WEIGHT PER HP: 1.97 lb.

#### PERFORMANCE

TAKE-OFF POWER: 165 hp at 2,800 rpm.  
CRUISE: 124 hp at 2,200 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

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S6RN21. 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 1/32 in. FUEL GRADE: 91 octane. BORE: 4.5 in. STROKE: 3.5 in. DISPLACEMENT: 335 cu. in. COMPRESSION RATIO: 8.5:1. DRY WEIGHT: 333 lb. with hub and accessories. WEIGHT PER HP: 1.66 lb.

### PERFORMANCE

TAKE-OFF POWER: 200 hp. FUEL CONSUMPTION: .52 lb. per hp hr. OIL CONSUMPTION: .002 lb. per hp hr.

### EQUIPMENT

CARBURETOR: Marvel-Schebler MA4-5 or Bendix PS5-C. IGNITION: Dual Scintilla S6-RN21. STARTER: Delco-Remy. GENERATOR: Delco-Remy. FUEL PUMP: Weldon.

### REMARKS

This model was designed for helicopter installations.

**MODEL: Franklin 6V4-178-B32 and B-33.**

### DATA

TYPE: 6 cylinder, air-cooled, horizontally opposed; 178 hp; CAA TYPE CERTIFICATE: 244.

### SPECS

LENGTH: 34 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: 308 lb. with hub and accessories. WEIGHT PER HP: 1.73 lb.

### PERFORMANCE

TAKE-OFF POWER: 178 hp. FUEL CONSUMPTION: .52 lb. per hp hr. OIL CONSUMPTION: .002 lb. per hp hr.

### EQUIPMENT

CARBURETOR: Marvel-Schebler MA4-5 or

Bendix PS5-C. IGNITION, Dual Scintilla S6RN21. STARTER: Delco-Remy. GENERATOR: Delco-Remy. FUEL PUMP: Weldon. Designed for helicopter installation.

**MODEL: Franklin 6V6-245-B16F.**

### DATA

TYPE: 6 cylinder, air-cooled, horizontally opposed. CAA TYPE CERTIFICATE: 258.

### SPECS

LENGTH: 39 7/32 in. FUEL GRADE: 80 octane. BORE: 4.75 in. STROKE: 4 in. DISPLACEMENT: 425 cu. in. COMPRESSION RATIO: 7.5:1. DRY WEIGHT: 353 lb. with hub and accessories. WEIGHT PER HP: 2.26 lb.

### PERFORMANCE

TAKE-OFF POWER: 245 hp at 3,275 rpm. FUEL CONSUMPTION: .52 lb. per hp hr. OIL CONSUMPTION: .002 lb. per hp hr.

### EQUIPMENT

CARBURETOR: Bendix PS-7BD. IGNITION: Dual Eisemann LA-6. Designed for helicopter installation.

**MODEL: Franklin 6A4-150-B3.**

### DATA

TYPE: 6 cylinder, air-cooled, horizontally opposed. CAA TYPE CERTIFICATE: 238.

### SPECS

LENGTH: 37 3/8 in. FUEL GRADE: 80 octane. BORE: 4.5 in. STROKE: 3.5 in. DISPLACEMENT: 335 cu. in. COMPRESSION RATIO: 7:1. DRY WEIGHT: 321 lb. with hub and accessories. WEIGHT PER HP: 2.14 lb.

### PERFORMANCE

TAKE-OFF POWER: 150 hp at 2,600 rpm. CRUISE: 113 hp at 2,350 rpm. FUEL CONSUMPTION: .5 lb. per hp hr. OIL CONSUMPTION: .002 lb. per hp hr.

### EQUIPMENT

CARBURETOR: Marvel-Schebler MA-3SPA. IGNITION: Dual Eisemann LA-6 or Scintilla S6RN21. STARTER: Delco-Remy. GENERATOR: Delco-Remy. FUEL PUMP: AC

## ALLISON DIVISION GENERAL MOTORS CORP. Indianapolis 6, Ind.

**MODEL: 501-D13 Turboprop engine.**

### DATA

TYPE: Axial flow turboprop.

### SPECS

LENGTH: 145 in. WIDTH: 27 in. WEIGHT: 1750 lbs. COMPRESSOR STAGES: 14. TURBINE STAGES: 4.

### EQUIPMENT

STARTER: Airframe-furnished.

### REMARKS

Scheduled for installation in Lockheed Electra commercial transport; ESHP 3,750 at 13,820 rpm, sea level conditions.

**MODEL: T56-A-1.**

### DATA

TYPE: Axial flow turbo-prop.

### SPECS

LENGTH: 145 in. WIDTH: 27 in. TOTAL WEIGHT: 1,645 lb. COMPRESSOR STAGES: 14. TURBINE STAGES: 4. STARTER: Gov. furn. equip.

### REMARKS

Current production installation is in Lockheed C-130 Hercules; E.S.H.P. 3,750 at 13,820 rpm, sea level conditions.

## ENGINES IN PRODUCTION

### MODEL: J33-A-20.

#### DATA

TYPE: Centrifugal flow turbo-jet.

#### SPECS

LENGTH: 105 in. WIDTH: 48 in. TOTAL WEIGHT: 1,800 lb. COMPRESSOR STAGES: dual inlet single. TURBINE STAGES: 1. STARTER: Gov. furn. equip.

#### REMARKS

Current production installation is in Lockheed TV-2 trainer: Thrust 4,600 max. at sea level conditions.

### MODEL: J33-A-37.

#### DATA

TYPE: Centrifugal flow turbo-jet.

#### SPECS

LENGTH: 156 in. WIDTH: 48 in. TOTAL WEIGHT: 1,800 lb. COMPRESSOR STAGES: dual inlet single. TURBINE STAGES: 1. STARTER: Gov. furn. equip.

#### REMARKS

Current production installation is in Martin TM-61A & C Matador. Thrust 4,600 lbs. max. at sea level conditions.

### MODEL: J33-A-18A.

#### DATA

TYPE: Centrifugal flow turbo-jet.

#### SPECS

LENGTH: 94 in. WIDTH: 49 in. TOTAL WEIGHT: 1,790 lb. COMPRESSOR STAGES: dual inlet single. TURBINE STAGES: 1. STARTER: Gov. furn. equip.

#### REMARKS

Current production installation is in Chance Vought Regulus; Thrust 4,600 lbs. max. at sea level conditions.

### MODEL: J71-A-11.

#### DATA

TYPE: Axial flow turbo-jet.

#### SPECS

LENGTH: 192 in. WIDTH: 40 in.

#### REMARKS

Current production installation is in Douglas B-66 bomber and RB-66 reconnaissance bomber.

### MODEL: J71-A-2.

#### DATA

TYPE: Axial flow turbo-jet.

#### SPECS

LENGTH: 285 in. WIDTH: 42 in.

#### REMARKS

Current production installation is in McDonnell F3H-2N Demon.

### MODEL: 501-D13.

#### DATA

TYPE: Axial flow turbo-prop.

#### SPECS

LENGTH: 145 in. WIDTH: 27 in. TOTAL WEIGHT: 1,750 lb. COMPRESSOR STAGES: 14. TURBINE STAGES: 4. STARTER Airframe-furnished.

#### REMARKS

Scheduled for installation in Lockheed Electra commercial transport; ESHP 3,750 at 13,820 rpm, sea level conditions.

### MODEL: T56-A-1.

#### DATA

TYPE: Axial flow turbo-prop.

#### SPECS

LENGTH: 145 in. WIDTH: 27 in. TOTAL WEIGHT: 1,645 lb. COMPRESSOR STAGES: 14. TURBINE STAGES: 4. STARTER: Gov. furn. equip.

#### REMARKS

Current production installation is in Lockheed C-130 Hercules; E.S.H.P. 3,750 at 13,820 rpm, sea level conditions.

## CONTINENTAL AVIATION & ENGINEERING CORP.

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. STARTER: Electric.

#### PERFORMANCE

TAKEOFF: Thrust (lb.) 920, rpm 22,700, SFC 1.13; NORMAL: Thrust (lb.) 725, rpm 21,000, SFC 1.06.

#### REMARKS

Current production installation: Cessna T-37 USAF Intermediate Trainer, Temco TT-1 Navy Trainer Beech Model 73 Jet Mentor.

### MODEL: 354-8 (J69-T-19A)

#### DATA

TYPE: Turbojet.

#### SPECS

LENGTH: 61.53 in. WIDTH: 22.32 in. TOTAL WEIGHT: 317 lb. COMPRESSOR STAGES: 1. TURBINE STAGES: 1. STARTER: Electric.



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### PERFORMANCE

TAKEOFF: Thrust (lb.) 1,000, rpm 21,250, SFC 1.27; NORMAL: Thrust (lb.) 795, rpm 20,000, SFC 1.25.

### REMARKS

Current production installation: Ryan Q-2 Firebee Target Drone.

### MODEL: 354-9 (J69-T-17)

#### DATA

TYPE: Turbojet.

#### SPECS

LENGTH: 61.53 in. WIDTH: 22.32 in. TOTAL WEIGHT: 324 lb. COMPRESSOR STAGES: 1. TURBINE STAGES: 1. STARTER: Special Equipment.

#### PERFORMANCE

Same as J69-T-19A (Model 354-8).

#### REMARKS

Current production installation: Radtoplane Missile.

### MODEL: 140

#### DATA

TYPE: Gas Turbine Air Compressor. SPECS

LENGTH: 45.08 in. WIDTH: 18.66 in. TOTAL WEIGHT: 215 lb. COMPRESSOR STAGES: 1. TURBINE STAGES: 2. STARTER: Electric.

#### REMARKS

Used in Model TC-104-1 Trailer Mounted Gas Turbine Air Compressor (USAF Type MA-1).

### MODEL: 141

TYPE: Gas Turbine Air Compressor. SPECS

LENGTH: 44.6 in. WIDTH: 15.94 in. TOTAL WEIGHT: 197 lb. COMPRESSOR STAGES: 1. TURBINE STAGES: 2. STARTER: Electric.

#### REMARKS

Used in TC-106 (USAF Type MA-1A) Trailer Mounted Gas Turbine Air Compressor.

## CONTINENTAL MOTORS CORP.

Muskegon, Michigan

### MODEL: 0-470-G.

#### DATA

TYPE: 6 cylinders, air-cooled horizontally opposed CAA type certificate

#### 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. CARBURETOR: Bendix. MAGNETOS: Scintilla. STARTER: Delco-Remy (12 volt). GENERATOR: Delco-Remy (50 amp 12 volt.)

#### PERFORMANCE

RATING: 240 BHP @ 2600 RPM, sea level.

### MODEL: 0-470-J.

#### DATA

TYPE: 6 Cylinders, 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 Octane. DRY WEIGHT: 415 lb. CARBURETOR: Marvel. MAGNETO: Scintilla. STARTER: Delco Remy. GENERATOR: Delco Remy. PERFORMANCE RATING: 225 hp at 2,550 rpm at sea level.

#### REMARKS

Current installation: Taylorcraft.

### MODEL: 0-470-M.

#### DATA

TYPE: 6 Cylinders, 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. CARBURETOR: Bendix. MAGNETO: Scintilla. STARTER: Delco Remy #11046. GENERATOR: Delco Remy 24V-15A. PERFORMANCE RATING: 240 hp at 2,600 rpm at sea level.

#### REMARKS

Current installation: Cessna Aircraft Model 310.

### MODEL: 0-300-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. DRY WEIGHT: 310.88 lb. CARBURETOR: Marvel. MAGNETO: Scintilla. PERFORMANCE RATING: 145 hp at 2,700 rpm at sea level.

#### 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: 0-470-Series K and 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. DRY WEIGHT: 438 lb. CARBURETOR: Marvel. MAGNETO: Scin-

## ENGINES IN PRODUCTION

tilla. STARTER: Delco Remy. GENERATOR: Delco Remy. PERFORMANCE RATING: 230 hp at 2,600 rpm at sea level.

### 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 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 2,300 rpm at sea level.

#### EQUIPMENT

CARBURETOR: Stromberg. IGNITION: Elsmann 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 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 2,575 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 3/4 in. FUEL GRADE: 80 octane. BORE: 4.062 in. STROKE: 3.875 in. DISPLACEMENT: 200.91 cu. in. COMPRESSION RATIO: 7:1. DRY WEIGHT: 186 lb.

#### PERFORMANCE

90 hp at 2,475 rpm at sea level.

#### EQUIPMENT

CARBURETOR: Bendix-Stromberg. IGNITION:

Scintilla. STARTER: Delco-Remy. GENERATOR: Delco-Remy.

### MODEL: C145-2.

#### DATA

TYPE: 6 cylinder, air-cooled, horizontally opposed. CAA TYPE CERTIFICATE: 253.

#### SPECS

LENGTH: 41 in. FUEL GRADE: 80 octane. BORE: 4.062 in. STROKE: 3.875 in. DISPLACEMENT: 301.37 cu. in. COMPRESSION RATIO: 7:1. DRY WEIGHT: 263 lb.

#### PERFORMANCE

145 hp at 2,700 rpm at sea level.

#### EQUIPMENT

CARBURETOR: Marvel. IGNITION: Scintilla. STARTER: Delco-Remy. GENERATOR: Delco-Remy.

### MODEL: E185.

#### DATA

TYPE: 6 cylinder, air-cooled, horizontally opposed. CAA TYPE CERTIFICATE: 246.

#### SPECS

LENGTH: 46.66 in. FUEL GRADE: 80 octane. BORE: 5 in. STROKE: 4 in. DISPLACEMENT: 471 cu. in. COMPRESSION RATIO: 7:1. DRY WEIGHT: 350 lb.

#### PERFORMANCE

205 hp at 2,600 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 2,650 rpm at sea level.

#### EQUIPMENT

CARBURETOR: Bendix-Stromberg. IGNITION: Scintilla. STARTER: Eclipse. GENERATOR: Delco-Remy. This engine also available with full AN accessory section.

## FAIRCHILD ENGINE DIVISION FAIRCHILD ENGINE & AIRPLANE CORP.

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: 1,000 lb. RATED RPM: 15,780. STARTER: Compressed air or electric.

### MODEL: J-44-R-20B.

#### DATA

TYPE: Pilotless Aircraft Turbojet.

#### SPECS

LENGTH: 88 in. DIAMETER: 22 in. WEIGHT: 359 lb. COMPRESSOR STAGES: 1 mixed flow. TURBINE STAGES: 1.

#### PERFORMANCE

STATIC THRUST: 1,000 lb. RATED RPM: 15,780. STARTER: Compressed air or electric.

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### MODEL: XJ83.

DATA  
TYPE: 2,000 lb. thrust class.

### REMARKS

Design and development of extremely light-weight, high performance engine for piloted and pilotless aerial vehicles.

## GENERAL ELECTRIC CO. AIRCRAFT GAS TURBINE DIVISION

Cincinnati, Ohio

### MODEL: J79.

REMARKS  
Specifications and performance of the J79

jet engine are still classified. It powers the Air Force's Lockheed F-104A fighter and Convair B-58 supersonic bomber. The CJ805, a commercial version of the J79, will also power the Convair 880 commercial liner.

## SMALL AIRCRAFT ENGINE DEPARTMENT

Lynn, Massachusetts

### MODEL: T58.

DATA  
TYPE: Small Aircraft gas turbine engine (turboshaft engine).

SPECS  
LENGTH: 55 in. WIDTH 16 in. TOTAL WEIGHT 250 lb.

REMARKS  
Will be test flown first part of 1957 in Sikorsky HSS and Vertol H-21 helicopters.

## JACOBS AIRCRAFT ENGINE CO.

Pottstown, Pennsylvania

### MODEL: R-755A Series.

DATA  
TYPE: 7 Cyl. air-cooled, rad., CAA T.C. 237.  
SPECS  
LENGTH: 39.5 in. DIAMETER: 44 in. DISPLACEMENT: 757 in. BORE: 5¼ in. STROKE: 5 in. COMPRESSION RATIO 6:1. FUEL GRADE: 80 octane. DRY WEIGHT: 505 lb. CARBURETOR: Bendix-Stromberg NA-R7A. MAGNETOS: 1 MAG. Scintilla VNM-7DF5. DISTRIBUTOR: Scintilla WL-7A with coil. STARTER: Eclipse. GENERATOR: Eclipse.  
PERFORMANCE  
TAKEOFF: 300 hp at 2,200 rpm. FUEL CONSUMPTION: .45 lb/hp hr. OIL CONSUMPTION: .010/hp hr.

### MODEL: R-755B Series.

DATA  
TYPE 7 cyl. air-cooled radial C.A.A.T.C. 237.  
SPECS  
LENGTH: 39.5 in. DIAMETER: 44 in. DISPLACEMENT: 757 in. BORE: 5.25 in. STROKE: 5.00. COMPRESSION RATIO 6:1. FUEL GRADE: 80 octane. DRY WEIGHT: 505 lb. CARBURETOR: Bendix-Stromberg NA-R7A. MAGNETOS: 1 MAG Scintilla VNM-7DF5. DISTRIBUTOR: Scintilla WL-7A with coil. STARTER: Eclipse. GENERATOR: Eclipse.  
PERFORMANCE  
TAKEOFF: 275 hp at 2,200 rpm. FUEL CONSUMPTION: .45 lb/ hp hr. OIL CONSUMPTION .010 lb/hp hr.

## LYCOMING DIVISION AVCO MFG. CORP.

Stratford, Conn.

### 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 lbs. FUEL GRADE: 100/130.

PERFORMANCE  
TAKE-OFF POWER: 400 hp. at 3,300 rpm. RATED POWER: 350 at 3,000 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.

## ENGINES IN PRODUCTION

### 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

TAKE-OFF POWER: 140 hp. at 2,800. RATED POWER: 135 hp. at 2,600 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.

### 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 lbs. FUEL GRADE: 91/96.

#### PERFORMANCE

TAKE-OFF and RATED POWER: 170 hp. @ 2700 rpm. FUEL CONSUMPTION: 8.5 gal. per hr. at 2,350 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

TAKE-OFF and RATED POWER: 168 hp at 2,700 rpm. FUEL CONSUMPTION: 8.5 gal. per hr. at 2,350 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: GO-480-B1B.

#### DATA

TYPE: 6 cylinder, horizontally-opposed, air cooled, gear drive, 270 hp CAA TYPE CERTIFICATE: 275.

#### SPECS

LENGTH: 41.62 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: 438 lbs. FUEL GRADE: 80/87.

#### PERFORMANCE

TAKE-OFF POWER: 270 hp at 3,400 rpm. (2,180 prop rpm.). RATED POWER: 260 at 3,000 rpm. FUEL CONSUMPTION: 14.1 gal. per hr. at 2,600 rpm., economy cruise.

#### EQUIPMENT

CARBURETOR: Bendix-Stromberg PS-5BD. MAGNETOS: Scintilla S6LN-50 and S6LN-51.

### MODEL: GO-480-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 lbs. FUEL GRADE: 80/87.

#### PERFORMANCE

TAKE-OFF POWER: 270 hp at 3,400 rpm. (2,180 prop rpm.). RATED POWER: 260 at 3,000 rpm. FUEL CONSUMPTION: 14.1 gal. per hr. at 2,600 rpm., economy cruise.

#### EQUIPMENT

CARBURETOR: Bendix-Stromberg PS-5BD. MAGNETOS: Scintilla S6LN-20, S6LN-21.

### MODEL: GO-480-C2C6.

#### DATA

TYPE: 6 cylinder, gear drive, horizontally opposed, air cooled, 275 hp., CAA TYPE CERTIFICATE: 275.

#### SPECS

LENGTH: 42.18. WIDTH: 33.12. BORE: 5.125 in. STROKE: 3.875 in. COMPRESSION RATIO: 8.70:1. DISPLACEMENT 479.7 cu. in. WEIGHT: 448 lbs. FUEL GRADE: 100/130.

#### PERFORMANCE

TAKE-OFF POWER: 295 hp at 3,400 rpm. RATED POWER: 285 hp. at 3,100 rpm. FUEL CONSUMPTION: 13.5 gal. per hr. at rated speed and 60 percent rated power.

#### EQUIPMENT

CARBURETOR: Bendix-Stromberg PS-58D. MAGNETOS: Scintilla S6LN-50 and S6LN-51.

### MODEL: GO-480-C1D6.

#### DATA

TYPE: 6 cylinder, gear drive, horizontally opposed, air cooled, 275 hp., CAA TYPE CERTIFICATE: 275.

#### SPECS

LENGTH: 38.64. WIDTH: 33.12. BORE: 5.125 in. STROKE: 3.875 in. COMPRESSION RATIO: 8.70:1 DISPLACEMENT 479.7 cu. in. WEIGHT: 438 lbs. FUEL GRADE: 100/130.

#### PERFORMANCE

TAKE OFF POWER: 295 hp at 3,400 rpm. RATED POWER: 285 hp at 3,100 rpm. FUEL CONSUMPTION: 13.5 gal. per hr. at rated speed and 60 percent rated power.

#### EQUIPMENT

CARBURETOR: Bendix-Stromberg PS-58D. MAGNETOS: Scintilla S6LN-20 and S6LN-21.

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### MODEL: GO-480-C2D6.

#### DATA

TYPE: 6 cylinder, gear drive, horizontally opposed, air cooled, 275 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 lbs. FUEL GRADE: 100/130.

#### PERFORMANCE

TAKE-OFF POWER: 295 hp at 3,400 rpm. RATED POWER: 285 hp at 3,100 rpm. FUEL CONSUMPTION: 13.5 gal. per hr. at rated speed and 60 percent rated power.

#### EQUIPMENT

CARBURETOR: Bendix-Stromberg PS-58D. MAGNETOS: Scintilla S6LN-20 and S6LN-21.

### MODEL: GO-480-C1B.

#### 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 lbs. FUEL GRADE: 100/130.

#### PERFORMANCE

TAKE-OFF POWER: 295 hp at 3,400 rpm. RATED POWER: 280 hp at 3,000 rpm. FUEL CONSUMPTION: 13.0 gal. per hr. at rated speed and 60 percent rated power.

#### EQUIPMENT

CARBURETOR: Bendix-Stromberg PS-58D. MAGNETOS: Scintilla, S6LN-20 and S6RN-21.

### MODEL: GO-480-D1A.

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. COMPRESSION RATIO: 7.30:1. DISPLACEMENT: 479.7 cu. in. WEIGHT: 454 lbs. FUEL GRADE: 80/87.

#### PERFORMANCE

TAKE-OFF POWER: 275 hp at 3,400 rpm. RATED POWER: 260 hp at 3,000 rpm. FUEL CONSUMPTION: 13.0 gal. per hr. at rated speed and 60 percent rated power.

#### EQUIPMENT

CARBURETOR: Bendix-Stromberg PS-58D. MAGNETOS: Scintilla, S6LN-20 and S6RN-21.

### MODEL: O-320.

#### 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 lbs. FUEL GRADE: 80/87.

#### PERFORMANCE

TAKE-OFF and RATED POWER: 150 hp at

2,700 rpm. FUEL CONSUMPTION: 8.2 gal. per hr. at 2,350 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: GSO-480-A1A6.

#### DATA

TYPE: 6 cylinder, horizontally opposed, geared, supercharged, 340 hp. CAA TYPE CERTIFICATE: 284.

#### SPECS

LENGTH: 42.22. HEIGHT: 33.08. WIDTH: 33.12. BORE: 5.125. STROKE: 3.875. DISPLACEMENT: 479.7. COMPRESSION RATIO: 7.3:1. WEIGHT: 498 lbs. FUEL GRADE: 100/130.

#### PERFORMANCE

TAKE-OFF POWER: 340 hp at 3,400 rpm. (2,180 prop. rpm). RATED POWER: 320 hp. at 3,200 rpm. FUEL CONSUMPTION: 16.0 gal. per hr. at 60 percent rated power at 2,600 rpm.

#### EQUIPMENT

CARBURETOR: Bendix PSH-7BDE. MAGNETOS: Scintilla S6LN-20 and S6RN-21.

### MODEL: GO-480-F6.

#### DATA

TYPE: 6 cylinder, gear drive, horizontally opposed, air cooled, 275 hp CAA TYPE CERTIFICATE: 275.

#### SPECS

LENGTH: 42.18 in. HEIGHT 28.02 in. WIDTH: 33.12 in. FUEL GRADE: 80/87. BORE: 5.125 in. STROKE: 3.875. DISPLACEMENT: 479.7. COMPRESSION RATIO: 7.30:1. WEIGHT 442 lbs.

#### PERFORMANCE

TAKE-OFF POWER 275 hp at 3,400 rpm (218 prop. rpm). RATED POWER 265 at 3100 rpm. FUEL CONSUMPTION 14.0 gal per hr. at 2,600 rpm and 60 percent rated power.

#### EQUIPMENT

CARBURETOR: Bendix-Stromberg PS-5-BD. MAGNETOS: Scintilla S6LN-50 and S6LN-51.

### 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 lbs.

#### PERFORMANCE

TAKE-OFF POWER 275 hp at 3,400 rpm (218 prop. rpm). RATED POWER: 265 at 3,100 rpm. FUEL CONSUMPTION: 14.0 gal per hr. at 2,600 rpm and 60 percent rated power.

#### EQUIPMENT

CARBURETOR: Bendix-Stromberg PS-5BD. MAGNETOS: Scintilla S6LN-20 and S6LN-21.

### MODEL: VO-435-A1B (O-435-23).

#### DATA

TYPE: 6 cylinder, air cooled, horizontally

## ENGINES IN PRODUCTION

opposed, for vertical helicopter installation, 260 hp. CAA TYPE CERTIFICATE: 279.

### SPECS

HEIGHT: 35.17 in. 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: 400 lbs.

### PERFORMANCE

TAKE-OFF: 260 hp. at 3,400 rpm. RATED POWER: 250 hp at 3,200 rpm. FUEL CONSUMPTION: 20.0 gal. per hr. at 80 percent rated power.

### EQUIPMENT

CARBURETOR: Marvel-Schebler MA4-5. MAGNETOS: Scintilla S6LN-20 and S6RN-21. Hand cranking provisions optional.

## MODEL: VO-435-A1C (O-435-23A).

### 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 lbs.

### PERFORMANCE

TAKE-OFF: 260 hp at 3,400 rpm. RATED POWER: 250 hp at 3,200 rpm. FUEL CONSUMPTION: 20.0 gal. per hr. at 80 percent rated power.

### EQUIPMENT

CARBURETOR: Marvel-Schebler MA-4-5 AA. MAGNETOS: Scintilla S6LN-20 and S6RN-21. Hand cranking provisions optional. New design crankcase and oil sump, hydraulic and fuel pump drives.

## MODEL: VO-435-A1D.

### 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 lbs.

### PERFORMANCE

TAKE-OFF: 270 hp at 3,400 rpm. RATED POWER: 250 hp at 3,200 rpm. FUEL CONSUMPTION: 20.0 gal. per hr. at 80 percent rated power.

### EQUIPMENT

CARBURETOR: Marvel-Schebler MA-4-5 AA. MAGNETOS: Scintilla S6LN-20 and S6RN-21. Hand cranking provisions optional. New design crankcase and oil sump.

## 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. COM-

PRESSION RATIO: 8.50:1. FUEL GRADE: 91/96. DRY WEIGHT: 282 lbs.

### 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

TAKE-OFF AND RATED POWER 168 hp at 2,700 rpm.

### EQUIPMENT

CARBURETOR Marvel-Schebler MA4-5. MAGNETOS: Scintilla S4LN-20, S4LN-21. STARTER: Delco-Remy. GENERATOR: Delco-Remy.

## MODEL: GO-435-C2B (O-435-17).

### DATA

TYPE: 6 cylinder, horizontally opposed, geared, air cooled. APPROVED TYPE CERTIFICATE 228, 240 hp.

### SPECS

LENGTH: 41.62 in. WIDTH: 33.12 in. HEIGHT 28.02. WEIGHT: 435 lb. 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-50 and S6LN-51.

## MODEL: GO-435-C2B2.

### DATA

TYPE: 6 cylinder, horizontally opposed, geared, air cooled. APPROVED 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.

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## MODEL: GO-480-DIA.

### DATA

TYPE: 6-cylinder, horizontally opposed, air cooled. 275 hp TYPE CERTIFICATE: 275.

### SPECS

LENGTH: 40.29 in. WIDTH: 33.12 in. DISPLACEMENT: 479.7 cubic in. BORE: 5.125 in. STROKE: 3.875. COMPRESSION RATIO: 7.3:1. FUEL GRADE: 80/87. DRY WEIGHT: 453 lb.

### EQUIPMENT

CARBURETOR: Bendix-Stromberg PS-5BD. MAGNETOS: Scintilla S6LN-20. STARTER: accessories cross-wise mounted.

## 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

TAKE-OFF POWER: 115 hp 2,800 rpm. CRUISE: 86 hp at 2,350 rpm. FUEL CONSUMPTION: .52 lb. per hp hr. OIL CONSUMPTION: .012 lb. per hp hr.

### EQUIPMENT

CARBURETOR: Marvel-Schebler MA-3A. IGNITION: Dual Scintilla S4LN-21. STARTER: Delco-Remy. GENERATOR: Delco-Remy.

## MODEL: 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

TAKE-OFF POWER: 190 hp at 2,550 rpm. CRUISE: 145 hp at 2,300 rpm. FUEL CONSUMPTION: .52 lb. per hp hr. OIL CONSUMPTION: .0012 lb. per hp hr.

### EQUIPMENT

CARBURETOR: Marvel Schebler MA-4-5 IGNITION: Dual Scintilla S6LN-50. STARTER: Delco-Remy. GENERATOR: Delco-Remy.

## MODEL: GSO-580-D.

### DATA

TYPE: 8 cylinder, air-cooled, horizontally opposed, geared, super charged. 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

TAKE-OFF POWER: 400 hp. FUEL CONSUMPTION: .57 lb. per hr.

### EQUIPMENT

CARBURETOR: Bendix. IGNITION: Scintilla. FUEL PUMP: PESCO.

## MODEL: SO-480.

### DATA

TYPE: 6 cylinder, aircooled, supercharged, helicopter engine for horizontal or vertical installation.

### SPECS

DISPLACEMENT: 479.7 cu. in. BORE: 5.125 in. STROKE: 3.875 in. COMPRESSION RATIO: 7.3:1. FUEL GRADE: 100/130. DRY WEIGHT: 444 lb. WIDTH: 33.12 in. LENGTH: 38.53 in.

### PERFORMANCE

CONTINUOUS HP: 325 at 3,200 rpm. FUEL CONSUMPTION: 25 gals./hr. at 80 percent normal, 3,200 rpm.

### EQUIPMENT

CARBURETOR: Bendix PS7BD. MAGNETOS: Scintilla S6RN20, 21.

## MODEL: -76A & -76B.

### DATA

TYPE: R-1820, 9 (radial) cylinder aircooled; 1,275 rated hp.

### SPECS

LENGTH: 48.50 in. HEIGHT: 54.95 in. dia. BORE: 6.125 in. STROKE: 6.875 in. DISPLACEMENT: 1,820. COMPRESSION RATIO: 6.80:1. FUEL GRADE: 100/130. WEIGHT: 1,380:0 lb.

### PERFORMANCE

TAKE-OFF POWER and SPEED: 1,425 at 2,700 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 aircooled, 1,275 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: 1,820. COMPRESSION RATIO: 6.80:1. FUEL GRADE 100/130. WEIGHT: 1,404 lb.

### PERFORMANCE

TAKE-OFF POWER and SPEED: 1,475 bhp. at 2,800 rpm. RATED POWER and SPEED: 1,275 bhp. at 2,500. FUEL CONSUMPTION: .700 lb/bhp. hr.

### EQUIPMENT

CARBURETOR: PD12K18. MAGNETO: Bosch S9LU-3.

## MODEL: -82.

### DATA

TYPE: R-1820, 9 (radial) cylinder aircooled, 1,275 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: 1,820. COMPRESSION RATIO: 6.80:1. FUEL GRADE: 115/145. WEIGHT: 1,469 lb.

## ENGINES IN PRODUCTION

### PERFORMANCE

TAKE-OFF POWER and SPEED: 1,525 at 2,800 rpm. RATED POWER and SPEED: 1,275 at 2,500 rpm. FUEL CONSUMPTION: .677 lb/bhp./hr.

### EQUIPMENT

CARBURETOR: PD12K18. MAGNETO: Scintilla Model D9LN-2.

### MODEL: -84.

#### DATA

TYPE: R-1820, 9 (radial) cylinder aircooled, 1,275 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: 1,820. COMPRESSION RATIO: 6.80:1. FUEL GRADE: 115/145. WEIGHT: 1,405 lb.

### PERFORMANCE

TAKE-OFF POWER and SPEED: 1,525 at 2,800 rpm. RATED POWER and SPEED: 1,275 at 2,500. FUEL CONSUMPTION: .677 lb/bhp./hr.

### EQUIPMENT

CARBURETOR: PD12R1. MAGNETO: Scintilla D9LN-2. 39° from horizontal nose up.

### MODEL: -86.

#### DATA

TYPE: R-1820, 9 (radial) cylinder aircooled, 1,275 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: 1,820. COMPRESSION RATIO: 6.80:1. FUEL GRADE: 100/130. WEIGHT: 1,385 lb.

### PERFORMANCE

TAKE-OFF POWER and SPEED: 1,425 at 2,700 rpm. RATED POWER and SPEED: 1,275 at 2,500. FUEL CONSUMPTION: .695 lb/bhp./hr.

### EQUIPMENT

CARBURETOR: PD12K18. MAGNETO: Bosch S9LU-3.

### MODEL: -103.

#### DATA

TYPE: R-1820, 9 (radial) cylinder aircooled, 1,275 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: 1,820. COMPRESSION RATIO: 6.80:1. FUEL GRADE: 100/130. WEIGHT: 1,350 lb.

### PERFORMANCE

TAKE-OFF POWER and SPEED: 1,425 at 2,700 rpm. RATED POWER and SPEED: 1,275 at 2,500. FUEL CONSUMPTION: .700 lb/bhp./hr.

### EQUIPMENT

CARBURETOR: PD12K19. MAGNETO: Bosch S9LU-3.

### MODEL: -3.

#### DATA

TYPE: R-1300, 7 (radial) cylinder aircooled, 700 bhp. rated hp.

#### SPECS

LENGTH: 49.68 in. HEIGHT: 50.45 in. dia. BORE: 6.125 in. STROKE: 6.312 in. DISPLACEMENT: 1,300. COMPRESSION RATIO: 6.20:1. FUEL GRADE: 91/96. WEIGHT: 1,080 lb.

### PERFORMANCE

TAKE-OFF POWER and SPEED: 800 bhp. at 2,600 rpm. RATED POWER and SPEED: 700 bhp. at 2,400 rpm. FUEL CONSUMPTION: .700 lb/bhp./hr.

### EQUIPMENT

CARBURETOR: Bendix PD9G1. MAGNETO: Bosch S7LU-3.

### MODEL: -4.

#### DATA

TYPE: R-1300, 7 (radial) cylinder aircooled, 700 bhp. rated hp.

#### SPECS

LENGTH: 48.12 in. HEIGHT: 50.45 in. dia. BORE: 6.125 in. STROKE: 6.312 in. DISPLACEMENT: 1,300. COMPRESSION RATIO: 6.20:1. FUEL GRADE: 91/96. WEIGHT: 1,092 lb.

### PERFORMANCE

TAKE-OFF POWER and SPEED: 800 bhp. at 2,600 rpm. RATED POWER and SPEED: 700 bhp. at 2,400 rpm. FUEL CONSUMPTION: .720 lb/bhp./hr.

### EQUIPMENT

CARBURETOR: Bendix PD9F1. MAGNETO: Bosch S7LU-3.

## PRATT & WHITNEY AIRCRAFT DIVISION OF UNITED AIRCRAFT CORP.

East Hartford, Conn.

### MODEL: Twin Wasp D Series, (R-2000).

#### DATA

TYPE: 14 cylinder, air-cooled, radial. CAA TYPE CERTIFICATE: 230.

#### SPECS

DIAMETER: 49.1 in. LENGTH: 59.66 in. FUEL GRADE: 100/130. BORE: 5.75 in. STROKE: 5.5 in. DISPLACEMENT: 2,004 cu.

in. COMPRESSION RATIO: 6.5:1. DRY WEIGHT: Single speed, 1,585 lb.; two speed, 1,605 lb.

### PERFORMANCE

TAKE-OFF: 1,450 at 2,700 rpm and 1,000 ft. NORMAL RATED POWER: 1,200 hp at 2,550 rpm and 5,000 ft.

### EQUIPMENT

CARBURETOR: Stromberg PD-12F13. IGNITION: two Scintilla SF-14LN-8.



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### REMARKS

Powers Douglas C-54 military transport, workhorse of World War II, the Berlin Airlift and the Trans-Pacific Airlift in support of the Korean campaign.

### MODEL: Double Wasp CA and CB series, (R-2800)

#### DATA

TYPE: 18 cylinder, air-cooled, radial. CAA TYPE CERTIFICATES: 231 and 264.

#### SPECS

DIAMETER: 52.8 in. LENGTH: 81.40 in. FUEL GRADE: 100/130 or 108/135. BORE: 5.75 in. STROKE: 6 in. DISPLACEMENT: 2,804 cu. in. COMPRESSION RATIO: 6.75 to 1. DRY WEIGHT: Two speed, 2,390 lb.; single speed, 2,357 lb.

#### PERFORMANCE (CB3)

TAKE-OFF POWER: 2,400 hp at 2,800 rpm at 4,000 ft. with water injection; 2,050 hp at 2,700 rpm at 6,000 ft. dry. NORMAL RATED POWER: 1,800 hp at 2,600 rpm at 8,500 ft.

#### EQUIPMENT

CARBURETOR: Stromberg PR-58E5. IGNITION: Scintilla DLN-10 low tension. CB16, same in low, but has maximum continuous rating in high of 1,700 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 and 340 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: 2,080 lb. FUEL: Kerosene, gasoline or special jet fuel.

#### PERFORMANCE

TAKE-OFF POWER: 7,250 lb. thrust. MILITARY RATING: 7,250 lb. thrust. NORMAL RATING: 5,600 lb. thrust. CRUISE RATING: 3,750 lb. or 3,100 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.

### MODEL: Turbo-Wasp PT2G-1.

#### DATA

TYPE: Axial-flow turboprop.

#### SPECS

DIAMETER: 34.06 in. LENGTH: 156.8 in. COMPRESSOR: Multi-stage axial-flow. TURBINE: three-stage, axial-flow. WEIGHT: 2,590 lb. FUEL: JP-4.

#### PERFORMANCE

TAKE-OFF POWER: 5,500 hp. FUEL CONSUMPTION: 0.63 lb. hp hr.

### MODEL: Turbo-Wasp J57 (JT-3)

#### DATA

TYPE: Twin-spool axial-flow turbojet.

#### REMARKS

Specifications and performance are still classified other than mention that engine is in the 10,000 lb. thrust class. It powers the Air Force's Boeing B-52 long-range bomber, the North American F-100, McDonnell F-101, Convair F-102, and the Navy's Douglas F4D fighter, A3D bomber and Chance Vought XF8U fighter. The J-57 also powers the Boeing 707. The fighter aircraft are powered by afterburner versions of the J-57 engine.

## WESTINGHOUSE ELECTRIC CORP.

### AVIATION GAS TURBINE DIVISION

P. O. Box 288, Kansas City, Mo.

### MODEL: J34-WE-36.

#### DATA

TYPE: Axial-flow turbojet.

#### SPECS

DIAMETER: 27 in. LENGTH: 111.4 in. HEIGHT: 34.7 in. WEIGHT: 1,207 lb. COMPRESSION RATIO: 4.35.

#### PERFORMANCE

TAKE-OFF THRUST: 3,400 lb. at 12,500 rpm. OPERATING ALTITUDE: 45,000 ft.

### MODEL: XJ81-WE-3.

#### DATA

TYPE: Axial-flow turbojet.

#### SPECS

Small, light-weight turbojet initially designed for drones and missiles.

#### PERFORMANCE

All other information classified.

### MODEL: J54-WE-2.

#### DATA

TYPE: Axial-flow turbojet.

#### SPECS

Medium size, light-weight turbojet designed for high altitude piloted aircraft.

#### PERFORMANCE

All other information classified.

## ENGINES IN PRODUCTION

### WRIGHT AERONAUTICAL DIVISION CURTISS WRIGHT CORP.

Wood-Ridge, N. J.

#### MODEL: R-1300-2A & 2B.

##### DATA

TYPE: 7-Cylinder, Air-cooled, Radial.

##### SPECS

LENGTH: 48.10 in. WIDTH: 50.45 in. WEIGHT: 1,067 lb. DISPLACEMENT: 1,300 cu. in. BORE: 6.125 in. STROKE: 6.312 in. COMPRESSION RATIO: 6.2 to 1. FUEL GRADE: 91/98. CARBURETOR: Stromberg PD9F1. MAGNETO: Bosch SF-7LU-2.

##### PERFORMANCE

TAKEOFF HP: 800 at 2,600 rpm. NORMAL RATED HP: 700 at 2,400 rpm. up to 5,000 ft. MILITARY RATING: 800 at 2600 rpm at 3500 ft. FUEL CONSUMPTION: .72 lb. per bhp. hr. OIL CONSUMPTION: .025 lb. per bhp hr. at normal rated power.

##### 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: 1,080 lb. DISPLACEMENT 1,300 cu. in. BORE 6.125 in. STROKE: 6.312 in. COMPRESSION RATIO: 6.2 to 1. FUEL GRADE: 91/96. CARBURETOR: Bendix PD9G1. MAGNETO: Amer. Bosch S7LU-3.

##### PERFORMANCE

TAKEOFF HP: 800 at 2,600 rpm. NORMAL RATED HP: 700 at 2,400 rpm. MILITARY RATING: 800 at 2600 rpm at 3500 ft. FUEL CONSUMPTION: .720 lb. per bhp-hr. at normal rated power. OIL CONSUMPTION: .020 lb. per bhp hr. at normal rated power.

##### REMARKS

Current production installation is Sikorsky H-19 helicopter. Designed for operation at 39° angle nose-up. Direct drive. Commercial version 990C7BA1 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: 1,300 cu. in. BORE: 6.125 in. STROKE: 6.312. COMPRESSION RATIO 6.20:1. FUEL GRADE: 91/96. DRY WEIGHT: 1,092 lb. CARBURETOR: Bendix PD9F1. MAGNETOS: Bosch S7LU-3.

##### PERFORMANCE

TAKE-OFF HP: 800 at 2,600 rpm. MILITARY RATING: 800 at 2,600 rpm at 3,500 ft. NORMAL RATING: 700 at 2,400 rpm up to 5,000 ft. SPECIFIC FUEL CONSUMPTION: .720 lb. per bhp-hr. at normal rated power. OIL CONSUMPTION: .025 lb. per bhp-hr. at normal rated power.

##### REMARKS

Installation—Goodyear Blimp ZS2G-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: 1,820 cu. in. BORE: 6.125 in. STROKE: 6.875. COMPRESSION RATIO 6.80:1. FUEL GRADE: 100/130. DRY WEIGHT: 1,385 lb. CARBURETOR: Bendix PD-12K18. MAGNETOS: Bosch S9LU-2.

##### PERFORMANCE

TAKE-OFF HP: 1,425 at 2,700 rpm. MILITARY RATING: 1,425 at 2,700 rpm at 2,000 ft. NORMAL RATING: 1,275 at 2,500 rpm up to 3,100 ft. SPECIFIC FUEL CONSUMPTION: .693 lb. per bhp-hr. at normal rated power. OIL CONSUMPTION: .025 lb. per bhp-hr. at normal rated power.

##### REMARKS

Installation: North American T-28B. Commercial version 987C9HDI installed in Learstar Mark I.

