

December 31, 1956 50 cents

AVIATION WEEK

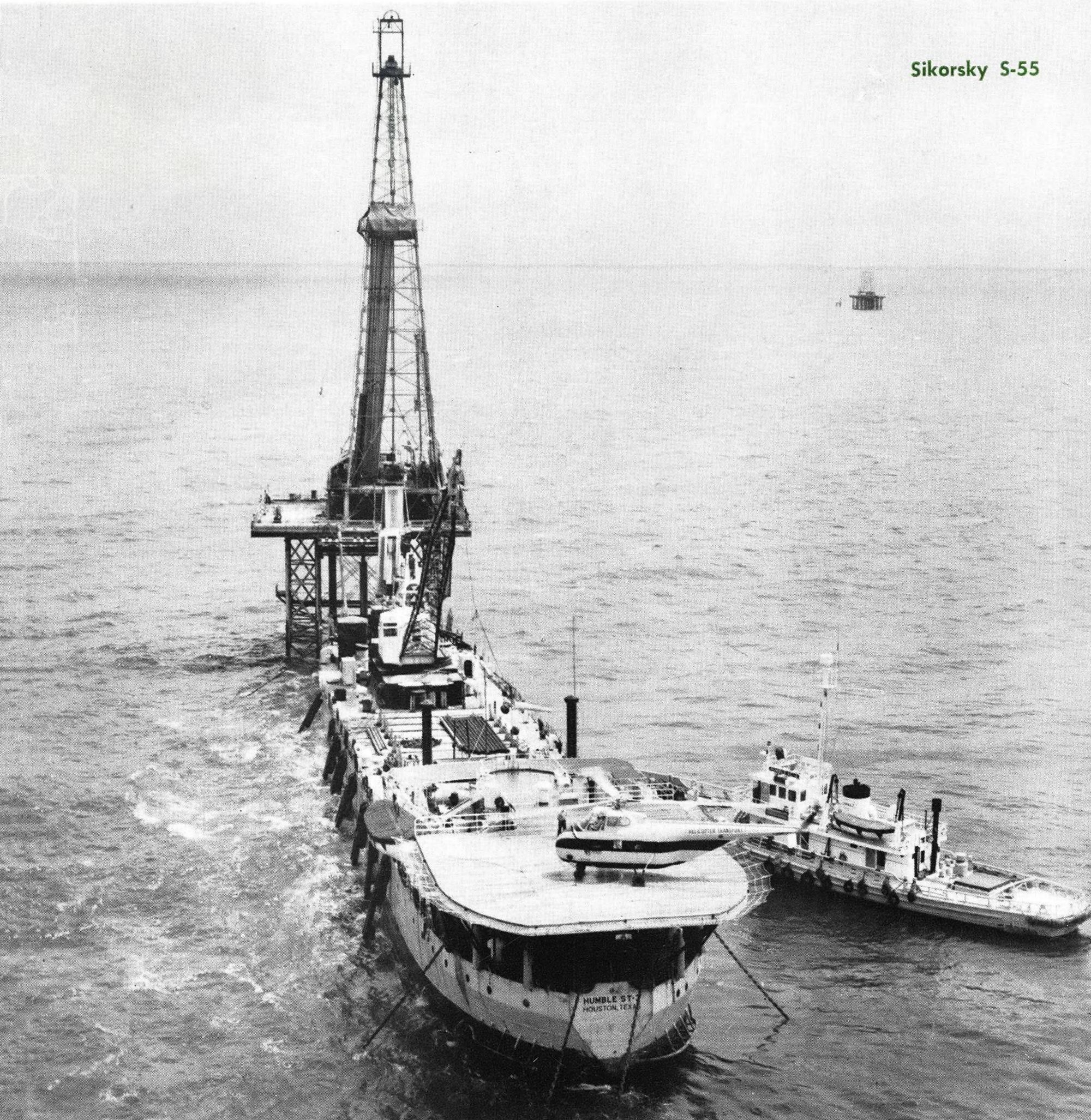
A MCGRAW-HILL
PUBLICATION

Offshore Oil Brings
Helicopter Boom

•

Foreign Jets Move
Into World Market

Sikorsky S-55

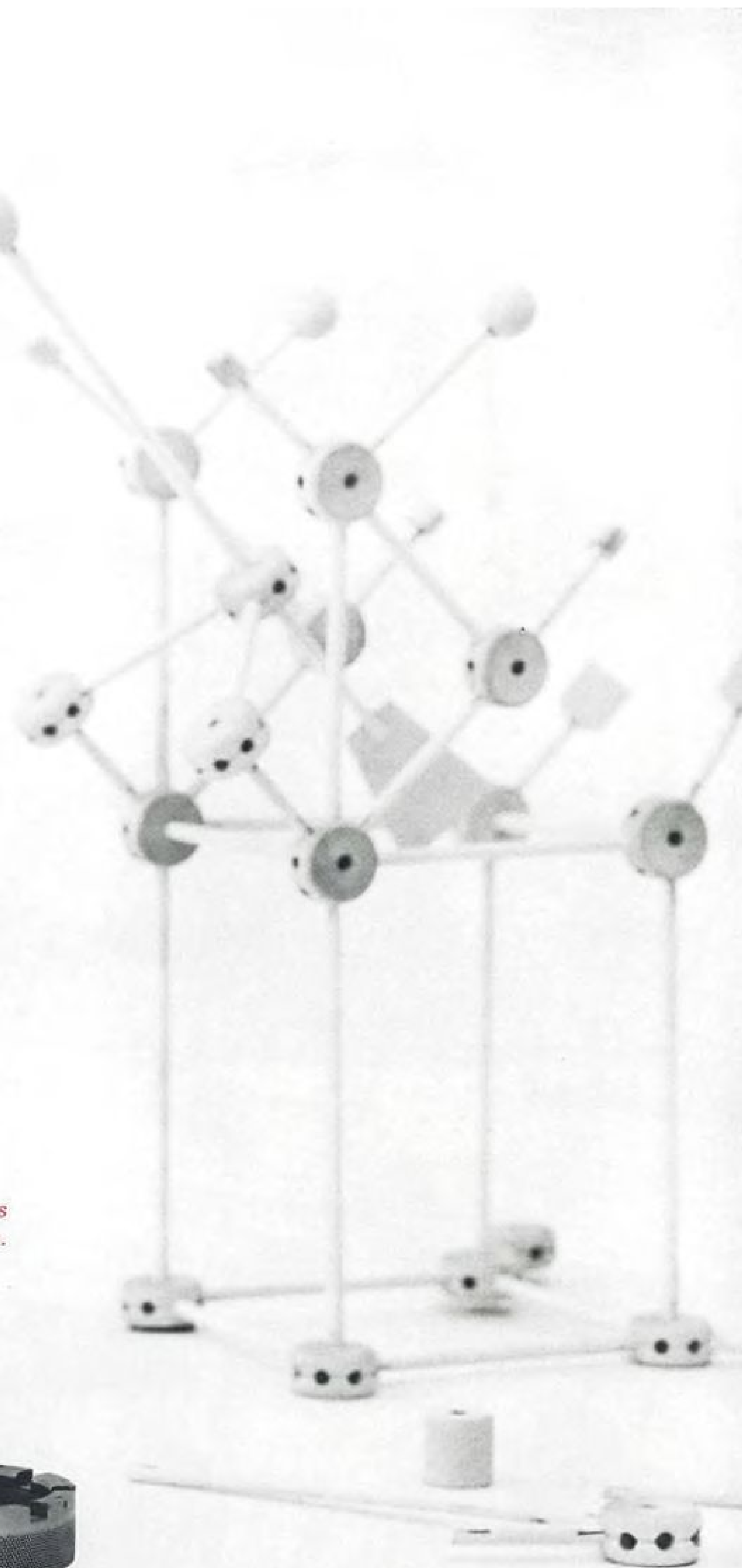


engineers agree

Not on how to mix a Martini —
nor necessarily on how to build
a missile platform —
but every day,
throughout the industry,
Engineers agree
on Wiggins Connectors.

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*The authority on connectors
Engineered for Reliability.*



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Axelson in action



landing the hot ones

Two "hot" performers by Douglas . . . landing gear by Axelson.

The DC-3/C-47, the plane that won't wear out, has been overworked and overloaded for more than 20 years . . . for 150 scheduled airlines in 70 countries . . . through two wars, in every theater of operation, in every major campaign and invasion. And over half of the 12,000 DC-3s built by Douglas have been equipped with Axelson-produced shock struts.

Today, Axelson landing gears continue to prove themselves on Douglas "hot ones" like the F4D, the carrier-based high-altitude interceptor and world's record-holder for the 3-kilometer and 100-kilometer courses. From a standing start, the bat-winged jet leaps to 10,000 feet in less

than a minute. Mission accomplished, it touches down on Axelson-produced landing gear.

Douglas Aircraft Company is only one of the many aircraft manufacturers who turn to Axelson for the expert solution of tough component and sub-assembly problems. Call on our engineering staff for the planning and successful completion of your aircraft programs.



Axelson Manufacturing Company

AIRCRAFT

Division of U. S. Industries, Inc.

6160 South Boyle Avenue, Los Angeles 58, California



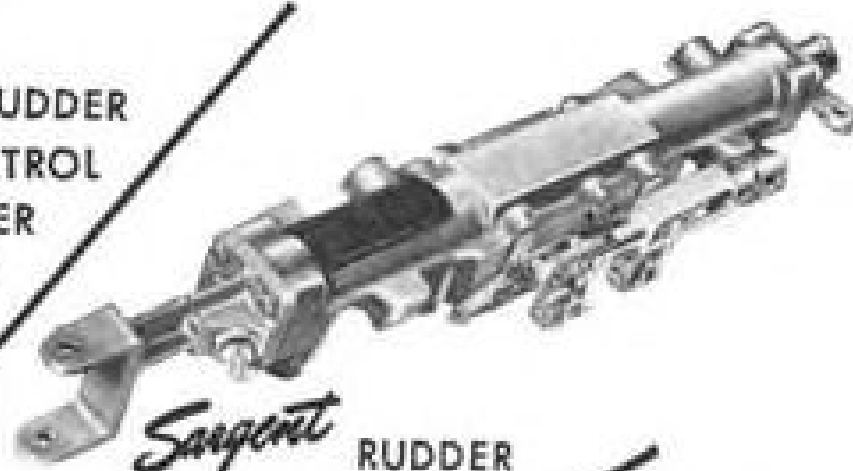
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Nine Sargent quality units have been selected to provide Chance Vought's F8U-1 Crusader with instantaneous, positive, feathertouch response.

These units, Sargent fabricated to Vought specifications, provide a system for control for the safe, positive, efficient operation of this great fighter.

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AVIATION CALENDAR

Jan. 8-9-15th Annual Miami-Havana Air Cruise, sponsored by Florida Air Pilot's Assn. For details write: James G. Page, cruise director, FAPA, 310 S.E. 2d Ave., Miami, Fla.

Jan. 14-16-National Symposium on Reliability and Quality Control in Electronics, sponsored by IRE, ASQC, AIEE and RETMA, Hotel Statler, Washington, D. C.

Jan. 21-22-Symposium on Solar Furnace Design and Operation, Hotel Westward Ho, Phoenix, Ariz.

Jan. 27-28-American Society for Metals, Albuquerque and Los Alamos Chapters, "Heat Tolerant Metals for Aerodynamic Applications," Albuquerque, N. M.

Jan. 28-31-8th Plant Maintenance & Engineering Conference, Public Auditorium, Cleveland, Ohio.

Jan. 28-31-25th Annual Meeting, Institute of the Aeronautical Sciences, Sheraton-Astor Hotel, New York, N. Y. Honors Night Dinner, Jan. 28.

Jan. 31-Sixth Annual Instrument Short Course, Los Angeles Harbor Junior College, Wilmington, Calif. Additional course will be held Feb. 1.

Jan. 31-Feb. 1-Conference on Digital Computing in the Aircraft Industry, sponsored by New York University and International Business Machines Corp., NYU Bronx Campus, New York, N. Y.

Feb. 4-8-Course on X-ray diffraction, sponsored by North American Phillips Co., 750 S. Fulton Ave., Mt. Vernon, N. Y.

Feb. 7-Operations Research Symposium University Museum Lecture Hall, University of Pennsylvania, Philadelphia, Pa.

Feb. 7-Annual Mid-Winter Symposium of the New York Section, Instrument Society of America, Garden City Hotel, Long Island, N. Y.

Feb. 8-9-Symposium on Composition of Petroleum Oils-Determination and Evaluation, sponsored by Research Division IV on Hydrocarbon Analysis of American Society for Testing Materials Committee D-2 and American Petroleum Institute, Jung Hotel, New Orleans, La.

Feb. 14-15-1957 Transistor and Solid State Circuits Conference, University of Pennsylvania, Philadelphia, Pa.