#### MODEL: R-1820-82.

##### DATA

TYPE: 9-Cylinder, Air-Cooled, Radial.

##### SPECS

LENGTH: 50.07 in. WIDTH: 55.74 in. DISPLACEMENT: 1,820 cu. in. BORE: 6.125 in. STROKE: 6.875. COMPRESSION RATIO 6.80:1. FUEL GRADE: 115/145. DRY WEIGHT: 1,469 lb. CARBURETOR: Bendix PD-12K-18. MAGNETOS: Bendix Scintilla D9LN-2.

##### PERFORMANCE

TAKE-OFF HP: 1,525 at 2,800 rpm. MILITARY RATING: 1,425 at 2,700 rpm at 2,400 ft. NORMAL RATING: 1,275 at 2,500 rpm up to 3,500 ft. SPECIFIC FUEL CONSUMPTION: .677 lb. per bhp-hr. at normal rated power. OIL CONSUMPTION: .025 lb. per bhp-hr. at normal rated power.

##### REMARKS

Installation: Gruman 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: 1,820 cu. in. BORE: 6.125 in. STROKE: 6.875. COMPRESSION RATIO 6.80:1. FUEL GRADE: 115/145. DRY WEIGHT: 1,405 lb. CARBURETOR: Bendix PD-12R1. MAGNETOS: Bendix Scintilla D9LN-2.

##### PERFORMANCE

TAKE-OFF: 1,525 at 2,800 rpm. MILITARY RATING: 1,425 at 2,700 rpm at 2,400 ft. NORMAL RATING: 1,275 at 2,500 rpm up to 3,500 ft. SPECIFIC FUEL CONSUMPTION: .677 lb. per bhp-hr. at normal rated power. OIL CONSUMPTION: .025 lb. per bhp-hr. at normal rated power.

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## 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: 1,820 cu. in. BORE: 6.125 in. STROKE: 6.875. COMPRESSION RATIO 6.80:1. FUEL GRADE: 100/130. DRY WEIGHT: 1,560 lb. CARBURETOR: Bendix PD-12K18. MAGNETOS: Bendix Scintilla D9LN-2.

### PERFORMANCE

TAKE-OFF HP: 1,525 at 2,800 rpm. MILITARY RATING: 1,425 at 2,700 rpm at 2,400 ft. NORMAL RATING: 1,275 at 2,500 rpm up to 3,500 ft. SPECIFIC FUEL CONSUMPTION: .677 lb. per bhp-hr. at normal rated power. OIL CONSUMPTION: .025 lb. per bhp-hr. at normal rated power.

### 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: 1,820 cu. in. BORE: 6.125 in. STROKE: 6.875. COMPRESSION RATIO 6.80:1. FUEL GRADE: 100/130. DRY WEIGHT: 1,362 lb. CARBURETOR: Bendix PD12K19. MAGNETOS: Bosch S9LU-3.

### PERFORMANCE

TAKE-OFF HP: 1,425 at 2,700 rpm. MILITARY RATING: 1,425 at 2,700 rpm at 1,000 ft. NORMAL RATING: 1,275 at 2,500 rpm up to 3,000 ft. SPECIFIC FUEL CONSUMPTION: .700 lb. per bhp-hr. at normal rated power. OIL CONSUMPTION: .025 lb. per bhp-hr. at normal rated power.

### REMARKS

Installation: Vertol Helicopter H-21. Commercial version 977C9H1D1 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: 2,953 lb. DISPLACEMENT: 3,350 cu. in. BORE: 6.125 in. STROKE: 6.312 in. COMPRESSION RATIO: 6.7:1. FUEL GRADE: 115/145. CARBURETOR: PR58U1. MAGNETO: Scintilla DLN-9.

### PERFORMANCE

TAKEOFF HP: 2,700 at 2,900 rpm. MILITARY RATING 2700 at 2900 rpm at 3700 ft. NORMAL RATED HP: 2,300 at 2,600 rpm up to 6200 ft. FUEL CONSUMPTION: .720 lb. per bhp hr. OIL CONSUMPTION: .030 lb. per bhp hr at normal rated power.

### 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: 3,350 cu. in. BORE: 6.125 in. STROKE: 6.312. COMPRESSION RATIO: 6.70:1. FUEL GRADE: 115/145. DRY WEIGHT: 3,521 lb. CARBURETOR: Bendix PR58S2. MAGNETOS: Bendix Scintilla DLN9.

### PERFORMANCE

TAKE-OFF HP: 3,700 at 2,900 rpm. MILITARY RATING: 3,420 at 2,900 rpm at 2,400 ft. NORMAL RATING: 2,850 at 2,600 rpm up to 4,100 ft. SPECIFIC FUEL CONSUMPTION: .669 lb. per bhp-hr. at normal rated power. OIL CONSUMPTION: .022 lb. per bhp-hr. at normal rated power.

### 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: 98ITC18EA1 (Turbo Compound).

### DATA

TYPE: 18-Cylinder, Air-Cooled, Radial.

### SPECS

LENGTH: 89.53 in. WIDTH: 56.59 in. DISPLACEMENT: 3,350 cu. in. BORE: 6.125 in. STROKE: 6.312. COMPRESSION RATIO 6.70:1. FUEL GRADE: 115/145. DRY WEIGHT: 3,651 lb. CARBURETOR: Bendix PR58S2. MAGNETOS: Bendix Scintilla DLN9.

### PERFORMANCE

TAKE-OFF HP: 3,700 at 2,900 rpm. NORMAL RATED HP: 2,850 at 2,600 rpm. CRUISE RATED HP: 1,910 at 2,400 rpm. FUEL CONSUMPTION: .645 lb. per bhp hr. OIL CONSUMPTION: .022 lb. per bhp-hr.

### REMARKS

Installation: CL28 Bristol Britannia for RCAF.

## MODEL: 98ITC18EA1-2 and 3.

### DATA

TYPE: 18 Cylinder, Air Cooled, Radial.

### SPECS

LENGTH: 89.53 in. WIDTH: 56.59 in. WEIGHT: 3,645 lb. DISPLACEMENT: 3,350 cu. in. BORE: 6.125 in. STROKE: 6.312 in. COMPRESSION RATIO: 6.7 to 1. FUEL GRADE: 115/145. CARBURETOR: Bendix PR58S2. MAGNETO: Bendix-Scintilla DLN-9.

### PERFORMANCE

TAKEOFF HP: 3,400 at 2,900 rpm. NORMAL RATED HP: 2,850 at 2,600 rpm. CRUISE RATED HP: 1,910 at 2,400 rpm. FUEL CONSUMPTION: .645 lb. per bhp hr. at 2,800 rpm. OIL CONSUMPTION: .022 lb. per bhp hr.

### REMARKS

Reduction gear ratio of EA-1 and 3 is 0.4375 to 1; EA-2 reduction gear ratio is 0.355 to 1. Installation: EA-1 in Douglas DC-7C, EA-2 Lockheed 1649, EA-3 Lockheed 1049 G and H.

## ENGINES IN PRODUCTION

### MODEL: J65-W-16.

#### DATA

TYPE: Axial Flow Turbojet.

#### SPECS

LENGTH: 112.80 in. WIDTH: 37.5 in.  
TOTAL WEIGHT: 2,742 max. lb. COMPRESSOR STAGES: 13 of 29.375. TURBINE STAGES: 2 of 30.5 in.

#### PERFORMANCE

MAXIMUM THRUST: 7,700 at 8,300 rpm.  
NORMAL RATED THRUST: 6,780 at 8,070 rpm. 75% NORMAL THRUST: 5,080 at 7,510 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: 3,425 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: YJ67-W1.

All data classified.

Rocket and engine production line at Ryan Aeronautical Co.



## The AIRCRAFT YEAR BOOK

# 1956 DAY BY DAY CHRONOLOGY

(NOTE: The following chronology is condensed principally from *American Aviation Daily*, only daily in the aviation field, published by American Aviation Publications, Inc., Wayne W. Parrish, Publisher.)

### JANUARY

Jan. 3

Lockheed Aircraft Corp. starts quantity production of the T2V-1 Sea Star jet trainer.

Air Transport Association reports that scheduled airline passenger traffic in 1955 gained nearly 3.2-billion revenue passenger-miles over 1954.

Jan. 4

National Airlines' purchase of 20 Lockheed Electra turboprop aircraft announced simultaneously by the airline and Lockheed.

Hamilton-Standard Division of United Aircraft Corp. buys the Aero Pneumatics Division of Pacific Airmotive Corp., Burbank, Calif.

Cessna Aircraft Co. receives a \$2.5-million Army order for 230 L-19 lightplanes.

Jan. 5

Ralph S. Damon, president of Trans World Airlines, dies of pneumonia Jan. 4 at Nassau Hospital, Long Island, after a brief illness.

Lockheed Aircraft Corp. reveals plans for multi-million dollar expansion of its Sunnyvale, Calif., missile systems division.

Jan. 6

Convair announces its fourth and largest order for the F-102A series.

President Eisenhower in his State of the Union message asserts the maintenance of a strong military capability will continue to call for a large share of the national budget, with increasing amounts destined for the development of long-range missiles and nuclear-powered aircraft.

Jan. 9

First F-104A is rolled out at Lockheed on the Air Force's expedited schedule for the supersonic fighter.

Jan. 10

Pentagon lifts ban which blocked release of information on new aircraft for a year after their entry into tactical units.

Convair announces additional orders for the 440 Metropolitan, boosting total sales of the new model to 67.

The Air Force awards Boeing Airplane Co. a \$248-million follow-on order for additional purchase of B-52 bombers.

The Navy and Lockheed jointly confirm shelving of work on the XFV-1 vertical take-off plane.

Jan. 11

Douglas Aircraft Co. is awarded Navy contract for production of AD-7s, a new model of the AD Skyraider series.

Pentagon announces wide changes in its policies for creating and maintaining a reservoir of machine tools and production equipment for emergency use.

Jan. 12

Lockheed Aircraft Corp. reports 1955 orders for new transports by airlines totaled \$335-million, a four-fold increase over the previous annual record.

Douglas Aircraft Co. discloses that its 1955 commercial sales amounted to \$1,125,000,000.

Jan. 13

Defense Secretary Wilson tells Congress that the Air Force plans a build-up from the current 127-wing AF to 137 wings.

Jan. 16

Lear, Inc.'s LearCal Division establishes an International Sales Dept. headed by Henry J. Hamm, formerly commercial sales manager.

The Air Transport Association appoints Warren N. Martin Director of Public Affairs.

F. J. Iseman, of Merrill Lynch, Pierce, Fenner and Beane, predicts a possible 100 percent rise in air passenger travel in the next decade.

Jan. 17

President Eisenhower in his annual budget message requests a total of \$7,537,900,000 in new obligational authority aircraft and related equipment by the Navy and Air Force.

President asks Congress for a record \$202,618,000 appropriation for the Civil Aeronautics Administration.

The Martin Company of Baltimore announces receipt of a new Air Force contract for production of the TM-61 Matador missile.

Jan. 18

Mackey Airlines, with an order for two, becomes first U.S. carrier to purchase the Fairchild-Fokker F-27 turboprop transport.

Commerce Department announces an Air Force award of a \$265,776,509 contract to Ford Motor Co. for three models of the Pratt & Whitney J57 turbojet.

Curtiss-Wright Corp. announces purchase of Turbomotor Associates of Hempstead, L.I.

Jan. 19

Air Force awards North American Aviation, Inc., a \$25,000,000 contract for production of the radar-equipped F-100D.

President Eisenhower accepts recommendation made to the Bureau of the Budget by the Harding Committee for a long-range study of aviation facilities.

Air Force gives Lycoming Division, AVCO Manufacturing Corp., Stratford, Conn., a \$7,935,976 contract for aircraft engines, data and special tools.

DeWitt C. Ramsey, president of the Aircraft Industries Association, asserts that 2500 jet engines of more than 10,000 pounds thrust are currently in service.

Jan. 20

H. Julian Allen, chief of the high-speed research division of NACA's Ames Aeronautical Laboratory, wins Sylvanus Albert Reed Award, and Capt. Wilbur E. Kellum, U.S.N., commander of the Naval Medical Research Institute at the Naval Medical Center, wins the John Jeffries Award, NACA announces.

Jan. 23

CAA announces appointment of William B. Davis as director of the Office of Aviation Safety.

The Air Force decides to equip all existing Lockheed C-130A turboprop transports with AeroProducts propellers.

## 1956 CHRONOLOGY

Giles J. Strickroth, Martin electronics engineer who developed the guidance system for the TM-61 Matador missile, receives 1955 Lawrence Sperry Award.

Jan. 24

Presidents of the intra-Alaskan airlines open bid for legislation providing permanent certification for their routes.

Lt. Col. Robert C. Bundgaard, USAF, receives the Institute of the Aeronautical Sciences' Robert M. Losey Award for 1955 in recognition of "outstanding contributions to the science of meteorology as applied to aeronautics."

Jan. 25

Douglas Aircraft Co. completes delivery of 166 DC-6 type transports for the Air Force and Navy.

Allison Division announces shipment of its 100,000th aircraft engine, a T56 turboprop.

Jan. 26

The Air Force awards Aerojet-General Corp., Azusa, Calif., a \$9-million contract for facilities for the pilot production and production testing of liquid rocket engines.

The Doman LZ-5 helicopter, which earlier was awarded a CAA type certificate, receives a corresponding certificate from the Federal Transport Department in Canada.

Jan. 27

Convair Division of General Dynamics launches exploratory talks with several airlines on a new airplane designed to keep it in the commercial transport field.

CAB issues decision permitting Eastern Air Lines to acquire assets of Colonial Airlines.

Jan. 30

Swissair orders three Douglas DC-8s.

Senator Warren G. Magnuson (D-Wash.) reveals he will introduce legislation providing for permanent certification for the intra-Alaska, U. S.-Alaska and Hawaiian airlines.

Rep. Daniel J. Flood (D-Pa.) discloses that the Pentagon has promised to devise reforms in MATS which may save up to \$49.5-million annually.

Aircraft Industries Association's Helicopter Council meets in Washington to elect officers for 1956.

Jan. 31

The Atomic Energy Commission announces it has started test work on an aircraft nuclear powerplant at its National Reactor Testing Station in Idaho.

President Eisenhower makes the Federal Communications Commission a full voting member of the Air Coordinating Committee.

The Air Force awards Convair Division, General Dynamics Corp., a \$50-million contract for F-102A interceptors.

## FEBRUARY

Feb. 1

Lockheed announces plans to spend \$7-million in guided missile and production facilities, part of a \$20-million general expansion program.

Aircraft Industries Association's Helicopter Council announces selection of Don R. Berlin, chairman and president of Piasecki Helicopter Corp., as chairman for 1956, succeeding Stanley Hiller.

Feb. 2

Production of Lockheed Aircraft Corp's T2V-1 is guaranteed through 1957 by a new \$25-million follow-on order for the trainer for the Navy.

Feb. 3

Iberia, a Spanish airline, signs a contract for five Convair 440 Metropolitans.

Feb. 6

Air Force Secretary Donald Quarles concedes that the AF can live with budget of \$16.5-billion appropriated for fiscal 1957.

Feb. 7

The Air Force gives Allison Div., General Motors Corp., a \$31,905,800 contract to manufacture T56-A-1 turboprop engines.

The Navy awards the Garrett Corp. a contract for research and development of an auxiliary power system for an atom-powered seaplane.

Feb. 8

Hughes Tool Co. orders eight Boeing 707-120 jet airliners for use by its subsidiary, Trans World Airlines.

Cessna Aircraft Company announces the first successful flight of a helicopter incorporating boundary layer control.

Feb. 9

General Electric Co. reveals its plan to build a \$20-million supersonic jet engine test facility at Evendale, Ohio.

Bendix Aviation Corp. establishes a Systems Planning Group as a new section of management to coordinate the efforts of all Bendix manufacturing divisions. Dr. Russell D. O'Neal is named director.

Feb. 10

CAA discloses that a total of 319 new Federal-aid-to-airports projects totaling \$38,932,065 are included in the fiscal 1956 portion of the Monroney Act.

Feb. 13

The Air Force awards North American Aviation, Inc., two contracts totaling \$7,992,977 to provide and install extended leading edges and advanced electronic systems in 900 F-86-D fighters.

Boeing Airplane Co. announces plans to build an \$8.5-million manufacturing and office facility at its Renton plant near Seattle.

Air Force Secretary Donald Quarles gives the Glenn L. Martin Co. an official nod on its plans to construct a multi-million dollar guided missile research facility near Denver, Colo.

Feb. 14

Delta Air Lines places a \$28.5-million order for six Douglas DC-8 jet transports with first delivery scheduled for June 1, 1959.

Boeing Airplane Co. announces a \$29.5-million facilities expansion program.

The Senate passes by voice vote legislation (S.2972) providing severe new penalties, including death, for persons convicted of aircraft sabotage.

Feb. 15

Lockheed receives the Navy's largest order to date for WV-2 early-warning radar Super Constellations in a contract worth about \$60-million.

Feb. 16

The Army assigns weapon system responsibility for developing the joint Army-Navy intermediate-range ballistic missile at Huntsville, Ala., to the Chrysler Corp.

The Navy Bureau of Aeronautics awards a contract calling for the development of a turbojet engine in the 25,000-pound-thrust class to Allison Division of General Motors.

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Ryan Aeronautical Co. reports its Firebee remote-controlled jet drones are in operational use.

Feb. 17

Douglas Aircraft Co. releases detailed specifications of its DC-8 jet transport, disclosing that it is somewhat larger than the model originally announced.

Feb. 20

The Navy Bureau of Aeronautics gives Kollsman Instrument Corp., Elmhurst, N. Y., a \$1,102,792 contract to manufacture periscopic sextants, spare parts and mounts.

The Air Force reveals the first loss of a B-52 bomber. The Stratafortress crashed near Tracy, Calif., Feb. 16.

Feb. 23

The Air Materiel Command gives higher status to missiles by establishing a new office of Deputy Director-Ballistic Missiles in the Directorate of Procurement and Production. Brig. Gen. Ben I. Funk, AMC's Assistant for Programming, is named to head the office, headquartered in Los Angeles.

Aircraft Industries Association reports that 640 civilian aircraft of 3,000 pounds and under and valued at about \$7.5-million were shipped to 54 countries in 1955.

Bureau of the Census and CAA disclose jointly that the U. S. aircraft industry in 1955 shipped 4753 civilian planes valued at \$271,010,000.

Feb. 24

Pan American World Airways reveals it has increased its Boeing 707 order from 20 to 23 at a total cost of \$135-million.

### MARCH

Mar. 1

KLM Royal Dutch Airlines announces plans to buy 12 Lockheed Electras.

Mar. 2

The White House announces the swearing in on March 1 of Edward P. Curtis as Special Assistant to the President for Aviation Facilities Planning.

Military Air Transport Service reports its 1955 accident rate dropped to 6.06 per 100,000 flying hours, lowest in its history.

Mar. 5

General Dynamics board of directors discloses it has given the green light to the Convair Division's medium-sized jet transport program.

The Air Force reveals a new version of the Martin Matador missile, designated the TM-61B.

Aircraft Industries Association reports shipment of 509 one-to-10-place utility and executive aircraft by six companies in January, with a dollar value of \$6,950,000.

Mar. 6

The Navy gives Westinghouse Electric Corp. a \$22,750,000 contract for production of the Aero-13 fire control system, to be installed in the nose of the supersonic Douglas F4D Skyray interceptor.

Mar. 8

McDonnell Aviation Corp.'s F3H-2N Demon fighter begins its tour as an operational fighter of the U. S. fleet.

Mar. 13

Eastern Air Lines decides to buy 12 Convair 440 Metropolitans.

Mar. 14

Cessna announces it will reinstate its L-19 production line following receipt of a new

Air Materiel Command contract totaling \$688,694.

Mar. 15

The Defense Department announces that more than 55 percent of its expenditure for passenger travel in the calendar year 1955 went to the airlines.

Hughes Aircraft Co. awards a contract totaling over \$5-million to Air Associates, Inc., for research and development of advanced airborne communications equipment.

Sikorsky Aircraft Division of United Aircraft Corp. extends its license agreements with Westland Aircraft, permitting the British company to manufacture the S-58.

Mar. 19

The Air Force Air Materiel Command gives Ford Motor Co. a \$70,483,279 contract to manufacture J57 engines at Chicago.

Cessna Aircraft Co. announces that the prototype of its Model 620 four-engine executive transport is in final assembly.

Mar. 20

American Airlines announces it will start transcontinental nonstop coach service flights with Douglas DC-7s on May 20.

Air Research and Development Command reports that Battelle Memorial Institute, Columbus, Ohio, has successfully accomplished cold extrusion of titanium.

President Eisenhower asks Congress for \$3-billion in direct military aid for U. S. allies in fiscal 1957.

Mar. 22

Navy gives Chance Vought Aircraft a new order for \$45-million worth of supersonic F8U-1 air superiority fighters.

French government reveals orders for 50 Vertol H-21Cs and that an identical number of Sikorsky S-58s have been bought by SNCA du Sud-Est.

CAA calculates that general aviation flew an estimated 9,500,000 hours in 1955, a 6 percent increase over 1954.

Mar. 23

President Eisenhower nominates James R. Durfee 56, to replace Ross Rizley on the Civil Aeronautics Board.

Ryan Aeronautical Co. receives a \$12.5-million order to build fuselage sections for Boeing 707 commercial transports.

Adm. Arleigh Burke, Chief of Naval Operations, tells the Senate Armed Services Committee the Navy is working on a supersonic seaplane, an advanced version of the Martin P6M Seamaster.

Mar. 26

House Appropriations Committee releases 400-page report, describing major military procurement as rife with "waste," "delay," "duplication," and "chaos."

Aero Design & Engineering Co. delivers its first model 680 Super Aero Commander to the Long Manufacturing Co., Tarboro, N. C.

Mar. 27

Lockheed Aircraft Corp. orders four Rolls-Royce RB 109 Tync turboprops.

Defense Secretary Charles E. Wilson announces the appointment of Eger V. Murphree, president of Esso Research and Engineering Co., as his missile "czar" to coordinate the nation's guided missile program.

Mar. 28

Rep. Carl Hinshaw (R.-Calif.) introduces legislation authorizing Federal participation in

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the design and development of prototype aircraft for local service airline needs.

Mar. 29

The Navy gives McDonnell Aircraft Corp. an additional \$22.5-million contract for the development of the F4H-1 supersonic all-weather attack fighter.

J. Gordon Bennett takes oath as executive assistant to Edward P. Curtis, Special Presidential Assistant for Aviation Facilities.

Mar. 30

Air Force Secretary Quarles and Chief of Staff Gen. Nathan F. Twining warn Congress that the fiscal 1958 budget will have to be raised over 1957's.

Lufthansa's board of directors authorizes the purchase of four Boeing 707-320 jet transports.

The Senate passes legislation repealing transportation taxes on travel between the U. S. and much of North and Central America.

### APRIL

Apr. 2

The Air Force reportedly fires an air-breathing guided missile (a Northrop SM-62 Snark) a distance between 1,500 and 3,000 miles from Patrick Air Force Base, Fla.

Aircraft Industries Assn. reports shipments of 576 ten-place utility and executive aircraft valued at \$8,041,000 in February.

Apr. 3

Navy Secretary Charles S. Thomas reports the Navy's program to procure guided missiles has climbed from \$126-million in fiscal 1955 to \$238-million in 1956 and \$353-million in 1957.

Apr. 4

The Army places its first research and development contract for a new airplane. The \$1,007,087 award goes to Fairchild's Aircraft Division at Hagerstown for design, construction and testing of an STOL-VTOL research plane.

Scandinavian Airlines System selects the P&W JT4 (J75) as the powerplant for its fleet of seven Douglas DC-8s.

The Navy announces that the Fairchild Petrel air-to-surface guided missile is in fleet operational use.

Apr. 11

The U. S. Air Force indicates that its atomic-airplane project will likely be limited to airframe types, scheduled to be constructed by Convair and Lockheed.

Apr. 19

Election of Foster Jones, director of the Louisville, (Ky.) and Jefferson County Air Board, as president of the Airport Operators Council is announced.

Asst. Navy Air Secretary James H. Smith, Jr. reports the Defense Department has formally approved a Navy request and has provided funds for a nuclear-powered seaplane program.

Apr. 20

Western Air Lines disclose its decision to buy nine Lockheed Electra turboprop transports and to increase a prior order for 13 Douglas DC-6Bs to 17 aircraft.

Link Aviation, Inc., announces receipt of a \$1-million-plus contract from Douglas Aircraft Co. to build a "total task" flight simulator for the DC-8.

Apr. 24

The Air Force schedules a new 18 percent increase in B-52 production at Boeing plants in Seattle and Wichita.

Apr. 25

West Coast Airlines reveals its intention to pick up its option on up to six F-27 Fokker Friendship transports.

Fairchild announces that CAA has granted a type certificate to its Engine Division for the 1,000-pound-thrust J-44 turbojet.

Successful maiden flight of the Douglas C-133A turboprop transport at Long Beach, Calif., is reported.

Apr. 26

United Air Lines orders a jet aircraft electronic flight simulator from Link Aviation, Inc.

Air Materiel Command reveals its plan to sell 220 cargo and trainer aircraft which originally cost the government \$20-million.

Apr. 27

Fairchild Engine & Airplane Corp. says it has decided to go into volume production on the Fokker-designed F-27 40-place turboprop transport.

The Air Force awards Douglas-Long Beach a \$22,685,705 contract to convert an unspecified number of B-66B tactical bombers into the RB-66B configuration.

Apr. 30

The Air Force announces plans to order a total of 1,898 new aircraft in fiscal 1957, or 314 fewer than it had anticipated a year ago.

Possibility that guided missiles, which account for 20.3 percent of the AF's fiscal 1957 request for aircraft and related procurement, will climb to 35 percent by fiscal 1959 is voiced before House subcommittee.

### MAY

May 1

The Glenn L. Martin Co. awarded AF Phase II contract for a supersonic tactical bomber.

May 2

Defense Secretary Charles E. Wilson reports the Air Force is planning to raise the number of B-52s in its 11 SAC heavy bomber wings from 30 to 45.

Air Force awards Cessna Aircraft Co., Wichita, Kans., a \$1,768,411 contract to conduct Phase III flight tests on three XT-37 jet trainers.

Doman Helicopters, Inc., delivers its first YH-31 helicopter to the Army.

May 3

Air Force and Convair disclose plans to erect a \$41-million guided missile facility at Sorrento, Calif., apparently for work on the Atlas WS-107A intercontinental ballistic missile.

General Electric reveals first design and performance details on its T58 engine, a "free turbine" weighing only 325 lbs. and producing 1,024 shaft horsepower.

May 4

Douglas Aircraft Co. reports its F4D bat-winged jet interceptor is in operational service with the Navy.

May 8

President Eisenhower reports that the U. S. has shipped more than \$12.4-billion worth of military equipment to free world countries during the past six years.

Navy and Grumman Aircraft Engineering Corp. release details and photographs on the company's new F9F-8P, a photo-reconnaissance version of the Cougar series.

CAA reports a total of 19,480,000 aircraft operations for calendar year 1955, a 9 percent increase over 1954's 17,945,000.



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May 9

Navy issues a final report on the loss of the Martin XP6M-1 Seamaster, attributing the accident to a "malfunction of the aircraft control system."

Resort Airlines, Inc., says it will place an order for an undisclosed number of Lockheed 1049-II Super Constellations.

May 10

Trans-Canada Airlines orders four Douglas DC-8s, powered by Rolls-Royce Conway bypass engines.

Ryan Aeronautical Co. announces it will build an unspecified number of afterburners for a new high thrust Allison engine.

May 11

Douglas Aircraft Co. puts a price tag of \$2,999,000 on its DC-9 medium jet transport project.

The House rejects efforts to boost AF appropriations for more B-52s by \$1-billion.

May 14

Ford Motor Co., paving the way for its entry as a prime manufacturer in the aircraft and missile industry, announces formation of Aeronutronic Systems, Inc., a subsidiary for design, development and manufacture of weapons systems for the military and related systems for commercial use.

Aircraft Industries Association reports shipment of 599 one-to-ten place utility planes worth \$8,847,000 by seven companies in March.

May 15

The Air Force confirms that it has placed a multi-million dollar order with North American Aviation for F-100F Super Sabres.

Change in the name of North American Airlines to Trans American Airlines becomes official on May 14.

May 16

Defense Secretary Charles Wilson says the U. S. will not make any "appreciable" changes in its military strength following Russia's promised reduction in the size of its armed forces.

The Senate Commerce Committee concludes hearings on the nomination of CAA Administrator Charles J. Lowen.

May 17

Boeing Airplane Co. reveals plans to the short-range jet transport field to compete with the proposed Convair 880 and Douglas DC-9.

The Air Force Air Materiel Command awards Curtiss-Wright Corp. a total of \$33,249,935 in contracts for aircraft jet engines and propellers.

May 18

Douglas Aircraft Co. receives a CAA type certificate for the long-range model of its DC-7, the DC-7C.

Horning-Cooper, Inc., Monrovia, Calif., announces the development of a new high-altitude research rocket, known as the ASP, for the Navy's Bureau of Ships.

May 21

Cessna Aircraft discloses an Army order for "an evaluation quantity" of its YH-41 helicopter.

An \$850,000 research contract calling for the design and development of a turbine-powered tilting-wing VTOL test bed is awarded to Vertol Aircraft Corp. by the Army and ONR.

May 22

The selection of Garrison Norton to succeed James H. Smith, Jr., as Assistant Navy Secretary for Air is revealed.

May 23

Pratt & Whitney Aircraft Division announces the development of a noise control attachment for turbojet engines. P&W is offering to license it to any qualified acoustical engineering firm on a royalty-free basis.

National Advisory Committee for Aeronautics unveils a new \$32,856,000 unitary plan wind tunnel at Lewis Flight Propulsion Laboratories, Cleveland.

May 24

The Senate Commerce Committee approves the nominations of G. Joseph Minetti as CAB Member and Charles J. Lowen as CAA Administrator.

The Second XP6M-1 Seamaster makes its first flight on May 18.

Aircraft Industries Association reports shipment by seven firms of one-to-ten place aircraft worth \$9,971,000 in April.

May 25

Chance Vought Aircraft, Inc. is awarded a Navy contract totaling more than \$20-million for additional production of an undisclosed number of F-8U-1 Crusader jets, including fighter and photographic versions.

The Soviet Union invites Gen. Nathan F. Twining, USAF Chief of Staff, and other top air officers to attend the air show in Moscow on June 24.

May 28

McDonnell completes mock-up versions of the F-101B fighter-interceptor and the twin-engine F4H Navy carrier fighter.

Hamilton Standard Division of United Aircraft Corp. announces receipt of an order from KLM for a new Model 54H60 propeller for the Dutch Airlines 12 Lockheed Electras.

The Aircraft Industries Association reports that the aircraft industry during the past five years has boosted the combat strength of U. S. airpower by 160 percent.

May 29

Lockheed Aircraft Corp. announces receipt of a \$106-million Air Force contract for a "large quantity" of Hercules C-130 turboprop transports at its Marietta, Ga., plant.

The Air Force formally announces that the Glenn L. Martin Co. won the Phase I competition for the development of an advanced tactical bomber.

President Eisenhower accepts the resignation of James Smith, Assistant Secretary of the Navy for Air, and nominates Garrison Norton, former Assistant Secretary of State, to replace him.

May 31

The Air Force offers to turn over its control of research, development and procurement of helicopters to the Army, provided the Army agrees to leave the field of high-speed aerial reconnaissance to the Air Force.

## JUNE

June 1

Pratt & Whitney Div., United Aircraft Corp., receives a \$33,676,013 contract to manufacture J57-P-23, P-21 and P-5 jet engines for the Navy.

Bonanza Air Lines places an order for three F-27 turboprop transports with Fairchild Engine & Airplane Corp., and takes an option on three more.

The merger of Colonial Airlines and Eastern Air Lines is formally accomplished on May 31.

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Ryan Aeronautical Co. is awarded an Air Force contract for a new version of the Firebee jet drone missile to be capable of high subsonic speeds and operation at altitudes above 50,000 feet.

June 4

Donald W. Douglas, president of Douglas Aircraft Co., is selected to receive the 1956 Elmer A. Sperry Award.

The Senate passes a bill appropriating \$1.4-billion to run the Commerce Department and its related agencies, including CAA and CAB.

June 5

Air Materiel Command awards fiscal 1957 LOGAIR domestic freight contracts to Resort Airlines, Riddle Airlines, American Export & Import Co., and Capital Airways.

Douglas Aircraft Co. announces it will use a vapor cycle system developed by the Carrier Corp. for air conditioning its DC-8 jet transport.

June 6

Convair Division, General Dynamics Corp., receives a \$61,528,000 Air Force contract for the production of additional F-102 fighter-interceptors.

Joseph T. McNarney, president of Convair, is named "National Management Man of the Year" by the National Management Association.

June 7

The Air Force discloses that it expects to dispose of 4,000 to 5,000 obsolete machine tools during the course of the next year, as a step in its program to modernize its inventory of 140,000 machine tools valued at \$1.25-billion.

Piper Aircraft Co. officials announce the first flight of the all-metal four-place high performance Comanche.

June 8

Reaction Motors, Inc. completes its 1,000,000-pound-thrust rocket engine stand.

Republic Aviation Corp. announces development of a closed-circuit television technique designed to cut costs and speed construction of large jigs and fixtures used to support aircraft assemblies and sub-assemblies.

June 11

The Army, through the Office of Naval Research, awards Ryan Aeronautical Co. a \$700,000 contract to develop and build a flying test bed employing a deflected slipstream for vertical takeoff and landing.

Boeing Airplane Co. announces formation of a tri-company coordination agency involving the B-47 modification and overhaul program in Wichita, Kans.

June 12

The Commerce Department announces the second installment of the four-year \$252-million airport authorization program.

Air Coordinating Committee's policy guaranteeing the use of VOR at least through 1965 is upheld in an earlier meeting.

June 13

Trans World Airlines and Delta Air Lines sign contracts to buy the Convair 880 medium-range jet transport. TWA orders 30 and Delta 10.

Cessna Aircraft Co. successfully negotiates a \$5-million long-term loan to be used for additional working capital and expansion of plant facilities.

June 14

The Institute of the Aeronautical Sciences announces that A. M. "Tex" Johnston, Chief of

Flight Test, Boeing Airplane Co., will receive the 1956 Octave Chanute Award on June 20 in Los Angeles.

June 15

Air Materiel Command announces that nine contractors have been selected as successful bidders for the operation of the Air Force's primary pilot training schools for 1957.

June 18

The Air Force Air Materiel Command awards Boeing Airplane Co. a \$143,000,024 contract to manufacture KC-135A aerial tankers, spare parts, ground support equipment and data.

June 19

North American Aviation, Inc., receives a \$16,152,146 contract for missiles, presumably the Navaho.

North American Aviation indicates it may announce plans for production of a turboprop-powered executive aircraft.

June 20

Piedmont Aviation, Inc., Winston-Salem, N. C., gives Fairchild Engine & Airplane Corp., Hagerstown, Md., a firm order for 12 F-27 turboprop transport aircraft, taking an option on 12 more at a total cost of \$8-million.

Missile "Czar" Eger Murphree confirms that the Navy has a project under way to develop a solid propellant IRBM.

Dr. John L. Barnes announces formation of the Systems Laboratories Corp. He says it will be the first professional scientific organization in the U. S. designed solely for research and development in the field of interplanetary travel.

June 21

Roger Fleming, public relations director for Allison Division, General Motors Corp., is elected chairman of the Public Relations Advisory Committee of the Aircraft Industries Association for the 1956-1957 year.

June 22

Announcement that it has become the prime contractor on a new guided missile and has won a major subcontract on a second is made by McDonnell Aircraft Corp.

Dr. Theodore von Karman, chairman emeritus of the Air Force Scientific Advisory Board, receives the Presidential Medal of Freedom.

June 25

Garrison Norton is confirmed by the Senate as the new Assistant Navy Secretary for Air.

General Electric's Aircraft Gas Turbine Division receives a \$42,100,220 contract from the Air Materiel Command for engineering changes on the J79 turbojet.

June 26

Piasecki Aircraft Corp. reports receipt of a Navy contract to build an experimental vertical lift craft called the Sea Bat.

June 27

The Senate votes to increase the fiscal 1957 AF budget by more than \$900-million over Administration requests.

The Senate Armed Services Committee rejects AF requests for funds to set up four Talos-equipped anti-aircraft bases. Simultaneously, it approves Army plans for expanding its Nike anti-aircraft missile system.

June 28

The Air Force discloses plans to improve the performance of the Boeing KB-50 tanker fleet for the Tactical Air Command by fitting each of the planes with one General Electric J47 turbojet engine in a pod under each wing.

Republic Aviation Corp. discloses it is working on two new guided missile systems, includ-

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ing one "that can be considered more advanced than the much-discussed earth satellite."

June 29

Ryan Aeronautical Co., San Diego, Calif., announces receipt of a \$5-million Navy contract for production of electronic rate-of-climb-and-descent detectors to facilitate helicopter hovering at night or in poor weather.

JULY

July 2

The House and Senate approve a compromise Defense Appropriation Bill providing about \$900-million in AF funds over Administration requests.

Lockheed announces it will set up a new aeronautical engineering office at Dunedin on the West Coast of Florida to handle aircraft and weapon systems design work for advanced aircraft.

Aircraft Industries Assn. reports shipments of 666 one-to-ten place utility and executive aircraft worth \$10,524,000 by seven companies in May.

Air Force awards Ford's Aircraft Engine Division, Chicago, a \$188,253,655 follow-up contract for the manufacture of J57 engines, raising total value of Ford J57 orders to more than \$1-billion, including powerplants already delivered.

Army gives Chrysler Corp. a \$3,175,000 contract for engineering and production work on the intermediate-range Jupiter ballistic missile.

USAF's highest ranking civil medal, the Exceptional Civilian Service Award, is granted to Joseph J. Leibling, special assistant for security to Lt. Gen. Clarence S. Irvine and Donald L. Putt.

July 3

President Eisenhower on July 2 signs the fiscal 1957 Defense Appropriations Act, allocating \$34,656,727,000, about a half a billion more than the Administration asked for.

July 5

Teneco Aircraft Corp., Dallas, wins its first production order for a complete aircraft of its own design with receipt of a Navy contract for an "evaluation quantity" of two-place Model 51 primary jet trainers.

Convair reports that its development of new techniques in the construction of bonded panels and honeycomb sandwich panels for aircraft structures "may well be the greatest major development in airplane construction since the all-metal airplane."

The Defense Department announces that Kaman Aircraft Corp., Bloomfield, Conn., has developed a remotely-controlled helicopter for the Army and Navy "which can perform a wide range of military missions."

July 6

Gen. Nathan F. Twining, returning from an 8-day visit to Moscow, tells President Eisenhower the U. S. is "out in front" in the airpower race with the USSR. Twining, however, repeats prior assertions that the Soviet Union is catching up.

July 10

Capital Airlines announces purchase of 15 more Vickers Viscounts at a cost of about \$15-million.

The Army gives Melpar, Inc., Falls Church, Va., a \$1,983,981 contract to develop a helicopter flight simulator.

July 11

Beach Aircraft Corp. announces receipt of a \$12.5-million Air Force contract for the manufacture of an additional quantity of MD-3 ground support units for jet fighters and bombers.

CAA reports it expects to take delivery this month of an Air Force B-57 as part of its air traffic control study program for the jet age.

Vertol Aircraft Corp. reports it received a contract calling for production of more than \$2.5-million H-21C Workhorse helicopters.

July 12

A Boeing 707 flies from Seattle to Los Angeles International Airport on July 10, marking the jet prototype's first landing at a civil airport other than its home base at Boeing Field.

United Aircraft Corp.'s board chairman, H. M. Hoerner, reveals that the company has invested \$212.9-million of its own funds in new production and experimental facilities in Connecticut during the past decade.

July 13

Boeing announces that the first KC-135 tanker is scheduled to roll out on July 18.

General Electric's Aircraft Gas Turbine Division, Evendale, Ohio, announces receipt of two Air Force contracts totaling \$107,540,320, calling for the manufacture of J79s and the development of an "advanced engine."

Ryan Aeronautical Co. announces receipt of \$12-million in orders of mid and aft fuselage sections for the Boeing KC-135 tanker.

July 16

Convair changes the name of its jet transport from the Golden Arrow to the Convair 880. The Skylark 600 tag also is dropped.

July 17

Gen. Nathan F. Twining in testimony to the Senate Armed Services Committee says the twin-jet Blowlamp supersonic light bomber is the most important aircraft he observed on his recent visit to Russia.

Insurance claims stemming from the UAL-TWA Grand Canyon collision on June 30 reach nearly \$5,500,000.

July 18

Maj. Gen. B. A. Schriever, Commander of ARDC's Western Development Division, asserts the AF's top-priority ICBM project is proceeding "about as fast as it can go."

The Commerce Department makes public a census of the Aircraft Propeller Industry showing that 16 companies engaged in the industry in 1954 performed \$108.4-million in manufacturing operations.

July 19

Stroukoff Aircraft Corp. reports its YC-134 is due to roll off the assembly line at West Trenton, N. J., at the end of September.

An allocation of \$6,745,000 of Air Force funds is made to Douglas Aircraft in support of its C-132 turboprop transport project at Tulsa.

The USAF Air Research and Development Command discloses its Wright Air Development Center has worked out a new altimeter which is 400 percent more accurate below 50,000 feet and 100 percent more accurate above that altitude than present instruments.

CAA reports that a total of 127 mid-air collisions occurred in the years 1948-55.

July 20

Boeing Airplane Co. rolls out its first KC-135

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jet tanker and its 888th and last KC-97 piston-engine tanker on July 19.

July 23

President Eisenhower signs a bill (S.3163), authorizing permanent certification of air carriers operating within Alaska and Hawaii and legislation (S.3412) extending the provisions of the Civil Aeronautics Act relating to war risk insurance.

A House Armed Services Investigations Subcommittee, headed by F. Edward Hebert (D-La.) asserts that "the Government is getting substantial value from its investment in military airframes."

The CAA reports that eight cities boarded over a million air passengers in 1955.

Col. Horace A. Hanes, Air Research and Development Command, is named winner of the 1955 Mackay Trophy for his world speed record of 822,135 mph on Aug. 20 in a North American F-100 C.

July 24

Rear Admiral John E. Clark, Director, Guided Missile Division, Office of Chief of Naval Operations, discloses the Navy intends to equip 89 ships with surface-to-air missiles in the period 1956-61.

July 25

Capital Airlines formally announces its order for 14 De Havilland Comet 4s for delivery starting in the last half of 1958.

American Airlines discloses it will construct a \$1-million school to train airline stewardesses on a site near Fort Worth International Airport.

July 26

The Senate Appropriation Committee recommends granting of the full Administration request for \$68,043,000 for CAA expansion of the Federal Airways System.

Republic Aviation Corp. assigns the name "Thunderchief" to the latest of its fighter-bombers, the supersonic F-105.

July 30

Convair reports sales of 25 more 440s, boosting total sales on this latest model of the company's twin-engine transport to 111.

Donald W. Douglas, president of Douglas Aircraft, is named winner of the 7th annual National Defense Transportation Association's Award.

The U. S. Census Bureau, according to preliminary results from the 1954 Census of Manufactures, reports the value added by manufacture in the aircraft engine industry totaled \$1,435,000,000, an increase of 469 percent over 1947.

CAA estimates that scheduled airlines of the nation carried their 300-millionth passenger on July 29.

July 31

Cessna reports its four-place CH-1A helicopter will go into commercial production in the near future.

Beech Aircraft Corp. announces receipt of an order for five Super 18 transports from the Air Force of Brazil.