Feb. 26-28-Western Joint Computer Con-

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Vol. 65, No. 27

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A HOT OPERATOR

... in sub-zero climates!

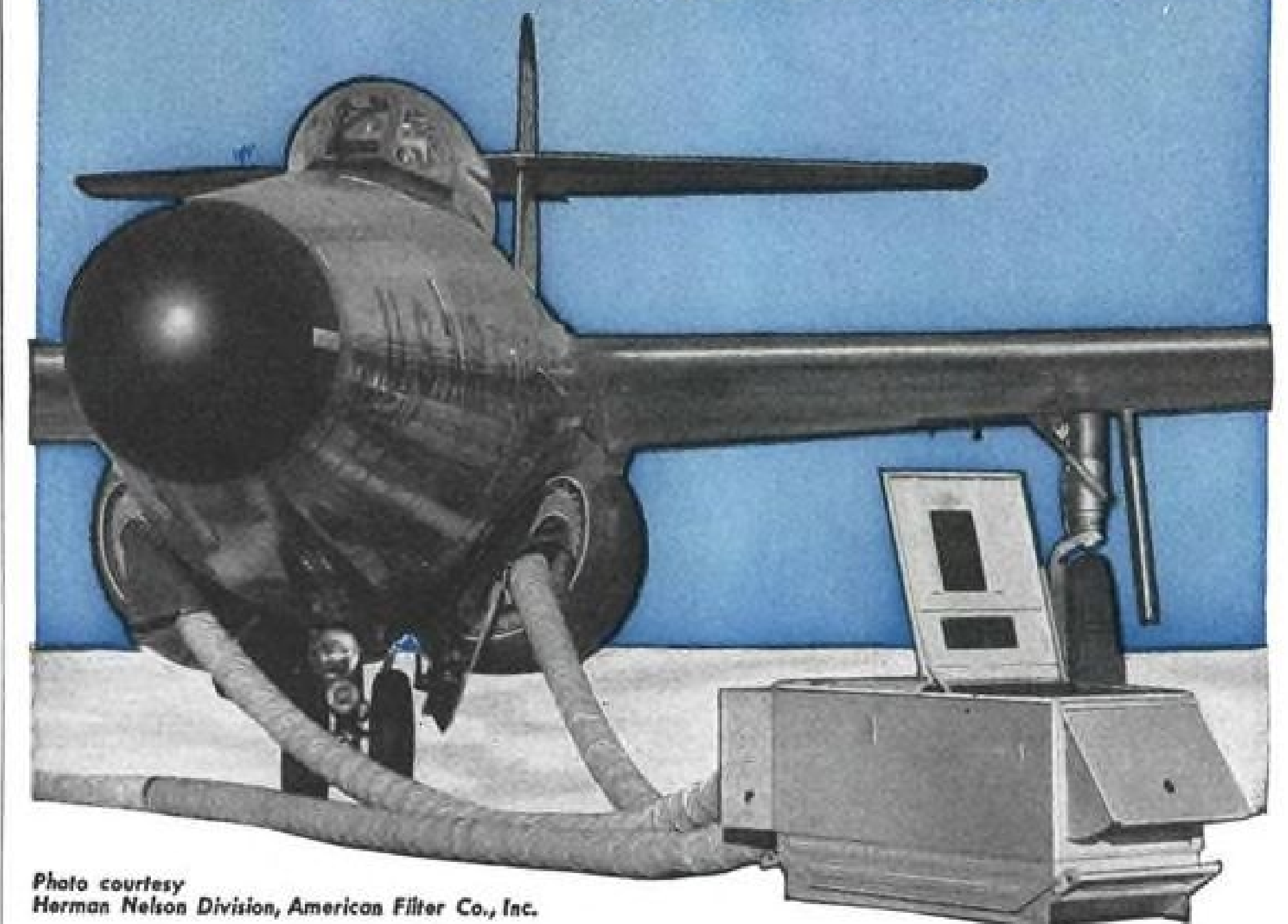


Photo courtesy
Herman Nelson Division, American Filter Co., Inc.

THIS HEAT EXCHANGER

of stainless steel for the Herman Nelson Portable Air Heater, "Aviation's cold weather friend", is another precision fabricated assembly made by Lavelle for military aircraft application. At Air Force bases everywhere, the BT-400 Heater provides a ready source of heat for pre-heating engines, cockpits, and for countless maintenance jobs... wherever reliable space heat is required to help keep America's defense planes airborne.



Heat Exchanger
Stainless Steel
16" dia. x 18"

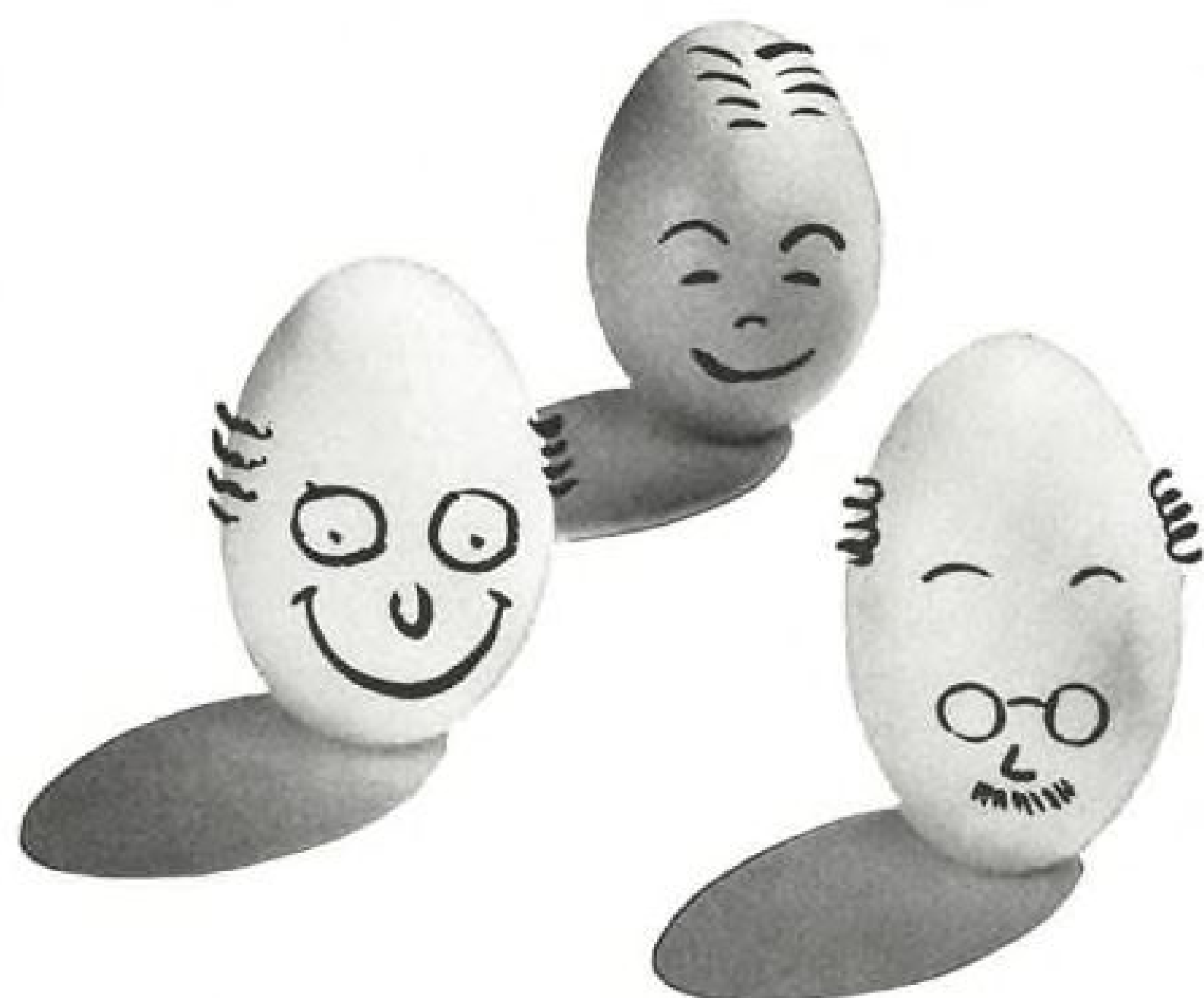
Extensive fabricating facilities, plus Government Certified welding technicians has enabled Lavelle to produce over 6,000 of these complex assemblies, each requiring 16 separate airfoil section heat exchanger tubes. To assure close tolerances and speed production of the many component parts of the unit, special tools were designed and made at the Lavelle plant. Complete inspection includes pressure testing of each unit prior to shipment to Herman Nelson. Simple or complex, Lavelle has the capacity to fabricate the precision parts and assemblies you need... wherever you need them.

A new brochure describes Lavelle's specialized fabricating services. Write for a copy without obligation.

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- ☐ Structural Design
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- ☐ Thermodynamics
- ☐ Weights

ference, sponsored by IRE, AIEE and ACM, Hotel Statler, Los Angeles, Calif. Feb. 16-19—6th Annual Trade Show & Convention, Institute of Surplus Dealers, New York Trade Show Bldg., New York, N. Y.

Mar. 7-9—National Conference on Aviation Education, Hotel Mayflower, Washington.

Mar. 11-15—1957 Atomic Exposition, including Nuclear Engineering & Science Congress, 5th Atomic Energy in Industry Conference and 5th Hot Laboratories & Equipment Conference, Convention Hall, Philadelphia, Pa.

Mar. 14-15—Flight Propulsion Meeting, (Classified), sponsored by IAS, Hotel Carter, Cleveland, Ohio.

Mar. 18-21—Pacific Coast Plastics Exposition, in conjunction with The Society for Plastics Industry National Conference, Shrine Exposition Hall, Los Angeles.

Mar. 18-21—National Convention Institute of Radio Engineers, New York Coliseum and Hotel Waldorf-Astoria, New York, N. Y.

Mar. 19-21—151st National Meeting of the American Meteorological Society, University of Chicago.

Mar. 25-27—Silver Anniversary Technical Meeting and Convention, American Society of Tool Engineers, Shamrock Hilton Hotel, Houston, Tex.

Mar. 25-29—Western Metal Congress and Exposition, Ambassador Hotel and Pan-Pacific Auditorium, Los Angeles.

Mar. 27-29—Educational Colloquium on Radiation Effects on Materials, sponsored by ONR and Glenn L. Martin Co., Johns-Hopkins University, Baltimore, Md.

Apr. 8-12—Fifth Welding & Allied Industry Exposition, Convention Hall and Hotel Sheraton, Philadelphia, Pa.

Apr. 15-17—First Demonstration and Symposium on Systems for Organization, Storage and Retrieval of Information, sponsored by School of Library Science (Center for Documentation and Communication Research), Western Reserve University, Cleveland, Ohio.

Apr. 16-18—Symposium on Nondestructive Tests in the Field of Nuclear Energy, Morrison Hotel, Chicago, Ill.

Apr. 17-20—Eighth Annual Conclave, Arnold Air Society, including aviation equipment display, Hotel New Yorker, New York, N. Y.

Apr. 24-25—Second National Industrial Research Conference, sponsored by Armour Research Foundation, Conrad Hilton Hotel, Chicago, Ill.

Apr. 29-May 3—Seventh National Materials Handling Exposition, Convention Hall, Philadelphia, Pa.

May 1-3—Spring Meeting and Exhibit, Society for Experimental Stress Analysis, Hotel Statler, Boston, Mass.

May 6-8—28th Annual Meeting, Aero Medical Assn., Shirley Savoy Hotel, Denver, Colo.

May 14-16—Second Annual Industrial Nuclear Technology Conference, sponsored by Armour Research Foundation of Illinois Institute of Technology and Nucleonics magazine, Museum of Science and Industry, Chicago, Ill.

May 24-June 2—22nd Paris Air Show, Society of French Aircraft Constructors, Le Bourget Airport, Paris.

**NEW TURBOROTOR 'COPTER...
another Kaman First!**



1951
Kaman built the first
turborotor helicopter
flown anywhere.



1954
Kaman again pioneered in the helicopter gas turbine field with this HTK powered with twin turbines.



Kaman Aircraft and Lycoming scored a turborotor first when this Kaman HOK helicopter took to the air powered by Lycoming's XT-53, the first U.S. free-shaft gas turbine specifically designed as a helicopter power plant.

Kaman leads the field in turborotor experience and development and is proud of the forward steps it is taking in the interest of our National Defense.

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BUAER'S NEW AVIONICS DIVISION MEETS ELECTRONIC WEAPONS NEEDS OF NAVY AIR ARM



U. S. Navy Photo

Brand new in the Navy Bureau of Aeronautics, the Avionics Division is responsible for all aspects of research and development of electronic fire control and weapons launching equipment for Navy aircraft and guided missiles. This Division deals daily with problems undreamed of as recently as World War II. To ensure that our Navy air arm will continue to be the most effective and ultra-modern in the world, it plans in terms of 10, 15, or 25 years hence. Its personnel must think in terms of Mach 10 speeds or altitudes of 20 or more miles.