## AUGUST

Aug. 1

Avco Manufacturing Corp.'s Crosley Division receives a \$25,150,558 contract for the production of defense and armament systems for B-52 bombers.

The USAF Air Materiel Command gives Gen-

eral Electric Co., Cincinnati, a \$11,680,000 contract for the design, manufacture, procurement and installation of tooling for J79 turbojet engines.

Aug. 2

Cessna Aircraft Co. rolls out the prototype of its four-engine Model 620 pressurized executive transport.

Aug. 3

Existence of three new missile test vehicles, the Lockheed X-7 and X-17 and the North American X-10, is confirmed at the Air Force Association convention in New Orleans.

Special Presidential aide Edward P. Curtis appoints an eight-man systems engineering team to develop a master plan for the future air traffic control system.

Maj. Gen. Richard C. Lindsay, director of plans for the USAF, predicts at the AFA convention in New Orleans that guided missiles will ultimately take on 30 percent of the Tactical Air Command's targets, 50 percent of the targets of the Strategic Air Command and an even greater percentage of the mission of the Air Defense Command.

Aug. 6

The 1956 Harmon Aviation Award winners are announced as follows: Aviation, Group Captain John Cunningham, Great Britain, chief test pilot for de Havilland Aircraft Co.; Aviatrice, Mme. Jacqueline Auriol, France, and Aeronaut, Lt. Commander Charles A. Mills, (USN), Memphis, Tenn., assigned to Airship Early Warning Squadron No. 1, Lakehurst, N. J.

Minneapolis-Honeywell discloses it will build a new \$4-million aeronautical plant for development and production of highly advanced aerial navigation equipment near St. Petersburg, Fla.

Aug. 7

Douglas Aircraft Co. climaxes 10 years of DC-6/7 production on Aug. 6 by delivering the 700th transport in the series, a DC-7B to Eastern Air Lines.

Sen. Stuart Symington (D-Mo.) is named winner of the AFA's highest award, the Gen. H. H. Arnold Trophy, for his "determined and enlightened inquiries into the true status of our national airpower."

Aug. 8

New York Airways over the weekend introduces its first Sikorsky S-58 helicopter into service on its metropolitan New York inter-airport routes.

The Army completes a \$12-million rocket test facility described as the largest test stand for rocket motors in the United States. Located at Redstone Arsenal, it will enable firing of the Jupiter IRBM.

House-Senate conferees reduce the Administration's request for a supplemental appropriation of \$68,043,000 to \$45-million for new air navigation facilities and CAA operating expenses in connection with expansion of the Federal Airways system.

Aug. 9

Lockheed Aircraft Corp. reports its total of spare parts sales recently passed the billion-dollar mark.

Douglas Aircraft Co. delivers the first AD-7 to the Navy one month ahead of schedule.

Beech Aircraft Corp. unveils a new four-place twin-engine aircraft following its first successful flight. Designated the Beechcraft 95 "Badger," it will be in the \$35,000 to \$55,000 price range.

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Aug. 10

The McDonnell XV-1 convertiplane sets an unofficial speed record for helicopters of 200 mph.

Aug. 13

Gen. Nathan Twining reveals that he "expects" to recommend an acceleration in KC-135 production to a rate of 20 a month, thereby matching B-52 goals.

North American Aviation, Inc., announces the first flight of the new F-100F, described as the world's fastest two-man airplane.

USAF's Air Materiel Command gives Georgia Division of Lockheed Aircraft Corp. two contracts totaling \$37,637,220.

Aug. 15

Army announces it will award a \$16,565,000 contract to Utica-Bend Corp., newly-formed subsidiary of Curtiss-Wright Corp., to manufacture the Dart anti-tank missile.

North American Aviation, Inc., Columbus, Ohio, receives a \$39,713,624 AF contract for manufacture of F-100D aircraft, spare parts, ground handling equipment and droppable tanks.

Cessna discloses that its Model 620 four-engine executive transport prototype made its first successful test flight Aug. 11.

Defense Secretary Charles Wilson sets up a special Pentagon committee to study the problem of protecting military information.

Aug. 16

Air Materiel Command gives Boeing Airplane Co. two contracts totaling \$567,369,524 for production of B-52D intercontinental bombers, spare parts and data.

USAF Air Materiel Command issues bids to the aircraft industry to participate in competition for two new types of aircraft—a twin-jet readiness trainer and a four-jet utility transport.

Col. David C. Schilling, 37, holder of the 1951 Harmon Trophy and winner of the Air Force Association's top honor in 1952, is killed in an auto crash in England.

Aug. 20

George F. Worley, chief of advanced design at Douglas Aircraft Company's Santa Monica Division, predicts no supersonic transports will be in service before 1970.

The French Defense Ministry announces that it has placed an order for an additional 50 H-21 helicopters with the Vertol Corp.

Lycoming Division of AVCO Mfg. Corp. releases specifications of its new Model 0-360 180-hp engine, which it says has the "highest horsepower rating of any four-cylinder engine certificated and produced in the United States."

Aug. 21

Bell Aircraft Corp. receives a CAA airworthiness certificate for its Model 47-J four-place helicopter.

Continental Can Co. signs a contract for an executive Fairchild F-27 turboprop transport, becoming the second large corporation to order the aircraft. General Tire & Rubber Co. of Akron was first.

Aug. 22

Grumman Aircraft Engineering Corp. acquires 50 percent interest in Dynamic Developments, Inc., Islip, L. I.

Aug. 23

CAB approves the change in the name of Helicopter Air Service, Inc., to Chicago Helicopter Airways, Inc.

Aug. 24

Continental Can Corp. becomes the first customer for Fairchild's M-185 executive jet transport with an order for three to be delivered about 1960.

Bell Aircraft Corp. announces an order from the French government for 20 Bell 47G-2 helicopters worth \$1.2-million.

Douglas Aircraft reveals that electronic equipment on the DC-8 jet transport may weigh as much as a ton and cost \$140,000, or more than the whole cost of a prewar DC-3.

Aug. 27

Aircraft Industries Assn. reports 65 civil aircraft of 6,000 lbs. and under and valued at \$1,057,145 were exported in July, marking a 30 percent increase over July a year ago.

Manufacturers of aircraft, missiles, accessories and related equipment continue to head the list of 100 corporations receiving the largest volume of U. S. defense contracts.

Aug. 28

Speedup of Boeing KC-135 tanker production as recommended by Gen. Nathan Twining is approved by Defense Secretary Charles Wilson.

The Indian government approves a request by Air-India International for authorization to buy three Boeing 707s at an estimated cost of \$24-million.

Aug. 29

The National Business Aircraft Association officially notifies the Air Coordinating Committee that it "cannot accept" recommendations of the NAV Panel, calling for a TACAN/compatible DME system.

Aug. 30

CAA safety director W. B. Davis goes on record opposing CAB's proposed economic regulation requiring 75 percent on-time scheduling by airlines.

Aug. 31

Col. John L. Zoekler is named chief of the Aircraft and Missiles Division, Wright-Patterson AFB, replacing Col. Carl F. Damberg, who will take over as Deputy Commander, Air Materiel Force, European Area.

North American Aviation, Inc. announces plans to build a six-place twin-jet utility aircraft to meet the design requirements proposed his month by the USAF in its competition for a twin-jet pilot readiness trainer.

The Air Coordinating Committee reaches a unanimous decision on the new common short range navigation system. The decision calls for eliminating the civil DME, retaining VOR, and implementing TACAN/DME into an azimuth-distance system to be called VORTAC.

## SEPTEMBER

Sept. 4

The Navy issues its first production order for the P6M-1 Seamaster jet flying-boat in a \$102.2-million letter of intent to the Martin Co.

Air Force Under Secretary James H. Douglas hints of possible reduction in the number of AF wings.

Military officials reveal that they are willing to move 181 TACAN installations now under way, if necessary, to sites suitable to all users.

Sept. 5

CAA announces a reorganization encompassing three principal changes: establishment of six program offices; streamlining of the Administrator's office, and establishment of

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"readily identifiable" counter-parts of the program offices in the regions.

The KC-135 City of Renton, the first production model of Boeing's Jet Stratotanker series, makes its maiden flight from Renton Municipal Airport to Boeing Field on Aug. 31.

Navy captures the nation's speed record at the National Aircraft Show with the official declaration that the Chance Vought F8U Crusader flew 1015.428 mph in the running of the Thompson Trophy.

Sept. 6

Pratt & Whitney Division, United Aircraft Corp., announces it will build a multi-million dollar auxiliary aircraft engine facility in Florida.

Aircraft Owners & Pilots Association gives qualified endorsement to the ACC VORTAC plan.

Sept. 7

Qantas Empire Airways becomes the first non-American airline to order the P&W J57-powered version of the Boeing 707, as the Australian carrier announces it will buy seven.

CAA Administrator Charles J. Lowen, 41, dies of cancer Sept. 5.

Sept. 10

American Airlines reportedly orders 19 additional Douglas DC-7s at the presumed cost of between \$35-million and \$40-million.

Sept. 11

The Atomic Energy Commission discloses that two of its laboratories are studying the possibilities of nuclear propulsion for rocket engines.

Air Materiel Command announces award of a contract worth \$18,951,360 to Lockheed Aircraft Corp. for T-33A aircraft, spare parts and special tools.

Sept. 12

Beech Aircraft Corp. receives a \$2.5-million follow-on contract for manufacture of a sizeable additional quantity of Beechcraft MA-3 jet aircraft ground service units for the Air Force.

Sept. 13

Lockheed Aircraft Corp. reports a \$20-million fixed-price order for T-33 jet trainers, which will extend production into mid-1958 and raise the number to nearly 5,500.

Sept. 17

Air Materiel Command announces the award to Douglas Aircraft's Tulsa division of a \$30,034,933 contract for IRAN and modification of B-47 aircraft.

Plans for the eventual transfer of all Pratt & Whitney piston-engine and spares from the U. S. to Canadian P&W Co. are revealed in Dallas.

Sept. 18

Navy confirms the award of a contract to the Columbus Division of North American Aviation, Inc., for research and development of the A3J twin-jet two-place attack aircraft.

Organization of a new airline financing company, Air Finance Corp., is announced by three prominent hotel officials, Conrad Hilton, his son, Barron Hilton and Joseph Drown, an independent owner.

Chance Vought Aircraft, Inc., announces receipt of a \$200-million Navy order for the F8U-1 Crusader fighter.

The Air Force Air Research and Development Command discloses the existence of a research rocket which can accelerate to velocities of nearly 5000 mph in just about two seconds.

Sept. 19

Air Products, Inc., Allentown, Pa., announces it will start construction of a \$2,810,000 liquid oxygen generating plant this year on a three-acre site adjacent to the new Martin Titan ICBM plant southwest of Denver.

Sept. 24

The first CAA flight test of a Boeing 707 to determine its adaptability to the nation's airway and airport systems is scheduled in Seattle.

Sept. 26

Temco Aircraft Corp. launches a campaign to sell its Model 31 primary jet trainer to NATO members.

Douglas Aircraft Co. awards a \$3.5-million contract to American Seating Co., Grand Rapids, Mich., to produce milled extrusions for the DC-8 jet transport.

The Flight Safety Foundation elects Adm. John H. Cassady USN (Ret.) to the position of executive vice president.

Sept. 27

Convair releases detailed specifications of its Model 880 jet transport and announces formal contracts with Hughes Tool Co. and Delta Air Lines for 40 aircraft valued at \$200-million.

Sept. 28

Lockheed Aircraft Corp. announces a \$166-million order in letter contracts for its Mach 2 F-104 Starfighter series.

Lockheed Aircraft Corp.'s Georgia Division files formal application with CAA for certification of two transports, Models GL-108 and GL-135.

Aircraft industry employment reaches 803,700, marking the first time it has topped the 800,000 figure since the peak of the Korean War.

The Bell X-2 rocket plane crashes on a flight at Edwards AFB, Calif., killing its pilot.

## OCTOBER

Oct. 1

USAF Air Materiel Command gives Hazeltine Electronics Corp., Little Neck, N. Y., a \$3,604,392 contract to manufacture indicator groups for use in search and height finding radar sets.

A new two-stage high-altitude research rocket called the "Terrapin" soars to a height of 80 miles from the National Advisory Committee for Aeronautics' proving ground at Wallops Island, Va.

NACA awards its Distinguished Service Medal to Richard T. Whitecomb, developer of the area rule concept for supersonic aircraft.

Oct. 2

Air Force gives Allison Division, General Motors Corp., a \$13,096,000 contract to manufacture J71-A-2 engines for installation in McDonnell F3H aircraft.

Oct. 3

The nation's major airlines approve a statement suggesting they will speed up efforts to eliminate racial discrimination in hiring.

North American's F-107 fighter-bomber successfully completes its second test flight.

Oct. 4

USAF Air Research and Development Command announces creation of a new Design Engineering Branch for its Flight Control Laboratory at Wright Air Development Center, Dayton, Ohio.

Oct. 5

Air Force awards the Georgia Division of the Lockheed Aircraft Corp. a letter contract of

## The AIRCRAFT YEAR BOOK

over \$100-million for additional production of the Hercules C-130 turboprop transport.

Don R. Berlin, president and chairman of the board of Vertol Aircraft Corp., confirms receipt of an offer from Northrop Aircraft, Inc., to consider combining the two companies.

The Martin Co. announces that the Lacrosse surface-to-surface missile is in production for the Army.

Oct. 8

The Accessories Division of Thompson Products, Inc., discloses it will construct a \$10-million facility for testing rocket and missile fuel and auxiliary power systems on a 1000-acre site near Roanoke, Va.

Oct. 9

Northrop Aircraft, Inc., Hawthorne, Calif., receives a \$26-million developmental production contract for the Snark SM-62 intercontinental missile.

Dr. William F. Ballhaus, chief engineer of Northrop Aircraft, is elected chairman of the Aircraft Industries Association's Guided Missile Committee for the coming year.

Oct. 10

The Navy gives Raytheon Mfg. Co., Waltham, Mass., a \$60-million contract to manufacture Sparrow air-to-air missiles.

AF Secretary Donald Quarles discloses that Capt. Milburn G. Apt, pilot of the ill-fated Bell X-2 rocket plane which crashed in Sept., "was flying faster than any other human being has been known to fly," shortly before his death.

The Douglas A4D Skyhawk carrier-based bomber goes into service with the Navy.

Navy gives Pratt & Whitney Division, United Aircraft Corp., two contracts totaling \$28-million, and calling for continued development of the J57 and development and manufacture of one J75-P-5 engine and one J75-P-9 engine.

A three-stage rocket assembly fired from Patrick AFB, Fla., last month attained a distance of 3000 miles, it is revealed.

Oct. 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.

Oct. 12

Eastern Air Lines' order for Convair 440s is increased to 21.

USAF Air Materiel Command gives North American Aviation four contracts totaling \$75,327,903.

Lockheed's Model 1649A Super Constellation makes its maiden flight on schedule on Oct. 11 at Burbank, Calif.

Oct. 15

Defense Secretary Charles Wilson asserts that military spending next year will rise probably "something like" 4 percent to 6 percent.

Commerce Department announces three more contract awards totaling \$750,000 for CAA's fiscal 1957 airway program.

Oct. 16

General Electric Co. establishes new engineering facilities for designing future power plants for aircraft and guided missiles in temporary quarters in Danville, Calif.

Boeing Airplane Co. reports its Model 707 prototype passed the 600-hour mark in its testing-demonstration program.

Oct. 18

James H. Doolittle is named chairman of

the National Advisory Committee for Aeronautics, succeeding Dr. Jerome C. Hunsaker.

The Defense Department cancels its quota system for controlling consumption of critical materials in jet engine manufacture.

Air Force spokesmen indirectly confirm the ill-fated Bell X-2 rocket plane reached a speed of more than 2100 mph before it crashed on Sept. 27.

New York Airways accepts delivery on three of four Sikorsky S-58 helicopters on order.

Oct. 19

Receipt of a \$50-million re-order from the Navy for WV-2 Super Constellation radar planes pushes the total of military contracts awarded to the Lockheed Aircraft Corp.'s California division within a month to nearly \$240-million.

CAB estimates the U.S. airline industry's subsidy bill for the current fiscal year will be the highest of the four-year period 1955 through 1958.

NACA awards Distinguished Service Medals to John W. Moise and Charles W. Littleton for "outstanding bravery beyond the call of duty" following a high-altitude explosion in the rocket-propelled X-1A research plane in August 1955.

Oct. 22

California Eastern Aviation is awarded an Air Force contract worth \$1,895,000 to overhaul and modernize 115 C-16 transports at its Oakland maintenance base.

The Eastern Air Defense Forces team, flying North American F-86Ds, take top honors in the rocketry phase of the USAF Fighter Weapons Meet at Vincent AFB, Yuma, Ariz.

Oct. 23

Gen. W. C. Wyman, commanding general, Continental Army Command, Fort Monroe, Va., announces establishment of a special Army Aviation Section.

North American Sabrejet fighters capture top honors in all phases of the Air Force's 1956 Fighter Weapons Meet at Nellis AFB, Las Vegas, and Vincent AFB, Yuma, Arizona.

Oct. 25

The Navy gives McDonnell Aircraft Corp. a \$58,124,717 order for additional production of the F3H-2N Demon all-weather fighters.

Commerce Under Secretary Louis Rothschild reports that CAA obligated \$15-million in the first quarter of fiscal 1957 for new airway equipment.

Oct. 26

Air Force orders a new design study of the WS-116A chemical bomber by Boeing and North American and informally decides to stretch out Convair's WS-125A nuclear bomber project.

Maj. Gen. Hamilton Howze, Director of Army Aviation, discloses the Army is pondering design requirements for seven brand new aircraft, including three vertical-lift machines.

CAA control towers report a total of 20,384,000 aircraft operations in the year ended June 30.

Oct. 31

Convair announces that it has started taxiing tests of its B-58 Hustler.

Aircraft employment in August rose to 814,400, a new post-Korean peak.

## NOVEMBER

Nov. 1

Convair officials announce that the first flight

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of the 880 transport is scheduled to be made on Jan. 30, 1959.

Western Air Lines places a \$700,000 order for Bendix RDR-1b X-band weather mapping radar for its Douglas DC-6Bs now in service and on order. Equipment will go in WAL's Lockheed Electras, also.

Nov. 2

Defense Department discloses that Navy's first guided missile cruiser, the Boston, will be dispatched to Mediterranean to join U. S. Sixth Fleet.

Army gets first deliveries of Hiller YH-32 ramjet helicopter for testing.

Nov. 5

AIA survey reveals that five major U. S. airframe builders now hold more than \$2-billion in orders for new jet and turboprop transport aircraft.

Nov. 9

RCA Defense Electronic Products receives \$7.2-million order from Air Materiel Command for airborne TACAN units.

AFL-CIO forms Aviation Legislative Committee to seek legislation for a "disaster-free" air transport system.

Lightplane shipments for nine-month period ending Sept. 30 total 5,215.

Navy's Martin XP6M-1 Seamaster jet flying-boat crashes in north end of Delaware Bay.

Nov. 13

North American F-107 reaches Mach 2 speed in flights at Edwards Air Force Base, Calif.

Nov. 14

Lockheed receives \$70-million Navy contract for T2V-1 Seamaster jet trainers.

Army awards contract to Hiller Helicopters for two prototypes of a multi-engine version of the flying platform.

Convair reports "exceedingly successful" 38-minute maiden flight of B-58 Hustler bomber.

Clarence N. Sayen is re-elected president of Air Line Pilots Association.

Nov. 15

Missile czar Eger Murphree discloses that missiles would be used to defend U. S. bombers against enemy aircraft.

Sikorsky S-56 sets speed and altitude records in Bridgeport, Conn.

Nov. 20

CAA awards \$9-million contract to Raytheon Manufacturing Co. for 23 long-range radars.

Nov. 21

Lockheed gets \$25-million contract from Navy for P2V-7 Neptunes.

Nov. 27

Defense Secretary Charles Wilson issues document giving Air Force sole responsibility for

all land-based Intermediate Range Ballistic Missiles, and Navy the responsibility for ship-launched IRBM, dashing Army's hopes for major role in military aviation and long-range missiles.

Eight B-52's break the jet bomber's record by staying aloft an estimated 32½ hours, covering 17,000 miles.

Nov. 29

Air Force spokesman confirms that Northrop supersonic trainer design will replace the T-33 jet trainer.

Nov. 30

North American Aviation, Inc. delivers its first F-86L, advanced version of the F-86D interceptor, to the Air Force.

Admiral James S. Russell, Chief of Navy BuAer says combination rocket and turbojet engine will power future Navy planes.

## DECEMBER

Dec. 3

Aircraft Industries Association announces that General Orval R. Cook (USAF, Ret.) will replace Admiral DeWitt C. Ramsey, (USN, Ret.) as AIA president.

Dec. 4

Bureau of Labor reports that aircraft employment in September reached new postwar peak of 825,000.

Dec. 5

North American FJ-4B powered by a Curtiss-Wright J65 makes first flight at Port Columbus, Ohio.

Dec. 11

Boeing Airplane Co. gets \$50-million follow-on contract from Air Materiel Command for KC-135As.

Defense Dept. reports that it obligated \$2.6-billion for aircraft, missiles, drones and production facilities during first three months of fiscal 1957.

Dec. 12

Navy places \$26-million contract with Hamilton Standard division of United Aircraft for propeller assemblies.

Grumman Aircraft Engineering Corp. gets \$24-million re-order for TF-1 Tracker transport aircraft.

Dec. 13

Atomic Energy Commission confirms reports that it more than doubled expenditures for the atomic-powered aircraft project in fiscal 1956.

Dec. 17

Aircraft industry observes 53rd year of flight at annual Wright Memorial Dinner at Sheraton-Park Hotel, Washington, D. C.

AIRCRAFT YEAR BOOK COMES TO PRESS.



A CHRONOLOGY  
of  
U. S. AVIATION

The following chronology was compiled and edited by the late Ernest J. Jones, (Lt. Col., ret.).

Although this chronology has been expanded considerably over previous editions, it still represents only brief excerpts from Colonel Jones' vast store of air data. Space has forced us to deal only with the highlights.

We are deeply indebted to Colonel Jones for his thorough knowledge of aeronautics in this country and the generosity with which he shared it.

We also wish to thank the National Air Museum, Smithsonian Institution for providing the photographs used in this section.

**Caudron, French Bomber used by American Expeditionary Forces in  
World War I**



# A CHRONOLOGY OF U. S. AVIATION

## United States Chronology

1784, Jan. 16—Airborne troops proposed by Benjamin Franklin in reporting on the first balloon ascents.

1784, July 17—First U. S. balloon flight in Peter Carnes' captive balloon, Baltimore, Md.

1784, Nov. 30—First ascent by an American abroad, by Dr. John Jefferies, physician, with French aeronaut Blanchard, at London. On Jan. 7, 1785, they make the first Channel crossing by air.

1793, Jan. 9—Balloon flight by Jean Pierre Blanchard from Philadelphia, Pa., to Woodbury, N. J. (Letter from George Washington carried on this flight.)

1837, Sept. 18—First parachute demonstration in America when John Wise drops animals from a balloon at Philadelphia.

1838, Aug. 11—John Wise safely lands with his parachuted balloon at Easton, Pa.

1840, Sept. 8—Col. John H. Sherburne urges Secretary of War to use night balloons to locate Seminoles.

1842, Oct. 22—John Wise proposes to capture Vera Cruz by air.

1844, Oct. 16—America's first air patent to Muzio Muzzi on direction of balloons.

1845, Sept. 18—Rufus Porter proposes steam airship line, New York-California, to carry gold-seekers at \$100 a trip. Stock sales unsatisfactory. His 1849 booklet illustrates a jet-propeller passenger rocket.

1859, July 1—World record balloon trip, 809 miles, St. Louis to Henderson, N. Y., by John Wise and three companions.

1859, Aug. 16—Airmail carried by John Wise in balloon flight from Lafayette to Crawfordsville, Ind.

1860, Aug. 21—Capt. E. B. Hunt, Corps of Engineers, U.S.A., advocates balloon telegraphy.

1860, Oct. 13—Successful aerial photos taken by William Black from a balloon, Boston, Mass.

1861, June 10—Military flight by James Allen, First Rhode Island State Militia, in balloon over Washington, D. C.

1861, June 18—Balloon telegraph demonstrated by T. S. C. Lowe. (Message to Abraham Lincoln.)

1861, June 22-24—Military reconnaissance by T. S. C. Lowe and Army officers from balloon using telegraph, over Arlington and Falls Church, Va. Military air observation continues into 1863.

1861, Aug. 3—Civilian aeronaut La Mountain inaugurates aircraft carrier operations with his war balloon. Lowe follows.

1861, Sept. 24—Air artillery adjustment from Lowe's Army balloon near Washington.

1861, Nov. 7—Helicopter proposed for Union Army. After experiments, a machine is partly built before Appomattox ends the project.

1862, Mar. 9—War helicopter bomber designed and urged by William C. Powers of Mobile, Ala.

1866, May 25—Solomon Andrews' airship maneuvers over New York with 4 passengers.

1873, Oct. 7—Unsuccessful trans-Atlantic flight by W. H. Donaldson, Alfred Ford and George A. Lunt in balloon, *Graphic*, from Brooklyn, N. Y., to New Canaan, Conn.

1877—Prof. William H. Pickering, Harvard

University, begins experiments with model helicopters. In 1903 a rabbit is sent aloft.

1880—Thomas A. Edison conducts helicopter experiments for James Gordon Bennett.

1883, Mar. 17—First of a series of glider flights by John Joseph Montgomery, Otay, Cal.

1885, Jan. 7—Russell Thayer, C. E., a graduate of West Point, urges on Secretary of War Robert T. Lincoln a compressed-air airship of his design. No action.

1887, Jan. 30—Thomas E. Baldwin makes his first parachute jump at San Francisco.

1886, July—W. E. Irish, publisher of *Aeronautical World*, proposes balloon radio.

1887—American altitude record made by aeronaut Moore and Prof. H. A. Hansen of U. S. Signal Service, at St. Louis; 15,400 feet, in balloon of St. Louis *Post Dispatch*.

1890, July 31—During the month, L. Gathmann, of Chicago, explodes a shell at high altitude in attempt to produce rain.

1890, Oct. 1—President Harrison approves legislation creating the Weather Bureau and re-establishing the Signal Corps which is charged with collection and transmission of information, among other duties. Military aeronautics is then considered as among such means, and Army aeronautics is revived.

1892, Oct. 10—Balloon section is being organized with each telegraph train by Chief Signal Officer, General A. W. Greely, who anticipates military airships and airplanes.

1892, Nov. 5—Wingless aerial torpedo suggested by Prof. A. F. Zahm.

1893, Aug. 1-4—International Conference on Aerial Navigation held at Chicago; Octave Chanute, Chairman; Dr. A. F. Zahm, Secretary.

1893, Oct. 9—The Chief Signal Officer, General Greely reports the purchase of a La-chambre balloon for the Signal Corps balloon section. First ascents since the war are made at the Chicago exposition from Oct. 31, 1893.

1896, Apr. 29—First American wind tunnel begins operation at M.I.T.

1896, May 6—Steam-powered airplane model flown by Samuel Langley, Washington, D. C.

1898, Apr. 29—War and Navy Departments examine Langley's work, approve, and Board of Ordnance and Fortification makes two allotments of \$25,000 each to build his airplane.

1898, Dec. 22—The Secretary of War approves a Fort Myer site for barracks, officer quarters, administration building and a balloon house to concentrate Signal Corps schools at one point.

1901, Sept. 1—Simon Newcomb, Ph.D., LL.D., writes in *McClure's* for September: "The first successful flyer will be the handwork of a watchmaker and will carry nothing heavier than an insect."

In December, Rear Admiral Melville, USN says in the *North American Review*: "A calm survey . . . leads the engineer to pronounce all confident prophecies at this time for future success as wholly unwarranted, if not absurd."

1902, Sept. 15—A. Lee Stevens sails his airship *Pegasus* over Manhattan Beach in a race with Edward C. Bayce in the latter's Santos Dumont airship.

1903, Mar. 23—Orville and Wilbur Wright

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- apply for patent on their flying machine. (Patent issued May 22, 1906.)
- 1903, Dec. 8—Samuel Langley's flying machine, piloted by Charles Manly, plunges in the Potomac and is wrecked on its second test, Washington, D. C.
- 1903, Dec. 17—First sustained controllable flight of powered heavier-than-air machine by Orville and Wilbur Wright, Kitty Hawk, N. C.
- 1904, Aug. 3—Circuit flight in airship (Curtiss motor) by Capt. Thomas S. Baldwin at Oakland, Cal.
- 1904, Wright brothers make 104 flights, covering 20 miles. British representative visits the Wrights in November.
- 1905, Jan. 18—Wright brothers open negotiations with U. S. War Department for disposition of their invention. Correspondence is had through 1907.
- 1905, Apr. 29—Daniel Maloney begins series of glides with Montgomery glider, taking off from captive balloon. Later killed.
- 1905, Aug. 5—Charles K. Hamilton begins series of kite flights, towed by cars and boats.
- 1905, Sept. 26-Oct. 5—Wright brothers make 55 flights, the longest being 24 miles in 38 min. 3 sec. Frank S. Lahm, in France, obtains report on Wrights' flying from Ohio relative. French remain skeptical. In October the French government is negotiating along with British.
- 1905—Lt. Frank P. Lahm becomes first Army balloon pilot.
- 1906, Jan. 13-20—First indoor aero exposition, New York.
- 1906, Mar.—French and British visit Wright brothers at Dayton.
- 1906, Sept. 30—First Bennett international balloon race won by Lt. F. P. Lahm—Paris to England.
- 1906, Dec. 1-8—Second indoor air exhibition of Aero Club of America.
- 1907, June 8—Building devoted exclusively to aeronautics dedicated at Jamestown (Va.) Exposition.
- 1907, Aug. 1—Aeronautical Division established. Army Office of Chief Signal Officer.
- 1907, Sept. 2—Walter Wellman airship *America* fails in polar attempt.
- 1907, Sept. 30—Ornithopter of H. C. Gammeter, multigraph inventor, lifts temporarily.
- 1907, Oct. 1—Aerial Experiment Association formed by Dr. A. Graham Bell, F. W. Baldwin, J. A. D. McCurdy, Glenn H. Curtiss and Thomas E. Selfridge.
- 1907, Oct. 3—Record altitude of 23,110 feet by U. S.—Weather Bureau meteorological kite.
- 1907, Oct. 18—Air bombing prohibition signed at second Hague conference.
- 1907, Oct. 21—Second Bennett international balloon race, St. Louis, won by Oscar Erbslof of Germany. Airship races are held Oct. 22-23.
- 1907, Oct. 28-29—International Aeronautic Congress held in New York.
- 1907, Oct. 28—Admiral C. M. Chester urges anti-submarine airships and shipboard airplanes at International Aeronautic Congress.
- 1907, Dec. 6—Seven-minute towed flight from motor boat tug in Dr. Bell's kite, flown by Lt. T. E. Selfridge.
- 1907, Dec. 16—Chief Signal Officer advertises for airship bids, resulting in purchase of Baldwin airship.
- 1907, Dec. 23—Chief Signal Officer advertises for airplane bids, after visit of Wrights.
- 1908, Feb. 10—First Army plane contract signed by Signal Corps with Wright Brothers. (Other contracts signed with A. M. Herring and J. F. Scott.)
- 1908, Mar. 12—First Aerial Experiment Association's plane, *Red Wing*, flown by F. W. Baldwin. Later, three other machines fly.
- 1908, May 6-18—Wright brothers renew flying preliminary to delivery of Army airplane. Charles Furnas is first airplane passenger.
- 1908, May 13—Balloon radio reception demonstrated by Signal Corps.
- 1908, May 31—G. H. Curtiss Manufacturing Company announces planes for sale.
- 1908, June 10—Aeronautical Society formed in New York and Morris Park Airfield shortly obtained—first of kind in U.S.
- 1908, June 20—Anthony radio-controlled airship model demonstrated.
- 1908, July 4—*Scientific American* Trophy awarded Glenn H. Curtiss for first public flight of one kilometer circuit in his biplane, *June Bug*, Hammondsport, N. Y.
- 1908, July 17—First air ordinance passed by Kissimmee, Fla., with registration and regulation.
- 1908, Aug. 8—Demonstration flights under French syndicate control begin near LeMans, France, by Wilbur Wright, continuing through December, making a number of astounding records. Training of students follows.
- 1908, July 31-Aug. 8—Henri Farman of France makes first exhibition airplane flights in U.S.
- 1908, Aug. 22—First Army Baldwin airship accepted.
- 1908, Sept. 17—First plane fatality, killing Signal Corps Lt. Thomas E. Selfridge and severely injuring Orville Wright, in delivery of first Army airplane, Fort Myer, Va.
- 1908, Dec. 28—Matthew B. Sellers makes several flights with 7 hp quadroplane.
- 1909, Jan. 22—Commercial airplane, built by Glenn Curtiss, sold to Aeronautic Society of New York.
- 1909, April 16-28—Wilbur Wright delivers an airplane in Italy and teaches pupils.
- 1909, June 10—President Taft presents Aero Club of America medal to Wright brothers. Congressional medal presented at a celebration at Dayton, June 17-18.
- 1909, June 26—Glenn H. Curtiss demonstrates at the Aeronautical Society's meet, Morris Park, New York, the machine ordered Jan. 22. Further flights are made at the Society's meet July 5, before removal of the machine to Mineola and the instruction of member Charles F. Willard.
- 1909, July 17—Curtiss flies 52 mins. in longest U.S. flight except Wrights and wins *Scientific American* trophy for second time. On this success in the Mineola flights the Aero Club of America names him as America's entry in the Bennett international race.
- 1909, Aug. 22-29—Glenn H. Curtiss wins first Bennett international airplane race and other events of first International Flying meet, Rheims, France. Speed: 45.7 mph.
- 1909, Aug. 25—First Army airfield leased at College Park, Md.
- 1909, Aug. 28—After instruction by Glenn H. Curtiss and subsequent practice in the machine contracted by the Aeronautical Society, Charles F. Willard gives his first exhibition at

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Searsborough Beach, Toronto—America's first exhibition pilot. His exhibitions continue over several years.

1909, Sept. 7-Oct. 15—At Berlin, Orville Wright makes flights under German contract, with more records.

1909, Sept. 30—Inception of Wright-Curtiss patent litigation.

1909, Sept. 30—Emile Berliner describes a proposed guided missile.

1909, Oct. 3—At Zurich, Switzerland, E. W. Mix wins the Bennett International balloon race the second time for America.

1909, Oct. 4—Wilbur Wright makes sensational flight, Governors Island to Grant's Tomb and return. Glenn H. Curtiss makes a short flight Sept. 29 and Oct. 3.

1909, Oct. 7—Glenn H. Curtiss flies his first exhibition at St. Louis. Chicago is next. The same month, Charles K. Hamilton and Otto Brodie learn to fly, followed by others. An exhibition company is formed and Curtiss returns to his development work.

1909, Oct. 8-Nov. 5—First Army aviators taught to fly by Wilbur Wright, College Park, Md.: Lt. Frank P. Lahm, Lt. Frederic E. Humphreys, and Lt. B. D. Foulois.

1909, Nov. 27—Anti-aircraft firings begin at Sandy Hook by Ordnance Department.

1909, Nov. 22—The Wright Co. formed with \$1,000,000 capital. In 1914, Orville Wright buys the company back. On Oct. 13, 1915, a syndicate buys the company and adds the Simplex Co. In 1916 it becomes the Wright-Martin Co.

1910, Jan. 10-20—First flying meet held at Los Angeles; Louis Paulhan, of France, the star performer.

1910, May 29—Record flight from Albany to New York by Glenn Curtiss, 142.50 mi. in 2 hr., 50 min.

1910, Mar. 25—Wright patent condemnation urged by William M. Page, attorney for C. F. Bishop, president, Aero Club of America.

1910, June 13—Charles K. Hamilton flies New York-Philadelphia and return for N. Y. Times and Philadelphia *Public Ledger* and \$10,000 prize—149.5 miles in flying time 3 hr. 27 min.; elapsed time, 6 hr. 57 min.

1910, June 13-18—First show of Wright exhibition team, Indianapolis, Ind. where Walter Brookins is star and makes new records. Exhibitions by single pilots or groups continue about the country until the Wright exhibition business is discontinued in Nov. 1911.

1910, June 30—Dummy bomb demonstration made by Glenn H. Curtiss to Army and Navy officers.

1910, Aug. 4—Plane-ground radio demonstrated by E. N. Pickerill.

1910, Aug. 8—Tricycle landing gear installed by Lt. B. D. Foulois on Army Wright at San Antonio.

1910, Aug. 27—Air-land plane radio used by J. A. D. McCurdy, Sheepshead Bay, N. Y.

1910, Sept. 2—First American woman pilot solos: Blanche Stuart Scott. First exhibition at Fort Wayne, Oct. 22.

1910, Oct. 8-10—Former President Theodore Roosevelt is flown at St. Louis exhibition by Arch Hoxsey.

1910, Oct. 14-16—Wellman airship, *America*, abandons trans-Atlantic trip after some 800 miles.

1910, Oct. 22-31—Second Bennett international airplane race won by C. G. White (Bleriot) at 61 mph during Belmont Park meet where numerous records are made.

1910, Nov. 14—First battleship takeoff by Eugene Ely from U.S.S. *Birmingham* in Hampton Roads, Va.

1910—Night flights by Walter R. Brookins

Packard Le Pere, World Altitude Flight, Dayton, Ohio, 1920



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(Montgomery, Ala., Apr. 18) and Charles Hamilton (Camp Dickenson, Nashville, Tenn., June 21-26).

1911, Jan. 7—Didier Masson flies Los Angeles-San Bernardino to deliver *Times* newspapers. Mail and papers delivered Feb. 17 by Fred J. Wiseman.

1911, Jan. 7-25—Dive bombing, aerial photography, airplane radio demonstrated by Army officers in San Francisco meet.

1911, Jan. 27-28—Lieut. T. G. Ellyson, U.S.N., is first U.S. naval aviator when he takes his Curtiss off at San Diego during Curtiss exhibitions.

1911, Jan. 30—J. A. D. McCurdy attempts Key West-Havana flight but lands in water ten miles short and is rescued by Navy destroyer. In 1913 Domingo Rosillo makes the entire distance.

1911, Feb. 17—Curtiss flies tractor seaplane from North Island to cruiser *Pennsylvania*. Plane hoisted on board and return flight later made.

1911, Mar. 3—Lt. B. D. Foulois and P. O. Parmelee fly record cross-country Laredo-Engle Pass, Tex., 106 mi. in 2 hr. 10 min. in Wright plane loaned Army by R. J. Collier. Messages dropped en route, radio received and sent.

1911, Mar. 13—Capt. W. Irving Chambers, U.S.N., is assigned the Bureau of Navigation to devote exclusive efforts to naval aeronautics.

1911, Mar. 31—About this date Missouri National Guard Signal Corps establishes air section and members taught flight and ballooning.

1911, May 8—First Navy airplane ordered, Curtiss Triad, amphibian. By July the three 1911 planes of the Navy are delivered—Curtiss A-1, A-2; Wright B-1.

1911, May 13—Lieuts. H. H. (Hap) Arnold and Thomas DeWitt (Tommy) Milling complete flying training at Wright School: 7th and 8th Army pilots.

1911, June 7—Lieut. John P. Kelley, Med. Res. Corps, assigned Army School at College Park—first U. S. air medical officer.

1911, June 8—Connecticut state air regulation is first state air law.

1911, June 21—Short-lived Aeronautical Manufacturers 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.

1911, July 31—During the month, Frank E. Boland begins flying his tailless, allegedly non-infringing airplane.

1911, Aug. 5—Lincoln Beachy wins over Eugene Ely and Hugh Robinson in New York-Philadelphia race for Gimbel \$5000 purse. Elapsed time: 1 hr. 50 min. 18 sec.; one stop for fuel.

1911, Aug. 14-25—Harry N. Atwood flies St. Louis-New York, 1155 miles by route; longest cross-country flight to this date.

1911, Aug. 20—World altitude record set at 11,642 ft. by Lincoln Beachy in Curtiss biplane.

1911, Sept. 4—Earle L. Ovington (Bleriot-Gnome 70) wins over Lieut. T. D. Milling (Burgess-Wright-Wright 30) in 160-mile tri-state

race during Boston meet, in 3 hr. 6 min. 22 sec.

1911, Sept. 7—Lt. T. G. Ellyson, U.S.N., demonstrates shipboard launching by taking off from aerial cable at Hammondsport, N. Y.

1911, Sept. 17-Nov. 5 — Transcontinental flight by Calbraith P. Rodgers from New York to Pasadena, Calif.—3,390 mi., 49 days.

1911, Sept. 23-30—Earle L. Ovington appointed Airmail Pilot No. 1, flying mail from Nassau Boulevard to Mineola, L. I., N. Y.

1911, Sept. 30—Lt. H. H. Arnold is "stunt man" for the lead in pioneer air movies at Nassau Boulevard meet where Army pilots compete.

1911, Oct. 9—Demonstration of Tarbox automatic pilot made before officers at College Park. Other similar inventions follow.

1911, Oct. 10—Bombsighting and dropping device demonstrated by Riley Scott, College Park, Md.

1911, Oct. 19-Feb. 12, 1912—Eastbound transcontinental flight of Robert G. Fowler (Wright B), Los Angeles-Pablo Beach, Fla., 2520 mi. in 116 days.

1911, Oct. 24—Orville Wright makes soaring record of 9 min. 45 sec. at Kitty Hawk.

1912, Feb. 12—Frank T. Coffyn takes automatic movie aerials over New York harbor.

1912, Feb. 17—First pilot physical exam published by U. S. Army.

1912, Mar. 1—Attached type parachute jump by Bert Berry from Benoist pusher plane, St. Louis.

1912, Apr. 16—First U. S. licensed woman pilot, Harriet Quimby, flies English Channel. (Killed at Boston Aviation Meet, July 1.)

1912, May 24—Paul Peck makes American duration record of 4 hr. 23 min. 5 sec. in biplane with Berliner Gyro engine.

1912, May 30—Death of Wilbur Wright by typhoid.

1912, June 7-8—Machine gun fired from Wright biplane by Capt. Charles DeForest Chandler, College Park, Md.

1912, July 2—Vaniman 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, Aug. 12—First Army tractor plane, Burgess, received; flown by Lts. H. H. Arnold and Roy C. Kirtland from Marblehead, Mass.

1912, Oct. 6—In night flight, Lt. J. H. Towers, U.S.N., (Curtiss A-2) makes world seaplane duration record, 6 hr. 10 min. 35 sec. at Annapolis; American record for any plane.

1912, Oct. 8—First Navy physical exam for pilots published by Bureau of Medicine and Surgery.

1912, Oct. 9—First competition for Mackay Trophy won by Lt. H. H. Arnold.

1912, Nov. 5-13—First U. S. airplane artillery adjustment, Ft. Riley, Kans., Lt. H. H. Arnold and observer Lt. Follett Bradley.

1912, Nov. 6-Dec. 15—Antony Jannus (Benoist seaplane Roberts 2-cycle 100 hp) flies Omaha-New Orleans, with mail and merchandise, carrying passengers at stops en route—1835 mi., flying time: 31 hr. 43 min.

1913, Jan. 13-Mar. 31—Air parcel post flight, Boston-New York, by Harry M. Jones (Wright B).

1913, Feb. 11—James Hay bill in Congress

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inaugurates the project of a separate air service.

1913, Feb. 13—Langley Field Aerodynamical Laboratory project inaugurated.

1913, Apr. 27—First cross-Isthmus flight by Robert G. Fowler and cameraman R. A. Duhem, Panama-Cristobal. Publication of story and pictures results in arrest.