This vital R & D mission, which was formerly accomplished by the joint efforts of Armament and Electronics Divisions, has been merged in the Avionics Division to include a wide variety of electronic functions. Among these are ground station telemetering and instrumentation; guidance systems; warheads; fusing and launching of guided missiles; fighter attack systems; airborne early warning systems, and many others.

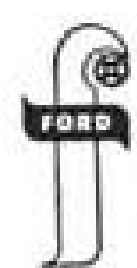
To coordinate the many programs under its jurisdiction, the Division has established a "Project Manager" system of organization. This system provides maximum streamlined operation and facilitates industry contacts as well. The personnel of the Avionics Division thus are enabled to develop with maximum facility the incredible electronic equipment needed by today's and tomorrow's aircraft and missiles. With their special knowledge and far seeing outlook, they will make certain that the new higher speeds, altitudes and ranges of aircraft are utilized to full effectiveness.

◀FJ-3 Fury goes aloft from one of the after catapults of the U.S.S. Forrestal. An F2H-3 Banshee is in the foreground. Electronics developed by BuAer's Avionics Division provides planes such as these with their highly effective weapons and control systems.



▲ Engineer at Ford Instrument Company opening salt spray chamber in which equipment for BuAer is being subjected to environmental test.

This is one of a series of ads on the technical activities of the Department of Defense.



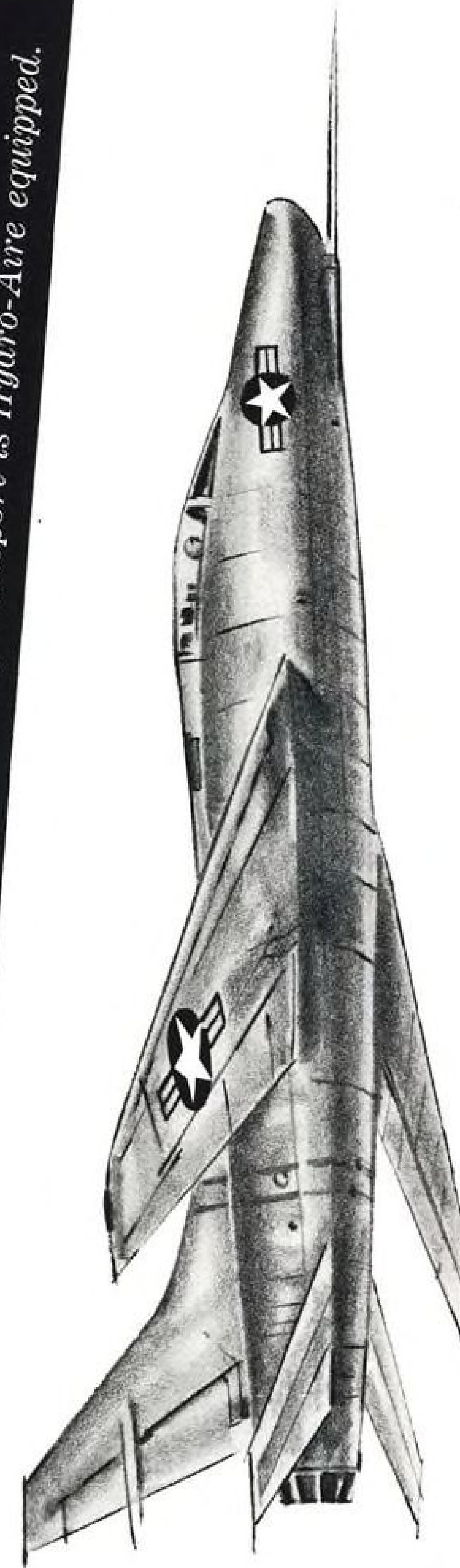
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- No more blow-outs due to skidding.
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HYTROL—the accepted Anti-Skid Braking System is standard equipment on the B-47, B-52, A3D, RB-66, RF-84F, F-100, C-130, QF-80 and has been proved on more than 30 different types of aircraft.

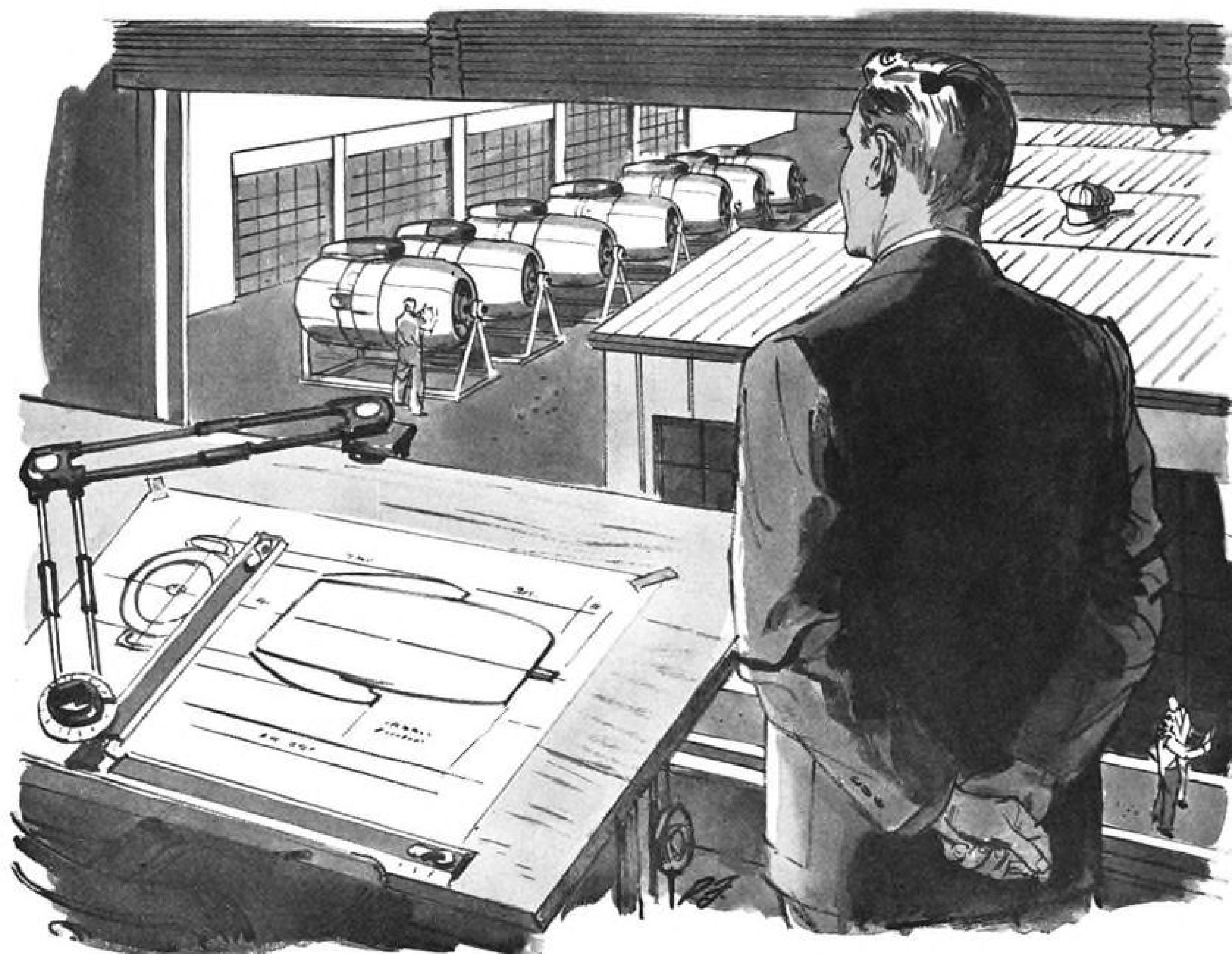


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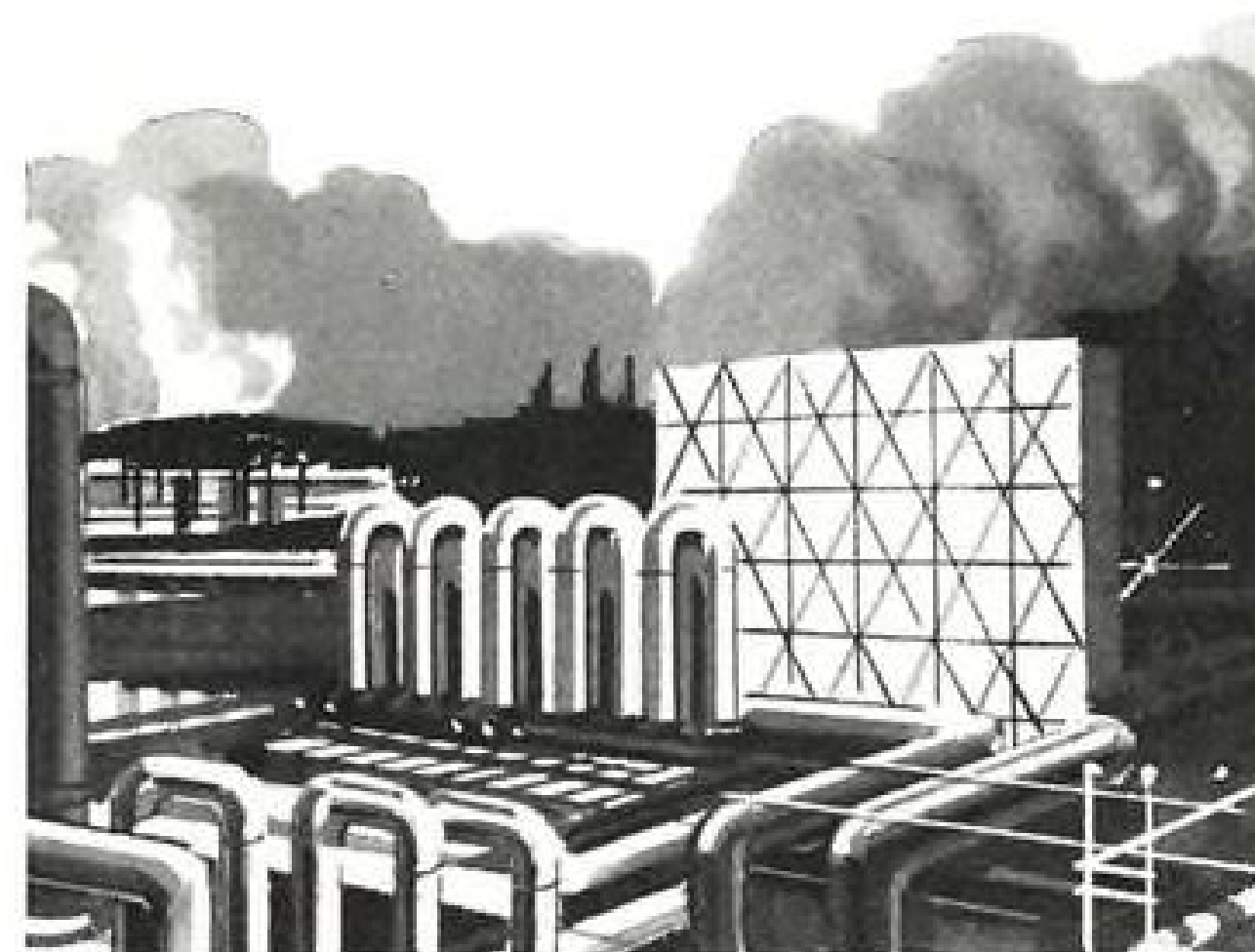


GRUMMAN AIRCRAFT ENGINEERING CORPORATION Bethpage • Long Island • New York

Designers and builders of the supersonic F11F-1 Tiger, transonic F9F-8 Cougar fighter, F9F-8T fighter-trainer, F9F-8P photo-recon, S2F Tracker, SA-16 Albatross rescue amphibian, metal boats, and Aeroblitz truck bodies.