1913, May 10—Didier Masson and bomber Dean attack Mexican federal gunboats in Guaymas Bay. A number of other Americans fly for Villa in this and subsequent years.

1913, May 28—Lt. T. D. Milling and Lt. W. C. Sherman make 2-man duration and distance record of 4 hr. 22 min. and 220 miles (Burgess tractor-Renault 70), Texas City-San Antonio.

1913, May 30—About this date is instituted M.I.T.'s aerodynamics course under Asst. Naval Constructor Jerome C. Hunsaker.

1913, June 20—First Naval aviator killed when Ensign W. D. Billingsley is thrown from seaplane.

1913, July 19—Sky writing initiated by Milton J. Bryant over Seattle.

1913, Oct. 12—Eighth Bennett international balloon race won for U. S. for fourth time at Paris by R. H. Upson and R. A. D. Preston, landing in England.

1913, Nov. 27—First exhibition loop by Lincoln Beachy in Curtiss biplane, Coronado, Cal.

1913, Dec. 4—Tactical Air Unit, First Aero Squadron, set up as provisional organization, San Diego, Cal.

1913, Dec. 12—Wright pilot Oscar Brindley reports at San Diego as Army's first civilian instructor. Scores of others subsequently employed through 1918.

1913, Dec. 31—Orville Wright demonstrates automatic pilot; awarded Collier Trophy.

1914, Jan. 1—First scheduled airline begins operations with Benoist flying boat between St. Petersburg and Tampa, Fla.; Tony Jannus, pilot.

1914, Jan. 31—During the month first U. S. Navy air station established at Pensacola, following temporary camps at San Diego and Annapolis, 1911-1912.

1914, Feb. 17—Seaplanes and flying boats classed as "vessels" by the Department of Commerce and the license No. 1 is issued to Antony Jannus.

1914, Feb. 24—Army Board condemns all pusher type airplanes.

1914, Apr. 15—Electric self starter fitted to Anzani 200-hp engine of Collier flying boat.

1914, June 23—Curtiss' Wanamaker trans-Atlantic flying boat tested. With outbreak of World War I the project is abandoned.

1914, July 2—Lawrence Sperry wins French War Dept. prize for "stable airplane" flown by early automatic pilot over Seine River in Paris.

1914, July 18—Aviation Section of Signal Corps created by Congress, authorizing 60 officers and students and 260 enlisted men.

1914, Dec. 1-16 — Two-way plane-ground radio demonstrated by Lt. H. A. Dargue and Lt. J. O. Mauborgne, Manila, P. I.

1915, Mar. 3—National Advisory Committee for Aeronautics established by Congress.

1915, May 14—Contract let for first Navy airship D-1 to Connecticut Aircraft Co. In July is contracted a floating airship shed.

1915, June 22—Wisconsin State Forester.



Witteman-Lewis XNBL-1,  
Barling Bomber, 1923

E. M. Griffith, flown by Jack Vilas, in first air forest patrol.

1915, Sept. 17—Joseph Dolgos of Philadelphia demonstrates air incendiary bombs.

1916, Feb. 9—Cpl. A. D. Smith (Martin S. Hall Scott 125) makes world seaplane duration record of 8 hr. 42 min.

1916, Feb. 12—Invitation for bids on air mail issued by Post Office in Massachusetts and Alaska.

1916, Mar. 15—First Aero Squadron, under command of Capt. B. D. Foulois, begins operations at Columbus, N. M., with Gen. Pershing's Punitive Expedition.

1916, Apr. 5—The Governors Island Training Corps organized by Philip A. Carol.

1916, Apr. 14—A power-driven turret is proposed without result by Col. F. P. Gobham.

1916, June 3—National Defense Act increases strength of Aviation S. G. 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 Balesley shot down. (Member of Lafayette Escadrille, flying for France.)

1916, Aug. 29—First U. S. Coast Guard Aviation Division organized.

1916, Oct. 2—Allocation airship development to Army or Navy raised by Chief Signal Officer. Rigid later assigned Navy.

1916, Nov. 2—Chicago-New York commercial airmail line asked by Glenn Haffly. Sponsored by New York Times, Victor Carlstrom flies mail demonstration, Nov. 2-3.

1916, Nov. 14—More than 60 civilians are to Curtiss contract school at Newport News, Va., beginning this date and before Apr. 6, 1917. Others are sent to Curtiss school at Miami. Gen. Mitchell learns to fly here at this period.

1916, Nov. 18-20—Group National Guard cross-country high under Capt. B. C. Bolling from New York to Petersburg, N. J. and return. On Dec. 30, another is made to Philadelphia.

1916, Nov. 29-20—Rush Law flies her 1914 Curtiss pusher Chicago-New York, with 2 stops en route, for new cross-country record.

1916, Dec. 17—To this date the Aero Club of America has certified 626 airplane pilots. In addition are many other pilots who have

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never flown for the Aero Club certificate. On Dec. 31, the Army has graduated 122 pilots since 1909.

1916, Dec. 18—Non-exclusive licenses are offered by Wright-Martin Aircraft Corp. on royalty basis. Terms are considered prohibitory and in 1917 Congress appropriates \$1,000,000 to acquire basic patents. Solution is the cross-license agreement of the Aircraft Manufacturers Association.

1917, Feb. 13—Capt. Francis T. Evans, U.S.-M.C., loops and spins a seaplane at Pensacola.

1917, Feb. 15—Aircraft Manufacturers Association completes organization.

1917, Apr. 6—U. S. declares war on Germany.

1917, Apr. 6—Official strength of the Aviation Section, S. C., is 131, including regular and reserve. Of these, 112 are airplane pilots or student pilots. Enlisted strength is given variously from 1087-1800. At armistice the figures are: total officers, 20,708 (pilots and student pilots, 12,449); enlisted, 174,315.

Airplane strength, "less than 300." Produced in U. S., Apr. 6, 1917—Nov. 1, 1919: 13,894; received from Allies, 5,229; total: 19,123.

1917, May 10—Arrangements made for eight ground schools for theoretical training Reserve officer candidates.

1917, May 16—Aircraft Production Board created. Superseded by the Aircraft Board Oct. 1. Dissolved May 19, 1919.

1917, May 23—French Premier Ribot asks U.S. to furnish 5,000 pilots, 50,000 mechanics, 4,500 planes for active service by spring 1918.

1917, May 29—Liberty engine project inaugurated. An 8-cylinder Liberty is flown in an L.W.F., July 25. The 12-cylinder production Liberty follows in December.

1917, June 1—Barlow robot bomber urged. Armistice ends project.

1917, July 13—Fiske torpedo plane tested with dummy missile. Experiments continue.

1917, July 24—First great U. S. air appropriation, \$640,000,000. Act also provides for increase in organization of Aviation Section, S. C.

1917, July 27—Secretary of Navy authorizes a Naval Aircraft Factory at Philadelphia.

1917, July 27—First British DH-4 arrives to be the first American service plane put into production, with Liberty engine. First American DH-4 completed is flown Oct. 29 by civilian test pilot H. M. Rinehart.

1917, Aug. 5—Original First Aero Squadron leaves Columbus, N.M. for overseas under Maj. Ralph Royce.

1917, Aug. 13—First AEF squadron program calls for 89 wings and 508 squadrons. One wing equals six squadrons (5 airplanes, 2 balloons). A brigade comprises two or more wings.

1917, Sept. 5—Bristol fighter project started. Condemned July 20, 1918, after 27 planes are built.

1917, Sept. 22—Montgomery heirs sue Wright-Martin Aircraft Corp. for infringement. Suit withdrawn June 6, 1921. Suit of same date against U. S. is dismissed May 28, 1928.

1917, Oct. 16—Airplane to airplane radio-phone conversation is demonstrated.

1917, Oct. 18—McCook Field established as Signal Corps Experimental Laboratory.

1917, Oct. 18—Aviation Medical Research Board established by Signal Corps.

1917, Nov. 15—J. Newton Williams' helicopter proposal results in recommendation of N.A.C.A. for Government prize of \$20,000, not accomplished.

1917, Nov. 21, Robot bomber demonstrated to Army and Navy officers.

1917, Nov. 27—Brig. Gen. B. D. Foulois made Chief of Air Service, AEF.

1917—Gen. William Mitchell claimed as first officer to fly over enemy lines.

1918, Jan. 19—U. S. School of Aviation Medicine begins operations under Signal Corps Maj. William H. Wilmer, Hazelhurst Field, Mineola, L. I., N. Y.

1918, Feb. 28—Under President Wilson's proclamation, licenses are required for civilian pilots or owners; more than 800 are issued.

1918, Mar. 3—Maj. Edward C. Schneider and flight, reach artificial altitude of 34,000 ft. in 24 min. at Signal Corps, Mineola, N. Y. laboratory.

1918, Mar. 11—First D.S.C. awarded Army air service personnel goes to Lt. Paul Baer of 103rd Squadron for his performance this date.

1918, Mar. 14—Two pilots of First Pursuit Group (95th Squadron) go on patrol.

1918, May 9—Flight Surgeons are organized at flying fields.

1918, May 11—U. S.-built DH-4 Liberty planes received by AEF.

1918, May 15—Congress establishes Air Mail Flyer's Medal of Honor. First award is to M. F. Freeburg, 1932.

1918, May 15—Regular airmail service flown by Army between New York and Washington, D. C.

1918, May 20—Army aeronautics severed from Signal Corps; two departments created: Bureau of Military Aeronautics and Bureau of Aircraft Production.

1918, June 26—A trans-Atlantic flight is urged by Gen. William L. Kenly, Director Military Aeronautics as "most necessary." On Aug. 8, Roy N. Francis is assigned to study project. Experiments continue to 1919 when Navy's NC4 makes the flight.

1918, July 4—Plan to distribute tons of propaganda by balloon over Germany this day fails attainment. Previously extended experiments had been conducted and contracts let.

1918, Aug. 2—First DH Liberty patrol by 135th Aero Squadron

1918, Aug. 17—First Martin bomber flown at Cleveland by Thomas Eric Springer.

1918, Sept. 7—First U. S. demonstration of troop transport by air.

1918, Sept. 12-13—Greatest air concentration of history at St. Mihiel under Gen. William Mitchell—1481 planes.

1918, Sept. 16—German attached type parachutes being in use at least as early as May 1, 1918, the AEF cables need and suggests Floyd Smith, test pilot, prosecute development. Smith develops tree type chute. Leslie L. Irving makes first free jump Apr. 28, 1919.

1918, Sept. 18—Altitude of 28,899 ft. reached by Maj. R. W. Schroeder.

1918, Sept. 25—First Congressional Medal of Honor awarded for air activity voted 1st Lt. Edward V. Rickenbacker of 94th Aero Squadron.

1918, Sept. 26—First phase of Meuse-Arzonne attack.

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Consolidated PT-1, first modern primary trainer, replaced "Old Jenny" in 1926

1918, Sept. 28—Pilotless airplane maneuvered from another airplane by radio, after some months of experiment. Various automatic pilots and radio controllers tried over the years.

1918, Oct. 2—First successful flights of Army's guided missile. Its prototype had been flown by H. M. Rinehart in July, substituting for the explosive load and the automatic controls.

1918, Oct. 3—Flight refueling demonstrated by Lt. Godfrey L. Cabot, U.S.N.R., continuing into 1920.

1918, Oct. 12—Use of oxygen tanks ordered all pilots over German lines.

1918, Oct. 25—Charles E. Hughes reports on his investigation of dishonesty in aircraft production.

1918, Nov. 11—Armistice signed.

1918, Dec. 4—First Army trans-continental flight made by Major Albert D. Smith's group of JN4 planes, San Diego-Jacksonville-New York-San Diego. Major Smith's plane alone completes the full round trip.

1919, Jan. 2—Maj. Gen. Charles T. Menoher becomes Director of Air Service.

1919, Jan. 21-30—Army second transcontinental flight; Major T. C. Macaulay (DH-4 Liberty), Ft. Worth-San Diego-Miami-Ft. Worth. Repeated in April.

1919, Jan. 24—At Issoudun, France, 1st Lt. Temple M. Joyce (Morane) makes 300 consecutive loops.

1919, Mar. 3—U. S.-Canada airmail flown by Edward Hubbard in Boeing seaplane, Type C.

1919, Apr. 26—Lt. Comdr. H. B. Grow, U.S. N. in F5L flying boat makes non-stop endurance record: 20 hr. 10 min.

1919, Apr. 28—Leslie L. Irving makes first free type manually operated airplane parachute jump over McCook Field. (See 9/16/18).

1919, May 8-31—Trans-Atlantic crossing by Lt. Albert C. Read and crew from Rockaway Beach, N. Y., to Plymouth, England, in NC-4, 53 hr. 58 min.

1919, May 14—Navy airship C-5 makes

American non-stop record of 25 hr. 50 min., Montauk Pt., L. I. to St. Johns, N.F.

1919, May 18—In first trans-Atlantic takeoff, H. C. Hawker and McKenzie Grieve alight in ocean 1200 miles and 14½ hours out with engine trouble. Rescued.

1919, May 19—First award of DFC made to M/Sgt. Ralph W. Bottrill for first jump by Army personnel with free-type 'chute.

1919, June 1—First organized and sustained forest fire patrol inaugurated at Rockwell.

1919, June 14—First non-stop Atlantic crossing by Capt. John Alcock and Lt. A. W. Brown (Vickers-2 Rolls 375) St. Johns to Clifden, Ireland: 1890 mi. in 16 hr. 12 min.

1919, June 28—Treaty of peace with Germany signed at Versailles.

1919, July 1—Aerial fish patrols inaugurated at San Diego by Comdr. E. W. Spencer, Jr., U.S.N.

1919, July 2-6—First airship ocean crossing, British R-34, E. Fortune, Scotland, to Mitchel Field, N. Y., 3270 mi. in 108 hr. 12 min.; Lt. Comdr. L. Lansdowne, U.S.N. on board. Return made July 9-12, Col. William M. Hensley, representing Air Service.

1919, Aug. 14—Airmail from Aeromarine flying boat to White Star liner, *Adriatic*.

1919, Aug. 27-29—New York-Toronto race of military and civilian pilots.

1919, Aug. 28-Sept. 19—Lawson "air liner," 26-passenger, twin Liberty biplane, makes demonstration trip Milwaukee-Washington via Chicago, New York and other cities. It returns Sept. 25-Nov. 6.

1919, Sept. 1—Dive bombing demonstrated about this date at Aberdeen Proving Ground.

1919, Sept. 16—Flood relief provided by four JN4D's from Corpus Christi to stranded inhabitants.

1919, Sept. 18—Roland Rohlf's (Curtiss triplane-K12 Curtiss 400) makes world altitude record of 31,420 ft.

1919, Oct. 8-31—Army transcontinental reliability and endurance test New York-San Francisco and return. Forty-four compete



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westbound; 15 eastbound. Ten planes make round trip.

1919, Oct. 30—Reversible pitch propeller tested at McCook Field, Dayton, Ohio.

1919, Nov. 12—June, 1920—Six Navy F-5L's cruise New York to West Indies and return, covering 12,731 nautical miles.

1920—Moon eclipse observed by Lts. J. H. Tilton and W. H. Cushing of Rockaway Naval air station from height of some three miles.

1920, Feb. 27—World altitude record of 33,113 feet set by Maj. R. W. Schroeder (Le Pere-Liberty).

1920, Mar. 29—Apr. 22—Marine Corps group flight Washington-San Domingo and return, 4842 miles.

1920, June 7—Lt. John H. Wilson makes unofficial world parachute jump record of 19,800 ft.

1920, June 4—Army Reorganization Bill approved, creating Air Service in Army.

1920, July 7—F-5L Navy seaplane flown by radio compass from Hampton Roads, Va., to U.S.S. *Ohio*, at sea.

1920, July 15—Oct. 20—New York-Alaska flight; Capt. St. Clair Street, 1st Lt. Clifford Nutt, 2nd Lts. Ross C. Kirkpatrick, Eric H. Nelson and C. E. Crumrine, Sgts. James Long and Joseph E. English, Capt. Howard Douglas, advance officer; Mitchel Field, N. Y., to Nome and return.

1920, Sept. 8—Transcontinental mail route, combination plane-train, New York-Chicago-San Francisco, completed.

1920, Nov. 1—U. S. international passenger service started by Aeromarine West Indies Airways between Key West, Fla., and Havana, Cuba.

1920, Nov. 25—1st Lt. C. C. Moseley (Ver-ville-Packard 600) wins first Pulitzer race at 156.54 mph; 24 contestants finish, 13 others start but do not finish.

1920, Dec. 13-14—Navy balloon of Lts. L. A. Kleer, Walter Hinton and S. A. Farrell land beyond Moose Factory, Ont., after 25 hours, 852 miles from start at Rockaway, N. Y.

1921, Feb. 18—First U. S. airplane parachute escape by C. C. Eversole, airmail pilot.

1921, Feb. 22-23—Night airmail flown by Jack Knight from North Platte, Neb., to Chicago, Ill.

1921, Feb. 24—Lt. W. D. Coney completes transcontinental flight, San Diego-Jacksonville, 2180 mi. in 22 hr. 27 min.; 57 hr. 24 min. elapsed time.

1921, Mar. 23—Lt. A. G. Hamilton drops 23,700 ft. by parachute, Chanute Field.

1921, June 21—Navy F5L planes sink German sub U-117 in demonstration.

1921, July 18-21—Sinking of captured German cruiser, *Frankfurt*, and battleship, *Ost-friesland*, by U. S. bombs proves vulnerability of naval craft to aerial attack.

1921, Aug. 10—Navy Bureau of Aeronautics formed with Rear Admiral W. A. Moffett as Chief.

1921, Sept. 28—New world altitude record of 34,508 ft. set by Lt. J. A. Macready.

1921, Nov. 5—Bert Acosta (Curtiss Navy-C12 Curtiss 400) wins Pulitzer race at 176.7 mph.

1921, Nov. 12—Refueling in air: Earl S. Daugherty transfers *Wesley May* with can of gasoline from wing of another plane.

1921, Nov. 15—Italian airship *Roma* makes initial ascent in U. S. at Langley Field.

1921, Dec. 1—Hellum airship, Navy dirigible C-7, flown from Hampton Roads, Va. to Washington, D. C.

1921, Dec. 29—World endurance record of 26 hr. 18 min. 35 sec. made at Roosevelt Field by Edw. Stinson and Lloyd Bertaud (CJL6 BMW 185).

1922, Jan. 1—Underwriters Laboratories starts registration of aircraft for benefit of insurance companies.

1922, Jan. 1—Aeronautical Chamber of Commerce organized, New York, with I. M. Upperco, president.

1922, Feb. 21—Airship *Roma* destroyed.

1922, Mar. 20—Airplane carrier U.S.S. *Langley*, commissioned at Norfolk, Va.

1922, June 16—Helicopter demonstrated by Henry Rehrler, Washington, D. C.

1922, July 14—Aeromarine Airways starts Detroit-Cleveland flying boat service.

1922, Aug. 5-7—Lt. Clayton Bissell completes first model airway flight, Washington-Dayton-Washington.

1922, Aug. 16—Sperry airway light beacon demonstration, McCook Field.

1922, Sept. 4-5—Transcontinental speed flight by Lt. James H. Doolittle, Pablo Beach, Fla.-San Francisco, Cal., in 22 hr. 35 min. elapsed time.

1922, Sept. 14-23—Transcontinental Army airship flight with Maj. H. A. Straus commanding crew of Capt. C. W. McEntire and others, from Langley Field, Va. to Arcadia, Cal.

1922, Oct. 5-6—World endurance record, 35 hr. 18 min. 30 sec., Rockwell Field, by Lts. J. A. Macready and O. G. Kelly (Fokker T2 Liberty 375).

1922, Oct. 14—Lt. R. L. Maughan wins Pulitzer race at 206 mph (Army Curtiss-D12 Curtiss 375).

1922, Oct. 18—World speed record of 222.97 mph set by Brig. Gen. William Mitchell in Curtiss racer.

1922, Oct. 23—American Propeller Co. demonstrates reversible propeller at Bolling Field.

1922, Dec. 18—Army's De Bothezat helicopter makes first successful flight, 1 min. 42 sec., Dayton, Ohio.

1923, Mar. 29—Lt. R. L. Maughan makes world speed record 236.58 mph (Curtiss R6-Curtiss 465), Dayton, Ohio.

1923, Apr. 16-17—World duration—distance records by Lts. J. A. Macready and O. G. Kelly (Fokker T2 Liberty 375), 36 hr. 4 min. 34 sec., 2516.55 miles.

1923, May 2-3—Cross-country non-stop flight by Lts. J. A. Macready and Oakley G. Kelly in Fokker T-2, from New York to San Diego, 2,520 miles in 26 hr. 50 min. 3 sec.

1923, Aug. 27-28—Lts. L. H. Smith and J. P. Richter (DH-4E Liberty 400) made world duration-distance refueled records: 3293.26 miles, 37 hr, 15 min. 14.8 sec.; Rockwell Field.

1923, Sept. 5—Smoke screen demonstrated by Thomas Buck Hine during naval bombing maneuvers, Cape Hatteras, N. C.

1923, Sept. 5—Langley Field bombers sink naval vessels *New Jersey* and *Virginia*.

1923, Oct. 6—Lt. A. S. Williams, U.S.N. wins Pulitzer race (Curtiss R2C1-D12 Curtiss 460) at 243.68 mph.

1923, Oct. 25-27—Barling bomber makes series weight-carrying records with greatest weight 3000 kg.; duration, altitude records. 1 hr. 19 min. 11.8 sec., 5,344 ft.

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1923, Nov. 4—Lt. A. J. Williams, U.S.N. (Curtiss R2C1-D12A Curtiss 500) makes world speed record 266.59 mph.

1923, Dec. 18—For \$100,000 the Christmas Aeroplane Co. assigns its aileron patent to U. S. Government.

1924, Jan. 16—Navy airship *Shenandoah* tears loose from mast in storm and rides it out during the night.

1924, Feb. 21—Alaskan airmail flown by Carl B. Eielson from Fairbanks to McGrath.

1924, Feb. 22—Lt. J. A. Macready (Lepere-supercharged Liberty 400) reaches 41,000 ft. indicated altitude.

1924, Apr. 6-Sept. 28—Round-the-world flight by Lts. Smith, Nelson, Arnold, and Harding, Seattle to Seattle, 26,445 miles, 175 days (368 hours flying time).

1924, June 2—Lt. James T. Neely and storm-riding meteorologist Dr. C. L. Meisinger, Weather Bureau, killed by lightning in balloon near Monticello, Ill.

1924, July 1—Through transcontinental airmail service begun by U. S. Post Office.

1924, Oct. 4—Lt. H. H. Mills wins Pulitzer trophy (Verville Sperry-Curtiss HC D12A) at 216.55 mph.

1924, Oct. 7-25—Navy airship *Shenandoah* makes record cross-country cruise over 7080 miles in 235 hr. 01 min. Air hours total of 422 hr. 23 min. Includes time moored.

1924, Oct. 12-15—U. S. Navy's German airship ZR3 (*Los Angeles*) makes fourth aircraft Atlantic crossing, Friedrichshafen-Lakehurst, in delivery under reparations.

1924, Oct. 29—Fog dispersal by electrified silica and sand demonstrated at Bolling Field.

1925, Jan. 29—Eclipse pictures and astronomical data secured at high altitudes by Air Service pilots.

1925, Feb. 2—Kelly Bill signed by President Coolidge authorizing private contract air transport of mail.

1925, Mar. 1—San Diego Airline service started by Ryan Airlines, Inc.—first daily scheduled service on all-season basis.

1925, Apr. 7—Navy carrier *Saratoga* launched.

1925, May 21-July 6—Amundsen-Ellsworth polar flight.

1925, July 15—Dr. A. Hamilton Rice Expe-

dition, first to employ planes in exploration, returns from Amazon; Lt. Walter Hinton, pilot, in Curtiss Seagull.

1925, Aug. 1—Survey flight of Pacific Air Transport flown by T. Claude Ryan and Vern Gorst in first Ryan M-1 mail plane.

1925, Aug. 4-22—MacMillan polar expedition, with Navy assistance.

1925, Aug. 5—Seven American pilots leave Paris to fly for the French in the Riff campaign in Africa. Others follow to a total of 17 pilots, 5 observers.

1925, Aug. 31-Sept. 8—In Navy's attempted San Francisco-Honolulu flight, Commander John Rodgers and crew (PN9-2 Packard 500 flying boat) alight short of mark, making non-stop cross-country seaplane record of 1,841 miles.

1925, Sept. 3—Navy dirigible, *Shenandoah*, collapsed in storm over Ava, O., killing 14 of 43 on board.

1925, Sept. 12—Morrow Board appointed by President Coolidge. (Laid down U. S. air policy.)

1925, Oct. 12—Lt. Cyrus Bettis wins 6th Pulitzer race (Curtiss R3C1-V1400 Curtiss 619) at 248.97 mph.

1925, Oct. 26—Lt. J. H. Doolittle wins 8th International Schneider Seaplane Trophy race in first contest in America (Curtiss R3C2-V1400 Curtiss 619) at 232.57 mph.

1925, Dec. 17—Gen. William Mitchell found guilty of violating 96th Article of War; had risked insubordination by demanding unrestricted use of air power. Sentenced five years suspension of rank, pay and command. Resigned.

1926, Jan. 18—A \$2,500,000 air promotion fund established by Daniel Guggenheim.

1926, Jan. 29—Lt. J. A. Macready (XC05A-Liberty 400) makes American altitude record: 38,704 ft.

1926, Feb. 11—Strip bombing tests made at Kelly Field.

1926, Apr. 16—First cotton dusting plane purchased by Department of Agriculture.

1926, Apr. 30—Capt. G. H. Wilkins and Lt. Carl B. Eielson complete third round trip Fairbanks-Pt. Barrow-Fairbanks.

1926, May 8-9—Flight over North Pole by

### Loening Amphibian flown on Pan American Good-Will Tour, 1926-1927



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Richard Byrd, navigator, and Floyd Bennett, pilot, in Fokker monoplane.

1925, May 21-July 6—Amundsen-Ellsworth bile airship *Norge* crosses Pole in voyage Spitzbergen-Teller, Alaska in 71 hours.

1926, May 20—Air Commerce Act (Bingham-Parker Bill) signed by President Coolidge; Aeronautics Branch, Department of Commerce, established.

1926, May 30—Bennett international balloon race, Brussels, brought to America by the win of W. T. Van Orman and W. W. Morton in Goodyear III balloon. Capt. H. C. Gray, Air Service, second.

1926, July 2—Army Air Service renamed Army Air Corps.

1926, July 2—First reforestation by airplane, Hawaii.

1926, July 14—Armstrong seadrome model demonstrated at Wilmington, Del. to Air Service.

1926, Aug. 18—Metal-clad airship contract let at not over \$300,000.

1926, Aug. 25—JN training plane dropped by parachute, San Diego Naval Air Station.

1926, Sept. 15—Pacific Air Transport begins operation of contract air mail service with Ryan M-1 monoplanes between Los Angeles and Seattle.

1926, Dec. 7—Airway beacon erected by Aeronautics Branch, Department of Commerce, on Chicago-Dallas route.

1927, Mar. 9—American balloon altitude record of 28,508 ft. made by Capt. H. C. Gray.

1927, Apr. 12—New American duration record of Clarence D. Chamberlin and B. B. Acosta (Bellanca-15 Wright 200) 51 hr. 11 min. 25 sec.

1927, May 4—Record balloon altitude attempt by Capt. H. C. Gray, 42,470 ft.

1927, May 15-19 — Greatest concentration since World War I (109 planes) in maneuvers under Brig. Gen. J. E. Fechet.

1927, May 20-21—Non-stop trans-Atlantic solo flight by Charles A. Lindbergh, New York-Paris, 3,610 miles, 33 hr. 30 min. (13th aircraft to make completed crossing.)

1927, May 25—Outside loop demonstrated by Lt. James H. Doolittle.

1927, June 4—First nonstop flight to Germany, Clarence D. Chamberlin and passenger (Bellanca-15 Wright 200), 3,911 miles, 43 hr. 49 min. 33 sec.

1927, July 25—World airplane altitude record by Lt. C. C. Champion, U. S. N. (Wright-P & W 425 supercharged) 38,484 ft.

1927, Aug. 16-17—A. C. Goebel and Lt. W. V. Davis, U. S. N. (Travelair-15 Wright 200) win Dole Oakland-Honolulu race One team finishes. Two teams lost.

1927, Sept. 1—Air express operations begun by American Railway Express and major airlines.

1927, Sept. 10—Bennett international balloon race, Dearborn, Mich., won by E. J. Hillard and A. G. Schlosser with 745 miles; 15 contestants.

1927, Oct. 12—Wright Field dedicated.

1928, Feb. 3-Dec. 28—Lt. H. A. Sutton conducts a series of spin tests; awarded Mackay Trophy.

1928, Mar. 1-9—Transcontinental amphibian flight by Army Lt. Burnie R. Dallas and civilian Beckwith Havens in Loening.

1928, Mar. 28-30—Edw. A. Stinson and George Holderman (Stinson-Wright 200) make

endurance record of 53 hr. 36 min. 30 sec.

1928, Apr. 12-13—First non-stop westbound North Atlantic airplane crossing made by Baron G. von Huenefeld, Capt. Hermann Koehl and Maj. James Fitzmaurice (Junker-Junker 280/310 metal cabin land monoplane) from Baldoon, Ireland to Greenly Island, N.F., 2,070 miles in 37 hours.

1928, Apr. 15-21 — First eastbound Arctic crossing made by Capt. G. H. Wilkins and Lt. C. B. Eielson (Lockheed-Wright 225) Pt. Barrow-Green Harbor, Spitzbergen, 2,200 miles, 20 hr. 20 min.

1928, May 24—Gen. Umberto's airship is over the Pole in trip from Spitzbergen. It is wrecked May 25, with loss of lives of crew and rescuers.

1928, May 31-June 8—First U. S.-Australian flight, by Capt. C. Kingsford-Smith, Capt. C. T. P. Ulm, H. W. Lyon and James Warner (F7 Fokker-3 Wright 200) Oakland-Brisbane, 7,410 miles; 83 hr. 19 min.

1928, June 11-12—Mexico-Washington flight by Capt. Emilio Carranza (Bryan-Wright 200).

1928, June 17-18—First woman to fly Atlantic, Amelia Earhart with Wilmer Stultz, pilot, from Trepassey Bay, N.F., to Burryport, England, in trimotored Fokker, 2,140 miles, 20 hr., 40 min.

1928, July 30-31—Twenty-second Bennett international balloon race, Detroit, won by Capt. W. E. Kepner and Lt. W. O. Fareckson; 460 miles, 43 hr.

1928, Sept. 19—First Diesel engine to power heavier-than-air craft; designed by I. M. Woolson, manufactured by Packard Motor Car Co.; flight-tested at Utica, Mich.

1928, Oct. 19—Parachute troop demonstration at Brooks Field.

1928, Nov. 11—First Antaretic flight made by Lt. C. B. Eielson and Sir Hubert Wilkins (Lockheed-Wright 22). Other flights subsequently.

1928, Nov. 23-Dec. 30—New York-Girardot, Colombia, flight by Capt. Benjamin Mendez, 4,600 miles.

1928, Dec. 19—Autogiro flight by Harold F. Pitcairn, Pitcairn Field, Willow Grove, Pa.

1929, Jan. 1-7—Refueling endurance record set by Maj. Carl Spaatz and Capt. Ira C. Eaker, Lt. Elwood R. Quesada, Lt. Harry A. Halverson, S/Sgt. Roy W. Hooe in 150 hr., 40 min., 51 sec.

1929, Apr. 3—Floyd Smith trap-door parachute demonstrated.

1929, Apr. 30—Jack Barstow makes duration glider record of 15 hr. 13 min. at Point Loma, Cali.

1929, June 28-29—Round transcontinental flight by Capt. Frank M. Hawks (Lockheed-P & W) in 40 hr. 4 min. 32 sec. Capt. E. G. Harper repeats the performance July 11-26.

1929, July 13-30—World endurance record of 420 hr. 17 min. by Forrest O'Brien and Dale Jackson (Curtiss Robin-Curtiss 70).

1929, July 18-20 — N. Y.-Alaska flight by Capt. Russ G. Hoyt. Return flight ends at Edmonton, after covering 6,000 miles out of 8,469 itinerary.

1929, Aug. 5-6—Group transcontinental flight of 9 Keystone bombers under Major Hugh J. Knerr.

1929, Sept. 24—Demonstration by Lt. James H. Doolittle results in Cuggenheim report blind flying solution.

1929, Oct. 21—Air Ambulance Service organ-

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- ized by Colonial Flying Service and Scully Walton Ambulance Co., New York.
- 1929 — Bennett international balloon race won by W. T. Van Orman and aide, 341 miles, 9 contestants.
- 1930, Mar. 15—Glider, piloted by Capt. Frank Hawks, released from seaplane, Port Washington, N. Y.
- 1930, Apr. 6—Transcontinental glider in tow, piloted by Capt. Frank Hawks; San Diego to New York; 2,860 miles in 36 hr., 47 min.
- 1930, May 20—Dirigible-launched Vought observation plane, flown by Lt. Comdr. Charles A. Nicholson from U.S.S. *Los Angeles* to U.S.S. *Saratoga*, Lakehurst, N. J.
- 1930, June 4—New world altitude record of 38,560 ft. set by Navy Lt. Apollo Soucek, Anacostia, Md.
- 1930, June 11-July 4—World endurance record of 553 hr. 41 min. 30 sec. established by John and Kenneth Hunter (Stinson-Wright 200).
- 1930, July 21-Aug. 17—Refueling endurance record raised to 647 hr., 28 min. by Forrest O'Brien and Dale Jackson in a Curtiss Robin, St. Louis, Mo.
- 1930, July 22—German air mail plane catapulted 250 miles out en route to New York; 198 such ship-shore flights 1929-1938.
- 1930, Sept. 1 — Bennett international balloon race again won for U. S. by W. T. Van Orman and aide, 542 miles.
- 1931, Feb. 14-19—Lts. W. W. Lite, Clement McMullen fly New York-Buenos Aires, 6,870 miles, 5 days, 5 hours elapsed time; 52:15:00 flying.
- 1931, Mar. 30—Airplane-airship mail transfer at Scott Field.
- 1931, Apr. 10—Airship sub-cloud observation car demonstration by Lt. W. J. Paul.
- 1931, May 25-28—World endurance record, non-refueled, set by Walter E. Lees and F. A. Brossi, Bellanca, Packard Diesel 225 hp; 85 hr., 32 min., 38 sec., Jacksonville, Fla.
- 1931, May 14-28—Transcontinental antogiro flight by John M. Miller, from Philadelphia to San Diego.
- 1931, June 4—Rocket glider flown by William G. Swan; remained aloft for 30 min. with 10 rockets, Atlantic City, N. J.
- 1931, June 23-July 1—World flight by Wiley Post and Harold Gatty (Lockheed-PW 550), New York-Harbor Grace-Berlin-Moscow-Irkutsk-Khabarovsk-Solomon Beach-Fairbanks-Edmonton-Cleveland-New York, in 14 hours, 8 days 16 hours, 16,500 miles.
- 1931, July 25-26—Glider duration record of 16 hr. 38 min. by 2nd Lt. John C. Crain, Honolulu.
- 1931, Oct. 3-5—Trans-Pacific non-stop airplane flight by Clyde Pangborn and Hugh Herndon, Samushiro Beach, Japan, to Wenatchee, Wash.
- 1931, Oct. 3-5—Herndon and Pangborn (Bellanca-PW 420) left New York July 28 on world trip and had reached Japan Aug. 6, abandoning attempt to better Post-Gatty record.
- 1931, Oct. 6-9—Navy bomber tests on U.S.S. *Pittsburgh* in Chesapeake Bay.
- 1931, Nov. 3—Dirigible, *Akron*, carried record number of 207 persons in flight over New York and Philadelphia.
- 1931, Dec. 17-18—Glider duration record of 21 hr. 34 min. by Lt. Wm. A. Cooke, Honolulu.
- 1932, May 9—First solo blind flight, by Capt. Albert F. Heegenberger, Wright Field, Dayton, O.
- 1932, May 20-21—Amelia Earhart soles across Atlantic, St. Johns, New Brunswick to Londonderry, Ireland, in Wasp-powered Lockheed Vega.
- 1932, Aug. 25—First woman to complete non-stop transcontinental flight, Amelia Earhart, Los Angeles to Newark.
- 1932, Dec. 1—Teletypewriter weather map service inaugurated by Department of Commerce.
- 1933, Jan. 19 — Rocket guided by sound waves from enemy aircraft proposed.
- 1933, Jan. 23 — Steam airplane project launched by Great Lakes Aircraft and General Electric Co. Later Besley brothers fly their steam airplane.
- 1933, Apr. 4—Navy dirigible, *Akron*, crashes into sea, killing 73; Comdr. Herbert V. Wiley, commanding.
- 1933, May 3-26 — Albatross troop logistics part of West Coast maneuvers, with 283 aircraft.
- 1933, July 15-22—Solo round-the-world flight by Wiley Post in Lockheed Vega monoplane, *Winnie Mae*, in 7 days, 18 hr., 49 min.
- 1933, Sept. 4—World speed record for land planes set at 304.98 mph by James R. Wedell in Wasp-powered Wedell-Williams racer.
- 1933, Nov. 20-21—World balloon altitude record set at 61,237 ft. by Lt. Comdr. T. C. W. Settle and Maj. C. L. Fordney over Akron, O.
- 1934, Jan. 10-11—Longest non-stop over-water mass flight completed by six P2Y-1 Navy flying boats under command of Lt. Comdr. Kneifer McGinnis, San Francisco to Honolulu.
- 1934, Feb. 9—Postmaster General Farley cancels certain mail contracts. Air Corps flies the mail Feb. 19-Mar 10; Mar. 19-May 5.
- 1934, June 12—Howell commission to study airmail act and report on all phases of aviation by Feb. 1, 1935.
- 1934, Dec. 31—War Department announces instruction governing GHQ Air Force organization and operation.
- 1935, Jan. 3—Antarctic flight by Ellsworth and Kenyon (Northrop-PW 600).
- 1935, Feb. 12—Navy dirigible, *Macon*, crashes into sea, killing 2.
- 1935, June 12-Aug. 14—Washington-Alaska-Washington flight (Douglas Amphibian-2 Wasp) in test of practicability of such flights with standard equipment and as any ordinary flight. Capt. Hex McClellan and crew of two.
- 1935, Aug. 15—Will Rogers and Wiley Post killed in take-off crash near Point Barrow, Alaska.
- 1935, Nov. 11—Balloon altitude record of 72,394 ft. by Capt. O. A. Anderson and Capt. Albert Stevens.
- 1935, Nov. 21-Dec. 5—Antarctic flights renewed by Ellsworth and Kenyon (Northrop-PW 600).
- 1935, Nov. 22-29—Trans-Pacific circum globe flight by Capt. Edwin C. Musick, Pan American Airways, from San Francisco to Honolulu, Midway Island, Wake Island, Guam and Manila, in Martin China Clipper.
- 1936, June 7—All-instrument transcontinental flight by Maj. Ira C. Eaker, between New York and Los Angeles.
- 1936, Sept. 18-Oct. 26—Regular trans-Atlantic flying boat service by Deutsche Luft-

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hansa. (Dornier twin Diesel engine 600.) Continued in 1937 and 1938.

1936, Sept. — Trans-Atlantic round-trip flight by Henry (Dick) Merrill and Harry Richman, New York to London and return.

1937, May 6—German dirigible, *Hindenburg*, burned on mooring, killing 36, Lakehurst, N. J.

1937, May 20-July 3—Amelia Earhart Putnam and Fred Noonan lost in Pacific in round-the-world attempt.

1937, June 25—Non-stop transcontinental amphibian flight by Richard Archbold in PBV-1, Catalina, from San Diego to New York.

1937, July 3-Sept. 3—Regular trans-Atlantic service test by Pan American Airways. Imperial Airways also similarly operate July 5-Aug. 2 and continue in 1938.

1937, Aug. 12—In joint coast defense exercise, Navy patrol planes locate target ship *Utah* 300 miles off San Francisco; Air Corps planes attack.

1937, Aug. 23—Wholly automatic landings made, "first in history," at Wright Field by Capt. Carl J. Crane with 2 passengers; awarded DFC.

1938, Feb. 26—Government acquires monopoly on helium by purchasing production facilities at Dexter, Kan.

1938, Apr. 22—Capt. E. V. Rickenbacker purchases Eastern Air Lines from North American Aviation, Inc., for \$3,500,000.

1938, June 23—Civil Aeronautics Authority with five members, an administrator, and a three-man Safety Board, created under Civil Aeronautics Act signed by President. This supersedes Aeronautics Branch, Department of Commerce.

1938, July 10-14—Howard Hughes and crew of four fly short northern course around world in 3 days, 19 hr., 8 min.

1938, July 17-18—Douglas (Wrong-Way) Corrigan flies from New York to Ireland in nine-year-old Curtiss Robin.

1938, Aug. 10-11 — First Berlin-New York nonstop flight by Capt. Alfred Henke and crew (Focke-Wulf Condor 200), 4,577 miles, 24 hr. 54 min.

1938, Aug. 22—Civil Aeronautics Act becomes effective.

1939, Feb. 4-6—Langley Field-Santiago Red Cross flight by Major C. V. Haynes in XB bomber with medicinal supplies.

1939, Mar. 5—Non-stop airmail system by pick-up demonstrated by Norman Rintoul and Victor Yesulantes in Stinson Reliant planes, Coatesville, Pa.

1939, Apr. 3—The National Defense Act, providing for aerial rearmament, signed by President Roosevelt.

1939, Apr. 17—Inclined runways for assisted takeoff studied by Air Corps Board.

1939, 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, Sept. 1-3—Germany invades Poland. England and France declare war on Germany.

1940, Mar. 26—U. S. commercial airlines complete a full year of flying without a fatal accident or serious injury to a passenger or crew member.

1940, July 1—Air Safety Board abolished with its functions delegated to the Civil Aeronautics Board. Civil Aeronautics Administration transferred to Department of Commerce.

1940, Sept. 23—House committee asks \$80 million for airport development, in \$500 million program; \$40 million voted.

1941, Mar. 17—Milwaukee renames its airport as General Mitchell Field.

1941, Apr. 15—First officially-recorded rotor helicopter flight in western hemisphere, Vought-Sikorsky VS-300A, piloted by Igor I. Sikorsky; flight time, 1 hr., 5 min., 14.5 sec., Stratford, Conn.

1941, May—Barrage balloon defense transferred from Air Corps to Coast Artillery.

1941, June 5—Ferry Command, for delivery of planes to Britain, organized by Army Air Corps.

1941, June 20—Army Air Force, comprising office of Chief of Air Corps and Air Force Combat Command, created.

1941, June—First woman to ferry bomber across Atlantic, Jacqueline Cochran, Canada to British Isles.

1941, Sept. 5—Mass trans-Pacific flight of heavy bombers completed by nine Army B-17 Flying Fortresses.

1941, Dec. 7—Pearl Harbor.

1942, Apr. 8—First flight of Ferry Command over Himalayan "Hump" made by Lt. Col. William D. Old, between Assam, India and Kunming, China.

1942, Apr. 18—First bombing attack on Japanese mainland by 16 B-25 Mitchell bombers from Navy carrier, *Hornet*; Lt. Col. James H. Doolittle commanding.

1942, May 4-9—Battle of Coral Sea.

1942, June 20—Ferry Command redesignated Air Transport Command under Maj. Gen. Harold L. George.

1942, June 3-7—Battle of Midway.

1942, June 17—AAF tow planes successfully pick up gliders in tests at Wright Field.

1942, Aug. 17—First official bombing raid of Eighth Air Force, 12 Flying Fortresses, Brig. Gen. Ira C. Eaker commanding, Rouen, France.

1942, Sept.—Fifty American Eagle squadron pilots, RAF, all Americans, transferred to Eighth Air Force. (Fourth Fighter Group.)

1942, Oct. 1—Jet plane built and flown by Robert M. Stanley; Bell Airacomet (XP-59A), Muroc Dry Lake, Cal.

1943, Mar. 1-4—Battle of Bismarck Sea.

1943, Mar. 19—Lt. Gen. Henry H. Arnold, commanding general of the AAF, advanced to full four-star general, the first in air history.

1943, June 24—World's longest parachute drop, 40,200 ft., made by Lt. Col. W. R. Loveless at Ephrata, Wash.

1943, June 11—First ground victory by air power when Pantelleria, Italy, surrenders unconditionally to Lt. Gen. Carl Spaatz. First case in history of a well-fortified citadel being defeated without aid of ground forces.

1943, Oct.—World's longest freight line opened by Capt. J. L. Okenfus and crew of five in 28,000-mile round-trip flight, Ohio to India.

1944, June—Army Air Force reaches peak with 78,757 aircraft.

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.

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- 1945, May 8—War in Europe ends.
- 1945, Aug. 6—Atomic bomb dropped on Hiroshima from B-29, *Enola Gay*, under command of Col. Paul W. Tibbets, Jr.
- 1945, Aug. 14—Japan's surrender ends World War II.
- 1945, Oct. 3—Ensign Jake C. West of Navy VF-66 Squadron makes first jet landing aboard an aircraft carrier.
- 1945, Sept. 28-Oct. 4—Round-the-world air service begun by Air Transport Command, Douglas C-54E, Globester, 9 passengers, 23,147 miles in 149 hr., 49 min.
- 1946, Jan. 26—Jet-propelled P-80, flown by Col. William H. Council, sets non-stop transcontinental record of 4 hr., 13 min., 26 sec., between Long Beach, Cal., and New York.
- 1946, Mar. 12—First commercial helicopter license granted by Civil Aeronautics Administration for Bell 2-place Model 47.
- 1946, Mar. 22—First American-built rocket to escape earth's atmosphere, reaches 50-mile height. Constructed by Douglas.
- 1946, July 21—The McDonnell XFH-1 Phantom is first U.S. jet to operate from carrier, U.S.S. *Franklin D. Roosevelt*.
- 1946, Aug. 6—Two B-17 radio-controlled bombers with stand-by crews, fly non-stop, Hilo, Hawaii, to Muroc Lake, Cal.
- 1947, Feb. 28—Lt. Col. Robt. E. Thacker and Lt. John M. Ard, in a North American F-82 (Rolls Royce V-1650) fly longest known flight by fighter aircraft, Honolulu to N. Y., 4,968 miles in 14 hr. 31 min. 50 sec.
- 1947, July 18—Air Policy Commission established by President.
- 1947, July 26—Army-Navy Merger Bill signed by President, making Department of Air Forces co-equal with Army and Navy, and creating Department of Defense.
- 1947, Oct. 17—First faster-than-sound flight by Capt. Charles E. Yeager in rocket-powered Air Force research plane, Bell XS-1, better 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, Sept. 15—U. S. Air Force recaptures world speed record with North American F-86 jet fighter traveling 670.981 mph, flown by Maj. Richard L. Johnson.
- 1948—Northrop's YB-49 Flying Wing, first eight-jet bomber in the U.S. Air Force, makes longest jet-propelled flight on record of approximately 3,400 miles at average speed of 382 mph.
- 1949, Jan. 7—Air Force announces a new unofficial climbing speed record set by the Bell X-1 at Muroc Air Force Base with Capt. Charles E. Yeager at the controls, climbing more than 13,000 ft. per min., compared with 8-10,000 ft. per min. for jet planes.
- 1949, Jan. 14—Capt. William Odom, flying a specially modified Beechcraft Bonanza, sets a new lightplane distance record, crossing from Honolulu to Oakland, Ca'
- 1949, Feb. 7—Eastern Air Lines reports new transcontinental speed record for transport aircraft set Feb. 5 by new-type Lockheed Constellation on delivery flight from Los Angeles to La Guardia Field in 6 hr. 17 min. 39-2/5 sec.
- 1949, Feb. 8—Boeing XB-47 jet bomber sets cross-country speed record to Andrews Field, Washington, D. C. from Meese Lake, Wash. in 3 hr. 46 min.
- 1949, Mar. 2—Air Force completes the first nonstop round-the-world flight in history, as a Boeing B-50 bomber, *Lucky Lady II*, lands at Carswell AFB, Ft. Worth, Tex. at 9:30 CST, after a 94-hour trip; piloted by Capt. James Gallagher, assisted by a crew of 13, the B-50 flew a total of 23,452 miles at an average speed of 249 mph. Four refueling contacts were made with B-29 tankers.
- 1949, Mar. 8—New world distance record for light planes set by Capt. William Odom in a Beechcraft Bonanza, flying 5,273 miles from Honolulu to Teterboro, N. J., in 36 hr. 2 min.
- 1949, May 3—The Martin Viking, 45-ft. research rocket, is fired successfully at White Sands Proving Ground, Las Cruces, N. M., reaching an altitude of 51½ miles and a speed of 2,250 mph.
- 1949, May 6—Sikorsky S-53-I helicopter sets new international speed record of 122.75 mph.
- 1949, Oct. 3—Navy jet-rocket special research plane, the Douglas D-558-II Skyrocket, reaches a top speed of slightly over 700 mph at an altitude of 25,000 ft. in test flight at Muroc, Cal.
- 1950, Jan. 3—Jacqueline Cochran sets new official F.A.I. 500 kilometer closed course record flying a North American F-51 (Packard-built Merlin V1650) at 444 mph.
- 1950, Jan. 22—Paul Mantz sets new transcontinental record flying a North American P-51 Mustang (Allison) from Burbank, Calif. to La Guardia Field, N. Y. in 4 hr. 52 min. 58 sec.
- 1950, Feb. 9—Navy Lockheed P2V Neptune (Wright 3350) patrol bomber completes 5,156 mile flight in 25 hr. 57 min.
- 1950, Mar. 31—Ann Louise Branger, flying a Piper Cub Special powered by a Continental C-90-BF engine, sets official new lightplane international altitude record of 24,504 feet.
- 1950, Sept. 5—North American Aviation announces successful completion of tests at Edwards AFB in which heavy bombs were dropped for first time at speeds over 500 mph with a B-45 Tornado (GEJ47).
- 1950, Sept. 23—Col. David C. Schilling and Lt. Col. William D. Ritchie fly London-New York nonstop 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, Nov. 10—A Lockheed F-80 shoots down a Russian-built MIG-15 in first jet aerial combat, Korea.
- 1951, Jan. 17—Convair RB-36D reconnaissance bomber makes 51 hr. 20 min. non-stop flight without refueling.
- 1951, Feb. 2—First successful air-to-air refueling of a U.S. jet bomber is carried out by a North American RB-45C Tornado and a Boeing KB-29P tanker at Edwards AFB, Calif.

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1951, Apr. 24—Piper Super Cub, piloted by Mrs. Ana Louisa Branger, sets an international altitude record of 26,820 feet in the minus 1,103-pound category.

1951, May 15—Max Conrad sets non-stop lightplane record in Piper Pacer (125 hp Lycoming), crossing the country in 23 hr. 4 min. 31 sec.

1951, Aug. 8—Navy's Martin Viking VII sets new altitude record for single stage missiles, flying 135 miles up from White Sands Proving Ground, N. M., reaching a top speed of 4,100 mph.

1951, Aug. 18—North American F-86A Sabre jet, piloted by Col. Keith K. Compton, flies from Edwards AFB, Calif., to Detroit, Mich., in 3 hr. 27 min. 56 sec. at an average speed of 553.761 mph.

1952, Jan. 2—A Sikorsky H-19 helicopter completes 1,800-mile flight from Great Falls, Mont., to Ladd AFB, Fairbanks, Alaska, in five days—probably the longest flight ever made by rotary wing craft.

1952, Mar. 18—Two Republic F-84 Thunderjets land in Neubiberg, Germany, after a 2,806 mile flight without refueling—believed to be the longest sustained jet fighter flight in history. The jets crossed seven countries, averaged 585 mph, and were in the air 4 hr. 48 min.

1952, Apr. 30—For the first time in aviation history, air passenger-miles (10,679,281,000) in 1951 exceeded the total passenger-miles traveled in Pullman cars (10,224,714,000).

1952, May 10—Transcontinental lightplane record is set by Max Conrad in a Piper Pacer, traveling from Los Angeles to New York (2,461 mi.) non-stop in 24 hr. 54 min.

1952, Aug. 1—Two Sikorsky H-19 helicopters complete first trans-Atlantic helicopter crossing and break non-stop distance record for rotary wing aircraft.

1952, Nov. 19—New record set by North American F-86D (GE J-47 GE-17) Sabre jet, piloted by Capt. J. Slade Nash, flying at 699.92 mph. (Previous world speed record—670.981 mph.)

1953, Jan. 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 Odium flies at record speed of 652.337 mph over a 100 km. course, in a Canadair F-86 swept-wing Sabre.

1953, Oct. 3—LCdr. James B. Verdin establishes new world speed record of 753.4 mph in Douglas XF4D-1 Skyray, Navy carrier fighter.

1953, Oct. 20—TWA Lockheed Super Constellation completes first scheduled nonstop transcontinental passenger trip from Los Angeles to New York in 8 hr. 17 min.

1953, Oct. 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, Dec. 12—Maj. Charles E. Yeager, USAF pilot, establishes new world speed record of more than 1600 mph in the Bell X-1A.

1954, Jan. 5—Air National Guard Col. Willard W. Millikan sets New York-Washington speed mark of 24 minutes in North American F-86F.

1954, Mar. 1—Peak is reached in number of U.S. airports: 6,760.

1954, Mar. 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, Aug. 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.

1955, Feb. 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, Mar. 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, Aug. 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, Aug. 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, Aug. 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, Oct. 15—Douglas A4D Skyhawk sets a new closed course world speed record of 695.163 mph.

## A CHRONOLOGY OF U. S. AVIATION

1956, Apr. 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, Aug. 10—McDonnell XV-1 convertiplane sets unofficial speed record for helicopters of 200 mph.

1956, Aug. 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, Sept. 5—Chance Vought F8U-1 captures Thompson Trophy for Navy by flying 1015.428 mph to establish new national speed record.

1956, Oct. 11—NACA discloses that four-stage research rockets, fired in connection with development of the ICBM and the North American X-15, hav hit speeds of 6864 mph or Mach 10.4.

1955, Nov. 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, Nov. 13—North American F-107 reaches Mach 2 speed in flights at Edwards Air Force Base, Calif.

1956, Nov. 27—Eight B-52's break the jet bomber's record by staying aloft an estimated 32½ hours, covering 17,000 miles.

Vertol H-21C sets distance record in August





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## Globe Aerostatique...1783

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The Federation Aeronautique Internationale, Paris, France, better known as the FAI, currently composed of the national aero clubs of fifty nations, is the governing body of the world for official aircraft records and sporting aviation contests. The FAI was organized in Paris in October, 1905, by representatives from Belgium, France, Germany, Great Britain, Italy, Spain, Switzerland, and the United States. Representing the FAI in the United States is the National Aeronautic Association, organized in 1922.

The rules for all official world and international aircraft records are proposed initially by the various national aero clubs who are members of FAI. Later they are evaluated by the International Sporting Aviation Commission of FAI and then submitted, for final approval, to the delegates of the many national aero clubs who attend each annual FAI conference. Developed over a period of forty-five years, the rules are markedly complete. All attempts to establish official aircraft records must meet identical FAI standards.

NAA also rules on the best national performances and on many records of strictly national interest, such as inter-city speed times of transport aircraft.

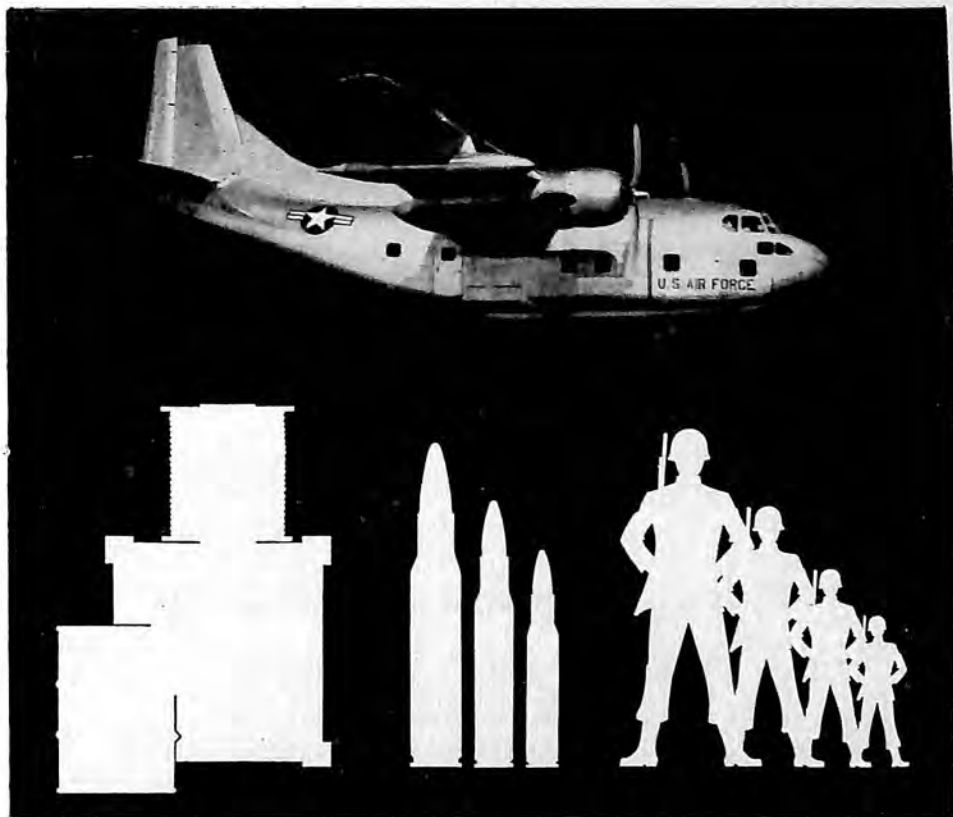
FAI-NAA rules have these goals: (1) an equal opportunity to every competitor, (2) competent, unbiased judging, and (3) scientifically accurate recording.

The NAA Contest Board enforces FAI-NAA regulations in the United States.

### OFFICIAL F.A.I. WORLD AIR RECORDS

Note: International Records are now designated World Class Records by F.A.I.

MAXIMUM SPEED OVER A STRAIGHTAWAY COURSE .....	1132.136 mph.
L. P. Twiss, Great Britain, March 10, 1936, Fairey Delta 2 Aircraft.	
MAXIMUM SPEED IN A CLOSED CIRCUIT .....	728.114 mph.
Robert O. Rahn, Oct. 16, 1953, Douglas XF4D Delta Wing Monoplane.	
DISTANCE IN A STRAIGHT LINE .....	11,235.600 mi.
Comdr. Thomas D. Davies, USN.; Comdr. Eugene P. Rankin, USN.; Comdr. Walter S. Reid, USN.; Lt. Comdr. Ray A. Tabeling, USN.; United States, Sept. 29 - Oct. 1, 1946, Lockheed P2-V Neptune.	
DISTANCE IN CLOSED CIRCUIT .....	8,854.308 mi.
Lt. Col O. F. Lassiter, pilot; Capt. W. J. Valentine, co-pilot and USAF crew, Tampa, Fla., Aug. 1-3, 1947, Boeing B-29 monoplane.	
ALTITUDE .....	72,395 ft.
Capt. Orvil Anderson and Capt. Albert Stevens, United States, Nov. 11, 1935, free balloon, the "Explorer II."	



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AIRPLANES—(Class C) Group II

RECIPROCATING ENGINES

DISTANCE, CLOSED CIRCUIT

World Class Record	8,854.308 mi.
Lt. Col. O. F. Lassiter, pilot; Capt. W. J. Valentine, co-pilot; Capt. William D. Bailey, Capt. F. O. Hinckley, 1st Lt. A. J. Orillon, 1st Lt. R. L. Lewis, M/Sgt. J. J. Blancio, T/Sgt. J. R. Sanders, S/Sgt. J. Gauthier, and M/Sgt. R. B. Corey, crew; USAAF, United States, Boeing B-29 monoplane, 44-84061, 4 Wright 3350-57A engines of 2,200 hp each, MacDill Field, Tampa, Fla., Aug. 1 - 3, 1947.	
National (U.S.) Record	Same as above.

DISTANCE IN A STRAIGHT LINE

World Class Record	11,235.600 mi.
Comdr. Thomas D. Davies, USN.; Comdr. Eugene P. Rankin, USN.; Comdr. Walter S. Reid, USN.; and Lt. Comdr. Ray A. Tabeling, USN; United States, Lockheed P2V-1 monoplane, 2 Wright R-3500 engines of 2,300 hp each, from Pearce Field, Perth, Australia, to Port Columbus, Columbus, O., Sept. 29 - Oct. 1, 1946.	
National (U.S.) Record	Same as above.

ALTITUDE

World Class Record	56,046 ft.
Mario Pezi, Italy, Caproni 161 biplane, Piaggio XI R.C. engine, Montecelio, Oct. 22, 1938.	
National (U.S.) Record	47,910 ft
Maj. F. F. Ross, pilot; Lt. D. M. Davis, co-pilot; Lt. C. B. Webster, Lt. L. B. Barrier, F/O Pamphile Morrisette, Sgt. W. S. George, crew; USAAF, Boeing B-29 monoplane, 4 Wright R-3350-23 A 2,000 hp engines, Harmon Field, Guam, M. I., May 15, 1946.	

MAXIMUM SPEED OVER A 1.86 MI. MEASURED COURSE

World Class Record	469.220 mph.
Fritz Wendel, Germany, Messerschmitt B. F. 109R, Daimler Benz 601 1,000 hp engine, Augsburg, Apr. 26, 1939.	
National (U.S.) Record	412.002 mph.
Jacqueline Cochran, North American F-51 monoplane, Packard built Rolls Royce Merlin 1,450 hp engine, Thermal, Cal., Dec. 17, 1947.	

MAXIMUM SPEED AT HIGH ALTITUDE

World Class Record	464.374 mph.
Jacqueline Cochran, United States, North American F-51 low wing monoplane, Packard built Rolls Royce Merlin 1,450 hp engine, near Indio, Cal., Apr. 9, 1951.	
National (U.S.) Record	Same as above.

SPEED FOR 62.137 MI. WITHOUT PAYLOAD

World Class Record	469.549 mph.
Jacqueline Cochran, United States, North American F-51, Rolls Royce Merlin 1,450 hp engine. Coachella Valley, Calif., Dec. 10, 1947.	
National (U.S.) Record	Same as above.

SPEED FOR 310.685 MI. WITHOUT PAYLOAD

World Class Record	436.995 mph.
Jacqueline Cochran, United States, North American F-51, Packard Rolls Royce Merlin 1,450 hp engine, Desert Center—Mt. Wilson Course, Dec. 29, 1949.	
National (U.S.) Record	Same as above.

SPEED FOR 621.369 MI. WITHOUT PAYLOAD

World Class Record	431.094 mph
Jacqueline Cochran, United States, North American F-51, Packard Rolls Royce Merlin 1,450 hp engine. Start and finish near Palm Springs, Cal., May 24, 1948.	
National (U.S.) Record	Same as above.



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### SPEED FOR 1,242.739 MI. WITHOUT PAYLOAD

World Class Record	447.470 mpt
Jacqueline Cochran, United States, North American P-51 monoplane, Packard built Rolls Royce Merlin Engine of 1,450 hp near Palm Springs, Cal., May 22, 1948.	
National (U.S.) Record	Same as above

### SPEED FOR 3,106.849 MI. WITHOUT PAYLOAD

World Class Record	338.392 mph
Capt. J. E. Bauer, pilot; Capt. J. E. Cotton, co-pilot; M/Sgt. Angelo Queses, T/Sgt. Richard McDonald and Cpl. Raymon Koss, crew; USAAF, United States, Boeing B-29 monoplane, 4 Wright R-3350-23A engines of 2,200 hp each, Dayton, O., June 28, 1946.	
National (U.S.) Record	Same as above

### SPEED FOR 6,213.698 MI. WITHOUT PAYLOAD

World Class Record	273.195 mph
Lt. Col. O. F. Lassiter, pilot; Capt. W. J. Valentine, co-pilot; Capt. William D. Bailey; Capt. F. O. Hinckley, 1st Lt. A. J. Orillon, 1st Lt. R. L. Lewis, M/Sgt. J. J. Blancio, T/Sgt. J. R. Sanders, S/Sgt. J. Gauthier, S/Sgt. R. B. Corey, crew; USAAF, United States, Boeing B-29 monoplane, 4 Wright R-3350-57A engines, 2,200 hp each, Wright Field, Dayton, O., July 29 - 30, 1947.	
National (U.S.) Record	Same as above

### WITH PAYLOAD OF 2,204.622 LB.

#### ALTITUDE

World Class Record	47,910 ft
Maj. F. F. Ross, pilot; Lt. D. M. Davis, co-pilot; Lt. I. B. Barrier, Lt. C. B. Webster, F/O Pamphille Morrissette and Sgt. W. S. George, crew; USAAF, United States, Boeing B-29 monoplane, 4 Wright 2,000 hp engines, Harmon Field, Guam, M.I., May 15, 1946.	
National (U.S.) Record	Same as above.

### SPEED FOR 621.369 MI.

World Class Record	325.713 mph.
Furio Nicolot, Italy, Breda 88, 2 Piaggio XI R. C. 40B, 1,000 hp engines, Dec. 9, 1937.	
National (U.S.) Record	259.398 mph.
Capt. C. S. Irvine and Capt. P. H. Robey, USAAC pilots; Capt. C. J. Crane and Lt. P. G. Miller, USAAC, Boeing YB-17A monoplane, 4 Wright 840 hp engines, Dayton, O., Aug. 1, 1939.	

### SPEED FOR 1,242.739 MI.

World Class Record	365.649 mph.
Lt. E. M. Grabowski, pilot; Lt. J. J. Liset, co-pilot; M/Sgt. D. P. Kelly, Cpl. F. M. Polmotier, and Cpl. O. W. Lambert, crew; USAAF, United States, Boeing B-29 monoplane, 4 Wright 2,200 hp engines, Dayton, O., May 17, 1946.	
National (U.S.) Record	Same as above.

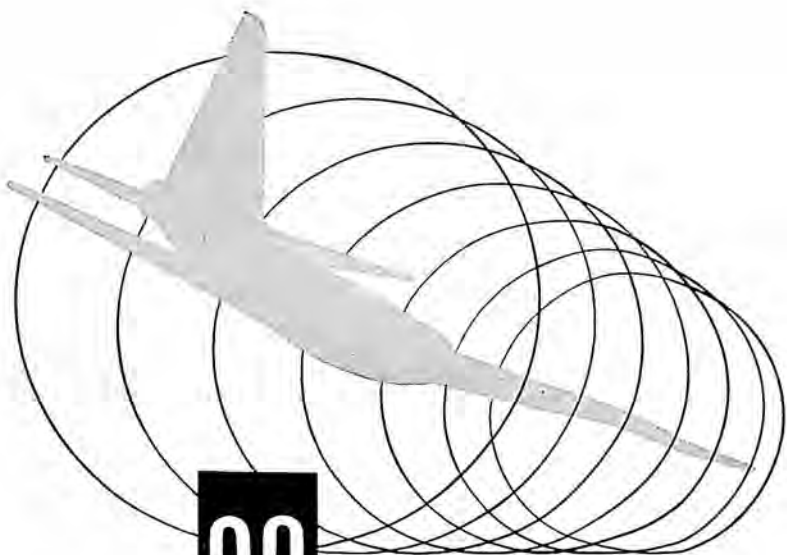
### SPEED FOR 3,106.849 MI.

World Class Record	338.392 mph.
Capt. J. E. Bauer, pilot; Capt. J. E. Cotton, co-pilot; M/Sgt. Angelo Queses, T/Sgt. Richard McDonald and Cpl. Raymon Koss, crew; USAAF, United States, Boeing B-29 monoplane, 4 Wright R-3350-23A engines of 2,200 hp each, Dayton, O., June 28, 1946.	
National (U.S.) Record	Same as above.

### WITH PAYLOAD OF 4,409.244 LB.

#### ALTITUDE

World Class Record	46,522 ft.
Col. E. D. Reynolds, pilot; Capt. B. P. Robson, co-pilot; Lt. J. G. Barnes, Lt. Theodore Madden, Lt. K. H. Morehouse, S/Sgt W. C. Flynn and Cpl. A. L. Lentowski, crew; USAAF, United States, Boeing B-29 monoplane, 4 Wright 2,000 hp engines, Harmon Field, Guam, M.I., May 13, 1946.	
National (U.S.) Record	Same as above.



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## The AIRCRAFT YEAR BOOK

### SPEED FOR 621,369 MI.

World Class Record.....	369,692 mph.
Lt. E. M. Grabowski, pilot; Lt. J. J. Liset, co-pilot; M/Sgt. D. P. Kelly, Cpl. F. M. Polmotier, and Cpl. O. W. Lambert, crew; USAAF, United States, Boeing B-29 monoplane, 4 Wright 2,200 hp engines, Dayton, O., May 17, 1946.	
National (U.S.) Record.....	Same as above.

### SPEED FOR 1,242,739 MI.

World Class Record.....	365,649 mph.
Lt. E. M. Grabowski, pilot; Lt. J. J. Liset, co-pilot; M/Sgt. D. P. Kelly, Cpl. F. M. Polmotier, and Cpl. O. W. Lambert, crew; USAAF, United States, Boeing B-29 monoplane, 4 Wright 2,200 hp engines, Dayton, O., May 17, 1946.	
National (U.S.) Record.....	Same as above.

### SPEED FOR 3,106,849 MI.

World Class Record.....	338,392 mph.
Capt. J. E. Bauer, pilot; Capt. J. F. Cotton, co-pilot; M/Sgt. Angelo Queses, T/Sgt. Richard McDonald and Cpl. Raymon Koss, crew; USAAF, United States, Boeing B-29 monoplane, 4 Wright 2,200 hp engines, Dayton, O., June 28, 1946.	
National (U.S.) Record.....	Same as above.

### WITH PAYLOAD OF 11,023 LB.

#### ALTITUDE

World Class Record.....	45,253 ft.
Lt. J. P. Tobinson, pilot; Lt. Lloyd A. Lee, co-pilot; Lt. D. B. Gleicher, Lt. A. W. Armistead, Lt. R. M. Beattie, Lt. F. J. Royce, F/O R. F. Johnson and Mario R. Genta, crew; USAAF, United States, Boeing B-29 monoplane, 4 Wright 2,000 hp engines, Harmon Field, Guam, M.I., May 14, 1946.	
National (U.S.) Record.....	Same as above.

### SPEED FOR 621,369 MI.

World Class Record.....	369,692 mph.
Lt. E. M. Grabowski, pilot; Lt. J. J. Liset, co-pilot; M/Sgt. D. P. Kelly, Cpl. F. M. Polmotier, and Cpl. O. W. Lambert, crew; USAAF, United States, Boeing B-29 monoplane, 4 Wright 2,200 hp engines, Dayton, O., May 17, 1946.	
National (U.S.) Record.....	Same as above.

### SPEED FOR 1,242,739 MI.

World Class Record.....	365,649 mph.
Lt. E. M. Grabowski, pilot; Lt. J. J. Liset, co-pilot; M/Sgt. D. P. Kelly, Cpl. F. M. Polmotier, and Cpl. O. W. Lambert, crew; USAAF, United States, Boeing B-29 monoplane, 4 Wright 2,200 hp engines, Dayton, O., May 17, 1946.	
National (U.S.) Record.....	Same as above.

### SPEED FOR 3,106,849 MI.

World Class Record.....	266,023 mph.
Lt. Col. R. G. Ruegg, pilot; Lt. Col. Carl P. Walter, co-pilot; 2nd Lt. J. E. Wetzel, M/Sgt. William Cunningham and M/Sgt. R. L. Hilton, crew; USAAF, United States, Boeing B-29 monoplane, 4 Wright 2,200 hp engines, Dayton, O., June 21, 1946.	
National (U.S.) Record.....	Same as above.

### WITH PAYLOAD OF 22,046 LB.

#### ALTITUDE

World Class Record.....	41,562 ft.
Capt. A. A. Pearson, pilot; Lt. V. L. Dalbey, co-pilot; Lt. R. S. Strasburg, Lt. I. E. Bork, Cpl. J. T. Collins and Cpl. Joseph Friedberg, crew; USAAF, United States, Boeing B-29 monoplane, 4 Wright 2,200 hp engines, Harmon Field, Guam, M.I., May 8, 1946.	
National (U.S.) Record.....	Same as above.

### SPEED FOR 621,369 MI.

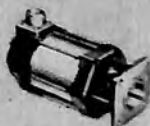
World Class Record.....	357,731 mph
Capt. J. D. Bartlett, pilot; Lt. William Murray, co-pilot; M/Sgt. C. M. Youngblood, Cpl. D. I. Shrader and Cpl. R. F. Wilden, crew; USAAF, United States, Boeing B-29 monoplane, 4 Wright 2,200 hp engines, Dayton, O., May 19, 1946.	
National (U.S.) Record.....	Same as above.



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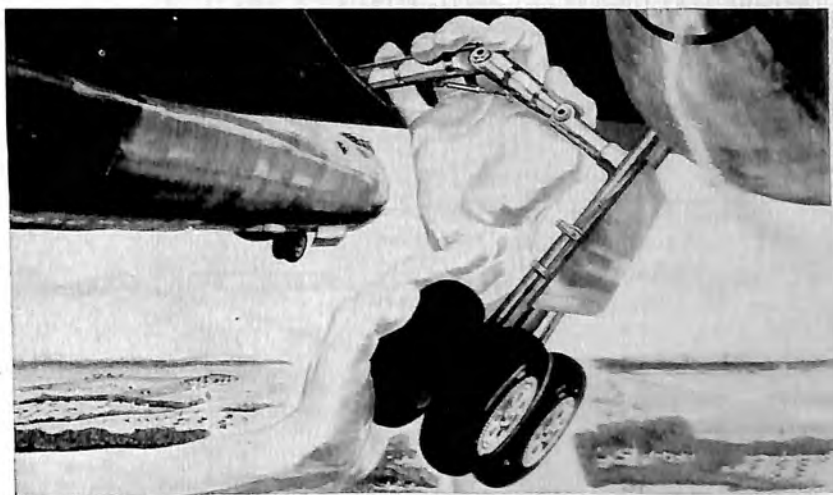
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<b>SPEED FOR 1,242,739 MI.</b>	
World Class Record	357.035 mph.
Capt. J. D. Bartlett, pilot; Lt. William Murray, co-pilot; M/Sgt. C. M. Youngblood, Cpl. D. J. Shrader and Cpl. R. F. Wilden, crew; USAAF, United States, Boeing B-29 monoplane, 4 Wright 2,200 hp engines, Dayton, O., May 19, 1946.	
National (U.S.) Record	Same as above
<b>SPEED FOR 3,106,849 MI.</b>	
World Class Record	266.023 mph.
Lt. Col. R. G. Ruegg, pilot; Lt. Col. Carl P. Walter, co-pilot; 2nd Lt. J. E. Wetzel, M/Sgt. William Cunningham and M/Sgt. R. L. Hilton, crew; USAAF, United States, Boeing B-29 monoplane, 4 Wright 2,200 hp engines, Dayton, O., June 21, 1946.	
National (U.S.) Record	Same as above
<b>WITH PAYLOAD OF 33,069 LB.</b>	
<b>ALTITUDE</b>	
World Class Record	39,521 ft.
Col. B. H. Warren, pilot; Maj. J. R. Dale, Jr., co-pilot; Lt. W. D. Collier, M/Sgt. Gordon S. Fish, S/Sgt. V. H. Worden and Sgt. Thomas H. Hall, crew; USAAF, United States, Boeing B-29 monoplane, 4 Wright 2,200 hp engines, Harmon Field, Guam, M.I., May 11, 1946.	
National (U.S.) Record	Same as above
SPEED FOR 621,369 MI.	No official record
SPEED FOR 1,242,739 MI.	No official record
SPEED FOR 3,106,849 MI.	No official record
<b>GREATEST PAYLOAD CARRIED TO AN ALTITUDE OF 6,561,660 FT.</b>	
World Class Record	33,435 lb
Col. B. H. Warren, pilot; Maj. J. R. Dale, Jr., co-pilot; Lt. W. D. Collier, M/Sgt. Gordon S. Fish, S/Sgt. V. H. Worden and Sgt. Thomas H. Hall, crew; USAAF, United States, Boeing B-29 monoplane, 4 Wright 2,200 hp engines, Harmon Field, Guam, M.I., May 11, 1946.	
National (U.S.) Record	Same as above.
CIRCUIT OF THE WORLD	No official record

**AIRPLANES—(Class C) Group I  
JET ENGINES**

<b>DISTANCE IN A CLOSED CIRCUIT WITHOUT REFUELING</b>	
World Class Record	1,143.134 mi.
Miss Elisabeth Boselli, France, Mistral aircraft, Hispano-Suiza "Nene" 104 c. jet engine, Mont de Marsan-Oran-Mont de Marsan Course, February 21, 1955.	
National (U.S.) Record	None established.
<b>DISTANCE IN A STRAIGHT LINE WITHOUT REFUELING</b>	
World Class Record	1,448.550 mi.
Miss Elisabeth Boselli, France, Mistral aircraft, Hispano-Suiza "Nene" 104 c. jet engine, from Creil to Agadir, March 1, 1955.	
National (U.S.) Record	None established.
<b>ALTITUDE WITHOUT PAYLOAD</b>	
World Class Record	20,083 meters (65,889 ft.)
Walter F. Gibb, Great Britain, English Electric Canberra B. Mark II aircraft, 2 Bristol Olympus Mark 102 jet engines, Filton Aerodrome, Bristol, August 29, 1955.	
National (U.S.) Record	47,169 ft.
Miss Jacqueline Cochran, Canadian-built F-86E swept-wing monoplane, Orenda jet engine, Edwards, Cal., May 24, 1953.	
<b>MAXIMUM SPEED OVER A 1.8 MI. STRAIGHTAWAY COURSE</b>	
World Class Record	752.943 mph.
Lt. Comdr. James B. Verdin, USN, United States, Douglas XF4D delta wing aircraft, Westinghouse J-40-WE-8 jet engine, Salton Sea, Cal., Oct. 3, 1953.	
National (U.S.) Record	Same as above.
<b>MAXIMUM SPEED OVER A MEASURED STRAIGHTAWAY COURSE (15.25 KM.)</b>	
World Class Record	Speed, 1,822 kmph (1,132.136 mph)
L. P. Twiss, D.S.C., Great Britain, Fairey Delta 2 aircraft, Rolls Royce "Avon" jet engine with afterburner, Ford-Chichester, March 10, 1956.	
National (U.S.) Record	Speed, 1,634.176 kmph (1,015.428 mph)
Comdr. R. W. Windsor, USN, Chance-Vought F8U-1, P&W J-57-P-4 engine, China Lake, Cal., Aug. 21, 1926.	
<b>SPED FOR 62.137 MI. WITHOUT PAYLOAD</b>	
World Class Record	728.114 mph.
Robert O. Rahn, United States, Douglas XF4D delta wing aircraft, Westinghouse J-40-WE-8 jet engine, Edwards, Cal., Oct. 16, 1953.	



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### SPEED FOR 500 KM. IN A CLOSED CIRCUIT WITHOUT PAYLOAD

World Class Record ..... Speed, 1,118.700 kmph (695.127 mph)  
 Lt. Gordon Larimore Gray, Jr., USN, United States, Douglas A4D-1  
 Skyhawk, Wright J-65 W-4 jet engine, Edwards, Cal., Oct. 15, 1955.  
 National (U.S.) Record ..... Same as above

### SPEED FOR 1,000 KM IN A CLOSED CIRCUIT WITHOUT PAYLOAD

World Class Record ..... Speed, 900.660 kmph (559.643 mph)  
 Capt. A. Hans M. Neij, Sweden, SAAB S.29 Monoplane, de Havilland "Ghost" jet engine, Nykoping-Natra-Nykoping Course, March 23, 1955.  
 National (U.S.) Record ..... Speed, 745.079 kmph (462.970 mph)  
 1st Lt. Henry A. Johnson, USAF, United States, P-80 jet propelled monoplane, Allison J-33 engine, Dayton, Ohio, June 3, 1946.

### SPEED FOR 1,242.739 MI. WITHOUT PAYLOAD

World Class Record ..... 440.298 mph.  
 Lt. John Hancock, USAAF, United States, Lockheed P-80 monoplane, Allison J-33 jet engine, Dayton, O., May 19, 1946.  
 National (U.S.) Record ..... Same as above.

SPEED FOR 3,106.849 MI. WITHOUT PAYLOAD ..... No official record.

SPEED FOR 6,213.698 MI. WITHOUT PAYLOAD ..... No official record.

### CLIMB TO 9,842.5 FT.

World Class Record ..... 1 min., 15.5 sec  
 Richard Bellingham, Great Britain, Gloster Meteor Mark 8 W.A. 820, two Armstrong Siddeley Sapphire Mark 2 jet engines, Moreton Valence airport, Gloucestershire, Aug. 31, 1951.  
 National (U.S.) Record ..... No official record

### CLIMB TO 19,685 FT.

World Class Record ..... 1 min., 50.0 sec  
 Richard Bellingham, Great Britain, Gloster Meteor Mark 8 W.A. 820, two Armstrong Siddeley Sapphire Mark 2 jet engines, Moreton Valence airport, Gloucestershire, Aug. 31, 1951.  
 National (U.S.) Record ..... No official record

### CLIMB TO 29,527.5 FT.

World Class Record ..... 2 min., 27.0 sec  
 Richard Bellingham, Great Britain, Gloster Meteor Mark 8 W.A. 820, two Armstrong Siddeley Sapphire Mark 2 jet engines, Moreton Valence airport, Gloucestershire, Aug. 31, 1951.  
 National (U.S.) Record ..... No official record.

### CLIMB TO 39,370 FT.

World Class Record ..... 3 min., 09.5 sec.  
 Richard Bellingham, Great Britain, Gloster Meteor Mark 8 W.A. 820, two Armstrong Siddeley Sapphire Mark 2 jet engines, Moreton Valence airport, Gloucestershire, Aug. 31, 1951.  
 National (U.S.) Record ..... No official record.

### WITH PAYLOAD OF 2,204.622 LB.

ALTITUDE ..... No official record.

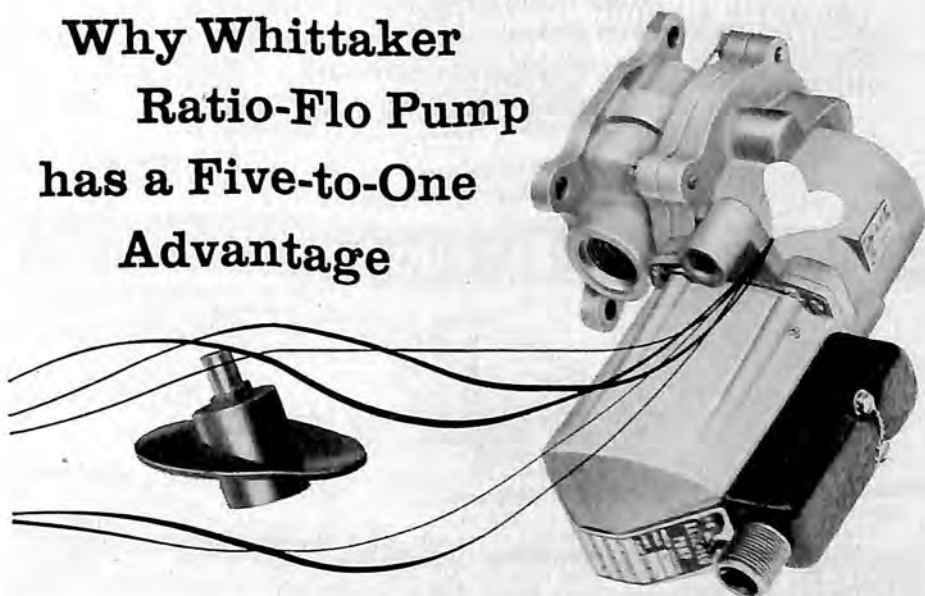
### SPEED FOR 621.369 MI.

World Class Record ..... 410.431 mph.  
 Lt. Col. T. P. Gerrity, pilot; Capt. Wm. Rickert, co-pilot, USAAF, United States, Douglas XA-26F monoplane, 2 Pratt and Whitney R-2800, 2,000 hp and 1 General Electric I-16 jet engine, Dayton, O., June 20, 1946.  
 National (U.S.) Record ..... Same as above

SPEED FOR 1,242.739 MI. .... No official record.

SPEED FOR 3,106.849 MI. .... No official record

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## The AIRCRAFT YEAR BOOK

### LIGHT AIRPLANES—(Class C-1.a)

#### FIRST CATEGORY (AIRCRAFT WEIGHING LESS THAN 1,102.3 LB., IN FLYING ORDER)

##### DISTANCE IN A CLOSED CIRCUIT, WITHOUT REFUELING

World Class Record	1,242.74 mi.
Albert Revillon, France, Minicab, Type G-Y 20, Continental 65 hp engine; gross weight 499.5 kilograms, Toussus-le-Noble-Tour-Bourges course, May 10, 1952.	
National (U.S.) Record	No official record.

##### DISTANCE IN A STRAIGHT LINE WITHOUT REFUELING

World Class Record	2,632.5 kilometers (1,635.756 mi.)
Peder IB Riborg Andersen, Denmark, Topsy B Belfair aircraft, Walter Mikron II 60 hp engine, from Chievres, Belgium, to Sidi Ifni, Spanish Morocco, Aug. 3-4, 1955.	
National (U.S.) Record	2,191.102 kilometers (1,361.485 mi.)
Robert C. Faris, Mooney M-18-1 Low Wing Monoplane, Lycoming 65 hp engine; gross weight 476.73 kilograms, Wichita, Kansas, to Montpelier, Vermont, August 9, 1952.	

##### ALTITUDE

World Class Record	27,152 ft.
Mrs. Ana L. Branger, Venezuela, Piper Super Cub, Model PA-18, Lycoming 0-290-D 125 hp engine, Hybla Valley Airport, Alexandria, Va., Apr. 10, 1951.	
National (U.S.) Record	No official record.

##### SPEED FOR 62.137 MI. IN A CLOSED CIRCUIT

World Class Record	171.097 mph.
Iginio Guagnellini, Italy, Ambrosini C-F.4 "Rondone" airplane, Continental 90 hp engine, gross weight 499.7 kilograms, Sesona-(Vergiate)-Cameri-Seveso-S. Pietro course, November 20, 1954.	
National (U.S.) Record	No official record.

##### SPEED FOR 310.685 MI. IN A CLOSED CIRCUIT

World Class Record	168.642 mph.
Iginio Guagnellini, Italy, Ambrosini C-F.4 "Rondone" Airplane, Continental 90 hp engine, gross weight 499.7 kilograms, Sesona-(Vergiate)-Cameri-Seveso-S. Pietro course, November 20, 1954.	
National (U.S.) Record	No official record.