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for
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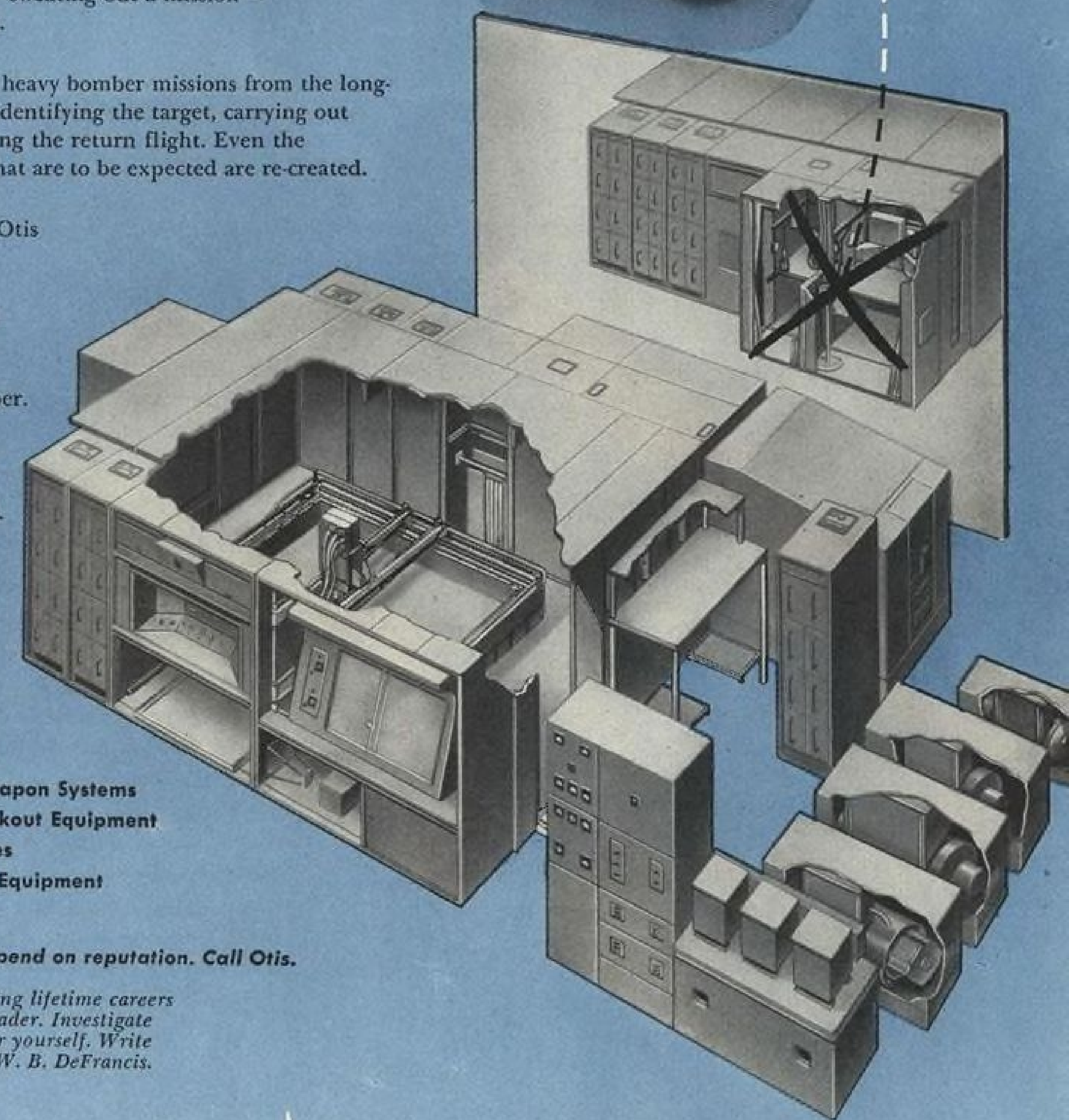
Fully equipped, and supported by every engineering and production resource of the world-famous parent company, the Otis Electronic Division researches, develops, designs, produces, tests and maintains large complex electronic gear on a mass scale.

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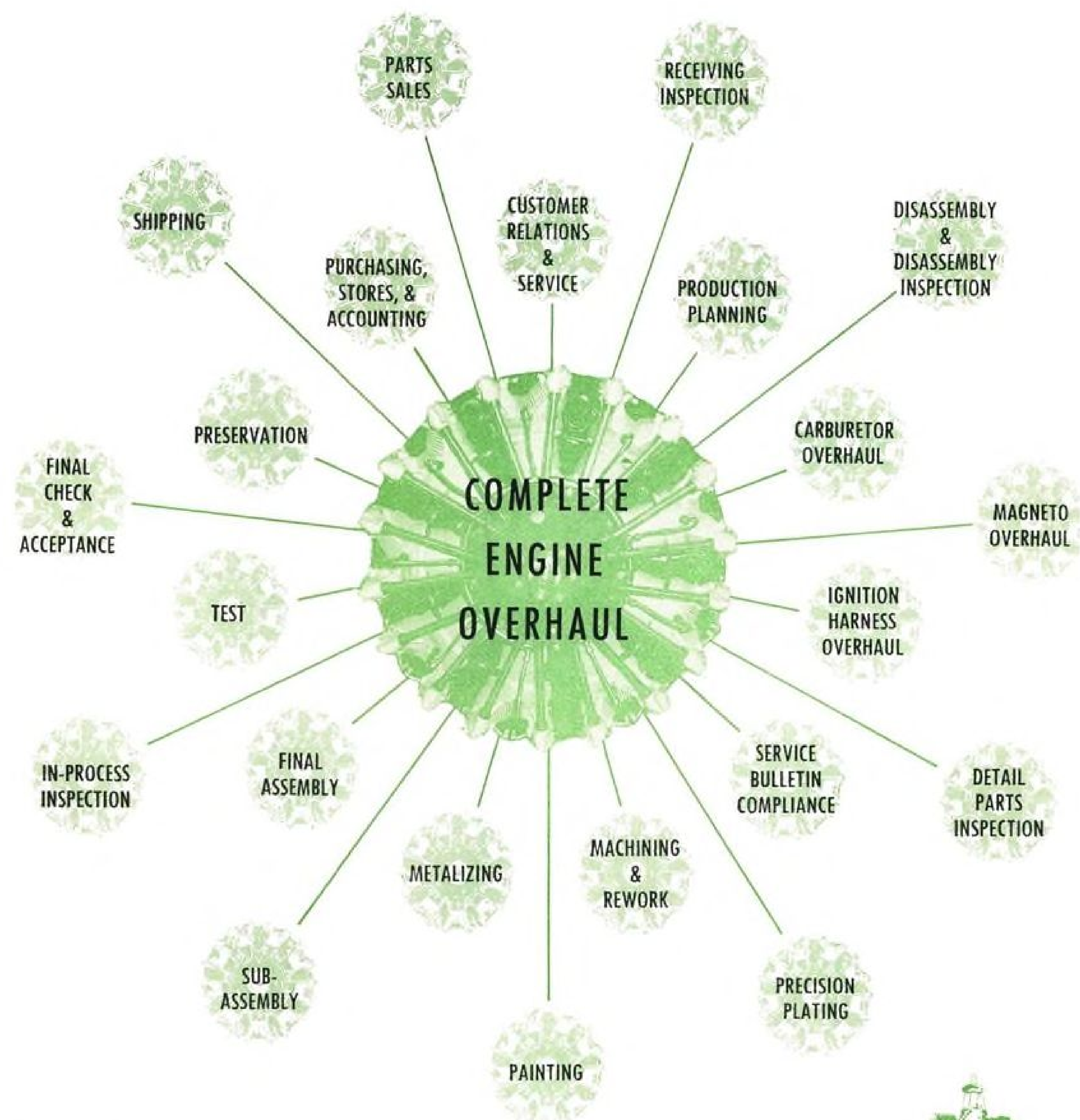
MACHINIST

...WILL THEY BE READY?

What kind of seniors will you hire this year from the high schools around you? Fast learners, steady workers, or...? Good schools are vital. And good schools *don't just happen*. If your company can help community groups to get better schools (population growth alone demands an extra 200,000 classrooms and 165,000 more teachers *right now*), the schools are sure to help your company. Think about it, won't you?



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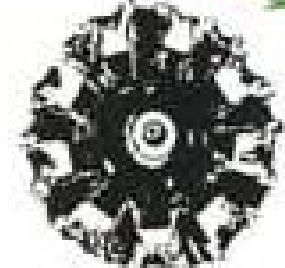
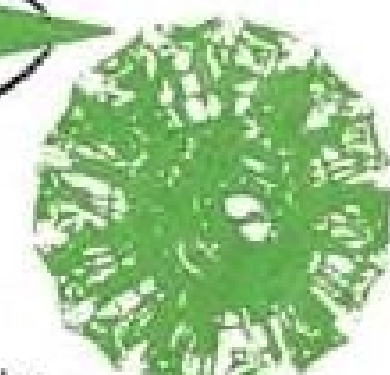


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NOTE: To designers, engineers and technicians. Foster's "SQUARCEL" high-temperature honeycomb is now being produced in quantity for control surfaces, for flight surface applications, engine applications and for other types of structural sandwich details. For complete information write the John J. Foster Mfg. Co., P.O. Box 2067, Santa Ana, 2880 North Harbor Boulevard, Costa Mesa, California, Attn: Department 12.

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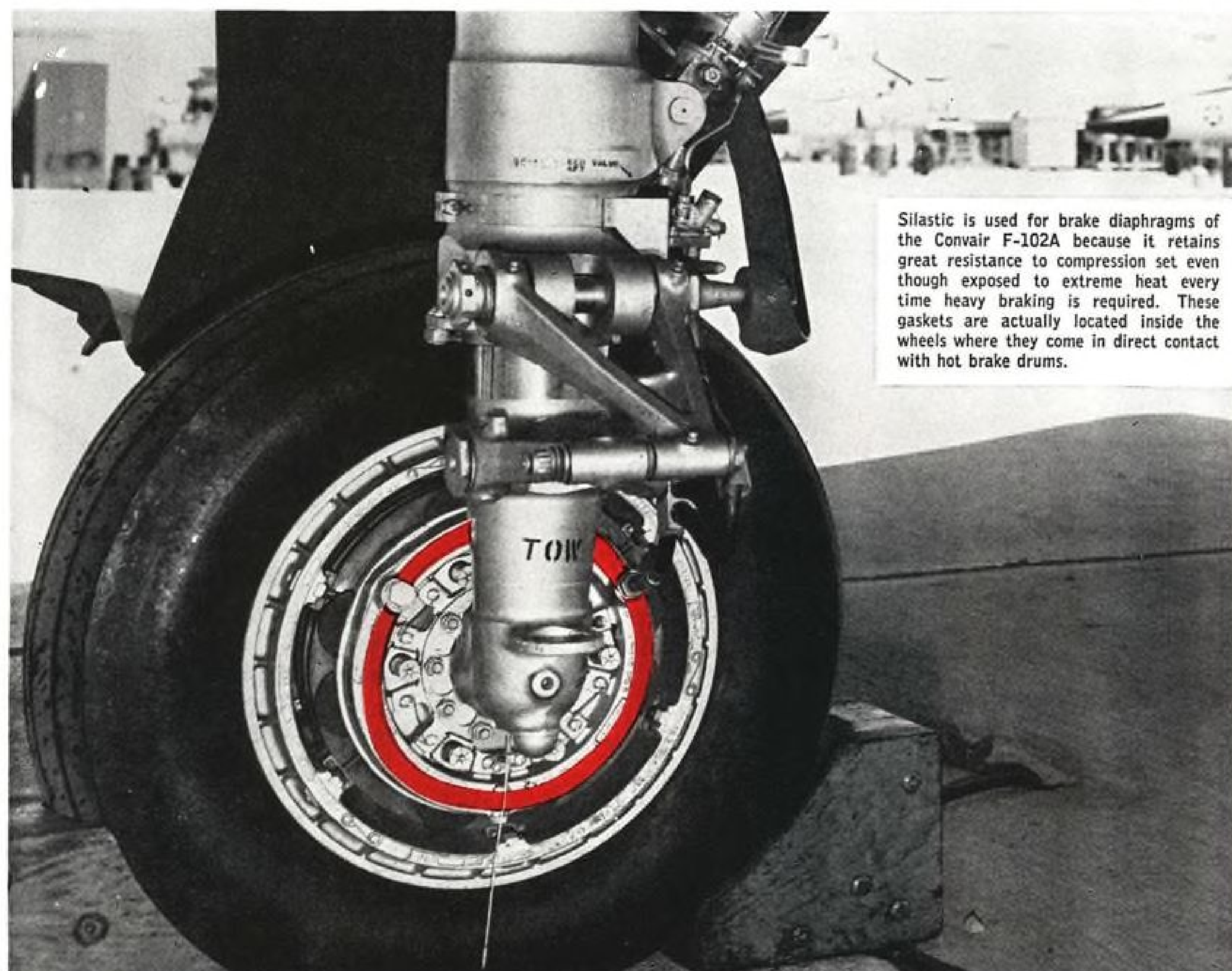
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Silastic is used for brake diaphragms of the Convair F-102A because it retains great resistance to compression set even though exposed to extreme heat every time heavy braking is required. These gaskets are actually located inside the wheels where they come in direct contact with hot brake drums.