##### SPEED FOR 621.369 MI. IN A CLOSED CIRCUIT

World Class Record	149.451 mph.
Nello Valzania, Italy, Ambrosini G.F.4 Rondone Airplane, Continental 90 hp engine, gross weight 499.9 kilograms, Sesona-(Vergiate)-Cameri-Seveso-S. Pietro course, December 19, 1954.	
National (U.S.) Record	No official record.

##### SPEED FOR 1,242.74 MI. IN A CLOSED CIRCUIT

World Class Record	113.979 mph.
Albert Revillon, France, Minicab, Type G-Y 20, Continental 65 hp engine; gross weight 499.5 kilograms, Toussus-le-Noble-Tour-Bourges course, May 10, 1952.	
National (U.S.) Record	No official record.

### LIGHT AIRPLANES—(Class C-1.b)

#### SECOND CATEGORY (ALL AIRCRAFT WITH A TOTAL WEIGHT, IN FLYING ORDER, BETWEEN 1,102.3 AND 2,204.6 LB.)

##### DISTANCE IN A CLOSED CIRCUIT WITHOUT REFUELING

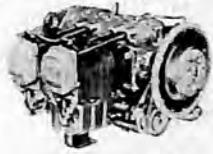
World Class Record	1,936.189 mi.
Frantisek Novak, Czechoslovakia, Sokol OK-DHH aircraft, Walter Minor engine, gross weight 870.5 kilograms, Brno-Hutsopce-Lettonice-Brno Course, June 23, 1955.	
National (U.S.) Record	No official record.

##### AIRLINE DISTANCE

World Class Record	2,462.330 mi
Maximilian A. Conrad, United States, Piper Pacer, Lycoming 0-290-D 125 hp engine; gross weight 998.4 kilograms, Los Angeles, Cal. to New York, N. Y., Apr. 30-May 1, 1952.	
National (U.S.) Record	Same as above.



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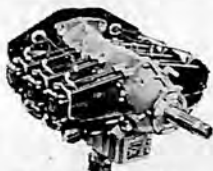


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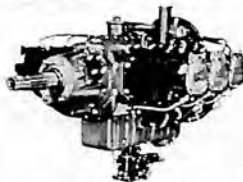


Lycoming O-435  
190 h.p.

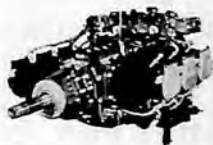


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## The AIRCRAFT YEAR BOOK

### ALTITUDE

World Class Record	37,063 ft.
William D. Thompson, Jr., United States, Cessna Turbo Prop XL-19B monoplane, Boeing 502-8 XT-50-BO-1 engine, Wichita, Kan., July 16, 1953.	
National (U.S.) Record	Same as above.
<b>SPEED FOR 62.137 MI. IN A CLOSED CIRCUIT</b>	
World Class Record	192.839 mph.
R. R. Paine, Great Britain, Miles Hawk Speed Six, de Havilland Gipsy Major 205 hp engine; gross weight 1,843 lb., at Wolverhampton, June 17, 1950.	
National (U.S.) Record	No official record.
<b>SPEED FOR 310.685 MI. IN A CLOSED CIRCUIT</b>	
World Class Record	164.231 mph.
Miss Marie Nicolas, France, Norecrin, Regnier engine; gross weight 2,082 lb., Montpellier-Frejorgues course, Dec. 5, 1951.	
National (U.S.) Record	No official record.
<b>SPEED FOR 621.369 MI. IN A CLOSED CIRCUIT</b>	
World Class Record	163.287 mph.
Miss Marie Nicolas, France, Norecrin, Regnier engine; gross weight 2,082 lb., Montpellier-Frejorgues course, Dec. 5, 1951.	
National (U.S.) Record	No official record.
<b>SPEED FOR 1,242.74 MI. IN A CLOSED CIRCUIT</b>	
World Class Record	149.650 mph.
Miss Marie Nicolas, France, Norecrin F. B.E.V.O. airplane, Regnier 4 L 00 engine Marignane-Avignon-Montpellier-Marignane Course, July 7, 1954.	
National (U.S.) Record	No official record.

### LIGHT AIRPLANES—(Class C-1.c)

#### THIRD CATEGORY (ALL AIRCRAFT WITH A TOTAL WEIGHT, IN FLYING ORDER, BETWEEN 2,204.6 AND 3,858 LB.)

### AIRLINE DISTANCE

World Class Record	4,957.240 mi.
William P. Odom, United States, Beech Bonanza Model 35 airplane, take-off weight 3,858 lb., Continental E-185-1 engine, from Honolulu, Hawaii to Teterboro, N. J., Mar. 7 - 8 (G.M.T.), 1949.	
National (U.S.) Record	Same as above.

### DISTANCE IN A CLOSED CIRCUIT

World Class Record	1,245.640 mi.
Yakov Forostenko, U.S.S.R., Yak-18 airplane, M.11-FR 160 hp engine, Touchino-Bogodoukhov-Misk-Touchino course, September 25, 1954. Gross Weight: 1,283 kilograms.	
National (U.S.) Record	No official record.

### ALTITUDE

World Class Record	20,705 ft.
Vladimir Choumilov, U.S.S.R., Yak 18 airplane, M.11 FR 160 hp engine, gross weight 1008.8 kilograms, at Klyazma, June 18, 1954.	
National (U.S.) Record	No official record.

### SPEED FOR 62.137 MI. IN A CLOSED CIRCUIT

World Class Record	260.654 mph.
Guido Ferrari, Italy, Super S-7 Ambrosini airplane, Gipsy Queen 330 hp engine, Punto X-Faro di Fiumicino-Faro di Anzio Torre Vaianica Punto X course, Dec. 5, 1953.	
National (U.S.) Record	No official record.

### SPEED FOR 310.685 MI. IN A CLOSED CIRCUIT

World Class Record	255.819 mph.
Guido Ferrari, Italy, Super S-7 Ambrosini airplane, Gipsy Queen 330 hp engine, Monte Cavo-Villa Odescalchi-Osservatorio Vesuvio-Monte Cavo course, Dec. 5, 1953.	
National (U.S.) Record	No official record.

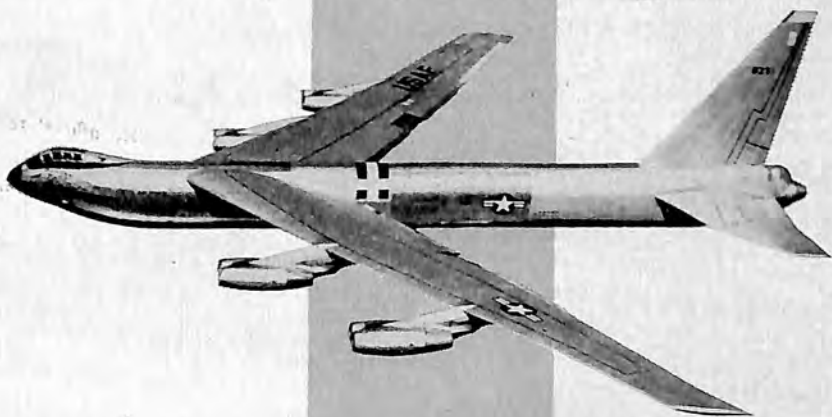
### SPEED FOR 621.369 MI. IN A CLOSED CIRCUIT

World Class Record	216.114 mph.
Leonardo Bonzi, Italy, SAI.7 Ambrosini, deHavilland Gipsy Queen 240 hp engine, gross weight, 3,197 lb., Fiumicino-Chiesa Antignano-Tauerna Pagliavone Course, Dec. 21, 1951.	
National (U.S.) Record	No official record.

### SPEED FOR 1,242.739 MI. IN A CLOSED CIRCUIT

World Class Record	158.932 mph.
Paul Burniat, Belgium, Beechcraft Bonanza, Continental 185 hp engine, gross weight 3,586 lb., Keerbergen-Ostende-Gosselies-Bierset Course, June 8, 1952.	
National (U.S.) Record	No official record.

for SAC's new B-52 Stratofortress...



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Like every Sperry flight control system developed over the past 40 years, the MA-2 system designed for SAC's intercontinental jet bomber is "tailor-made" for the job to be done.

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of many Sperry automatic flight control systems in the air today. Other Sperry systems are in use on many of the world's leading airlines, on hundreds of business planes and thousands of military aircraft. Tomorrow, new Sperry systems will be flying many of the multi-jet and turbo-prop transports now going into production.

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## The AIRCRAFT YEAR BOOK

### LIGHT AIRPLANES—(Class C-1.d)

FOURTH CATEGORY (ALL AIRCRAFT WITH A TOTAL WEIGHT, IN FLYING ORDER,  
BETWEEN 3,858.1 AND 6,613.9 LB.)

AIRLINE DISTANCE	
World Class Record	1,236.640 mi.
Ivan Tchernov, U.S.S.R., Yak-II airplane, ACH 21 650 hp engine, from Touchino Airport, Moscow to Peropavlovsk, September 11, 1954. Gross Weight: 2,382.273 kilograms.	
National (U.S.) Record	No official record.
ALTITUDE	
	No official record.
SPEED FOR 62.137 MI. IN A CLOSED CIRCUIT	
World Class Record	322.789 mph.
Miss R. M. Sharpe, Great Britain, Vickers Supermarine Spitfire 5B, gross weight 5,626 lb., Rolls Royce Merlin 55 M 1,280 hp engine, Wolverhampton, June 17, 1950.	
National (U.S.) Record	No official record.
SPEED FOR 310.685 MI. IN A CLOSED CIRCUIT	
World Class Record	292.881 mph.
Y. D. Forostenco, U.S.S.R., YAK II, A.C.H. 650 hp engine, gross weight 4,916 lb., Touchino-Skhodnia course, July 12, 1951.	
National (U.S.) Record	No official record.
SPEED FOR 621.369 MI. IN A CLOSED CIRCUIT	
World Class Record	274.825 mph.
Nicolay Golovanov, U.S.S.R., YAK II, ACH-21 engine, gross weight 5,251 lb., Skhodnia-Kourgane-Orel-Skhodnia course, Aug. 26, 1951.	
National (U.S.) Record	No official record.
SPEED FOR 1,242.739 MI. IN A CLOSED CIRCUIT	
World Class Record	223.713 mph.
Petre Zakhoudanine, USSR, YAK II Monoplane, ACH-21, 650 hp engine, Touchino-Kalouga-Viazma-Touchino course, Oct. 31, 1953	
National (U.S.) Record	No official record.

### SEAPLANES—(Class C-2)

DISTANCE, CLOSED CIRCUIT	
World Class Record	3,231.123 mi.
Mario Stoppani and Carlo Tonini, Italy, Cant Z I-LERO seaplane, 3 Alfa Romeo 126 RC.34 750 hp engines, May 27-28, 1937.	
National (U.S.) Record	1,569 mi.
Lts. B. J. Connell and H. C. Rodd, Pn-10, 2 Packard 600 hp each, San Diego, Cal., Aug. 15 - 16, 1927.	
AIRLINE DISTANCE	
World Class Record	5,997.462 mi
Capt. D. C. T. Bennett and First Officer L. Harvey, pilots; Great Britain, Short-Mayo Mercury seaplane, 4 Napier Rapiers J.I. 370 hp engines, from Dundee, Scotland to near Fort-Nolloth, S. Africa, Oct. 6-8, 1938.	
National (U.S.) Record	3,281.402 mi
Lt. Comdr. Knefler McGinnis, USN, Lt. J. K. Averill, USN, NAP T. P. Wilkinson, USN, Pilots; C. S. Bolka, A. E. J. Dionne and E. V. Sizer, crew; Navy XP3Y-1 seaplane, 2 Pratt and Whitney 825 hp engines, from Cristobal Harbor, C. Z. to San Francisco Bay, Alameda, Cal., Oct. 14-15, 1935.	
ALTITUDE	
World Class Record	44,429 ft
Col. Nicola Di Mauro, Italy, Caproni 161 seaplane, (biplane), Piaggio XI RC 100 engine, at Vigna di Valle, Sept. 25, 1939.	
National (U.S.) Record	38,560 ft
Lt. Appollo Soucek, USN, Apache, Pratt and Whitney 425 hp engine, supercharged, at Washington, D. C., June 4, 1929.	



**FORESIGHT**— Northrop Aircraft's long-range vision is continuously focused on new horizons. Advanced planning by Northrop scientists, engineers and administrators has resulted in the development of formidable aerial weapons for our national safety. Among them are the atom-armed Northrop Snark SM-62s, first intercontinental missiles to be disclosed by the U.S. Air Force, and the Northrop Scorpion F-89 interceptors, lethal guardians of our defense perimeter. In addition, Radioplane Company, a Northrop subsidiary, has delivered over 40,000 pilotless aircraft for use by all branches of the military. At Northrop, today's goal is tomorrow's starting point. In this forward-looking spirit, Northrop is continually achieving scientific breakthroughs which contribute to our national progress and welfare.



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## The AIRCRAFT YEAR BOOK

### MAXIMUM SPEED

World Class Record	440.681 mph
Francesco Agello, Italy, M.C. 72 seaplane, Fiat A.S. 6 engine at Lake Garda, Italy, Oct. 23, 1934.	
National (U.S.) Record	245.713 mph.
Lt. James H. Doolittle, USAF, Curtiss R3C-2, Curtiss V-1400, 600 hp engine, Bay Shore, Baltimore, Md., Oct. 27, 1925.	

### SPEED FOR 62.137 MI. WITHOUT PAYLOAD

World Class Record	391.072 mph.
Guglielmo Cassinelli, Italy, Macchi C. 72 seaplane, 2,400 hp Fiat AS 6 engine, Falconara-Pesaro permanent course, Oct. 8, 1933.	
National (U.S.) Record	241.679 mph.
Lt. G. T. Cuddihy, USN, Curtiss R3C-2, Curtiss V-1500, 700 hp at Norfolk, Va., Nov. 13, 1926.	

SPEED FOR 310.685 MI. WITHOUT PAYLOAD No official record.

### SPEED FOR 621.369 MI. WITHOUT PAYLOAD

World Class Record	250.676 mph.
M. Stoppani and G. Gorini, pilots; Ing. Luzzatto and E. Accomolli, passengers; Italy, Cant Z 509 seaplane, 3 Fiat A80 RC 41 1,000 hp engines, Mar. 30, 1938.	
National (U.S.) Record	165.040 mph
Maj. Gen. Frank M. Andrews, pilot; J. G. Moran and H. O. Johnson, crew; Martin BO12-A seaplane, 2 Pratt and Whitney 700 hp Hornet engines, Aug. 24, 1935.	

### SPEED FOR 1,242.739 MI. WITHOUT PAYLOAD

World Class Record	246.351 mph.
M. Stoppani and G. Gorini, pilots; Ing. Luzzatto and E. Accomolli, passengers; Italy, Cant Z 509 seaplane, 3 Fiat A80 RC 41 1,000 hp engines, Mar. 30, 1938.	
National (U.S.) Record	157.319 mph.
Edwin Musick, Boris Sergievsky and Charles A. Lindbergh, Sikorsky S-42 Seaplane, 4 Pratt and Whitney 670 hp Hornet engines, Aug. 1, 1934.	

### SPEED FOR 3,106.849 MI. WITHOUT PAYLOAD

World Class Record	191.534 mph.
Mario Stoppani and Carlo Tonini, Italy, Cant Z I-LERO seaplane, 3 Alfa Romeo 126 RC.34 750 hp engines, May 27-28, 1937.	
National (U.S.) Record	No official record.

SPEED FOR 6,213.698 MI. WITHOUT PAYLOAD No official record.

### WITH PAYLOAD OF 2,204.622 LB.

### ALTITUDE

World Class Record	34,085 ft.
Nicola di Mauro and Mario Stoppani, Italy, Cant Z. 506 B. seaplane, 3 Alfa Romeo RC.55 700 hp engines, at Monfalcone, Nov. 12, 1937.	
National (U.S.) Record	26,929 ft.
Boris Sergievsky, Sikorsky S-48 seaplane, 2 Pratt and Whitney Hornet, 575 hp each, at Bridgeport, Conn., July 21, 1930.	

### SPEED FOR 621.369 MI.

World Class Record	250.676 mph.
M. Stoppani, and G. Gorini, pilots; Ing. Luzzatto and E. Accomolli, passengers; Italy, Cant Z 509 seaplane, 3 Fiat A80 RC 41 1,000 hp engines, Mar. 30, 1938.	
National (U.S.) Record	165.040 mph.
Maj. Gen. F. M. Andrews, pilot; J. G. Moran and H. C. Johnson, crew; Martin B-12-A seaplane, 2 Pratt and Whitney 700 hp Hornet, engines, Aug. 24, 1935.	

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1649A SUPER CONSTELLATION, WORLD'S LONGEST-RANGE AIRLINER



U.S. NAVY T2V-1 CARRIER-BASED JET TRAINER



T-33-A/TV-2 JET TRAINER



1049G SUPER CONSTELLATION TRANSPORT



U.S. NAVY EXPERIMENTAL RADAR PICKET PATROL PLANE



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## The AIRCRAFT YEAR BOOK

### SPEED FOR 1,242.739 MI.

World Class Record	246.351 mph.
M. Stoppani and G. Gorini, pilots; Ing. Luzzatto and E. Accomoli, passengers; Italy, Cant Z 509 seaplane, 3 Fiat A80 RC 41, 1,000 hp engines, Mar. 30, 1938.	
National (U.S.) Record	157.319 mph.
Edwin Musick, Boris Sergievsky and Charles A. Lindbergh, Sikorsky S-42 seaplane, 4 Pratt and Whitney 670 hp Hornet engines, Aug. 1, 1934.	

### SPEED FOR 3,106.849 MI.

World Class Record	191.534 mph.
Mario Stoppani and Niccola di Mauro, Italy, Cant Z 506-B seaplane, 3 Alfa Romeo 126 RC.34 750 hp engines, May 27-28, 1937.	
National (U.S.) Record	No official record.

### WITH PAYLOAD OF 4,409.244 LB.

#### ALTITUDE

World Class Record	29,367 ft.
Mario Stoppani and Nicola di Mauro, Italy, Cant Z 506-B seaplane, 3 Alfa Romeo 700 hp engines, at Monfalcone, Nov. 3, 1937.	
National (U.S.) Record	19,709 ft.
Boris Sergievsky, S-38 seaplane, 2 Pratt and Whitney 424 hp Wasp, engines, at Stratford, Conn., Aug. 11, 1930.	

### SPEED FOR 621.369 MI.

World Class Record	250.676 mph.
M. Stoppani and G. Gorini, pilots; Ing. Luzzatto and E. Accomoli, passengers; Italy, Cant Z 509 seaplane, 3 Fiat A80 RC 41 1,000 hp engines, Mar. 30, 1938.	
National (U.S.) Record	157.580 mph.
Edwin Musick, Boris Sergievsky and Charles A. Lindbergh, Sikorsky S-42 seaplane, 4 Pratt and Whitney 670 hp Hornet engines, Aug. 1, 1934.	

### SPEED FOR 1,242.739 MI.

World Class Record	246.351 mph.
M. Stoppani and G. Gorini, pilots; Ing. Luzzatto and E. Accomoli, passengers; Italy, Cant Z 509 seaplane, 3 Fiat A80 RC 41 1,000 hp engines, Mar. 30, 1938.	
National (U.S.) Record	157.319 mph.
Edwin Musick, Boris Sergievsky and Charles A. Lindbergh, Sikorsky S-42 seaplane, 4 Pratt and Whitney 670 hp Hornet engines, Aug. 1, 1934.	

### SPEED FOR 3,106.849 MI.

No official record.

### WITH PAYLOAD OF 11,023.11 LB.

#### ALTITUDE

World Class Record	24,311 ft.
Mario Stoppani and Nicola di Mauro, pilots; Forlivesi, mechanic; Italy, Cant Z 506-B seaplane, 3 Alfa Romeo 700 hp engines, at Monfalcone, Nov. 7, 1947.	
National (U.S.) Record	20,406 ft.
Boris Sergievsky and Raymond B. Quick, Sikorsky S-42 seaplane, 4 Pratt and Whitney 670 hp Hornet engines, Bridgeport, Conn., May 17, 1934.	

### SPEED FOR 621.369 MI.

World Class Record	156.516 mph
Mario Stoppani and Ing. Antonio Maiorana, pilots; A. Spinelli, S. Forlivesi and R. T. Suriano, crew; Italy, Cant Z, 508 seaplane, 3 Isotta-Fraschini Asso 11 R.C. 836 hp engines, Grado-Faro Ancona-Faro di Rimini temporary course, May 1, 1937.	
National (U.S.) Record	No official record.

# Pesco AIRCRAFT ACCESSORIES

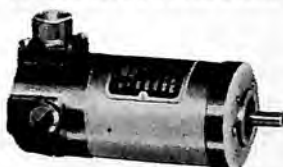


## ELECTRIC MOTOR-DRIVEN HYDRAULIC PUMPS

Models ranging in capacity from 0.1 to 7.0 gpm with pressures up to 3000 psi. DC motors, 6 to 36 volts. AC motors, 400 cycles, 440 volts.

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**ELECTRIC MOTORS** Designed for maximum power with minimum size and weight. AC Induction, 1 or 3-phase, 400 cycle at various voltages, 0.01 to 9 hp. DC Series, Shunt, or Compound, 6 to



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Centrifugal type, AC or DC, single or two speed motors. Tank-mounted—submerged or external; line-mounted; or plug-in. Flow to 40,000 pph, pressures to 40 psi. For gasoline or JP4 fuel to 50,000 feet.



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Gear type for jet engines, flow to 200 gpm, pressures to 1500 psi, designed to supply main, after-burner, and emergency fuel requirements.



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Advanced design, self-contained blowers with unmatched efficiency in space-saving "package". Single and multi-stage units for 27v. DC, 60 and 400 cycle AC. Capacities from 16 to 750 cfm and larger.

**CARTRIDGE PUMPS** Custom designed as an integral component of your packaged hydraulic or lubrication system. No shaft seals or external plumbing connections. Pressures to 4,000 psi, speeds to 12,000 rpm.



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## The AIRCRAFT YEAR BOOK

### SPEED FOR 1,242.739 MI.

World Class Record	154.356 mph.
Mario Stoppani and Ing. Antonio Maiorana, pilots; A. Spinelli, S. Forlivesi and R. T. Suriano, crew; Italy, Cant Z, 508 seaplane, 3 Isotta-Fraschini Asso 11 RC 836 hp engines, Grado-Faro Ancona-Faro di Rimini temporary course, May 1, 1937.	
National (U.S.) Record	No official record.

SPEED FOR 3,106.849 MI. No official record.

### WITH PAYLOAD OF 22,046.22 LB.

#### ALTITUDE

World Class Record	15,955 ft.
Mario Stoppani, pilot; G. Divari and A. Spinetti, passengers; Italy, Cant Z 508 seaplane, 3 Isotta Fraschini Asso 11 R.C. 836 hp engines, Monfalcone, Apr. 13, 1937.	
National (U.S.) Record	No official record.

### SPEED FOR 621.369 MI.

World Class Record	131.110 mph.
Guillaumet, Leclaire, Comet, Le Duff, Le Morvan and Chapaton, France, Latecoere 521 seaplane, <i>Lt. de Vaisseau Paris</i> , 6 Hispano-Suiza 650 hp engines, Lucon-Aureilhan base, Dec. 27, 1937.	
National (U.S.) Record	No official record.

SPEED FOR 1,242.739 MI. No official record

SPEED FOR 3,106.849 MI. No official record.

### WITH PAYLOAD OF 33,069.33 LB.

#### ALTITUDE

World Class Record	13,509 ft.
Guillaumet, Leclaire, Comet, Le Duff, Le Morvan and Chapaton, France, Latecoere 521 seaplane, <i>Lt. de Vaisseau Paris</i> , 6 Hispano-Suiza 650 hp engines, at Biscarosse, Dec. 30, 1937.	
National (U.S.) Record	No official record.

### SPEED FOR 621.369 MI.

World Class Record	117.899 mph.
Guillaumet, Leclaire, Comet, Le Duff, Le Morvan and Chapaton, France, Latecoere 521 seaplane, <i>Lt. de Vaisseau Paris</i> , 6 Hispano-Suiza 650 hp engines, Lucon-Aureilhan course, Dec. 29, 1937.	
National (U.S.) Record	No official record.

SPEED FOR 1,242.739 MI. No official record.

SPEED FOR 3,106.849 MI. No official record.

### GREATEST PAYLOAD CARRIED TO AN ALTITUDE OF 6,561.660 FT.

World Class Record	39,771 lb.
Guillaumet, Leclaire, Comet, Le Duff, Le Morvan and Chapaton, France, Latecoere 521 seaplane, <i>Lt. de Vaisseau Paris</i> , 6 Hispano-Suiza 650 hp engines, at Biscarosse, Dec. 30, 1937.	
National (U.S.) Record	16,608 lb
Boris Sergievsky, Sikorsky S-42 seaplane, 4 Pratt and Whitney Hornet 650 hp engines, Bridgeport, Conn., Apr. 26, 1934.	

## LIGHT SEAPLANES—(Class C-2.a)

### FIRST CATEGORY (LIGHT SEAPLANES WEIGHING LESS THAN 1,322.8 LBS.)

#### ALTITUDE

World Class Record	24,498 ft.
Charles L. Davis, United States, Piper Super Cub PA-18, Lycoming 125 hp engine, gross weight 1,295 lb., Detroit, Mich., June 18, 1952.	
National (U.S.) Record	Same as above.

DISTANCE IN A STRAIGHT LINE No official record.

#### SPEED FOR 62.137 MI. IN A CLOSED CIRCUIT

World Class Record	108.806 mph.
Charles L. Davis, United States, Piper Super Cub PA-18, Lycoming 125 hp engine, gross weight 1,321 lb., Grosse Point, Mich. Yacht Club, Aug. 29, 1952.	
National (U.S.) Record	Same as above.

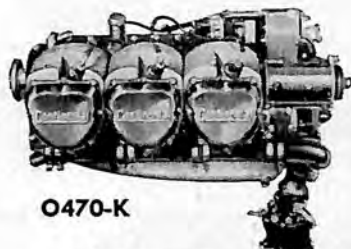
# CONTINENTAL MEANS

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### ... PLUS THE BACKING OF ESTABLISHED AND EXPANDING SERVICE



C90



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Continental's family of aircraft power plants—65 to 320 hp—is broader and more diversified today than ever before. Continentals give you dependability born of more than 54 years' engine-building experience, and backed by a steadily-growing network of ground facilities. Factory-approved service and genuine Continental parts are maintained all over the world, wherever people fly. Write for information.

	A65	C90	O300	*O470-K	O470-2	F5O526-A	GSO526
HP.....	65	95	145	230	265	260	320
RPM.....	2300	2625	2700	2600	2600	3000	3000
Cyl.....	4	4	6	6	6	6	6
Wt.**.....	170	186.5	311	438	515	568	560
Fuel Octane ...	73	80	80	80	91/96	91/96	91/96

\*Also available in 240-hp version as Model O470-M.

\*\*Engine weight is complete with accessories.



***Continental Motors Corporation***

***Aircraft Engine Division***

**MUSKEGON, MICHIGAN**

## The AIRCRAFT YEAR BOOK

SPEED FOR 310.137 MI. IN A CLOSED CIRCUIT	
World Class Record	105.354 mph.
Charles L. Davis, United States, Piper Super Cub PA-18, Lycoming 125 hp engine, gross weight 1,321 lb., Grosse Point, Mich. Yacht Club, Aug. 29, 1952.	
National (U.S.) Record	Same as above.
SPEED FOR 621.359 MI. IN A CLOSED CIRCUIT	
	No official record.
SPEED FOR 1,242.739 MI. IN A CLOSED CIRCUIT	
	No official record.

### LIGHT SEAPLANES—(Class C-2.b)

#### SECOND CATEGORY (LIGHT SEAPLANES WITH A TOTAL WEIGHT, IN FLYING ORDER, BETWEEN 1,322.8 AND 2,645.6 LB.)

ALTIITUDE	
World Class Record	26,266 ft.
Charles L. Davis, United States, Piper Super Cub Seaplane, N1997A, Lycoming 125 hp engine, Detroit Seaplane Base, Mich., Oct. 18, 1952.	
National (U.S.) Record	Same as above.
AIRLINE DISTANCE	
World Class Record	946.732 mi.
Harold E. Mistele, United States, Cessna 170, Continental 145 hp engine, gross weight 1,117 kilograms, from near Brownsville, Tex. to near Rosiclair, Ill., June 12, 1952.	
National (U.S.) Record	Same as above.
SPEED FOR 62.137 MI. IN A CLOSED CIRCUIT	
World Class Record	109.081 mph.
Harold E. Mistele, United States, Cessna 170, Continental 145 hp engine, gross weight 1,986.5 lb., Grosse Pointe, Mich., Yacht Club, Aug. 25, 1952.	
National (U.S.) Record	Same as above.
SPEED FOR 310.685 MI. IN A CLOSED CIRCUIT	
World Class Record	102.274 mph.
Harold E. Mistele, United States, Cessna 170, Continental 145 hp engine, gross weight 1,986.5 lb., Grosse Pointe, Mich., Yacht Club, Aug. 25, 1952.	
National (U.S.) Record	Same as above.
SPEED FOR 621.369 MI. IN A CLOSED CIRCUIT	
	No official record.
SPEED FOR 1,242.739 MI. IN A CLOSED CIRCUIT	
	No official record.

### LIGHT SEAPLANES—(Class C-2.c)

#### THIRD CATEGORY (LIGHT SEAPLANES WITH A TOTAL WEIGHT, IN FLYING ORDER, BETWEEN 2,645.6 AND 4,629.7 LB.)

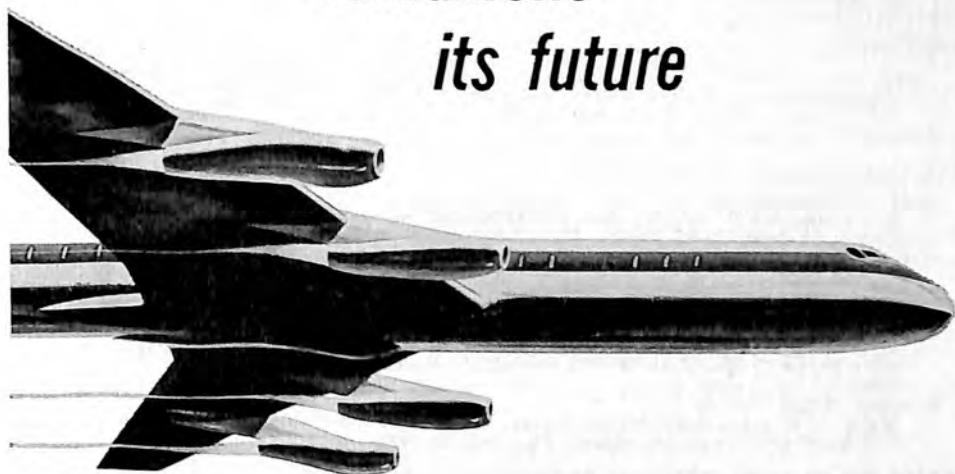
AIRLINE DISTANCE		No official record.
ALTIITUDE		
World Class Record		20,523 ft.
Harold E. Mistele, United States, Cessna 180 seaplane, Continental 225 hp engine, Aug. 18, 1954. (Pending confirmation by F. A. I. as we went to press.)		
National (U.S.) Record		Same as above.
SPEED FOR 62.137 MI.		
World Class Record		131.307 mph.
Harold E. Mistele, United States, Cessna 180 seaplane, Continental 225 hp engine, Aug. 18, 1954.		
National (U.S.) Record		Same as above.
SPEED FOR 310.685 MI. IN A CLOSED CIRCUIT		No official record.
SPEED FOR 621.369 MI.		No official record.
SPEED FOR 1,242.739 MI.		No official record.

### LIGHT SEAPLANES—(Class C-2.d)

#### FOURTH CATEGORY (LIGHT SEAPLANES WITH A TOTAL WEIGHT, IN FLYING ORDER, BETWEEN 4,629.7 AND 7,495.7 LB.)

AIRLINE DISTANCE		No official record.
ALTIITUDE		No official record.
SPEED FOR 62.137 MI.		No official record.
SPEED FOR 310.685 MI. IN A CLOSED CIRCUIT		No official record.
SPEED FOR 621.369 MI.		No official record.
SPEED FOR 1,242.739 MI.		No official record.

*Pioneer of aviation's past...  
refashions  
its future*



Soon . . . the speed  
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Tokyo to Seattle in 8½ hours . . .  
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the air always smooth.  
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make it come true.



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# The AIRCRAFT YEAR BOOK

## AMPHIBIANS—(CLASS C3)

### AIRLINE DISTANCE

World Class Record	1,855.610 mi.
Marquise Carina Negrone and Sign. Ada Marchelli, Italy, Piaggio P. 136 L airplane, 2 Lycoming Go 435 C2 240 hp. engines, from Ghedi (Brescia) to Luxor, Egypt, June 18, 1954.	
National (U.S.) Record	1,429.685 mi.
Maj. Gen. F. M. Andrews, pilot; Maj. John Whiteley, co-pilot; and crew, United States, Douglas YOA5 Amphibian, 2 Wright Cyclone 800 hp engines, from San Juan, Puerto Rico, to Langley Field, Va., June 29, 1936.	

### ALTITUDE

World Class Record	24,951 ft.
Boris Sergievsky, United States, Sikorsky S-43 amphibian, 2 Pratt and Whitney 750 hp Hornet engines, Stratford, Conn., Apr. 14, 1936.	
National (U.S.) Record	Same as above.

### MAXIMUM SPEED

World Class Record	230.413 mph.
Maj. Alexander P. de Seversky, United States, Seversky Amphibian, Wright Cyclone 710 hp engine, Detroit, Mich., Sept. 15, 1935.	
National (U.S.) Record	Same as above.

### SPEED FOR 62.137 MI. WITHOUT PAYLOAD

World Class Record	241.883 mph.
R. R. Colquhoun, Great Britain, Vicker's Supermarine Seagull I, Rolls Royce Griffon Mark 29 1380 hp engine, Marston Moor, July 22, 1950.	
National (U.S.) Record	209.451 mph.
Major A. P. deSeversky, United States, Seversky Amphibian, Wright "Cyclone" 1,000 hp engine, Miami, Fla., Dec. 19, 1936.	

### SPEED FOR 621.369 MI. WITHOUT PAYLOAD

World Class Record	186.076 mph.
Capt. W. P. Sloan and Capt. B. L. Boatner, USA AC, pilots; United States, Grumman YOA-9 amphibian, 2 Pratt and Whitney engines, 400 hp each, Dayton, O., July 31, 1939.	
National (U.S.) Record	Same as above.

### SPEED FOR 1,242.739 MI. WITHOUT PAYLOAD

World Class Record	154,701 mph.
Giuseppe Burei and Enrico Rossaldi, pilots; Gino Velati, passenger; Italy, Macchi C-94 I.-NEP I amphibian, 2 Wright Cyclone 750 hp engines, Rovine Ansedonia-Faro Fiumicino Antignano temporary course, May 6, 1937.	
National (U.S.) Record	No official record.

SPEED FOR 3,106.849 MI. WITHOUT PAYLOAD No official record.

SPEED FOR 6,213.689 MI. WITHOUT PAYLOAD No official record.

### WITH PAYLOAD OF 2,204.622 LB.

### ALTITUDE

World Class Record	23,405 ft.
Ivan Soukhomline, USSR, Tsagui 44 D Amphibian, 4 M-87 840 hp engines, Katcha, near Sebastopol, June 17, 1940.	
National (U.S.) Record	19,626 ft.
Boris Sergievsky, Sikorsky S-43, 2 Pratt and Whitney 750 hp Hornet engines, Stratford, Conn., Apr. 25, 1936.	

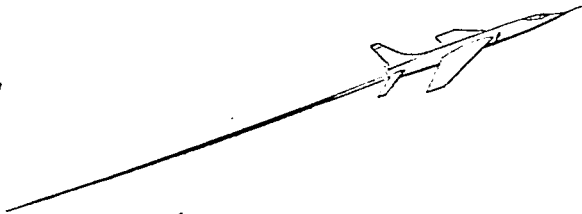
### SPEED FOR 621.369 MI.

World Class Record	172,409 mph.
Ivan Soukhomline, USSR, Tsagui 44 D Amphibian, 4 M-85, 750 hp engines, Katcha-Kersoness-Taganrog course, Sept. 28, 1940.	
National (U.S.) Record	No official record.

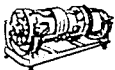
SPEED FOR 1,242.739 MI. No official record.

SPEED FOR 3,106.849 MI. No official record.

# Another Year of Advancement



Important news was made by products of United Aircraft Corporation during 1956 . . . as the divisions continued to advance in their fields—aircraft engines, propellers and jet equipment, and helicopters.



**PRATT & WHITNEY AIRCRAFT'S** J-57 and J-75 turbojets in commercial versions will power fleets of Douglas DC-8 and Boeing 707 transports ordered by many U.S. and foreign airlines. The J-57 engine powered the Chance Vought F8U, which set a 1015 mph record to win the Thompson Trophy. Also J-57 equipped, the Boeing KC-135 tanker made its first flight. The J-75 was announced for the Republic F-105 Air Force fighter, and for production models of the big Martin P6M seaplane. Meanwhile, the T-34 turboprop engine flew in new Douglas C-133A logistics carriers and in other four-engined transports for MATS, and the T-57 turboprop entered the flying test-bed phase.



**HAMILTON STANDARD'S** backlog of commercial orders for propellers was the largest in its history, resulting from airline orders for Douglas, Lockheed, and Convair transports. Expanding jet equipment activities included equipment for more than 40 types of turbine-powered aircraft. The division announced during the year that it would expand its operations into the electronics field.



**SIKORSKY AIRCRAFT'S** new S-58 helicopter went into service with New York Airways and Sabena World Airlines, and also set world closed-circuit speed records. Sikorsky 55s, of which the 1000th was produced during the year, saw increased use in many business and industrial activities, such as in the oil industry offshore in the Gulf of Mexico. Chicago joined New York and Los Angeles as a hub of helicopter passenger service, with Sikorsky equipment used on all scheduled passenger flights.

With employment at a peacetime high, with new and expanded facilities under construction, and with promising new products under development, United Aircraft Corporation continues to contribute to the advancement of aviation.

*United Aircraft Corporation*

EAST HARTFORD, CONNECTICUT



# The AIRCRAFT YEAR BOOK

WITH PAYLOAD OF 4,409.244 LB.

## ALTITUDE

World Class Record	20,617 ft.
Ivan Soukhomline, USSR, Tsagui 44 D Amphibian, 4 M-87 840 hp engines, Katcha, near Sebastopol, June 19, 1940.	
National (U.S.) Record	19,625 ft.
Boris Sergievsky, United States, Sikorsky S-43 Amphibian, 2 Pratt and Whitney, 750 hp engines, Stratford, Conn., Apr 25, 1936.	

## SPEED FOR 621.369 MI.

World Class Record	149.694 mph.
Ivan Soukhomline, USSR, Tsagui 44 D Amphibian 4 M-85 750 hp engines, Katcha-Kersoness-Taganrog course, Oct. 7, 1940.	
National (U.S.) Record	No official record.

SPEED FOR 1,242.739 MI.	No official record.
SPEED FOR 3,106.849 MI.	No official record.

WITH PAYLOAD OF 11,023.11 LB.

## ALTITUDE

World Class Record	17,123 ft.
Ivan Soukhomline, USSR, Tsagui 44 D Amphibian, 4 M-87 840 hp engines, Katcha, near Sebastopol, June 19, 1940.	
National (U.S.) Record	No official record.

SPEED FOR 621.369 MI.	No official record.
SPEED FOR 1,242.739 MI.	No official record.
SPEED FOR 3,106.849 MI.	No official record.

WITH PAYLOAD OF 22,046.22 LB.

ALTITUDE	No official record.
SPEED FOR 621.369 MI.	No official record.
SPEED FOR 1,242.739 MI.	No official record.
SPEED FOR 3,106.849 MI.	No official record.

## GREATEST PAYLOAD CARRIED TO AN ALTITUDE OF 6,561.660 FT.

World Class Record	11,023 lb.
Ivan Soukhomline, USSR, Tsagui 44 D Amphibian, 4 M-87 840 hp engines, at Katcha, near Sebastopol, June 19, 1940.	
National (U.S.) Record	No official record.

## ROTORPLANES—(Class E)

### DISTANCE IN A STRAIGHT LINE WITHOUT PAYLOAD

World Class Record	1,217.137 mi
Elton J. Smith, United States, Bell 47D1 Helicopter, Franklin 200 hp engine, from Hurst, Ft. Worth, Tex., to Niagara Falls, N. Y. Sept. 17, 1952.	
National (U.S.) Record	Same as above.

### DISTANCE CLOSED CIRCUIT WITHOUT PAYLOAD

World Class Record	1,199.078 mi.
Lt. Col. Harry L. Bush, USA, and Maj. Wm. C. Dysinger, USA, pilots; United States, Vertol H-21C helicopter, Wright R-1820-103 1,275 hp engine, Robbinsville, N. J., Aug. 11, 1956.	

### ALTITUDE, WITHOUT PAYLOAD

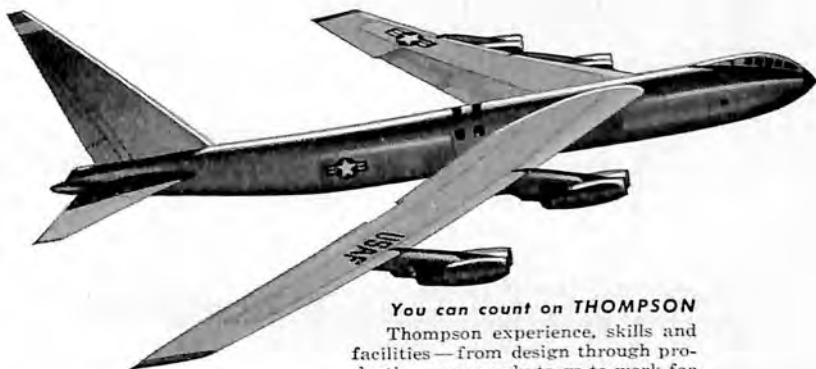
World Class Record	26,931 ft.
Jean Boulet, France, SE "Alouette" Helicopter, Turbomeca Artouste II 400 hp engine, Buc Airport, June 6, 1955.	
National (U.S.) Record	(7,474 meters) 24,521 ft.
W/O Billy I. Wester, USA, United States, Sikorsky XH-39 Helicopter, Turbomeca Artouste II 425 hp engine, Bridgeport, Connecticut, October 17, 1954.	
National (U.S.) Record	Same as above.