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|-------------------------------|-------------|
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| • Tensile strength, psi | 600 to 900 |
| • Elongation, % | 100 to 300 |
| • Tear strength, lb/in | 40 to 75 |
| • Compression set, %, @ 300 F | 20 to 40 |
| • Hardness range, durometer | 20 to 80 |

If you consider ALL the properties of a silicone rubber, you'll specify SILASTIC.

first in silicones

DOW CORNING
SILICONES

DOW CORNING CORPORATION • MIDLAND, MICHIGAN

DECEMBER 31, 1956

AVIATION WEEK

VOL. 65, NO. 27

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RESEARCH AND MARKETING

Mary Whitney Fenton, Joan Read,
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Aircraft Industry Sets Sales Record..... 26

► U. S. aircraft industry reaches \$8.6 billion peacetime record and becomes nation's largest employer in 1956.

Offshore Oil Fields Open Helicopter Boom..... 27

► Three-year boom worth at least \$5 million in sales to the U. S. aircraft industry; future prospects almost unlimited.

Airlines Reach New Peak, Future Bright..... 32

► Traffic, revenue increase continue through 1956; expanding economy indicates good year ahead.

Foreign Jets Move Into World Market..... 37

► Foreign aircraft builders expand prospects in world transport market now dominated by American manufacturers.

AERONAUTICAL ENGINEERING

Hustler Weapons Carrier..... 30
Antarctic Fuel Drops Tested..... 49
Falcon-Carrying Scorpion..... 52
Thrust & Drag..... 60

PRODUCTION ENGINEERING

Bulova Streamlines Crystal Making..... 56
Hydrogen Control Is Titanium Aid..... 61
Production Briefing..... 61

EQUIPMENT

CL-28 Hydraulics Revised..... 50
Material Withstands 3,000F..... 55
F84s for NATO..... 59
Italian Air-Aid Squadrons..... 60

AVIONICS

Computer Simulates Response..... 62
Expansions in Avionics..... 64
Filter Center..... 65

TRANSPORT

Smith Discounts Medium Jets..... 33
Xmas Weather Hurts Airlines..... 34
Examiner Favors RR Fare Increase..... 40
Local's Problems Brighten..... 41
Delay Asked in Irregular Case..... 42
MATS Will Have 717 Transports..... 46
Cockpit Viewpoint..... 41
Airline Traffic—October 1956..... 48

FINANCIAL

Venture Capital in Aviation..... 67
USAF Contracts..... 66

MANAGEMENT

Who's Where..... 23
Industry Observer..... 23
Washington Roundup..... 25
News Digest..... 29

EDITORIAL

A Year of Achievement..... 21

COVER: Sikorsky S-55 lands on flight deck of offshore drilling rig in the Gulf of Mexico off the Louisiana coast. Offshore oil fields, steadily moving further out into the gulf, represent one of the largest potential commercial helicopter markets in the world. For details on the part the helicopter is playing in the oil industry, see page 27.

Picture Credits:

38—Claude Witze.

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EDITORIAL

A Year of Achievement

This is the fading time of year to take a last backward look over the preceding twelve months and briefly savor their achievements before plunging on into the tasks and problems of the new year.

The year 1956 has been a very good year in aviation. Prosperity has fattened every segment of the industry. Technology has pushed us as far forward in this single year as it did over a five year span in the pre-jet era.

But, as always, this aura of past achievement will soon give way to the thorny economic, technical and political problems facing aviation in 1957 and beyond. We will become immersed in these soon enough. Before we do, it seems appropriate to call a roll of achievement for 1956, paying brief tribute to some of the men, machines and organizations that made the year so notable.

We Salute:

Gen. Nathan F. Twining, USAF Chief of Staff, for his candor and persistence in testimony on what the Fiscal 1957 defense budget really would do to the Air Force, the problems of Fiscal 1958 and his excellent, detailed reporting on what he and his mission learned about Soviet airpower during their visit to Russia.

James Pyle and the late **Charles Lowen** for the blast of fresh air they blew into the musty atmosphere of the Civil Aeronautics Administration and the courage and skill they displayed in tackling the twin problems of apathetic bureaucracy and the growing crisis in air traffic control. Nomination of Mr. Pyle to succeed Mr. Lowen as CAA Administrator, after the latter's untimely death, indicates a firm vote of confidence by the Eisenhower Administration in this approach to a vital and vexing problem that should hearten all segments of aviation now enmeshed in the traffic control snarl.

William Allen, president of Boeing Airplane Co. for his forthright, extemporaneous speech before the congressional subcommittee investigating aircraft industry profits. Mr. Allen's exposition before the Hebert committee opened congressional eyes to the genuine status of the aircraft industry in a capitalistic economy. The rest of the industry and its trade associations have been inexcusably laggard in picking up Mr. Allen's theme and spreading it to the taxpaying public, legislators and the military.

Convair's San Diego Division for a remarkable production record that enabled USAF to put the supersonic F-102A all-weather interceptor into service with the Air Defense Command and its Fort Worth Division for putting the XB-58, first supersonic medium bomber, into the air for successful flight testing within a few weeks of a contract date specified years ago.

Trevor Gardner for his long battle to achieve a sound research and development program for USAF and his

courage in speaking out publicly, regardless of personal sacrifice, when the research and development policies of the Defense Department endangered the future security of the nation.

The scheduled airlines for carrying a record total of 45.8 million passengers with a higher percentage of schedule completion than ever before.

The large irregular carriers for their perfect safety record in 1956.

National Advisory Committee for Aeronautics for its development of new hypersonic research tools and techniques that led to the blunt nose cone design for the intercontinental ballistic missile.

Lockheed, Grumman and North American for flying the first fighter aircraft capable of hitting Mach 2 in level flight—the F-104A, the F11F-1F, and the F-107.

General Electric for its J79 turbojet that has given the new crop of USAF and Navy fighters and the XB-58 bomber new capabilities in speed and altitude performance.

Lt. Gen. Thomas Power, Chief of the Air Research and Development Command, for his initiative and persistence in forging better working channels between military requirements and industry development potentials and the untiring effort of his command to seek new ways toward reducing the development cycle for aerial weapons systems.

Bell Aircraft Corp. and pilots of the USAF Flight Test Center at Edwards AFB, Calif., for the X-2 research aircraft program that pushed the range of piloted flight to a speed of 2,100 mph. and an altitude of 126,000 ft.

Boeing, Douglas and Convair for putting this country into the lead in the international turbojet-powered transport market with substantial sales of long and medium-range commercial jet transports.

Senators Stuart Symington and Henry Jackson for their persistent effort to place before the public an accurate record of the military airpower picture.

Congressman John Moss for his success in stripping some of the hypocrisy, stupidity and deceit from government policies on withholding official information from the public.

Civil Aeronautics Board's voting majority of Chairman **James R. Durfee**, Vice Chairman **Joseph Adams** and Member **G. Joseph Minetti** for carrying on the precedent established by former chairman **Ross Rizley**, **Adams** and **Josh Lee** in their decisions in favor of more competition in the airline business and better service for the travelling public.

—Robert Hotz

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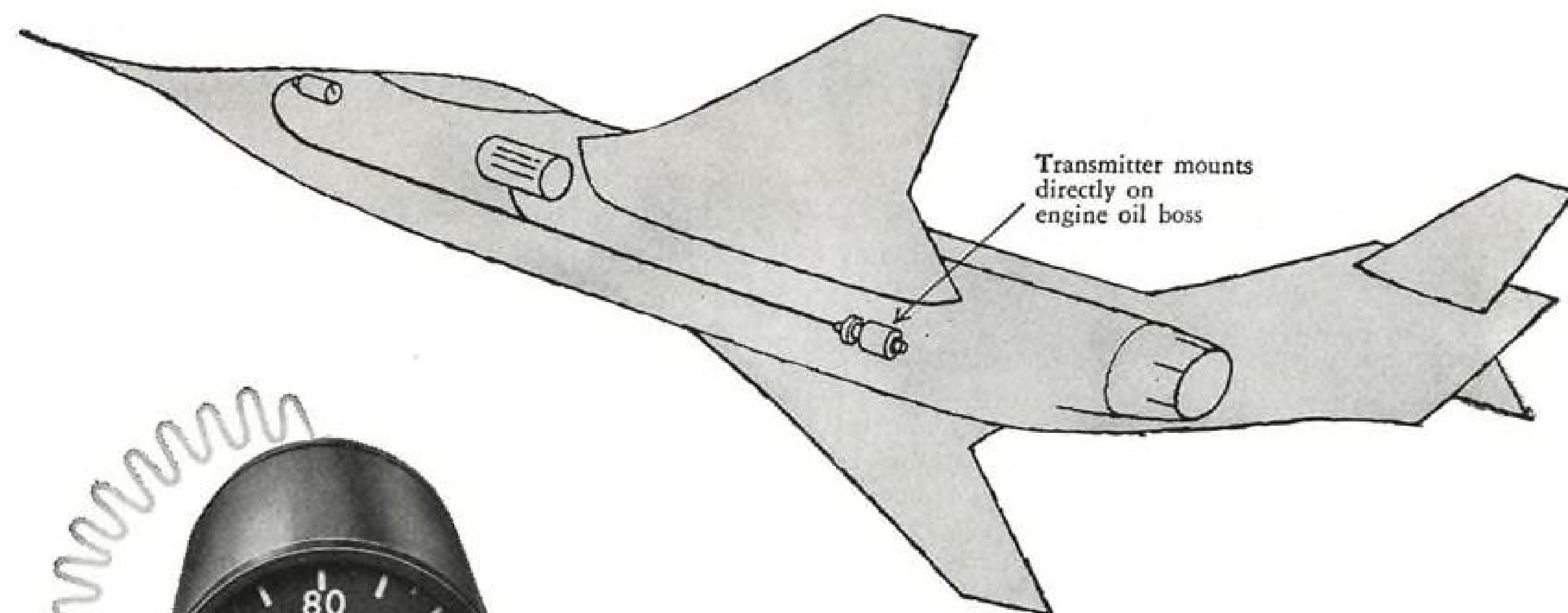
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new Pressure Indicating System eliminates shock mounting

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The transmitter is accurate through a vibration range up to 500 cps, temperatures up to 232°C and shock to 20 g. Oil hose or tubing is eliminated, thus removing a major cause of malfunction and delayed readings due to cold, sluggish oil. The transmitter has only one moving part and is frictionless.

The entire Edison Pressure Indicating System weighs only 2.5 pounds (plus wiring) and consumes a low 1.5 watts power. Because of its simplified electro-mechanical design, installation and maintenance problems have been minimized.

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WHO'S WHERE

In the Front Office

William S. Ginn and Jack S. Parker, vice presidents, General Electric Co., New York, N. Y. Mr. Ginn is general manager of GE's Transformer Division, Pittsfield, Mass., and Mr. Parker is general manager of GE's Aircraft Gas Turbine Division, Cincinnati, Ohio.

Byron G. Booth, president, George W. Borg Corp., Delavan, Wis. Mr. Booth succeeds George W. Borg who continues as board chairman. Also: G. Marshall Borg, vice chairman of the board.

T. M. Evans, board chairman, H. K. Porter Company, Inc., New York, N. Y. Charles L. Holbert succeeds Mr. Evans as president.

J. A. Cairns, a director, Allied Research Products, Baltimore, Md.

Joseph J. Dowling, president, Philadelphia Insulated Wire Co., Philadelphia, Pa.

Joseph F. Quaas, vice president-manufacturing and production, Eutectic Welding Alloys Corp., Flushing, N. Y.

David L. Steege, vice president and general manager, Newark Air Service, Newark Airport, Newark, N. J.

Carl F. Herbold, vice president-manufacturing, and Ralph J. Eschborn, vice president-engineering, Jack & Heintz, Inc., Cleveland, Ohio.

Leo J. Brancato, vice president, Heli-Coil Corp., Danbury, Conn.

Francis W. Dunn, assistant to the president for public relations and public affairs, Bell Aircraft Corp., Buffalo, N. Y. William A. Boles succeeds Mr. Dunn as director of public relations.

Honors and Elections

Mundy I. Peale, president of Republic Aviation Corp., has been elected president of the Institute of the Aeronautical Sciences for 1957. Mr. Peale succeeds Edward R. Sharp, director of the National Advisory Committee for Aeronautics' Lewis Flight Propulsion Laboratory. Newly elected IAS vice presidents are: Edwin E. Aldrin, aviation consultant to Standard-Thomson Corp.; Lt. Gen. Laurence C. Craigie (USAF, ret.), engineering vice president, Hydro-Aire, Inc.; Roy E. Marquardt, president Marquardt Aircraft Co.; Earl D. Osborn, board chairman, EDO Corp.

W. Paul Eddy, chief of engineering operations for Pratt & Whitney Aircraft Division, United Aircraft Corp., has been elected president of the Society of Automotive Engineers for 1957.

J. Turner Moore, Jr., vice president of the Battery Division of the Electric Auto-lite Co., has been elected president of the Aviation Distributors and Manufacturers Association. Mr. Moore succeeds Robert S. Northington, vice president of Piedmont Aviation, Inc.

INDUSTRY OBSERVER

► Raytheon-developed radar guidance system used in Navy's new Sparrow 3 air-to-air missile has been adopted for use in an Army missile for which Raytheon holds the prime contract. Navy's Bureau of Ordnance also has selected this type guidance for use in its surface-launched missiles. Raytheon is developing two new versions of the Sparrow that can be used in higher performance aircraft than present models.

► Naval Ordnance Laboratory has developed a mechanical recorder for measuring shock from underwater explosions. The recorder supplements electronic recorders which sometime fail under heavy shock conditions. The recorder is self contained in a seven-inch bronze ball, records frequency and amplitude of pressure of accelerations of up to 4,000 Gs over a 12-second period. Photographic record of the stylus trace can be made either by wrapping film around the recording drum or through a low-power microscope.

► Vertol Aircraft Corp. will open a St. Louis office early this year to establish closer liaison with Army's Transportation Supply and Maintenance Command. Beginning with Fiscal 1958, the command, headquartered at St. Louis, will take over the primary procurement functions for all Army aircraft maintenance.

► Minneapolis-Honeywell Regulator Co. will develop a design, mock-ups and wind tunnel models of an air-to-ground rocket for delivery by fighter aircraft. Work will be carried out at Honeywell's Aeronautical Division Missile Controls Laboratory in Los Angeles under a \$500,000 Air Research and Development Command contract.

► Douglas Aircraft's third C-133A is now flying at Edwards AFB, Calif. The second aircraft of the series has been returned to Douglas' Long Beach, Calif., plant to be readied for climatic tests at Wright-Patterson AFB, Calif., after completing 91 hr., 30 min. flight time from the time of its first takeoff on Sept. 22. After the Wright-Patterson tests, the aircraft will undergo cold weather tests at Eglin AFB, Fla.

► Air Materiel Command has ordered F-106A flight simulator trainers, spare parts, special tools and engineering data from Link Aviation, Inc. Contract is for \$2.1 million.

► Continental Army Command's Board 6 will have its name officially changed tomorrow to Army Aviation Board. The Ft. Rucker, Ala., unit, headed by Col. Robert R. Williams, conducts test and evaluation of aircraft and aviation equipment for the Army. Name change is designed to end confusion with other CONARC boards that test other equipment.

► Swedish Air Services Ltd., a civilian firm that tows aerial targets for the Swedish armed services on a contract basis, is considering use of the Beech Dart supersonic tow target. Representatives of the firm recently visited Beech's Wichita plant. The Dart is now being evaluated by U. S. armed services.

► Lockheed's first 1649A transport has completed approximately 125 flight test hours since its first flight on Oct. 22. Production of the new Super Constellation is being geared for seven deliveries per month. First delivery of the new aircraft will be in April to Trans World Airlines. First delivery to Air France is scheduled for June. Later deliveries to Lufthansa, Linee Aeree Italiane and Varig of Brazil are scheduled to extend into 1958.

► University of New Mexico will conduct research into extensive air showers in cosmic radiation under a \$28,500 contract from Air Research and Development Command's Air Force Office of Scientific Research.

► Aerfer Sagittario, an Italian swept wing experimental turbojet powered aircraft, has been flown at speeds above Mach 1. It is the first all Italian designed and built airplane to do so.



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supplies in and out of short, rough, unprepared fields, landing at regular *eight second intervals*. Proof that any large scale airlift is quicker and surer in the versatile, rugged C-123.

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Washington Roundup

Pentagon Numbers Game

Pentagon's number one numbers game—the annual tug of war over the budget—was at its hottest last week with speculative figures flying thick and fast. One speculation generally accepted as fact—the Air Force stands to get only a fraction of the \$6 billion increase its Chief of Staff believes necessary. In view of this, a program is reportedly under way designed to cut 10 wings from USAF's 137-wing goal, which it was supposed to reach by mid-1957. USAF already has been told it will lose three wings of C-124 transports to the new Military Air Transport Service single manager agency (AW Dec. 17, p. 34). MATS is expected to take another three wings from the Tactical Air Command, probably of C-130s. If the overall 10-wing cut materializes when the budget comes out of the White House, an additional four wings will be eliminated. Air Force Secretary Donald A. Quarles last week was still fighting for more dollars in the office of Defense Secretary Charles E. Wilson.

One spokesman told AVIATION WEEK: "We're going to hurt. And so are some contractors. It's mostly a question of which ones."

Aircraft Show's Demise

Air Foundation is digging hard to find a new format to replace the National Aircraft Show, which has been effectively killed by Defense Secretary Charles E. Wilson, with few mourners within the aircraft industry. Acting on the advice of USAF Secretary Donald A. Quarles, and buttressed by the Aircraft Industries Assn.'s Public Relations Advisory Committee (AW Dec. 17, p. 30), Wilson passed on this doctrine to the service secretaries:

- Benefits from the 1956 show at Oklahoma City were not worth the cost, and 1957 participation will not be authorized.
- This does not mean the Armed Forces cannot take part in sponsored regional and local air shows if they meet Defense Department standards.
- 1957 participation probably will be limited to Armed Forces Day programs.

Gen. Benjamin W. Chidlaw, retired USAF officer and vice president of Thompson Products, is heading a committee studying various alternate ideas, most of them centered around television. Fred C. Crawford, head of Thompson Products and of the Air Foundation, feels strongly that a substitute for the National Aircraft Show must be found and that the foundation has a responsibility to continue its tradition if at all possible. The idea of a nationwide television program, which looked attractive two or three years ago, has lost some of its appeal because the networks are now using a generous amount of military footage.

Small Business and Navy Research

Assistant Navy Secretary for Materiel R. H. Fogler has assured the Senate Small Business Committee that the Navy will follow USAF's lead and take steps to increase the participation of small firms in its research and development programs. The Air Force, acting upon a recommendation by the committee, recently established a small business office at the Baltimore headquarters of the Air Research and Development Command (AW Nov. 12, p. 27). Primary function of the office is to increase

small business participation in ARDC activities.

Fogler wrote Sen. John Sparkman (D.-Ala.), chairman of the committee:

"The research and development area is a very important area for both the Navy and small business. . . . The Office of Naval Materiel has already initiated a study . . . in order to determine whether or not the facilities of small business can be further utilized by the technical bureaus. It is estimated that this study will be completed during February 1957."

Early Confirmation for Pyle

James T. Pyle was officially sworn in last week as Administrator of the Civil Aeronautics Administration by Commerce Secretary Sinclair Weeks following his appointment to the top CAA post by President Eisenhower. Early Senate confirmation of the recess appointment is expected without any prolonged congressional investigation such as the one that delayed confirmation of the late Charles Lowen last spring. Pyle's future policies will conform to the overall CAA program established while he served as deputy under Lowen.

Independent CAA?

Sen. Mike Monroney (D.-Okla.), chairman of the Commerce Aviation Subcommittee, plans to renew his drive in the new Congress for separation of the Civil Aeronautics Administration from the Commerce Department—either as an independent agency or a department headed by a cabinet-rank officer. Monroney anticipates support from the Aviation Facilities Planning Group.

More Apprentice Training

Department of Labor has criticized the aircraft industry for failing to help meet its employee procurement problem through apprentice training programs. The department said a survey of 143 manufacturing plants showed most of them have training programs, but that only a third devote any effort to apprentices. The report added: "Technological changes and possible accelerated production schedules make it doubly important that plants in this key industry have training programs to develop a sufficient number of highly skilled craftsmen."

Realistic Scheduling

Airline officials failed to agree on an industry-wide policy for realistic scheduling standards at a meeting held earlier this month, but they will make another attempt to work out an acceptable plan early next month. The industry hopes to establish a set of standards for flight scheduling before the Civil Aeronautics Board goes ahead with plans to write statutory standards for realistic scheduling. The airlines are bitterly opposed to the CAB's proposed scheduling rules.

The CAB has proposed a regulation that would require an airline to set schedules capable of on-time performance 75% of the time. If they fail to meet this standard, the schedules would have to be changed. The rule is designed to bar the carriers from planning schedules that are unrealistically tight as a competitive practice. CAB's proposal was supported by Air Line Pilots Assn., opposed by individual airlines and by the Air Transport Assn.

—Washington staff

Aircraft Sales Hit \$8.6 Billion for 1956

New peacetime record set as industry becomes top U. S. employer, military output still declines.

Washington—U. S. aircraft industry set a new peacetime sales record of \$8.6 billion and became the nation's largest employer in 1956 despite a continued decline in the delivery of military planes. Sales in 1957 are expected to at least maintain the 1956 level.

It begins the new year with a substantial backlog, reported at \$18.4 billion on Oct. 1, compared with \$15.7 billion a year ago.

Why Decline in Deliveries

In a year-end summary issued by Adm. Dewitt C. Ramsey, retiring president of the Aircraft Industries Assn., these other 1956 achievements for the industry were noted:

- **Backlog of orders** for commercial transports was close to \$3 billion at the end of the year. During 1956, orders and options were placed for more than \$1 billion in jet and turbo-prop transports.

- **Output of military aircraft** fell to less than 7,000 units, and the trend is expected to continue. There were 8,000 units delivered in 1955.

- **Total of civil aircraft sold** in 1956 was 7,500, a substantial increase over the previous year's 4,823.

- **Industry employment** averaged 800,000 in 1956, making it the nation's largest employer for a full 12-month period for the first time in history. Hourly earnings for production workers averaged \$2.31 last September and the trend continues upward. Estimated wage and salary payments for the industry in 1956: \$4.4 billion.

- **Industry plans to spend \$1 billion** in its own money for research and devel-

opment facilities during the next five years.

Adm. Ramsey said the continuing decline in the number of aircraft delivered to the Air Force, Army and Navy is due in part to the growing emphasis on missiles. In addition, the effect on industry of the decline has been offset to some degree by the increasing weight of military planes. In 1956, he said, military sales represented between 85 and 90% of the industry's output.

Despite the fact that the year's total business set a new high for a peacetime year, AIA expects that company earnings and the ratio of profits to sales will decline. Figures for the 12 largest airframe manufacturers show 1956 sales of \$5.25 billion as compared with less than \$5.2 billion for 1955.

The summary pointed out that the stable production rate of the past few years has given manufacturers a chance to concentrate on improved manufacturing techniques and lower costs. At the same time, contributions were made to establishment of an improved mobilization base in case of war.

Civil Aircraft Boom

Most of the boom in civil aircraft sales last year is attributed to the growing interest in utility types, both fixed and rotary wing. Deliveries of these planes accounted for 7,100 out of the 7,500 civil aircraft sales. The 7,100 compares with 4,575 for 1955.

The year's payroll to production workers of \$4.4 billion, it was pointed out, does not include wages earned in the plants of industry suppliers, sub-

contractors and vendors. In the aircraft industry proper, about one out of 10 workers is engaged in engineering activity. In World War II, the ratio was one to 25.

For the future, Adm. Ramsey anticipates an increase in congressional appropriations for airpower in Fiscal 1958, but he also expects a continued shift from aircraft to missiles when the contracts are signed.

He predicts that the next budget will be 65-35 in favor of manned aircraft, with a 50-50 distribution of orders in Fiscal 1961.

NAA's Purchases Total \$624 Million

Los Angeles, Calif.—Small business firms, those with less than 500 employees, received exactly 50% of North American Aviation's total of \$624,700,692 in purchase orders during the 1956 fiscal year, according to Rulon Nagley, NAA's director of material.

North American did business with 12,879 firms, 85.6% of which were in the small business category.

Purchases included subcontracts for the manufacture and assembly of major aircraft components such as wing, empennage, fuselage, surface control and pylon assemblies for the Air Force's Sabre and Super Sabre fighters, Navy Fury fighters and T-28 trainer aircraft.

The company also utilized thousands of specialized items supplied by outside firms. For example, North American's Rocketdyne Division, which develops and manufactures liquid-propellant rocket engines, purchased \$42,584,610 from small business concerns during the year.

British Push Gnat; RAAF Prefers F-104

Melbourne—Strong British pressure reportedly is being applied to have Australia accept the Folland Gnat as its next fighter, with some sources pushing the English Electric P. 1 twin jet. Royal Australian Air Force officials still are enthusiastic about the Lockheed F-104A.

Meanwhile, further dismissals have been announced at several Australian aircraft manufacturing plants, and the government, occupied with other political and economic matters, has made no decision on the future of the Australian industry. Prime Minister R. G. Menzies is expected to examine the situation personally, and make an official announcement.

Offshore Oil Booms Helicopter Sales

By Claude Witze

New Orleans, La.—The Gulf of Mexico's offshore oil fields have opened the world's largest potential market for commercial cargo helicopters.

A three-year boom, worth at least \$5 million in sales to the U.S. aircraft industry, already has reached from here to the Persian Gulf, Venezuela and the jungles of New Guinea. Future prospects are almost unlimited.

Within six weeks, the first Sikorsky S-58 helicopters will go into scheduled operation along the Gulf Coast, joining older S-55s and Bell 47s. An AVIATION WEEK estimate indicates about 50 rotary-wing aircraft will then be serving the oil industry in this area.