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## The AIRCRAFT YEAR BOOK

### MAXIMUM SPEED WITHOUT PAYLOAD

World Class Record	156,006 mph.
W/O Billy I. Wester, USA, United States, Sikorsky XH-39 Helicopter, Turbomeca Artouste II 425 hp engine, Windsor Locks, Conn., Aug. 26, 1954. (Pending F.A.I. confirmation as we went to press.)	
National (U.S.) Record	Same as above.
<b>SPEED FOR 62.137 MI. IN A CLOSED CIRCUIT, WITHOUT PAYLOAD</b>	
World Class Record	141,915 mph.
Capt. C. E. Hargett and Capt. E. D. Hill, USA, United States, Sikorsky H-34 helicopter, Wright 1820 1275 hp engine, Milford, Conn., July 12, 1956.	
National (U.S.) Record	Same as above.
<b>SPEED FOR 310.685 MI. IN A CLOSED CIRCUIT, WITHOUT PAYLOAD</b>	
World Class Record	136,014 mph.
(Same pilots, aircraft, place and date as indicated above.)	
National (U.S.) Record	Same as above.
<b>SPEED FOR 621.369 MI. IN A CLOSED CIRCUIT, WITHOUT PAYLOAD</b>	
World Class Record	132,633 mph.
(Same pilots, aircraft, place and date as indicated above.)	
National (U.S.) Record	Same as above.
<b>SPEED FOR 1,242.739 MI. IN A CLOSED CIRCUIT, WITHOUT PAYLOAD—No official record.</b>	
<b>SPEED FOR 3,106.849 MI. IN A CLOSED CIRCUIT, WITHOUT PAYLOAD—No official record.</b>	

### WITH PAYLOAD OF 1,000 KILOGRAMS (2204.622 LB.)

<b>ALTITUDE, WITH PAYLOAD OF 1,000 KILOGRAMS</b>	
World Class Record	6,048 meters (19,842 ft.)
Vsevolode Vinizki, USSR, MI-4 Helicopter, ACH-88-B, 1,430 hp engine, Moscou-Touchino, April 26, 1956.	
National (U.S.) Record	None established
<b>SPEED FOR 1,000 KILOGRAMS (621.369 MILES) WITH PAYLOAD OF 1,000 KILOGRAMS</b>	
Neither World Class nor National (U.S.) Record has been established.	
<b>SPEED FOR 2,000 KILOGRAMS (1,242.739 MILES) WITH PAYLOAD OF 1,000 KILOGRAMS</b>	
Neither World Class nor National (U.S.) Record has been established.	
<b>SPEED FOR 5,000 KILOGRAMS (3,106.849 MILES) WITH PAYLOAD OF 1,000 KILOGRAMS</b>	
Neither World Class nor National (U.S.) Record has been established.	

### WITH PAYLOAD OF 2,000 KILOGRAMS (4,409.2 LB.)

<b>ALTITUDE, WITH PAYLOAD OF 2,000 KILOGRAMS</b>	
World Class Record	6,018 meters (19,744 ft.)
Rafail Kaprelian, USSR, MI-4 Helicopter, ACH-82-B, 1430 hp engine, Moscou-Touchino, April 25, 1956.	
National (U.S.) Record	None established
<b>SPEED FOR 1,000 KILOMETERS (621.369 MILES) WITH PAYLOAD OF 2,000 KILOGRAMS</b>	
Neither World Class nor National (U.S.) Record has been established.	
<b>SPEED FOR 2,000 KILOMETERS (1,242.739 MILES) WITH PAYLOAD OF 2,000 KILOGRAMS</b>	
Neither World Class nor National (U.S.) Record has been established.	
<b>SPEED FOR 5,000 KILOMETERS (3,106.849 MILES) WITH PAYLOAD OF 2,000 KILOGRAMS</b>	
Neither World Class nor National (U.S.) Record has been established.	
<b>GREATEST PAYLOAD CARRIED TO AN ALTITUDE OF 2,000 METERS (6,561.666 ft.)</b>	
World Class Record	4,000 kilograms (8,818.5 lbs.)
Egor Milutitchev, pilot, Gueerguii Tinjakov, co-pilot, USSR, "Wagon Volant" Dual Rotor Helicopter, 2 ACH-82-B, 1,430 hp engines, Touchino Aerodrome, Moscow, December 17, 1955.	
National (U.S.) Record	None established

### FIRST CATEGORY (ROTORPLANES WEIGHING LESS THAN 500 KILOGRAMS (1,102.3 LB.) IN FLYING ORDER)

<b>DISTANCE IN A STRAIGHT LINE</b>	
Neither World Class nor National (U.S.) Record has been established.	
<b>DISTANCE IN A CLOSED CIRCUIT</b>	
Neither World Class nor National (U.S.) Record has been established.	
<b>ALTITUDE</b>	
World Class Record	4,789 meters (15,712 ft.)
Jean Dabos, France, Djinn No. 2 SNCASO Helicopter, Turbomeca "Palouste" jet engine, at Villacoublay, December 29, 1953.	
National (U.S.) Record	None established
<b>SPEED FOR 100 KILOMETERS (62.137 MILES) IN A CLOSED CIRCUIT</b>	
Neither World Class nor National (U.S.) Record has been established.	

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## The AIRCRAFT YEAR BOOK

**SPEED FOR 500 KILOMETERS (310.6685 MILES) IN A CLOSED CIRCUIT**  
Neither World Class nor National (U.S.) Record has been established.

**SPEED FOR 1,000 KILOMETERS (621.369 MILES) IN A CLOSED CIRCUIT**  
Neither World Class nor National (U.S.) Record has been established.

**SPEED FOR 1,000 KILOMETERS (621.369 MILES) IN A CLOSED CIRCUIT**  
Neither World Class nor National (U.S.) Record has been established.

### SECOND CATEGORY (ROTORPLANES WEIGHING BETWEEN 500 AND 1,000 KILOGRAMS (1,102.3-2,204.6 LB.) IN FLYING ORDER)

**DISTANCE IN A STRAIGHT LINE**

Neither World Class nor National (U.S.) Record has been established.

**DISTANCE IN A CLOSED CIRCUIT**

Neither World Class nor National (U.S.) Record has been established.

**ALTITUDE, WITHOUT PAYLOAD**

World Class Record ..... 8,209 meters (26,931 ft.)

Jean Boulet, France, SE "Alouette" Helicopter, Turbomeca Artouste  
11 400 hp engine, Buc Airport, June 6, 1955.

National (U.S.) Record ..... None established

**MAXIMUM SPEED OVER A STRAIGHTAWAY COURSE**

Neither World Class nor National (U.S.) Record has been established.

**SPEED FOR 100 KILOMETERS (62.137 MILES) IN A CLOSED CIRCUIT**

Neither World Class nor National (U.S.) Record has been established.

**SPEED FOR 500 KILOMETERS (310.685 MILES) IN A CLOSED CIRCUIT**

Neither World Class nor National (U.S.) Record has been established.

**SPEED FOR 1,000 KILOMETERS (621.369 MILES) IN A CLOSED CIRCUIT**

Neither World Class nor National (U.S.) Record has been established.

### THIRD CATEGORY (ROTORPLANES WITH A TOTAL WEIGHT IN FLYING ORDER BETWEEN 1,000 AND 1,750 KILOGRAMS (2,204.6 AND 3,858 LB.))

**DISTANCE IN A STRAIGHT LINE**

Neither World Class nor National (U.S.) Record has been established.

**DISTANCE IN A CLOSED CIRCUIT**

World Class Record ..... 1,252.572 kilometers (778.311 mi.)

Jean Boulet, France, S.E. 3 120 Helicopter, Salmson 9 NH 200 hp  
engine, Buc-Etampes-Rambouillet Course, July 2, 1953.

National (U.S.) Record ..... None established

**ALTITUDE**

Neither World Class nor National (U.S.) Record has been established.

**MAXIMUM SPEED OVER A STRAIGHTAWAY COURSE**

Neither World Class nor National (U.S.) Record has been established.

**SPEED FOR 100 KILOMETERS (62.137 MILES) IN A CLOSED CIRCUIT**

World Class Record ..... Speed, 110.314 kmph (68.549 mph)

Jean Boulet, France, S.E. 3 120 Helicopter, Salmson 9 NH 200 hp  
engine, Buc-Etampes-Rambouillet Course, July 2, 1953.

National (U.S.) Record ..... None established

**SPEED FOR 500 KILOMETERS (310.685 MILES) IN A CLOSED CIRCUIT**

World Class Record ..... Speed, 107.193 kmph (66.607 mph)

Jean Boulet, France, S.E. 3 120 Helicopter, Salmson 9 NH 200 hp  
engine, Buc-Etampes-Rambouillet Course, July 2, 1953.

**SPEED FOR 1,000 KILOMETERS (621.369 MILES) IN A CLOSED CIRCUIT**

World Class Record ..... Speed, 103.813 kmph (64.506 mph)

Jean Boulet, France, S.E. 3 120 Helicopter, Salmson 9 NH 200 hp  
engine, Buc-Etampes-Rambouillet Course, July 2, 1953.

National (U.S.) Record ..... None established

### FOURTH CATEGORY (ROTORPLANES 1,750 AND 3,000 KILOGRAMS (3,850 AND 6,613.9 LB.))

**DISTANCE IN A STRAIGHT LINE**

Neither World Class nor National (U.S.) Record has been established.

**DISTANCE IN A CLOSED CIRCUIT**

Neither World Class nor National (U.S.) Record has been established.

**ALTITUDE, WITHOUT PAYLOAD**

Neither World Class nor National (U.S.) Record has been established.

**MAXIMUM SPEED OVER A STRAIGHTAWAY COURSE**

Neither World Class nor National (U.S.) Record has been established.

**SPEED FOR 100 KILOMETERS (62.137 MILES) IN A CLOSED CIRCUIT**

Neither World Class nor National (U.S.) Record has been established.

**SPEED FOR 500 KILOMETERS (310.685 MILES) IN A CLOSED CIRCUIT**

Neither World Class nor National (U.S.) Record has been established.

**SPEED FOR 1,000 KILOMETERS (621.369 MILES) IN A CLOSED CIRCUIT**

Neither World Class nor National (U.S.) Record has been established.



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# The AIRCRAFT YEAR BOOK

## AIRSHIPS—(CLASS B)

<b>AIRLINE DISTANCE</b>	
World Class Record	3,967.137 mi.
Dr. Hugo Eckener, Germany, L. Z. 127, <i>Graf Zeppelin</i> 5 Maybach 450-550 hp engines, from Lakehurst, N. J., to Friedrichshafen, Germany, Oct. 29, 30, 31, and Nov. 1, 1928.	
National (U.S.) Record	No official record

## GLIDERS—(CLASS D)

(Single-Place)

<b>DISTANCE IN A STRAIGHT LINE</b>	
World Class Record	535.169 mi
Richard H. Johnson, U.S. Ross-Johnson sailplane, N-3722C, from Odessa, Tex. to Salina, Kan., Aug. 5, 1951.	
National (U.S.) Record	Same as above.
<b>DISTANCE TO A PREDETERMINED POINT WITH RETURN TO POINT OF DEPARTURE</b>	
World Class Record	310.7 mi.
Lyle A. Maxey, United States, Kerns Sailplane, from El Mirage to Independence, Calif., and return, September 4, 1955.	
National (U.S.) Record	Same as above
<b>DISTANCE TO A PREDETERMINED DESTINATION</b>	
World Class Record	677.61 kilometers (421.047 mi.)
Comm. Rene Fontelles, France, Breguet 901 Sailplane from Troyes-Barbery to Dax, May 13, 1956.	
National (U.S.) Record	535.757 kilometers (322.903 mi.)
Wallace R. Wiberg, Laister-Kaufman 10A Sailplane N57826, from Odessa, Texas to Guymon, Oklahoma, August 5, 1951.	
National (U.S.) Record	Same as above.
National (U.S.) Record	332.903 mi
Wallace R. Wiberg, Laister-Kaufmann 10A Sailplane, N 57826, from Odessa, Tex. to Guymon, Okla., Aug. 5, 1951.	
<b>ALTITUDE GAINED</b>	
World Class Record	30,100 ft.
William S. Ivans, Jr., U.S., Schweizer SGS 1-23 sailplane, N-91876, Bishop, Cal., Dec. 30, 1950.	
National (U.S.) Record	Same as above
<b>ALTITUDE ABOVE SEA LEVEL</b>	
World Class Record	42,100 ft
William S. Ivans, Jr., U.S., Schweizer SGS 1-23 sailplane, N-91876, Bishop, Cal., Dec. 30, 1950.	
National (U.S.) Record	Same as above.
<b>SPEED FOR 62.137 MI. OVER A TRIANGULAR COURSE</b>	
World Class Record	59.475 mph.
Jersy Wojnar, Poland, Jaskolka SP 1325 Sailplane, Leszno-Rawicz-Gostyn-Leszno course, May 15, 1954.	
National (U.S.) Record	52.766 mph.
Richard H. Johnson, Ross-Johnson 5 Sailplane, Grand Prairie-Russell-Don's Airpark-Grand Prairie, Tex. Course, Aug. 28, 1952.	
<b>SPEED FOR 200 KILOMETERS OVER A TRIANGULAR COURSE</b>	
World Class Record	Speed, 67.304 kmph (41.821 mi.)
Edward Makula, Poland, Jakolska SP-1522 Sailplane, Lisie Katy-Przepalkowo-Zblewo-Lisie Katy Course, Aug. 16, 1955.	
National (U.S.) Record	None established
<b>SPEED FOR 300 KILOMETERS OVER A TRIANGULAR COURSE</b>	
World Class Record	Speed, 76.636 kmph (47.619 mph)
Comdr. G. A. J. Goodhart (RN), Great Britain, Hirth L. O. 150 Sailplane, Urinquinty-Yanko-Oaklands-Urinquinty, Australia course, January 9, 1956.	
National (U.S.) Record	Speed, 70.720 kmph (43.943 mph)
Paul F. Bikle, Schweizer SGS-123 Sailplane, N91877, El Mirage-Joshua Trie-Daggett-El Mirage, California, course, July 21, 1956.	

(Multi-Place)

<b>DISTANCE IN A STRAIGHT LINE</b>	
World Class Record	515.626 mi.
Victor Ilchenko, pilot; Grigory Petchnikov, passenger; USSR; A-10 Sailplane, from Kountsevo (Moscow) to Ilovlia (Stalingrad), May 26, 1933.	
National (U.S.) Record	309.678 mi.
Richard H. Johnson, pilot; R. A. Sparling, passenger; Schweizer TG-2 glider, NC-479903, from Prescott, Ariz. municipal Airport to the Ackerman Ranch approximately 11 miles west of Governador, N. M., Sept. 8, 1946.	

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### DISTANCE TO A PREDETERMINED POINT WITH RETURN TO POINT OF DEPARTURE

World Class Record .....	270.917 mi.
Evert Dommissie, pilot; Samuel J. Barker, passenger; South Africa, Kranich II ZS-G Sailplane, from Keetmanshoop to Mariental and return, Feb. 9, 1952.	
National (U.S.) Record .....	153.930 mi.

### DISTANCE TO A PREDETERMINED POINT WITH RETURN OF DEPARTURE

World Class Record .....	436.000 kilometers (270.917 mi.)
Evert Dommissie, pilot; Samuel J. Barker, passenger; South Africa Kranich II Z S-G Sailplane, from Keetmanshoop to Mariental and return, February 9, 1952.	
National (U.S.) Record .....	349.3 kilometers (207.038 mi.)
Harold D. Hutchinson, pilot; Elmore Hoggard, passenger; United States, TG4A Sailplane, N58353, Grand Prairie Airport, Grand Prairie, Texas to Breckenridge, Texas and return, August 8, 1956.	

### DISTANCE TO A PREDETERMINED DESTINATION

World Class Record .....	541.300 kilometers (336.348 mi.)
Jerzy Popiel, pilot; Adolf Siemaszkiewicz, passenger, Poland, Zuraw II, S.P.-1211 Glider, from Lublin to Hrubieszow, July 20, 1953.	
National (U.S.) Record .....	399.24 kilometers (248.073 mi.)
Harold D. Hutchinson, pilot; Bryant Denison, passenger; United States, TG4A Sailplane, N58353, Grand Prairie Airport, Grand Prairie, Texas to Tulsa Municipal Airport, Tulsa, Okla., August 4, 1956.	

### ALTITUDE GAINED

World Class Record .....	34,426 ft.
Laurence E. Edgar, pilot; Harold E. Klieforth, passenger, United States, Pratt-Read PR-G1 Sailplane, Bishop, Cal., Mar. 19, 1952.	
National (U.S.) Record .....	Same as above.

### ALTITUDE ABOVE SEA LEVEL

World Class Record .....	44,255 ft.
Laurence E. Edgar, pilot; Harold E. Klieforth, passenger, United States, Pratt-Read PR-G1 Sailplane, Bishop, Cal., Mar. 19, 1952.	
National (U.S.) Record .....	Same as above.

### SPEED FOR 62.137 MI. OVER A TRIANGULAR COURSE

World Class Record .....	49.920 mph.
Ernst-Gunter Haase, pilot; Reinaldo Picchio, passenger, Germany; Condor IV Sailplane, at Klippeneck, Aug. 13, 1952.	
National (U.S.) Record .....	27.873 mph.
William G. Briegleb, pilot; Jack LaMare, passenger; Briegleb BG-8 glider, N-33636, Adelanto, Cal., Aug. 12, 1949.	

### SPEED FOR 200 KILOMETERS OVER A TRIANGULAR COURSE

World Class Record .....	Speed, 66.048 kmph (41.040 mph)
Henryk Zydorzak, Poland, pilot; Eugeniusz Oles, passenger; Bocian SP-1564 Sailplane, Lisie Katy-Przepalkowo-Zblewo-Lisie Katy Course, August 14, 1955.	
National (U.S.) Record .....	None established

### SPEED FOR 300 KILOMETERS OVER A TRIANGULAR COURSE

World Class Record .....	Speed, 64.177 kmph (39.878 mph)
Zvonimir Rain, pilot, Petar Bogojevic, passenger; Yougoslavia, Kosava Sailplane, Vrsac-Becej-Jakovo-Vrsac Course, June 7, 1956.	
National (U.S.) Record .....	None established

## BALLOONS (CLASS A)

### FIRST CATEGORY—(8,828.6 CU. FT. OR LESS)

#### DURATION

Neither World Class nor National (U.S.) Record has been established.

#### DISTANCE

Neither World Class nor National (U.S.) Record has been established.

#### ALTITUDE

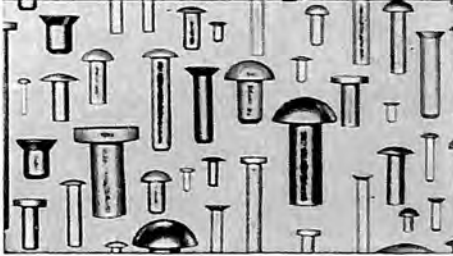
Neither World Class nor National (U.S.) Record has been established.

### SECOND CATEGORY—(8,828.7 TO 14,125.7 CU. FT.)

#### DURATION

World Class Record.....	4 hours, 00 minutes
Audouin Dollfus, France, "Zodiac" F.A.I.J.A. Balloon of 375 cubic meters volume, from Senlis to Cheverny, May 3, 1953.	
National (U.S.) Record.....	No official record

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### DISTANCE

World Class Record .....	208.622 kilometers (129.631 mi.)
Audouin Dollfus, France, "Zodiac" F.A.I.J. Balloon of 375 cubic meters volume, from Senlis to Cheverny, May 3, 1953.	
National (U.S.) Record .....	No official record.

### ALTITUDE

Neither World Class nor National (U.S.) Record has been established.

### DURATION

World Class Record .....	4 hours, 00 minutes
Audouin Dollfus, France, "Zodiac" F.A.I.J. Balloon of 375 cubic meters volume, from Senlis to Cheverny, May 3, 1953.	
National (U.S.) Record .....	None established

### DISTANCE

World Class Record .....	208.622 kilometers (129.631 mi.)
Audouin Dollfus, France, "Zodiac" F.A.I.J. Balloon of 375 cubic meters volume, from Senlis to Cheverny, May 3, 1953.	
National (U.S.) Record .....	None established

### ALTITUDE

Neither World Class nor National (U.S.) Record has been established.

### THIRD CATEGORY—(14,125.8 CU. FT.)

#### DURATION

World Class Record .....	46 hr. 10 min.
Serge Sinoveev, USSR, VR 80 Balloon, 21,082.458 cu. ft., take-off near Dolgoproudnaia, Mar. 30, 1941.	
National (U.S.) Record .....	No official record.

#### DISTANCE

World Class Record .....	499.69 mi.
Georges Cormier, France, July 1, 1922.	
National (U.S.) Record .....	No official record

#### ALTITUDE

World Class Record .....	23,286 ft.
Boris Nevernov, USSR, VR-80 Balloon, 13,984.344 cu. ft., at Dolgoproudnaia, Aug. 31, 1940.	
National (U.S.) Record .....	No official record

### FOURTH CATEGORY—(21,224 - 31,783 CU. FT.)

#### DURATION

World Class Record .....	61 hr. 30 min.
F. Bourlouzki and A. Aliochine, USSR, from Moscow to Charaboulski, Apr. 3-6, 1939.	
National (U.S.) Record .....	19 hr. 00 min.
W. C. Naylor and K. W. Warren, <i>Skylark</i> , Little Rock, Ark., to Crawford, Tenn., Apr. 29-30, 1926.	

#### DISTANCE

World Class Record .....	1,056.950 mi.
F. Bourlouzki and A. Aliochine, USSR, from Moscow to Charaboulski, region of Koustanai, Apr. 3-6, 1939.	
National (U.S.) Record .....	410.104 mi.
W. C. Naylor and K. W. Warren, <i>Skylark</i> , Little Rock, Ark., to Crawford, Tenn., Apr. 29-30, 1926.	

#### ALTITUDE

World Class Record .....	27,718 ft.
Alexei Rostine, USSR, VR-70 Balloon of 29,451.876 cu. ft. at Dolgoproudnaia, Oct. 4, 1940.	
National (U.S.) Record .....	No official record.

### FIFTH CATEGORY—(31,818 - 42,376.8 CU. FT.)

#### DURATION

World Class Record .....	61 hr. 30 min.
F. Bourlouzki and A. Aliochine, USSR, from Moscow to Charaboulski, Apr. 3-6, 1939.	
National (U.S.) Record .....	26 hr. 48 min.
E. J. Hill and A. G. Schlosser, Ford Airport to Montale, Va., July 4-5, 1927.	

# OFFICIAL RECORDS

**DISTANCE**  
 World Class Record \_\_\_\_\_ 1,056,950 mi.  
 F. Bourlouzki and A. Aliochine, USSR, from Moscow to Charaboulski,  
 region of Koustanai, Apr. 3-6, 1939.  
 National (U.S.) Record \_\_\_\_\_ 571.877 mi.  
 S. A. U. Rasmussen, Ford Airport to Hookerton, N. C., July 4-5, 1927.

**ALTITUDE**  
 World Class Record \_\_\_\_\_ 27,718 ft.  
 Alexei Rostine, USSR, VR-70 Balloon, 29,451.876 cu. ft., at Dolgoproud-  
 naia, Oct. 4, 1940.  
 National (U.S.) Record \_\_\_\_\_ No official record

## SIXTH CATEGORY—(42,411.8 - 56,502.4 CU. FT.)

**DURATION**  
 World Class Record \_\_\_\_\_ 69 hr. 20 min.  
 Boris Nevernov and Semion Gaiguerov, USSR, VR-73 Balloon, 50,357.764  
 cu. ft., from Dolgoproudnaia to Novosibirsk, Mar. 13-16, 1941.  
 National (U.S.) Record \_\_\_\_\_ 26 hr. 46 min.  
 E. J. Hill and A. G. Schlosser, Ford Airport to Montvale, Va., July  
 4-5, 1927.

**DISTANCE**  
 World Class Record \_\_\_\_\_ 1,719,215 mi.  
 Boris Nevernov and Semion Gaiguerov, USSR, VR-73 Balloon, 50,357.764  
 cu. ft., from Dolgoproudnaia to Novosibirsk, Mar. 13-16, 1941.  
 National (U.S.) Record \_\_\_\_\_ 571.877 mi.  
 S. A. U. Rasmussen, Ford Airport to Hookerton, N. C., July 4-5, 1927.

**ALTITUDE**  
 World Class Record \_\_\_\_\_ 27,718 ft.  
 Alexei Rostine, USSR, VR-70 Balloon, 29,451.876 cu. ft., at Dolgoproud-  
 naia, Oct. 4, 1940.  
 National (U.S.) Record \_\_\_\_\_ No official record

## SEVENTH CATEGORY—(56,537.7 - 77,690.8 CU. FT.)

**DURATION**  
 World Class Record \_\_\_\_\_ 69 hr. 20 min.  
 Boris Nevernov and Semion Gaiguerov, USSR, VR-73 Balloon, 50,357.764  
 cu. ft., from Dolgoproudnaia to Novosibirsk, Mar. 13-16, 1941.  
 National (U.S.) Record \_\_\_\_\_ 51 hr. 00 min.  
 T. G. W. Settle and C. H. Kendall, Gordon-Bennett Balloon Race,  
 Chicago, Ill., Sept. 2-4, 1933.

**DISTANCE**  
 World Class Record \_\_\_\_\_ 1,719,215 mi.  
 Boris Nevernov and Semion Gaiguerov, USSR, VR-73 Balloon, 50,357.764  
 cu. ft., from Dolgoproudnaia to Novosibirsk, Mar. 13-16, 1941.  
 National (U.S.) Record \_\_\_\_\_ 963.123 mi.  
 T. G. W. Settle and Wilfred Bushnell, from Basle, Switzerland to  
 Daugieliski, Poland, Sept. 25-27, 1932.

**ALTITUDE**  
 World Class Record \_\_\_\_\_ 30,755 ft.  
 Josef Emmer, Austria, *OE-Marek Emmer II* Balloon, Vienna-Lac de  
 Nuesiedl, Sept. 25-27, 1937.  
 National (U.S.) Record \_\_\_\_\_ No official record

## EIGHTH CATEGORY—(77,706 - 158,942 CU. FT.)

**DURATION**  
 World Class Record \_\_\_\_\_ 69 hr. 20 min.  
 Boris Nevernov and Semion Gaiguerov, USSR, VR-73 Balloon, 50,357.764  
 cu. ft., from Dolgoproudnaia to Novosibirsk, Mar. 13-16, 1941.  
 National (U.S.) Record \_\_\_\_\_ 51 hr. 00 min.  
 T. G. W. Settle and C. H. Kendall, Gordon-Bennett Balloon Race,  
 Chicago, Ill., Sept. 2-4, 1933.

**DISTANCE**  
 World Class Record \_\_\_\_\_ 1,719,215 mi.  
 Boris Nevernov and Semion Gaiguerov, USSR, VR-73 Balloon, 50,357.764  
 cu. ft., from Dolgoproudnaia to Novosibirsk, Mar. 13-16, 1941.  
 National (U.S.) Record \_\_\_\_\_ 963.123 mi.  
 T. G. W. Settle and Wilfred Bushnell, from Basle, Switzerland to  
 Daugieliski, Poland, Sept. 25-27, 1932.

## The AIRCRAFT YEAR BOOK

### ALTITUDE

World Class Record	30,755 ft
Josef Emmer, Austria, <i>OE-Marek Emmer II</i> Balloon, Vienna-Lac de Neusiedl, Sept. 25-27, 1937.	
National (U.S.) Record	28,508 ft
Capt. Hawthorne C. Gray, Scott Field, Belleville, Ill., Mar. 9, 1927.	

#### NINTH CATEGORY—(105,977 - 141,256 CU. FT.)

### DURATION

World Class Record	69 hr. 20 min.
Boris Nevernov and Semion Gaiguerov, USSR, VR-73 Balloon, 50,357,764 cu. ft., from Dolgoproudnaia to Novosibirsk, Mar. 13-16, 1941.	
National (U.S.) Record	51 hr. 00 min.
T. G. W. Settle and C. H. Kendall, Gordon-Bennett Balloon Race, Chicago, Ill., Sept. 2-4, 1933.	

### DISTANCE

World Class Record	1,719.215 mi.
Boris Nevernov and Semion Gaiguerov, USSR, VR-73 Balloon, 50,357,764 cu. ft., from Dolgoproudnaia to Novosibirsk, Mar. 13-16, 1941.	
National (U.S.) Record	963.123 mi.
T. G. W. Settle and Wilfred Bushnell, from Basle, Switzerland to Daugieliski, Poland, Sept. 25-27, 1932.	

### ALTITUDE

World Class Record	32,811 ft.
Z. J. Burzynski, Poland, at Legjonowo, Mar. 29, 1936.	
National (U.S.) Record	28,508 ft.
Capt. Hawthorne C. Gray, at Scott Field, Belleville, Ill., Sept. 2-4, 1933.	

#### TENTH CATEGORY—(141,291.3 CU. FT. OR OVER)

### DURATION

World Class Record	87 hr. 00 min.
H. Kaulen, Germany, Dec. 13-17, 1913.	
National (U.S.) Record	51 hr. 00 min.
Lt. Comdr. T. G. W. Settle and Lt. Charles H. Kendall, Gordon-Bennett Balloon Race, Chicago, Ill., Sept. 2-4, 1933.	

### DISTANCE

World Class Record	1,896.856 mi.
Berliner, Germany, Feb. 8-10, 1914.	
National (U.S.) Record	1,172.898 mi.
A. R. Hawley, St. Louis, Mo. to Lake Tschotogama, Canada, Oct. 17-19, 1910.	

### ALTITUDE

World Class Record	72,395 ft.
Capt. Orvil Anderson and Capt. Albert Stevens, United States, <i>Explorer II</i> , take-off approximately 11 miles southwest of Rapid City, S. D., landing on school reserve land approximately 12 miles south of White Lake, S. D., Nov. 11, 1935.	
National (U.S.) Record	Same as above.

## FEMININE RECORDS

### GLIDERS—(CLASS D)

(Single-Place)

#### DISTANCE IN A STRAIGHT LINE

World Class Record	465.532 mi.
O. Klepikova, USSR, Rot-Front 7 glider from Moscow to Otradnoie, region of Stalingrad, July 6, 1939.	
National (U.S.) Record	201.450 mi.
Miss Betsy Woodward, Briegleb BG-7 Sailplane, from Grand Prairie, Tex. to Sweetwater, Tex., Aug. 22, 1952.	

#### ALTITUDE GAINED

World Class Record	27,994.4 ft.
Miss Betsy Woodward, United States, Pratt-Read Sailplane, N 63195, Bishop, California, April 14, 1955.	
National (U.S.) Record	Same as above.

#### ALTITUDE ABOVE SEA LEVEL

World Class Record	39,994 ft.
Miss Betsy Woodward, United States, Pratt-Read Sailplane, N 63195, Bishop, California, April 14, 1955.	
National (U.S.) Record	Same as above.

## OFFICIAL RECORDS

### DISTANCE TO A PREDETERMINED DESTINATION

World Class Record ..... 315.067 mi.  
 Mrs. M. Choisnet-Gohard, France, Air-100 Sailplane No. 14, from  
 Beynes-Thiverval to Bordeaux-Leognan, Apr. 17, 1954.

National (U.S.) Record ..... 76.752 mi.  
 Miss Betsy Woodward, Briegleb BG-7 Sailplane, from Grand Prairie,  
 Tex. to Stephenville, Tex., Aug. 29, 1952.

### DISTANCE TO A PREDETERMINED POINT WITH RETURN TO POINT OF DEPARTURE

World Class Record ..... 341.9 kilometers (212.446 mi.)  
 Barbara Dankowska, Poland, Jaskolka SP-1489 Sailplane, Lisie Katy-  
 Kobylnica-Lisie Katy Course, May 23, 1956.

National (U.S.) Record ..... 193.848 kilometers (120.452 mi.)  
 Miss Betsy Woodward, Briegleb BG-7 Sailplane N1741B, from Grand  
 Prairie to Mineral Wells, Texas and return, August 21, 1952.

### SPEED FOR 62.137 MI. OVER A TRIANGULAR COURSE

World Class Record ..... 46.953 mph.  
 Wanda Szemplinska, Poland, Jaskolka SP-1311 Sailplane, Leszno-  
 Rawicz-Gostyn-Leszno Course, May 15, 1954.

National (U.S.) Record ..... 28.685 mph.  
 Miss Betsy Woodward, Briegleb BG-7 Sailplane, Grand Prairie-Russell-Don's Air Park-  
 Grand Prairie, Tex. Course, Aug. 28, 1952.

### SPEED FOR 300 KILOMETERS (AT LEAST) OVER A TRIANGULAR COURSE

World Class Record ..... Speed, 53.859 kmph (33.466 mph)  
 Cvetka Klančnik, Yugoslavia, Weihe sailplane, Vrsac-Ecka-Omoljica-  
 Vrsac Course, June 6, 1956.

National (U.S.) Record ..... None established

## GLIDERS—(CLASS D)

(Multi-Place)

### DISTANCE IN A STRAIGHT LINE

World Class Record ..... 275.711 mi.  
 O. Klepikova and V. Bardina, USSR, Stakanovetz glider, from Toula  
 to Konotop, June 19, 1940.

National (U.S.) Record ..... 170.316 mi.  
 Miss Betsy Woodward, pilot; Anna Saudek, passenger, Pratt Read  
 Sailplane N63189, Adelanto, Calif. to Las Vegas, Nevada, July 11, 1952.

### ALTITUDE ABOVE SEA LEVEL

World Class Record ..... 23,204 ft  
 Mrs. M. Choisnet-Gohard, pilot; Miss J. Queyrel, passenger; France,  
 Castel Mauboussin CM glider No. 02, St. Auban sur Durance, Jan. 18,  
 1951.

National (U.S.) Record ..... No official record.

### ALTITUDE GAINED

World Class Record ..... 19,981 ft.  
 Mrs. M. Choisnet-Gohard, pilot; Miss J. Queyrel, passenger; France,  
 Castel Mauboussin CM glider No. 02, St. Auban sur Durance, Jan. 18,  
 1951.

National (U.S.) Record ..... 18,797 ft.  
 Miss Betsy Woodward, pilot; Vera Gere, passenger; Schweizer TG-5  
 glider, N-67871, El Mirage Field, Adelanto, Cal., Apr. 7, 1950.

### DISTANCE TO A PREDETERMINED DESTINATION

World Class Record ..... 239.942 mi.  
 Miss Francine Abadie and Miss Jacqueline Trubert, France, Castel 25  
 Bi-place Sailplane, from La Ferte-Alais to Cognac, April 16, 1955.

National (U.S.) Record ..... 170.316 mi.  
 Miss Betsy Woodward, pilot Anna Saudek, passenger, Pratt Read  
 Sailplane N63189, Adelanto, Calif., to Las Vegas, Nevada, July 11, 1952.

### DISTANCE TO A PREDETERMINED DESTINATION WITH RETURN TO POINT OF DEPARTURE

World Class Record ..... 341.9 kilometers (212.446 mi.)  
 Pelagia Majewska, pilot, Halina Oleksiewicz, passenger, Poland,  
 Bocian SP-1564 Sailplane, Lisie Katy-Kobylnica-Lisie Katy Course,  
 May 23, 1956.

National (U.S.) Record ..... None established

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### SPEED FOR 62.137 MI. OVER A TRIANGULAR COURSE

World Class Record ..... 39.945 mph.  
 Anna Samocadova, pilot; A. V. Neventchannaya, passenger; U.S.S.R., A-10 glider No. 1,  
 Grabtsevo Makarova-Peremychl course, July 30, 1952.  
 National (U.S.) Record ..... No official record.

### SPEED FOR 200 KILOMETERS (AT LEAST) OVER A TRIANGULAR COURSE

World Class Record ..... Speed, 66.551 kmph (41.353 mph)  
 Pelagia Majewska, pilot, Wladyslawa Adamczyk, passenger; Poland,  
 Bocian SP-1564 Sailplane, Lisie Katy-Zbelwo-Przepalkovo-Lisie Katy  
 Course, May 24, 1956.  
 National (U.S.) Record ..... None established

## BALLOONS—(CLASS A)

### FOURTH CATEGORY—(14,126-21,188.4 CU. FT.)

**DURATION**  
 World Class Record ..... 22 hr. 40 min.  
 A. Kondratyeva, USSR, SSSR BP-31 Balloon, Moscow to Loukina  
 Polie, May 14-15, 1939.  
 National (U.S.) Record ..... No official record.

**DISTANCE**  
 World Class Record ..... 318.128 mi.  
 Mrs. Paulette Weber, France, F-AMAO Balloon of the Roubaix  
 (Nord) at Villers, May 8-9, 1953.  
 National (U.S.) Record ..... No official record.

**ALTITUDE** ..... No official record.

### SIXTH CATEGORY (10,629.514 - 56,502.4 CU. FT.)

**DURATION**  
 World Class Record ..... 34 hr. 21 min. 36 sec.  
 Miss L. Ivanova and Miss S. Tonkova, USSR, take-off near the Central  
 Aerology Observatory at Dolgoproudnaia, landing at Barachevo,  
 Apr. 22-24, 1948.  
 National (U.S.) Record ..... No official record.

**DISTANCE** ..... No official record.  
**ALTITUDE** ..... No official record.

### SEVENTH CATEGORY (56,537.714 - 77,690.8 CU. FT.)

**DURATION**  
 World Class Record ..... 34 hr. 21 min. 36 sec.  
 Miss L. Ivanova and Miss S. Tonkova, USSR, take-off near the Central  
 Aerology Observatory at Dolgoproudnaia, landing at Barachevo,  
 Apr. 22-24, 1948.  
 National (U.S.) Record ..... No official record.

**DISTANCE** ..... No official record.  
**ALTITUDE** ..... No official record.

### EIGHTH CATEGORY (77,726.114 - 105,942 CU. FT.)

**DURATION**  
 World Class Record ..... 34 hr. 21 min. 36 sec.  
 Miss L. Ivanova and Miss S. Tonkova, USSR, take-off near the Central  
 Aerology Observatory at Dolgoproudnaia, landing at Barachevo,  
 Apr. 22-24, 1948.  
 National (U.S.) Record ..... No official record.

**DISTANCE** ..... No official record.  
**ALTITUDE** ..... No official record.

### NINTH CATEGORY (105,977.314 - 141,256 CU. FT.)

**DURATION**  
 World Class Record ..... 34 hr. 21 min. 36 sec.  
 Miss L. Ivanova and Miss S. Tonkova, USSR, take-off near the Central  
 Aerology Observatory at Dolgoproudnaia, landing at Barachevo,  
 Apr. 22-24, 1948.  
 National (U.S.) Record ..... No official record.

**DISTANCE** ..... No official record.  
**ALTITUDE** ..... No official record.

### TENTH CATEGORY (141,291.314 CU. FT. OR OVER)

**DURATION**  
 World Class Record ..... 34 hr. 21 min. 36 sec.  
 Miss L. Ivanova and Miss S. Tonkova, USSR, take-off near the Central  
 Aerology Observatory at Dolgoproudnaia, landing at Barachevo,  
 Apr. 22-24, 1948.  
 National (U.S.) Record ..... No official record.

**DISTANCE** ..... No official record.  
**ALTITUDE** ..... No official record.

# OFFICIAL RECORDS

## ROTORPLANES—(Class E)

DISTANCE AIRLINE	
World Class Record	67.713 mi.
Miss Hanna Reitsch, Germany, FW. 61. V2, D-EKRA helicopter, from Stendal airport to Tempelhof airport, Oct. 25, 1937.	
National (U.S.) Record	No official record.
DISTANCE, CLOSED CIRCUIT	No official record.
ALTITUDE	No official record.
SPEED FOR 12.43 MI.	No official record.

## F.A.I. COURSE RECORDS

LOS ANGELES TO NEW YORK, N. Y.	
World Class Record	652.522 mph.
Lt. Col. Robert Scott, USAF, United States, Republic F-84F Thunderstreak, Wright J-65B3 jet engine, from Los Angeles International Airport to Floyd Bennett Field, Brooklyn, March 9, 1955. Distance (Center to Center): 2,445.90 statute miles. Elapsed time (Center to Center): 3 hrs., 44 min., 53.88 sec.	
National (U.S.) Record	Same as above.
NEW YORK, N. Y., TO LOS ANGELES, CAL.	
World Class Record	554.949 mph.
Lt. John M. Conroy, USANG, United States, North American F-86 A Sabre Jet, General Electric J-47-13 jet engine, May 21-22, 1955 (GMT). Distance: (Center to Center): 2,445.9 statute miles. Elapsed time: 4 hrs., 24 min., 26.64 sec.	
National (U.S.) Record	Same as above.
LOS ANGELES-NEW YORK-LOS ANGELES	
World Class Record	432.616 mph.
Lt. John M. Conroy, USANG, United States, North American F-86 A Sabre Jet, General Electric J-47-13 jet engine, May 21-22, 1955 (GMT). Distance, (Twice Center to Center): 4,891.8 statute miles; elapsed time: 11 hrs., 18 min., 27.0 sec.	
National (U.S.) Record	Same as above.
WASHINGTON, D. C. TO HAVANA, CUBA	
World Class Record	314.070 mph.
Woodrow W. Edmondson, United States, North American P-51 monoplane, Packard Rolls Royce 1,450 hp engine, from Washington National Airport to Rancho Boyeros Airport, Nov. 25, 1947. Elapsed Time; 3 hr. 37 min. 28.6 sec.	
National (U.S.) Record	Same as above
HAVANA, CUBA TO WASHINGTON, D. C.	
World Class Record	350.328 mph.
Woodrow W. Edmondson, United States, North American P-51 monoplane, Packard Rolls Royce 1,450 hp engine, from Rancho Boyeros Airport to Washington National Airport, Nov. 27, 1947. Elapsed Time: 3 hr. 15 min. 13 sec.	
National (U.S.) Record	Same as above
CAPETOWN, AFRICA TO LONDON, ENGLAND	
World Class Record	452.760 mph.
W/C A. H. Humphrey, pilot; Sqdn. Ldr. D. Bower and Sqdn. Ldr. R. F. B. Powell, navigators; Great Britain, English Electric Canberra B. MK II WH 699 aircraft, 2 Rolls Royce Avon RA.3 jet engines. Dec. 19, 1953. Elapsed time: 13 hr., 16 min., 25.2 sec.	
National (U.S.) Record	No official record
LONDON, ENGLAND TO ROME, ITALY	
World Class Record	447.219 mph.
John Cunningham and P. O. Bugge, Great Britain, de Havilland Comet DH-106 Mark I, 4 de Havilland Ghost Mark I jet engines, Mar. 16, 1950. Elapsed Time: 1 hr. 58 min. 37 sec.	
National (U.S.) Record	No official record
ROME, ITALY TO LONDON, ENGLAND	
World Class Record	453.308 mph.
John Cunningham and P. O. Bugge, Great Britain, de Havilland Comet DH-106 Mark I, 4 de Havilland Ghost Mark I jet engines, Mar. 16, 1950. Elapsed Time: 1 hr. 58 min. 04 sec.	
National (U.S.) Record	No official record
PARIS, FRANCE TO SAIGON, FRENCH INDO-CHINA	
World Class Record	67.926 mph.