Secret of their success is simple—the helicopters, being used on this scale for the first time, are performing a mission that is economically justified.

What's Behind Success

This does not mean oil producers have found a way to reduce the helicopter's inherent high operating costs. But in a business where they are spending \$18 million a month—40% of it for transportation—rotary wings are not a peril to anyone's budget.

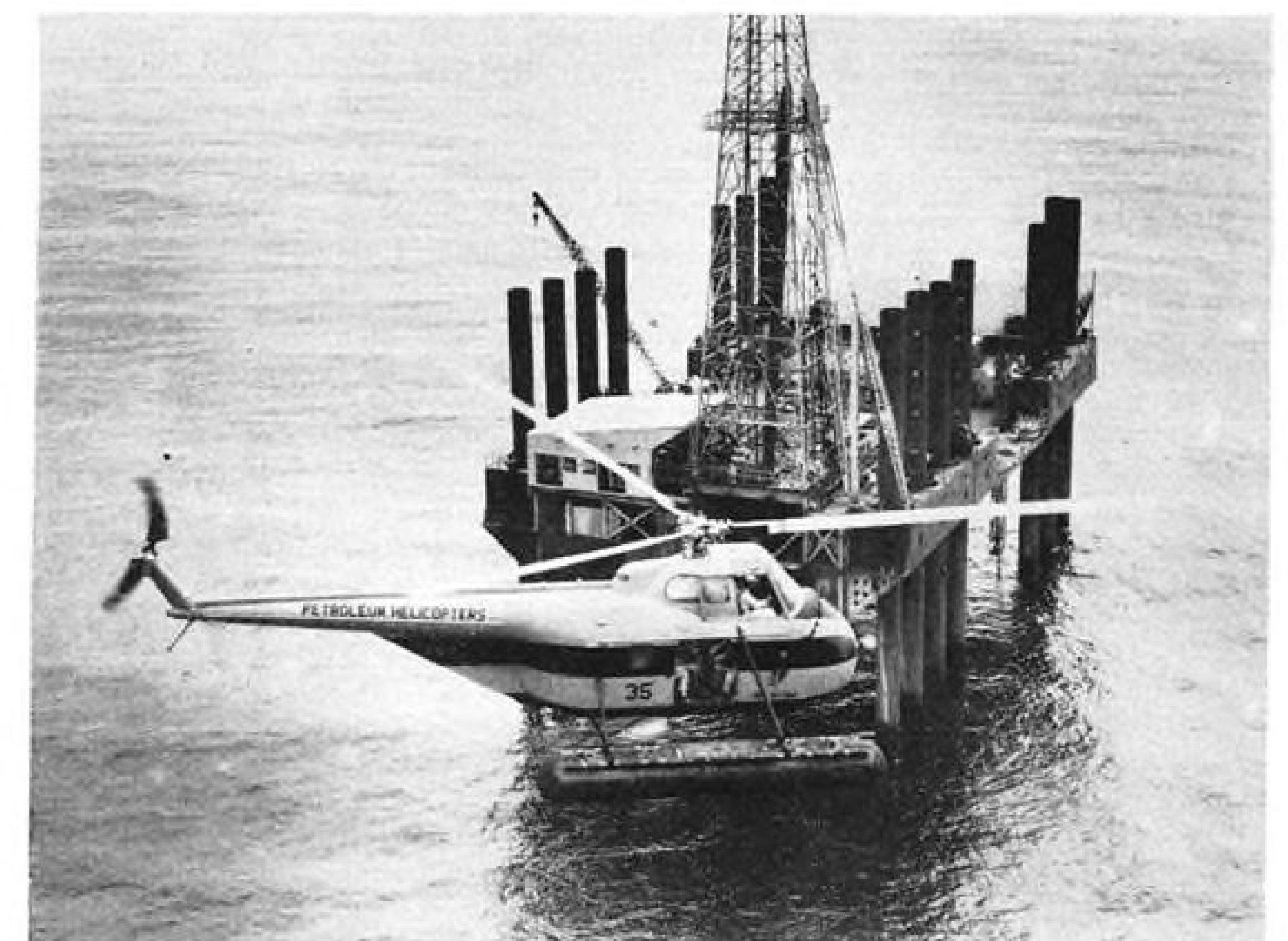
A tour of heliports and operations offices from the Mississippi delta to the Texas border reveals these evidences that the helicopter has found its happiest customer:

- **Reliability and safety** have reached a level unachieved, for the most part, by other operators—military or commercial.
- **Costs are equal to, or lower than,** the cost of surface transportation in this specialized operation.
- **Utilization rates are high.** Some of the figures would be considered impossible by other experienced helicopter operators.

Pinpoint Scheduling

For the first time, helicopters are living up to their advance notice and operating like streetcars. Most striking is the scheduled operation of the Sikorsky S-55, ferrying workers and supervisory personnel from shore bases to offshore rigs up to 50 miles away. The record has attracted the attention of the U. S. Army, which now has officers on the scene to study the operation. Within the past month there was a personal tour of the facilities in this area by Maj. Gen. Hamilton H. Howze, chief of Army Aviation, and his report is being used to spur and educate his military units into more efficient use of the helicopter.

It is difficult to substantiate the case with exact figures on such vital items as



PETROLEUM Helicopters S-55 with passenger load approaches an offshore rig.



HELICOPTER works with exploration crew in marsh buggy in Louisiana swamps.

the breakdown on maintenance, although Gen. Howze presumably has access to some of the records. The reason these are not made public is that the highly-competitive offshore oil industry is blanketed by inter-company secrecy and a security system that would do credit to the Pentagon. The caution used by oil company representatives and their contract helicopter operators in discussing the specifics of their business follows the standards set by such keen and notorious rivalries as the one between Gimbels and Macy's.

Through this competitive smoke it is possible to learn that the helicopters

replace boats, that boats are slow-moving and cost in excess of \$100,000 each. The S-55 helicopter, stripped, costs \$147,500.

The larger and more efficient S-58 will cost \$248,000.

Maintenance, as all helicopter owners have found, is expensive. But one oil company is convinced that it is saving from \$16,000 to \$18,000 a month on each S-55 it operates. Another company looks at these figures with a skeptical eye, says only that it costs no more to fly than to sail out to the rigs.

One pioneer operator with a highly efficient setup bluntly told AVIATION

Satellite Tracking Stations

Washington—At least 12 visual and optical-photographic tracking stations will be established around the world for precision observation of satellites launched in Project Vanguard. Data will be reduced at a computation center to be established at the Smithsonian Astrophysical Observatory in Cambridge, Mass.

Present plans call for stations in New Mexico, Florida, Spain, South Africa, Japan, Hawaii, the Netherlands Antilles, Australia and Argentina. Other sites in South America and the Middle East are under consideration, according to the U. S. Committee for the International Geophysical Year.

Modified Schmidt cameras, using continuous strip film, are planned for the 12 bases. They were developed by the Astrophysical Observatory, which has responsibility for optical and visual tracking under Dr. Fred L. Whipple.

Information telemetered from the satellites to 10 minitrack stations (AW Oct. 29, p. 31) will be reduced in a computation center here. Staff will be headed by Dr. Paul Herget, a consultant to the Naval Research Laboratory, and they will use an IBM 704 computer. A secondary computing facility will be maintained on a standby basis at another location.

Helicopters to New Guinea

Houston, Texas—Three Sikorsky S-58 helicopters are en route to Port Moresby, New Guinea, to pioneer a new area for the oil industry 15 miles in the tropical jungle.

National Supply, Inc., of this city, has designed a special drilling rig in "packages" not exceeding 4,000 lb. that will be moved by the helicopters, along with personnel, tools and living accommodations, to the interior site. The rig has been sold to Standard-Vacuum, which is preparing to hunt new oil sources in New Guinea.

The helicopters will be operated by Bahama Helicopters, Ltd., a subsidiary of the Knute Flint organization. They represent an investment of about \$1.25 million.

The alternative: Building a road through the jungle to the site would cost \$1 million and would be a pure gamble, an expendable highway if oil is not found at the site.

WEEK that cost is not a major factor in judging the advantage of the helicopter for his company. There is talk from time to time about the fact that offshore rig workers get portal-to-portal pay. It can take hours to get to some rigs by boat; they can be reached in minutes by helicopter.

Offshore Investments

The truth is that this is a minor consideration in view of the hardy economics of the offshore oil business. Here is a glimpse at some elephantine facts:

- **Thirty-five oil companies** already have \$1.25 billion invested in offshore oil. \$1 billion of this has been put out in the past three years, which is the period in which the cargo helicopter has proven its utility.

- **It will be from five to seven years** before income can possibly equal outlay, and the capital investment then still must be paid off.

- **An offshore well costs up to \$700,000** as compared with \$100,000 for an onshore rig. If an offshore rig is closed down, waiting for a boat to bring repair parts or supervisory personnel, it costs the owner \$6,000 a day while it stands idle. This is 80% of what it costs when it is operating.

- **Mobile drilling barge** used to sink an offshore well can cost anywhere from \$3 million to \$6 million. A drilling contractor gets more than \$4,000 a day for the use of this seagoing monster.

In this atmosphere an auditor's reaction to helicopter costs is a lot less important than missing a transportation schedule. The result is that reliability and utilization are setting new records for rotary wings.

Outstanding example of this is the three-helicopter schedule of Humble Oil & Refining Co. operating out of Grand Isle, La. The S-55s are in the air from 6:15 a.m. until 1:18 the next morning. There are 33 round trips with a total daily flight time of 20 hours, 20 minutes, or almost seven hours for each helicopter.

When Humble adds two S-58s to its fleet next month, daily flight time is

expected to increase to about 33 hours. By that time, they will be moving from 16,000 to 18,000 passengers each month.

The California Co., operating Bell and Sikorsky aircraft, made 4,113 flights in a seven-month period. Total flying time: 1,604 hours. They carried 14,140 passengers and 111,665 lb. of cargo. During the seven months, average flight time per aircraft was almost 535 hours; schedules were canceled only 3.5 days for maintenance purposes.

At Lafayette, La., home of the pioneering contract operator, Petroleum Helicopters Inc., figures were available on the work done for two customers, both buying S-55 service. In a recent three-month period, Gulf Oil Co., used 845 hours of flight time on 993 trips to offshore rigs. Transported were 4,632 passengers and 87,848 lb. of cargo.

Another firm, a four-company combine, rolled up 342½ hours of S-55 time in the same three months. There were 1,040 flights to move 3,578 passengers and 63,071 lb. of cargo.

Petroleum Helicopters

Petroleum Helicopters, started in 1949 as Petroleum Bell Helicopter Services, Inc., is credited with the real pioneering work in the days when there were huge uncertainties about offshore oil as well as helicopters. There is no doubt that this charter operation led the way, and it is flourishing despite the fact that its service has convinced some of its customers that they should own and operate their own aircraft.

Petroleum operates 28 aircraft. Of these, 24 are Bell 47 models and four are Sikorsky S-55s. Thirteen of the Bells are on duty in South America, principally in Venezuela. The company has one S-58 on order for delivery early in 1957. It will work primarily for Gulf Oil Co.

Outside of its main office and overhaul shop at Lafayette, Petroleum maintains auxiliary refueling bases at five points along the Louisiana Gulf Coast and radio bases at seven other sites. There are 45 pilots on the payroll and

56 mechanics. There are contracts with 10 oil companies, and service is provided to 29 offshore rigs. In October, Petroleum Helicopters flew 1,029 hours in this area, 848 hours in South America.

Swamp Exploration

In its early days, Petroleum led the way by adapting the Bell 47 to gravity, seismic and magnetometer surveys. There was a long struggle to develop techniques and equipment that would let the helicopter speed exploration work in the nearly impenetrable areas of the Louisiana swamps and bayous. It replaced the ungainly and slow marsh buggy and put geophysical survey work on a new, more exact level than previously was possible.

This operation led naturally to utilization of the helicopter when true offshore operations got under way on a major scale about three years ago. It was in March 1954, that the Supreme Court settled the basic Tideland argument and opened up the new reserves for exploitation. In the beginning, boats had to be used for offshore exploration, and there was no market for the helicopter's services until drilling began and rigs were set up. It was at this point that the cargo helicopter, the S-55, first went into operation.

The converted LSTs that were serving the oil companies in offshore drilling were altered to provide flight decks. For the most part, they measure 50 by 70 feet but probably will be enlarged to hold the new S-58 as it comes into operation.

Humble was one of the first companies to use the helicopter. One of their early drilling platforms was located 15 miles in the Gulf but 45 miles from the company's Grand Isle headquarters. The boat ride ran four to five hours over rough water. Seasickness was a problem, in addition to time, and morale did not climb as the rigs moved out into deeper water.