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Miss Maryse Hilsz, France, Caudron Simoun C. 635 airplane, Renault engine, from Le Bourget Airport to Tan Son Nhut Airport, Dec. 19-23, 1937. Elapsed Time: 96 hr. 36 min. 15 sec.	
National (U.S.) Record	No official record.
<b>PARIS, FRANCE TO HANOI, FRENCH INDO-CHINA</b>	
World Class Record	111.976 mph.
Andre Japy, France, Caudron Simoun airplane, Renault 6Q01, number 71 motor, from Le Bourget, Paris to Gia Lam Airport, Hanoi, Nov. 15-18, 1936. Elapsed Time: 50 hr. 59 min. 49 sec.	
<b>NEW YORK, N. Y. TO LONDON, ENGLAND</b>	
World Class Record	Speed, 885.703 kmph (550.349 mph)
Capt. J. W. Hackett, pilot; P. J. Monneypenny, navigator; Great Britain, English Electric Canberra PR Mk. 7 aircraft, 2 Rolls Royce "Avon" turbojet engines, August 23, 1955.	
National (U.S.) Record	Speed, 272.345 kmph (169.227 mph)
Henry T. Merrill and John S. Lambe, pilots; United States, Lockheed Electra Monoplane, Pratt & Whitney SH1 Engine, May 9-10, 1937. Elapsed time: 26 hrs., 29 mins., 45 secs.	
<b>LONDON, ENGLAND TO NEW YORK, N. Y., TO LONDON, ENGLAND</b>	
World Class Record	Speed, 774.935 kmph (481.521 mph)
Capt. J. W. Hackett, pilot; P. J. Monneypenny, navigator; Great Britain, English Electra Canberra PK Mk. 7 aircraft, 2 Rolls Royce "Avon" turbojet engines, August 23, 1955. Elapsed time: 14 hours, 21 minutes, 45.5 seconds.	
National (U.S.) Record	None established
<b>LONDON, ENGLAND TO MELBOURNE, AUSTRALIA</b>	
World Class Record	293.608 mph.
Capt. W. Baillie, pilot; Great Britain, BEA Vickers Viscount 700 G-AMAV airplane, 4 Rolls Royce Dart 503 RDA3 engines, Oct. 8-10, 1953. Elapsed time: 35 hrs., 46 min., 47.6 sec.	
National (U.S.) Record	121.267 mph.
Roscoe Turner and Clyde Pangborn, Boeing 247-D monoplane, 2 Pratt and Whitney supercharged 550 hp engines, Oct. 20-24, 1934.	
<b>LONDON, ENGLAND TO SYDNEY, AUSTRALIA</b>	
World Class Record	130.309 mph.
F/O A. E. Clouston and Victor Ricketts, Great Britain, de Havilland Comet monoplane, 2 D. H. Gipsy VI engines, Mar. 21-26, 1938. Elapsed Time: 80 hr. 56 min.	
National (U.S.) Record	No official record
<b>SYDNEY, AUSTRALIA TO LONDON, ENGLAND</b>	
World Class Record	81.261 mph.
F/O A. E. Clouston and Victor Ricketts, Great Britain, de Havilland Comet monoplane, 2 D. H. Gipsy VI engines, Mar. 21-26, 1938. Elapsed Time: 130 hr. 3 min.	
National (U.S.) Record	No official record.
<b>LONDON, ENGLAND TO WELLINGTON, NEW ZEALAND</b>	
World Class Record	194.657 mph.
Air Commodore N. H. d'Aeth, Squadron Leader J. S. Aldridge, Flight Lt. D. D. Hurditch, and crew, Great Britain, Modified Avro Lancaster Aries, 4 Rolls Royce Merlin engines of 1,200 hp each, Aug. 21-24, 1946. Elapsed Time: 59 hr. 50 min.	
National (U.S.) Record	No official record
<b>WELLINGTON, NEW ZEALAND TO LONDON, ENGLAND</b>	
World Class Record	83.454 mph
A. F. Clouston and Victor Ricketts, Great Britain; D. H. Comet airplane, 2 D. H. Gipsy VI engines, Mar. 20-26, 1938. Elapsed Time: 140 hr. 12 min.	
National (U.S.) Record	No official record
<b>LONDON, ENGLAND TO CAPETOWN, AFRICA</b>	
World Class Record	486.581 mph.
W/C G. G. Petty, pilot; Sqdn. Ldr. T. P. MacGarry and Sqdn. Ldr. J. McDonald Craig, navigators; English Electric Canberra B. MK II, WH 699 aircraft, 2 Rolls Royce Avon R.A.3 jet engines, Dec. 17, 1953. Elapsed time: 12 hr., 21 min., 3.8 sec.	
National (U.S.) Record	No official record.
<b>LONDON, ENGLAND TO KARACHI, INDIA</b>	
World Class Record	256.110 mph
S/Ldr. Neville Duke, Great Britain, Hawker Fury K.857, Bristol Centaurus XVIII 2,500 hp engine, May 12, 1949 Elapsed time: 15 hr., 18 min., 36 sec.	
National (U.S.) Record	No official record.

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LONDON, ENGLAND TO DARWIN, AUSTRALIA		
World Class Record	189.523 mph.	
Air Commodore N. H. d'Aeth, Squadron Leader J. S. Aldridge, Flight Lt. D. D. Hurditch, and crew, Great Britain, Modified Avro Lancaster <i>Aries</i> , 4 Rolls Royce Merlin engines, 1,200 hp each, Aug. 21-22, 1946. Elapsed Time: 45 hr. 35 min.		
National (U.S.) Record	No official record.	
PARIS, FRANCE TO TANANARIVO, MADAGASCAR		
World Class Record	94.391 mph.	
Genin and Robert, France, Caudron Simoun airplane, Renault 180 hp engine, from Le Bourget airport to Ivato airport, Dec. 18-21, 1935. Elapsed Time: 57 hr. 35 min. 21 sec.		
National (U.S.) Record	No official record.	
TOKYO, JAPAN TO LONDON, ENGLAND		
World Class Record	101.193 mph.	
Masaaki Linuma and Kenji Tsukaloshi, Japan, Kamikase monoplane, type <i>Karigane</i> , Mitsubishi <i>Nakajima</i> 550 hp engine, Apr. 6-9, 1937. Elapsed Time: 94 hr. 17 min. 56 sec.		
National (U.S.) Record	No official record.	
ROME, ITALY TO RIO DE JANEIRO, BRAZIL		
World Class Record	137.923 mph.	
Attilio Biseo, Magg. Amedeo Paradisi, S. Ten, Giovanni Vitalini Sacconi, pilots; Ubaldo Ardu, mechanic; Giovanni Cubeddu, radio operator; Italy, S.79 I-Bise airplane, 3 Alfa Romeo 126 RC.34 750 hp engines, Jan. 24-25, 1938. Elapsed Time: 41 hr. 32 min.		
National (U.S.) Record	No official record.	
ROME, ITALY TO ADDIS ABABA, ETHIOPIA		
World Class Record	242.988 mph.	
M. Lualdi, G. Mazzotti and E. Valente, pilots; S. Pinna, radio telegrapher and G. Guerrini, mechanic; Italy; Fiat BR. 20 L airplane, 2 Fiat Asso 80 1,000 hp motors, Mar. 6-7, 1939. Elapsed Time: 11 hr. 25 min.		
National (U.S.) Record	No official record.	
BERLIN, GERMANY TO NEW YORK, N. Y.,		
World Class Record	158.759 mph.	
Alfred Henke and Rudolf Freiherr von Moreau, pilots; Paul Dierberg, radiomechanicien, and Walter Kober, radiotelegraphiste; Germany, Focke-Wulf FW 200 Condor airplane, 4 BMW 132 L motors, 750 hp each, Aug. 10-11, 1938. Elapsed Time: 24 hr. 56 min. 12 sec.		
National (U.S.) Record	No official record.	
NEW YORK, N. Y. TO BERLIN, GERMANY		
World Class Record	199.409 mph.	
Alfred Henke and Rudolf Freiherr von Moreau, pilots; Paul Dierberg, radiomechanicien, and Walter Kober, radiotelegraphiste; Germany; Focke-Wulf FW 200 Condor airplane, 4 BMW 132 L motors, 750 hp each, Aug. 13-14, 1938. Elapsed Time: 19 hr. 55 min. 1 sec.		
National (U.S.) Record	No official record.	
BERLIN, GERMANY TO TOKYO, JAPAN		
World Class Record	119.494 mph.	
Alfred Henke and H. R. Freiherr von Moreau, pilots; P. Dierberg, radiomechanicien; W. Kober, radiotelegraphiste, and G. Kohne, mechanic; Germany, Focke-Wulf FW 200 Condor airplane; 4 BMW 132 L motors, 750 hp each, from Tempelhof to Tachikawa, Nov. 28-30, 1938. Elapsed Time: 46 hr. 18 min. 19 sec.		
National (U.S.) Record	No official record.	
BERLIN, GERMANY TO HANOI, FRENCH INDO-CHINA		
World Class Record	151 mph.	
Alfred Henke and H. R. Freiherr von Moreau, pilots; P. Dierberg, radiomechanicien; W. Kober, radiotelegraphiste, and G. Kohne, mechanic; Germany, Focke-Wulf FW 200 Condor airplane; 4 BMW 132 L motors, 750 hp each, from Tempelhof to Gia Lam, Nov. 28-30, 1938. Elapsed Time: 34 hr. 17 min. 27 sec.		
National (U.S.) Record	No official record.	
LONDON, ENGLAND TO PARIS, FRANCE		
World Class Record	669.475 mph.	
Lt. Comdr. M. J. Lithgow, Great Britain; Vickers-Armstrong Supermarine Swift Mark IV, WK.198 aircraft, Rolls Royce Avon RA.7 jet engine, July 5, 1953.		
National (U.S.) Record	No official record.	
PARIS, FRANCE TO LONDON, ENGLAND		
World Class Record	664.425 mph.	
Lt. Comdr. M. J. Lithgow, Great Britain, Vickers-Armstrong Supermarine Swift Mark IV, WK.198 aircraft, Rolls Royce RA.7 jet engine, July 5, 1953.		
National (U.S.) Record	No official record.	

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- LONDON, ENGLAND TO CAIRO, EGYPT**  
 World Class Record ..... Speed, 888.054 kmph (551.810 mph)  
 Peter Hillwood, D.F.C. pilot, D. A. Watson, D.F.C., navigator, Great Britain, English Electric Canberra Mk. 8 2 Rolls Royce "Avon" engines, February 16, 1956. Elapsed time: 3 hours, 57 minutes, 18.9 seconds.  
 National (U.S.) Record ..... None established
- CAIRO, EGYPT TO LONDON, ENGLAND**  
 World Class Record ..... 385.887 mhp.  
 John Cunningham, D.S.O., D.F.C., Great Britain, de Havilland DH 106 Mark I Comet, 4 Ghost D. Gt. 3 jet engines, May 11, 1950. Elapsed Time: 5 hr. 39 min. 21.7 sec.  
 National (U.S.) Record ..... No official record.
- LONDON, ENGLAND TO COPENHAGEN, DENMARK**  
 World Class Record ..... 541.417 mph.  
 Janusz Zurakowski, Great Britain, Gloster Meteor Mk. F8 V2468, 2 Rolls Royce Derwent V jet engines, Apr. 4, 1950. Elapsed Time: 1 hr. 5 min. 5 sec.  
 National (U.S.) Record ..... No official record
- COPENHAGEN, DENMARK TO LONDON, ENGLAND**  
 World Class Record ..... 500.670 mph.  
 Janusz Zurakowski, Great Britain, Gloster Meteor Mk. F8, 2 Rolls Royce Derwent V jet engines, Apr. 4, 1950. Elapsed Time; 1 hr. 11 min. 17 sec.  
 National (U.S.) Record ..... No official record
- GIBRALTAR TO LONDON, ENGLAND**  
 World Class Record ..... 435.886 mph.  
 Group Capt. A. C. P. Carner, Great Britain, de Havilland Hornet F Mark III, 2 Rolls Royce Merlin 130, 2,030 hp engines, Sept. 19, 1949. Elapsed Time: 2 hr. 30 min. 21 sec.  
 National (U.S.) Record ..... No official record.
- LONDON, ENGLAND TO LA VALETTE, FRANCE**  
 World Class Record ..... 387.896 mph.  
 Lt. Commander W. R. MacWhirter, Lt. P. C. S. Chilton, Lt. D. A. Hook and Lt. D. W. Morgan, Great Britain, Hawker XI Sea Fury, Bristol Centaurus XVIII 2,560 hp engine, July 19, 1949. Elapsed time: 3 hr. 20 min. 49 sec.  
 National (U.S.) Record ..... No official record.
- LONDON, ENGLAND TO KHARTOUM, EGYPT**  
 World Class Record ..... 481.126 mph.  
 Grp. Capt. John Cunningham, Great Britain, de Havilland Comet, Series 2, G-AMXA, 4 Rolls Royce Avon 503 engines, Jan. 22, 1954. Elapsed time: 6 hr., 22 min., 7.2 sec.  
 National (U.S.) Record ..... No official record.
- BELFAST, IRELAND TO GANDER, NEWFOUNDLAND**  
 World Class Record ..... 481.099 mph.  
 Roland P. Beamont, pilot; D. A. Watson, navigator; R. Rylands, radio operator, Great Britain, English Electric Canberra B. Mark 2, WD 940 aircraft, two Rolls Royce Avon RA 3 jet engines, Aug. 31, 1951. Distance: 2,071.7 mi.; Duration: 4 hr. 18 min. 24.4 sec.  
 National (U.S.) Record ..... No official record.
- LONDON, ENGLAND TO BRUSSELS, BELGIUM**  
 World Class Record ..... 665.890 mph.  
 David W. Morgan, Great Britain, Vickers Armstrong Supermarine Swift, Rolls Royce Avon R.A.7 jet engine, July 10, 1952. Elapsed time: 18 min., 3.3 sec.  
 National (U.S.) Record ..... No official record.
- LONDON, ENGLAND TO TRIPOLI, LYBIA**  
 World Class Record ..... 538.119 mph.  
 Squad. Ldr. L. C. E. De Vigne, pilot; Flt. Lt. P. A. Hunt, navigator; Great Britain, English Electric Canberra, BMK2, 2 Rolls Royce Avon MK.1 jet engines, from London Airport to Castel Benito Airport, Feb. 18, 1952. Elapsed time: 2 hr., 41 min., 49.5 sec.
- GANDER, NEWFOUNDLAND TO BELFAST, IRELAND**  
 World Class Record ..... 605.527 mph.  
 Wing Comm. R. P. Beamont, pilot; P. Hillwood, co-pilot; D. A. Watson, navigator, Great Britain, English Electric Canberra VX 185, two Rolls Royce Avon engines, Aug. 26, 1952.
- BELFAST-GANDER-BELFAST**  
 World Class Record ..... 411.992 mph.  
 Wing Comm. R. P. Beamont, pilot; P. Hillwood, co-pilot; D. A. Watson, navigator, Great Britain, English Electric Canberra VX 185, two Rolls Royce Avon engines, Aug. 26, 1952.

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### LONDON, ENGLAND, TO CHRISTCHURCH, NEW ZEALAND

World Class Record ..... 493.540 mph

Flt. Lt. R. L. E. Burton, pilot; Flt. Lt. D. H. Gannon, navigator; Great Britain, English Electric Canberra P.R. MK III WE 139 airplane, 2 Rolls Royce Avon R.A. 3 jet engines, Oct. 8-9, 1953. Elapsed time: 23 hr., 50 min., 42 sec.

National (U.S.) Record ..... No official record.

### LOS ANGELES, CALIFORNIA, TO PARIS, FRANCE

World Class Record ..... 276.311 mph.

Capt. Charles Billet, pilot; Philippe Wertheimer, co-pilot; Robert Girard, radio operator; Pierre Lemaitre, mechanic, France; Douglas DC-6, Pratt & Whitney R-2800 engine on May 28-29, 1953. Elapsed time: 20 hr., 26 min.

National (U.S.) Record ..... No official record.

### LONDON, ENGLAND, TO BASRA, IRAQ

World Class Record ..... 544.327 mph.

Flight Lieut. R. L. E. Burton, pilot; Flight Lieut. D. H. Gannon, Navigator; Great Britain; English Electric Canberra P.R. MK III aircraft, 2 Rolls Royce Avon R.A. 3 jet engines, Oct. 8, 1953. Elapsed time: 5 hr., 11 min., 5.6 sec.

National (U.S.) Record ..... No official record.

### LONDON, ENGLAND, TO COLOMBO, CEYLON

World Class Record ..... 519.468 mph.

Wing Comdr. L. M. Hodges, pilot; Sqdn. Ldr. R. Currie, Navigator, Great Britain; English Electric Canberra P.R. MK VII, 2 Rolls Royce Avon R.A. 7 jet engines, Oct. 8-9, 1953. Elapsed time: 10 hr., 25 min., 21.5 sec.

National (U.S.) Record ..... No official record.

### LONDON, ENGLAND, TO AMSTERDAM, HOLLAND

World Class Record ..... 571.511 mph.

Lt. J. R. S. Overbury, RN, pilot; Great Britain, Hawker Sea Hawk F.B. 3 airplane, Rolls Royce Nene Mark 101 jet engine, from Bowington Airport to Schipol Airport, July 29, 1954. Elapsed time: 23 min., 30.9 sec.

National (U.S.) Record ..... No official record.

### HAVANA, CUBA, TO MADRID, SPAIN (COMMERCIAL TRANSPORT)

World Class Record ..... 303.936 mph.

Ramon de la Pena Moulie, pilot; Sres Pena, Imaz, Martinez, German, G. Usera, Balaguer y San Salvador, crew; Spain, Iberian Airlines Lockheed Super Constellation, L-1049E, 4 Wright Turbo Compound engines, October 23-24, 1954. Elapsed time; 15 hr., 20 min.

National (U.S.) Record ..... No official record.

### NEW YORK, NEW YORK, TO MADRID, SPAIN (COMMERCIAL TRANSPORT)

World Class Record ..... 378.973 mph.

Cecilio Imaz Batida, pilot; Bengoa, Rein Loring, G. Usera, Vega S. Salvador and Vicente y Triguero, crew; Spain, Iberian Airlines Lockheed Super Constellation, L-1049E, 4 Wright Turbo Compound engines, November 26-27, 1954. Elapsed time: 9 hr., 26 min.

National (U.S.) Record ..... No official record.

### PARIS, FRANCE, TO NICE, FRANCE

World Class Record ..... 610.454 mph.

Gerard Muselli, pilot; E. Cornignon-Molinier, navigator; France, Mystere IV N, "Avon" turbojet, with afterburner, June 18, 1955. Elapsed time: 41 min., 55.8 sec.

National (U.S.) Record ..... No official record.

### OTTAWA, CANADA, TO LONDON, ENGLAND

World Class Record ..... 496.824 mph.

Sqd. Ldr. I. G. Broom, pilot; Sqd. Ldr. D. Bower and Sqd. Ldr. R. A. Seymour, navigators; Great Britain, English Electric Canberra "Aries IV," 2 Rolls Royce "Avon" Mark I jet engines, June 27-28, 1955. Elapsed time: 6 hr., 42 min., 12 sec.

National (U.S.) Record ..... No official record.

### LONDON, ENGLAND TO BAGHDAD, IRAQ

World Class Record ..... Speed, 842.463 mph (523.461 mph)

Wing Comdr. John Finch, pilot; Squad. Ldr. J. R. Tanner, co-pilot; Flt. Lt. A. Sacks and Flt. Lt. D. Fish, navigators; J.C.L.R. LeBlanc and B. A. Meries; Great Britain, Vickers Armstrong Valiant B1 WP 209 aircraft, 2 Rolls Royce "Avon" RA 14 turbojet engines, August 7-8, 1955. Elapsed time: 4 hours, 51 minutes, 28.8 seconds.

National (U.S.) Record ..... None established

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### SINGAPORE, MALAYA TO DARWIN, AUSTRALIA

World Class Record ..... Speed, 834.218 kmph (518.358 mph)  
Wing. Comdr. John Finch, pilot; Sqd. Ldr. J. R. Tanner, co-pilot;  
Flt. Lt. A. Sacks and Flt. Lt. D. Fish, navigators; J.C.I.R. LaBelle  
and B. A. Meries; Great Britain, Vickers Armstrong Valiant B1 WP  
209 aircraft, 2 Rolls Royce "Avon" RA 14 turbojet engines, July 31,  
1955. Elapsed time: 4 hours, 00 minutes, 50.1 seconds.  
National (U.S.) Record ..... None established

### LONDON, ENGLAND TO NEW YORK, N. Y.

World Class Record ..... Speed, 742.097 kmph (461.117 mph)  
Capt. J. W. Hackett, pilot; P. J. Monneypenny, navigator; Great  
Britain, English Electric Canberra PR MK. 7 aircraft, 2 Rolls Royce  
"Avon" turbojet engines, August 23, 1955. Elapsed time: 7 hours, 29  
minutes, 56.7 seconds.  
National (U.S.) Record ..... None established

## OFFICIAL NATIONAL TRANSCONTINENTAL AND INTER-CITY RECORDS

### WEST TO EAST TRANSCONTINENTAL (JET PROPELLED)

Lt. Col. Robert R. Scott, USAF, United States, Republic F-84F Thunderstreak, Wright  
J-65B3 jet engine, from International Airport, Los Angeles, Calif., to Floyd Bennett Field,  
Brooklyn, N. Y., March 9, 1955. Distance (Center to Center): 2,445.90 statute miles; Elapsed  
time (Center to Center): 3 hours, 44 minutes, 53.88 seconds. Average Speed: 652.522 mph.

### WEST TO EAST TRANSCONTINENTAL (MULTI-ENGINE MILITARY AIRCRAFT)

Col. C. S. Irvine, pilot; Lt. Col. G. R. Stanley, co-pilot; Lt. Col. F. J. Shannon, Maj. K. I.  
Royer, Capt. W. J. Bennett, Capt. R. A. Saltzman, M/Sgt. D. E. West, T/Sgt. J. F.  
Broughton, crew; USAAF; Boeing B-29 monoplane, 4 Wright R-3350-23A engines; from  
Burbank, Cal. to Floyd Bennett Field, Brooklyn, Dec. 11, 1945. Distance: 2,457 mi. Elapsed  
Time: 5 hr. 27 min. 19.2 sec. Average Speed: 450.385 mph.

### LOS ANGELES, CAL. TO MEXICO CITY, D. F.

A. Paul Mantz, North American F-51 monoplane, NX-1204, Packard built Rolls Royce  
Merlin 1,450 hp engine, from Lockheed Air Terminal, Burbank to Mexico City Airport,  
Mar. 8, 1950. Distance: 1,560.767 mi. Elapsed Time: 3 hr. 34 min. 45 sec. Average Speed:  
436.070 mph.

### WEST TO EAST TRANSCONTINENTAL (SINGLE RECIPROCATING ENGINE-SOLO)

Joe DeBona, North American F-51C, N 5528 N, Packard Merlin 1650 engine, from Los An-  
geles International Airport to Idlewild Airport, Mar. 31, 1954. Distance: 2,469.92 mi. Elapsed  
time: 4 hr., 24 min., 17 sec. Average speed: 560.744 mph.

### WEST TO EAST TRANSCONTINENTAL (COMMERCIAL TRANSPORT AIRCRAFT)

Capt. Joseph B. Glass, pilot; J. W. Hayes, 1st officer; H. W. Hornbach, flight engineer; and  
39 passengers; American Airlines' Douglas DC-7, 4 Wright Turbo Compound 3,250 hp. en-  
gines, from Los Angeles International Airport to Idlewild, N. Y., Mar. 29, 1954. Distance:  
2,469.92 mi. Elapsed time: 5 hr., 10 min. Average speed: 400.528 mph.

### EAST TO WEST TRANSCONTINENTAL (SINGLE RECIPROCATING ENGINE-SOLO)

A. Paul Mantz, North American P-51 monoplane, NX-1202, Packard Merlin 1,650 engine,  
1,450 hp, from La Guardia Airport, Jackson Heights, L. I., N. Y., to Lockheed Air Terminal,  
Burbank, Cal., Sept. 3, 1947. Distance: 2,453.805 mi. Elapsed Time: 7 hr. 00 min. 4 sec.  
Average Speed: 350.488 mph.

### EAST TO WEST TRANSCONTINENTAL (MULTI-ENGINE MILITARY AIRCRAFT)

Capt. Boyd L. Grubaugh, pilot; Capt. J. L. England, co-pilot; and M/Sgt. R. R. Pierron,  
M/Sgt. D. H. Atkins, M/Sgt. T. L. Wolfe, T/Sgt. D. B. Smith, crew; USAAF, Boeing B-29  
monoplane, 4 Wright R-3350-23A engines, from La Guardia Airport, L. I., N. Y., to Lockheed  
Air Terminal, Burbank, Cal., Aug. 1, 1946. Distance: 2,453.805 mi. Elapsed Time: 7 hr.  
28 min. 3 sec. Average Speed: 328.598 mph.

### LOS ANGELES, CAL. TO WASHINGTON, D. C.

Lt. Col. H. F. Warden, pilot; Capt. G. W. Edwards, co-pilot; Douglas XB-42 monoplane,  
2 Allison V-1710-129 engines, 1,820 hp each, from Long Beach Municipal Airport to Bolling  
Field, Anacostia, D. C., Dec. 8, 1945. Elapsed Time: 5 hr. 17 min. 34 sec. Distance: 2,295 mi.  
Average Speed: 433.610 mph.

### LOS ANGELES, CAL. TO MIAMI, FLA. (TRANSPORT AIRCRAFT)

Capt. David P. Gannon, pilot; Capt. L. J. Royal, co-pilot; National Airlines, Douglas DC-7,  
N 82054, 4 Wright Turbo Compound 3250 hp engines, from Clover Field, Santa Monica, to  
Miami International Airport, Nov. 21, 1953. Elapsed time: 5 hr., 50 min., 12 sec. Distance:  
2,341.32 mi. Average speed: 401.140 mph.

### LOS ANGELES, CAL. TO JACKSONVILLE, FLA. (TRANSPORT AIRCRAFT)

Capt. Thomas P. Ball and W. Lee McBride, III, pilots; crew of three; Delta-C&S Air Lines,  
Douglas DC-7, 4 Wright Turbo Compound 3,250 hp engines, from Clover Field, Santa Monica,  
to Jacksonville Municipal Airport, Mar. 18, 1954. Elapsed time: 5 hr., 29 min., 33 sec. Dis-  
tance: 2,154.448 mi. Average speed: 392.252 mph.

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- LOS ANGELES, CAL. TO TAMPA, FLA. (TRANSPORT AIRCRAFT)**  
 G. T. Baker, pilot; J. Bailey, co-pilot; and 17 passengers; Northwest Airlines' Douglas DC-6, NC-90891, 4 Pratt and Whitney 2,100 hp engines, from Clover Field, Santa Monica to Drew Field, June 3, 1947. Elapsed Time: 6 hr. 5 min. 10 sec. Distance: 2,157 mi. Average Speed: 354.413 mph.
- LOS ANGELES, CAL. TO ATLANTA, GA.**  
 Capt. Charles H. Dolson and R. W. Tiller, Delta C&S Air Lines' Douglas DC-7, 4 Wright 3,250 hp Turbo Compound engines, from Clover Field, Santa Monica, to Atlanta Municipal Airport, Apr. 9, 1954. Elapsed time: 5 hr., 15 min., 26 sec. Distance: 1,944.01 mi. Average speed: 369.174 mph.
- LOS ANGELES, CAL. TO CHARLESTON, S. C. (TRANSPORT AIRCRAFT)**  
 Capt. T. P. Ball and Capt. John Van Buren, pilots, six passengers; Delta Airlines' Douglas DC-6, 4 Pratt and Whitney R-2800-CA-15 1,800 hp engines, from Clover Field, Santa Monica to Charleston Municipal Airport, Nov. 6, 1948. Elapsed Time: 6 hr. 24 min. 32 sec. Distance: 2,203 mi. Average Speed: 344.192 mph.
- ATLANTA, GA., TO NEW YORK, N. Y. (TRANSPORT AIRCRAFT)**  
 H. T. Merrill and Clifford Zieger, pilots; Eastern Airlines' Lockheed Constellation, NC-108A, 4 Wright 3350 engines, 2,500 hp each, from Atlanta Municipal Airport to La Guardia Airport, Aug. 5, 1947. Elapsed Time: 2 hr. 36 min. 20 sec. Distance: 759.707 mi. Average Speed: 291.572 mph.
- NEW YORK, N. Y. TO HAVANA, CUBA**  
 Col. A. P. de Seversky, Modified Seversky P-35 monoplane, powered with a Pratt and Whitney 1830-9 850 hp engine, from Floyd Bennett Field to Camp Columbia, Havana, Dec. 3, 1937. Elapsed Time: 5 hr. 3 min. 5.4 sec. Distance: 1,307 mi. Average Speed: 258.735 mph.
- NEW YORK, N. Y., TO HOUSTON, TEX.**  
 Henry T. Merrill, pilot, J. D. Scott, co-pilot; Eastern Airlines' Lockheed Constellation, NC-102A, 4 Wright 2,100 hp engines from La Guardia Airport, Jackson Heights, L. I. to Houston Municipal, June 6, 1947. Elapsed Time: 4 hr. 39 min. 3 sec. Distance: 1,425.5 mi. Average Speed: 306.504 mph.
- HOUSTON, TEX. TO NEW YORK, N. Y. (TRANSPORT AIRCRAFT)**  
 Henry T. Merrill, pilot, J. D. Scott, co-pilot; Eastern Airlines' Lockheed Constellation, NC-102A, 4 Wright 2,100 hp engines, from Houston Municipal to La Guardia Airport, June 6, 1947. Elapsed Time: 4 hr. 41 min. 35 sec. Distance: 1,425.5 mi. Average Speed: 303.746 mph.
- NEW YORK, N. Y. TO MIAMI, FLA. (TRANSPORT AIRCRAFT)**  
 E. R. Brown, pilot; E. H. Parker, co-pilot; Eastern Airlines' Lockheed Constellation, 4 Wright engines, 2,100 hp each, from La Guardia Airport to 36th Street Airport, May 28, 1947. Elapsed Time: 3 hr. 58 min. 41.2 sec. Distance: 1,096.427 mi. Average Speed: 275.615 mph.
- MIAMI, FLA. TO NEW YORK, N. Y. (TRANSPORT AIRCRAFT)**  
 E. R. Brown, pilot; E. H. Parker, co-pilot; Eastern Airlines' Lockheed Constellation, NC-102A, 4 Wright engines, 1,200 hp each, from 36th Street Airport to La Guardia Airport, May 28, 1947. Elapsed Time: 3 hr. 29 min. 11.4 sec. Distance: 1,096.427 mi. Average Speed: 314.477 mph.
- NEW YORK, N. Y. TO NEW ORLEANS, LA. (TRANSPORT AIRCRAFT)**  
 H. T. Merrill and E. R. Brown, pilots; Eastern Airlines' Lockheed Constellation, NC-108A, 4 Wright 3350 engines, 2,500 hp each, from La Guardia Airport, L. I., to Moisant International Airport, July 23, 1947. Elapsed Time: 3 hr. 52 min. 29.8 sec. Distance: 1,182.466 mi. Average Speed: 305.157 mph.
- NEW ORLEANS, LA. TO NEW YORK, N. Y. (TRANSPORT AIRCRAFT)**  
 H. T. Merrill and E. R. Brown, pilots; Eastern Airlines' Lockheed Constellation, NC-108A, 4 Wright 3350 engines, 2,500 hp each, from Moisant International Airport to La Guardia Airport, L. I., July 23, 1947. Elapsed Time: 3 hr. 35 min. 10.8 sec. Distance: 1,182.466 mi. Average Speed: 329.714 mph.
- NEW YORK, N. Y. TO WASHINGTON, D. C.**  
 Capt. Martin L. Smith, USAF, Lockheed P-80 jet-propelled monoplane, Allison J-33-11 engine, from La Guardia Airport, Jackson Heights, L. I. to Washington National Airport, Apr. 21, 1946. Elapsed Time: 29 min. 15 sec. Distance: 214 mi. Average Speed: 488.974 mph.
- MEXICO CITY, D. F. TO NEW YORK, N. Y.**  
 Francisco Sarabia, Gee Bee monoplane, X-BAKE, Pratt and Whitney Hornet 980 hp engine, from the Military Airport, Mexico City to Floyd Bennett Field, May 24, 1939. Elapsed Time: 10 hr. 47 min. 46.8 sec. Distance: 2,087.5 mi. Average Speed: 193.353 mph.
- HONOLULU, HAWAII TO NEW YORK, N. Y.**  
 Lt. Col. Robert E. Thacker, pilot; 1st Lt. John M. Ard, co-pilot; North American P-82 monoplane, 2 Rolls Royce V-1650 engines, 2,250 hp each, from Hickam Field, Honolulu to La Guardia Airport, Jackson Heights, L. I., Feb. 28, 1947. Elapsed Time: 14 hr. 31 min. 50 sec. Distance: 4,968.852 mi. Average Speed: 341.959 mph.
- CHICAGO, ILL. TO ATLANTA, GA. (TRANSPORT AIRCRAFT)**  
 H. T. Merrill and S. A. Bell, pilots; Eastern Airlines' Lockheed Constellation, NC-108A, 4 Wright 3350 engines, 2,500 hp each, from Chicago Municipal Airport, to Atlanta Municipal Airport, Aug. 5, 1947. Elapsed Time: 1 hr. 48 min. 20 sec. Distance: 590.281 mi. Average Speed: 326.925 mph.

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- ATLANTA, GA. TO CHICAGO, ILL. (TRANSPORT AIRCRAFT)**  
H. T. Merrill and S. A. Bell, pilots; Eastern Airlines' Lockheed Constellation, NC-108A, 4 Wright 3350 engines, 2,500 hp each, from Atlanta Municipal Airport to Chicago Municipal Airport, Aug. 5, 1947. Elapsed Time: 2 hr. 1 min. 55 sec. Distance: 590.281 mi. Average Speed: 290.501 mph.
- CHICAGO, ILL. TO LOS ANGELES, CAL.**  
Howard R. Hughes, Northrop Gamma monoplane, NR-13761, Wright Cyclone engine, from Chicago Municipal Airport to Grand Central Air Terminal, Glendale, Cal., May 14, 1936. Elapsed Time: 8 hr. 10 min. 29.8 sec. Distance: 1,734.5 mi. Average Speed: 212.172 mph.
- CHICAGO, ILL. TO MIAMI, FLA. (COMMERCIAL TRANSPORT)**  
Capt. N. U. D. Buice and Flight Officer L. F. Woodruff, pilots; F. C. Stevens, Jr., Flight Engineer; two stewardesses and 23 passengers; Delta-C & S Air Lines' DC-7 monoplane, N-4876 C, 4 Wright Turbo Compound 3,250 hp engines, from Midway Airport to Miami International Airport, January 13, 1955. Elapsed Time: 2 hr., 43 min., 00 sec. Distance, 1,183.368 statute miles. Average speed: 435.259 mph.
- CHICAGO, ILL. TO WASHINGTON, D. C. (TRANSPORT AIRCRAFT)**  
Jack Frye, TWA, Northrop Gamma 2-D monoplane, NR-13758, Wright Cyclone 710 hp engine, from Chicago Municipal Airport to Washington-Hoover Airport, S. Washington, Feb. 18, 1936. Elapsed Time: 2 hr. 22 min. Distance: 599 mi. Average Speed: 253.098 mph.
- VANCOUVER, B. C., CANADA TO AGUA CALIENTE, MEXICO**  
Frank W. Fuller, Jr., Seversky monoplane, NX-70Y, Pratt and Whitney Twin Row Wasp 1,100 hp engine, from Vancouver Airport to Agua Caliente Airport, Nov. 4, 1937. Elapsed Time: 4 hr. 54 min. Average Speed: 244 mph.
- MIAMI, FLA. TO CHICAGO, ILL. (TRANSPORT AIRCRAFT)**  
Henry T. Merrill and P. L. Foster, pilots; Eastern Airlines' Lockheed Constellation, NC-105A, 4 Wright 3350 engines, 2,500 hp each, from 36th Street Airport to Chicago Municipal Airport, July 16, 1947. Elapsed Time: 3 hr. 56 min. 22 sec. Distance: 1,183.368 mi. Average Speed: 300.390 mph.
- VANCOUVER, B. C., CANADA TO OAKLAND, CAL.**  
Frank W. Fuller, Jr., Seversky monoplane, NX-70Y, Pratt and Whitney Twin Row Wasp 1,100 engine, from Vancouver Airport to Oakland Airport, May 28, 1938. Elapsed Time: 3 hr. 8 min. 43 sec. Distance: 792.5 mi. Average Speed: 251.965 mph.
- MARCH FIELD, CAL. TO MITCHEL FIELD, N. Y.**  
Lt. Ben S. Kelsey, USAF, Lockheed XP-38 airplane, 2 Allison liquid cooled 1,000 hp engines. Feb. 11, 1939. Elapsed Time: 7 hr. 45 min. 36 sec. Distance: 2,425 mi. Average Speed: 312.5 mph.
- RIVERSIDE, CALIFORNIA, TO PHILADELPHIA, PA.**  
Maj. L. J. Stevens, Aircraft Commander; Maj. F. J. Weedman, pilot; Capt. G. L. Fornes, Observer; Boeing B-47 Stratojet, 6 General Electric J-47 engines of 5970 hp each, from March AFB, Riverside, Calif, to Philadelphia International Airport, Philadelphia, Pa., September 4, 1955. Elapsed time: 3 hrs., 57 min., 59.2 sec. Distance: 2,337.4 statute miles. Average speed: 589.294 mph.
- WICHITA, KAN. TO LOS ANGELES, CAL.**  
Paul Mantz, Lockheed Orion NR-1222z, from Wichita Airport to Union Air Terminal, July 4, 1938. Elapsed Time: 7 hr. 11 min. 5 sec. Distance: 1,201 mi. Average Speed: 167.160 mph.
- DETROIT, MICH. TO AKRON, O.**  
Louise Thaden, Beechcraft biplane, NC-15835, from Detroit City Airport to Akron Municipal Airport, Jan. 21, 1937. Elapsed Time: 40 min. 43 sec. Distance: 123.5 mi. Average Speed: 181.989 mph.
- DETROIT, MICH. TO MIAMI, FLA. (TRANSPORT AIRCRAFT)**  
H. T. Merrill and F. Bennett, pilots; Eastern Airlines' Lockheed Constellation, NC-113A, 4 Wright 3350 engines, 2,500 hp each, from Willow Run Airport to 36th Street Airport, Aug. 7, 1947. Elapsed Time: 3 hr. 36 min. 29 sec. Distance: 1,150.455 mi. Average Speed: 318.857 mph
- TAMPA, FLA. TO MIAMI, FLA. (TRANSPORT AIRCRAFT)**  
G. T. Baker, pilot; J. Bailey, co-pilot; and passengers; National Airlines' Douglas DC-6, NC-90891, 4 Pratt and Whitney 2,100 hp engines, from Drew Field to 36th Street Airport, June 3, 1947. Elapsed Time: 39 min. 13 sec. Distance: 204.429 mi. Average Speed: 312.769 mph.
- LOS ANGELES, CALIFORNIA, TO MEXICO CITY, D. F. (TRANSPORT AIRCRAFT)**  
Capt. Roberto Pini, pilot; Guillermo S. Prieto, co-pilot; Cia. Mexicana de Aviacion Douglas DC-6, 4 Pratt and Whitney R-2800 engines, from Los Angeles International Airport to Mexico City Airport, Dec. 3, 1950. Elapsed time: 4 hr., 11 min., 50 sec. Distance: 1,551.941 mi. Average speed: 369.754 mph.
- MEXICO CITY, D. F., TO LOS ANGELES, CAL.**  
A. L. Rodriques, North American P-51-D, NX-33699, Rolls Royce Merlin 68 engine, from Mexico City (Balbuena) Airport to Clover Field, Santa Monica, Cal., Dec. 17, 1946. Elapsed time; 4 hr., 24 min., 30 sec. Distance: 1,557.5 mi. Average speed: 353.308 mph.
- LOS ANGELES, CALIFORNIA, TO DENVER, COLO.**  
Maj. C. E. Good, USAF, North American YF-100A, Pratt and Whitney XJ 57-P7—P420-088 engine, 13,200 hp from Los Angeles International Airport, Los Angeles, Calif. to Lowry Air Force Base, Denver, Colo., August 1, 1956. Elapsed time: 1 hour, 25 minutes, 59.8 seconds. Distance: 846.247 statute miles. Average speed; 590.428 mph.

## OFFICIAL RECORDS

### SAN FRANCISCO, CAL., TO LOS ANGELES, CAL.

Capt. R. D. Creighton, USAF, North American F-86-A, General Electric J-47-A jet engine, from San Francisco International Airport to Los Angeles International Airport, May 20, 1950. Elapsed time: 32 min. 56 sec. Distance: 339.121 miles. Average speed: 617.932 mph.

### SAN FRANCISCO, CAL., TO SALT LAKE CITY, UTAH

Frank W. Fuller, Jr., Seversky monoplane, NX-70-Y, Pratt and Whitney Twin Row Wasp 1200 hp engine, from San Francisco Airport to Salt Lake Municipal Airport, Apr. 20, 1939. Elapsed time: 2 hr., 9 min., 44 sec. Distance: 598.5 mi. Average speed: 276.799 mph.

### SAN FRANCISCO, CAL., TO SEATTLE, WASH.

Frank W. Fuller, Jr., Seversky NR-70-Y, Pratt and Whitney Twin Row Wasp 1,100 hp engine, from San Francisco Airport to Boeing Field, May 25, 1938. Elapsed time, 2 hr., 31 min., 41 sec. Distance: 684.5 mi. Average speed: 270.261 mph.

### SAN FRANCISCO, CAL., TO SAN DIEGO, CAL.

Earl Ortman, Marcoux-Bromberg Special, Pratt and Whitney Wasp. Jr. 1195 hp engine, from Oakland Airport to Lindbergh Field, June 1, 1938. Elapsed time: 1 hr., 48 min., 1 sec. Distance: 447 mi. Average speed: 248.295 mph.

### SAN FRANCISCO, CAL., TO PORTLAND, ORE.

Frank W. Fuller, Jr., Seversky NR-70-Y, Pratt and Whitney Twin Row Wasp engine, from San Francisco Airport to Pearson Field, Jan. 16, 1938. Elapsed time: 2 hr., 13 min., 53 sec. Distance: 553 mi. Average speed: 247.828 mph.

### SAN FRANCISCO, CAL., TO PHOENIX, ARIZ.

Frank W. Fuller, Jr., Seversky monoplane, NR-70-Y, Pratt and Whitney Twin Row Wasp engine, from San Francisco Airport to Sky Harbor Airport, Jan. 16, 1939. Elapsed time: 2 hr., 11 min., 58 sec. Distance: 650.5 mi. Average speed: 295.757 mph.

### SAN FRANCISCO, CAL., TO BOISE, IDA.

Frank W. Fuller, Jr., Seversky monoplane, NX-70-Y, Pratt and Whitney Twin Row Wasp 1,200 hp engine, from San Francisco Airport to Boise Municipal Airport, May 4, 1939. Elapsed time: 1 hr., 47 min., 26 sec. Distance: 525.5 mi. Average speed: 293.484 mph.

### SAN FRANCISCO, CAL., TO DENVER, COLO.

Frank W. Fuller, Jr., Seversky monoplane, NX-70-Y, Pratt and Whitney Twin Row Wasp 1,200 hp engine, from San Francisco Airport to Denver Municipal Airport, June 7, 1939. Elapsed time; 3 hr., 22 min., 26.8 sec. Distance: 954 mi. Average speed: 282.741 mph.

### SAN FRANCISCO, CAL., TO WASHINGTON, D. C. (TRANSPORT AIRCRAFT)

Capt Scott Flower, pilot; 1st Officer R. E. McDonald, co-pilot; crew of seven and nine passengers; Pan American Airways Boeing B-377 Stratocruiser, 4 Pratt and Whitney Wasp Major 4360 engines, from San Francisco Airport to Washington National Airport, Mar. 3, 1949. Elapsed time: 6 hr., 22 min., 25.4 sec. Distance: 2,436.917 miles. Average speed: 382.338 mph.

### NEW YORK, N. Y., TO ATLANTA, GA. (TRANSPORT AIRCRAFT)

H. T. Merrill and Clifford Zieger, pilots; Eastern Airlines' Lockheed Constellation, 4 Wright 3350 engines, 2,500 hp each from La Guardia Airport to Atlanta Municipal Airport, Aug. 5, 1947. Elapsed time: 2 hr., 18 min., 06 sec. Distance: 759.707 mi. Average speed: 330.068 mph.

### EDWARDS, CAL., TO VANDALIA, OHIO—NONSTOP—(Multi-Jet Engine Aircraft)

John J. Farley, pilot; Sherman Pruitt, Jr., navigator; Northrop F-89A 49-2448, two Allison J-35-A-21B jet engines, Edwards Air Force Base to Cox Municipal Airport, Sept. 7, 1953. Elapsed time; 3 hr., 45 min., 12.5 sec. Distance: 1,868.48 miles. Average speed: 497.800 mph.



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