A major factor in this situation is accidents. They are not uncommon on the rigs and frequently are serious. There are spots where a man can be badly hurt and where it will take seven hours to get him to a hospital by surface transportation.

The helicopter can have him on the ramp outside the operating room in approximately 45 minutes.

Men assigned to work on an offshore rig put in four-day shifts on their man-made island in the Gulf. Toolpushers, drillers, roughnecks and seamen, they weigh in and take off with an air of nonchalance that never is seen at LaGuardia or Washington National.

There was a time when Humble had to maintain living quarters on one of its platforms that served as a pumping station for the oil gathered from six



HUMBLE Oil pilots walk to platforms where Bell 47 helicopters await takeoff.

nearby wells. This was necessary to provide for a pumper and a cook to be on the job at all times, along with a standby boat that was available for emergencies.

Now the pumper lives ashore. Automatic controls flow the wells and shut them down if a piece of equipment fails.

At regular intervals, a Bell 47—Humble operates four of them in addition to the S-55s—takes the pumper to his station, leaves him for a few hours of work, and then brings him home.

Supervisory personnel are receiving a bigger day's work finished and are within minutes of their trouble spots. In three hours of skipping around Humble's offshore rigs in the Bell 47, a district superintendent can cover a route that would take 10 to 12 hr. by boat.

Boat vs. Helicopter

A chart developed by an oil company operating helicopters out of Venice, La., shows these comparative times for boat and helicopter runs from the base to offshore rigs 15 to 30 mi. away:

Boat	Helicopter
2:00	0:22
1:30	0:20
2:00	0:20
1:00	0:10
1:10	0:17

There are almost as many ways of getting helicopter service as there are oil companies. Next to the conventional contract arrangement with a firm such as Petroleum Helicopters, most popular is operation by the oil company itself.

The oil industry, already the most extravagant user of corporate aircraft, probably has as much operational know-how as some major airlines.

Some of the companies recognize, however, that the helicopter is a highly specialized piece of hardware and turn the maintenance problem over to a contractor. Humble, for example, is served by four Bell 47s that are used on contract from Rotor Aids, Inc., of Ventura, Calif. At the same time, Rotor Aids provides maintenance for the Humble-owned fleet of S-55s, paid with a fee for its management services plus labor costs.

Humble provides the spares and controls their use.

Other oil producers provide their own maintenance as part of their overall aviation program. Investing company money in the larger, cargo-type aircraft probably started because the contract operators at the outset were not prepared to finance a heavy spending program for equipment.

Biggest advance for the offshore operators will come within a month with delivery of the first new S-58s. This move will more than double the available payload—up from 1,500 to 4,000 lb. compared with the S-55 now in use. It will involve an initial outlay of \$100,000 more than the cost of the S-55, but the cargo ton/mile cost of using it should drop about 40%.

S-58 Performance

From a maximum of seven passengers on routes with a 50-mi. radius, the S-58 operator will be able to carry 12 persons as far as 150 mi. from his base. Cruising speed will climb from 86 to 104 mph.

This performance is important in terms of future development of the offshore fields as the industry's gamble grows. Rigs are being serviced today 50 mi. from shore. But the workable shelf in the Gulf of Mexico runs out

150 mi., where the S-55 would fall far short of the range requirement.

Activity along the Gulf of Mexico is only a small part of the potential. In addition to South America, four Westland-built S-55s are operating in the Persian Gulf, on offshore activities.

The oil industry already is mapping where the rotary wings will fly next. It is charting possibilities off Mexico, Honduras, Costa Rica and the British West Indies. There are hopes for offshore activity in the Amazon delta, Ecuador and Peru. The Middle and Far East and Africa will be tapped.

News Digest

East Germany's aviation industry reportedly hopes to produce 100 four-jet planes within the next few years. Technicians, workers, apparently will come from institutions like Dresden's Technical High School where almost 500 students are enrolled in an 11-semester aviation program.

Technical assistance contract between Republic Aviation International and Weser Aircraft Co., West Germany, will provide industrial support for the newly activated German air force. Amount of the contract was not announced. Republic will pass along its know-how on activation and maintenance of F-84F Thunderstreaks and RF-84 Thunderflashes. By April 1958, between 500 and 600 of these aircraft will have been turned over to the German air force.

Grants of \$34,655 were awarded by the Link Foundation to 13 colleges for studies in aeronautics during 1957.

Test range facilities will be built by Talco Engineering Co. on a 2,000 acre tract near Phoenix, Ariz. Although the first construction will not be completed till July, some tests will get underway this month. One of the principal projects will be testing rocket catapults for pilot escape systems on high-speed aircraft.

Air Force ordered \$6 million worth of kits from Lockheed Aircraft's Corp.'s Georgia Division for use in modernizing Strategic Air Command B-47s. Last new B-47 to be built at the Marietta plant will be delivered to the Air Force in February.

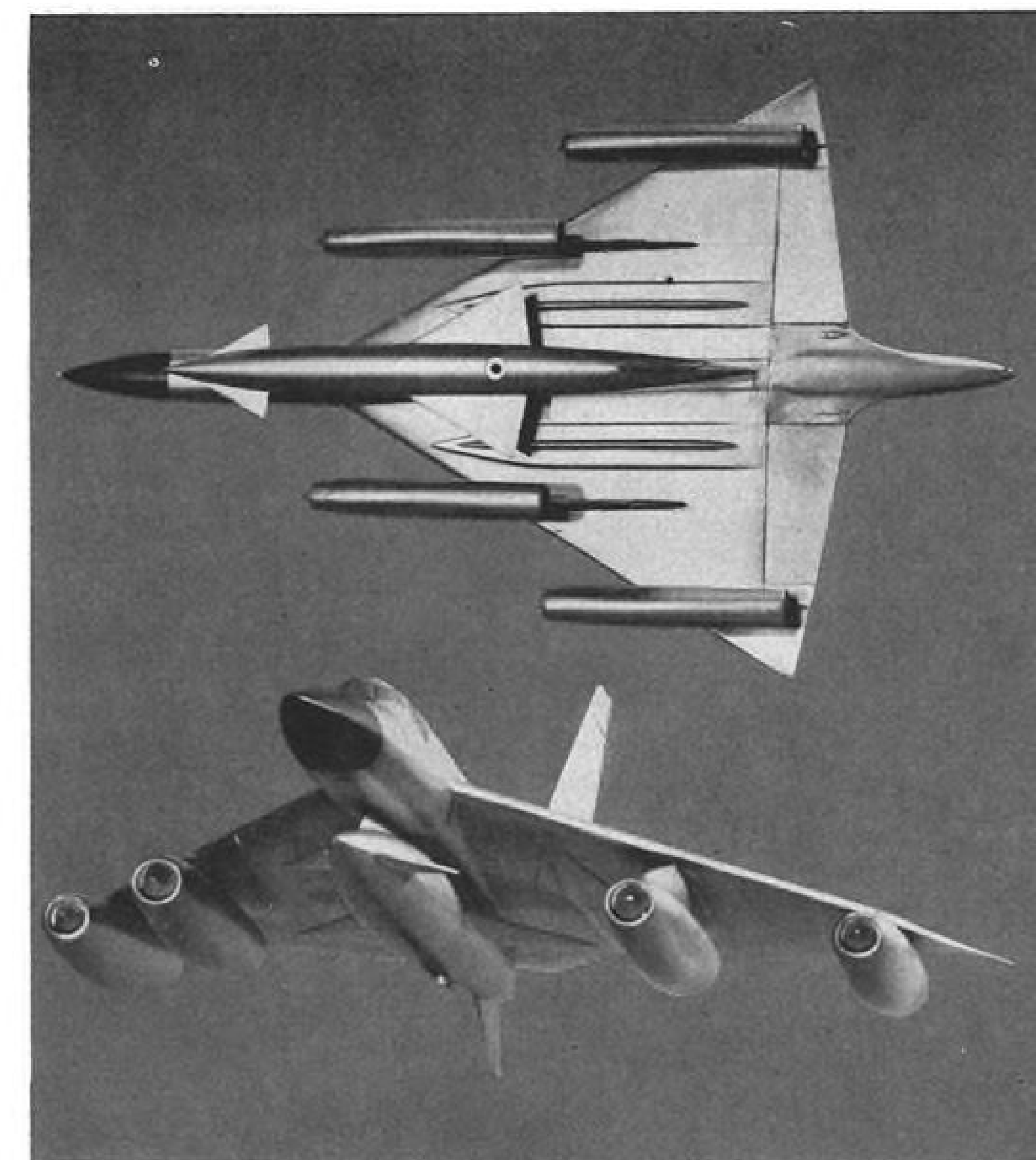
Northrop Aircraft, Inc., reports sales of \$73,342,553 for the three months ending Oct. 31, compared with \$68,935,416 for the same period in 1955. Net for the quarter was \$1,136,089, down from last year's \$2,021,961. Backlog as of Oct. 31 was \$251 million.



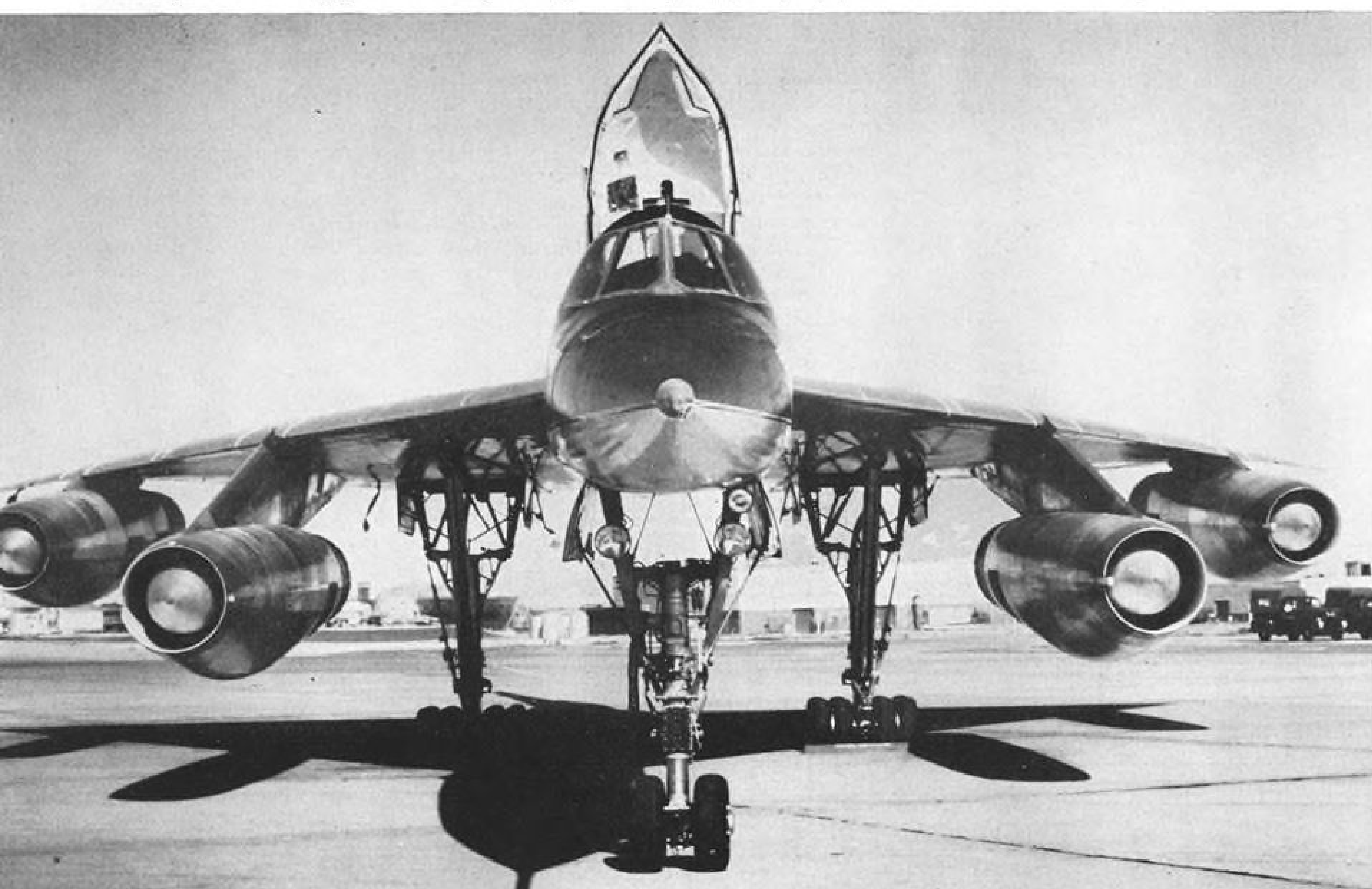
ENGINES, tires, create clouds of dust as B-58 takes off on test flight at Fort Worth, Texas, Convair plant. Four GE J79 turbojets can

HIGH, spider-like landing gear is necessary for large external pods, principal payload which nestles under fuselage.

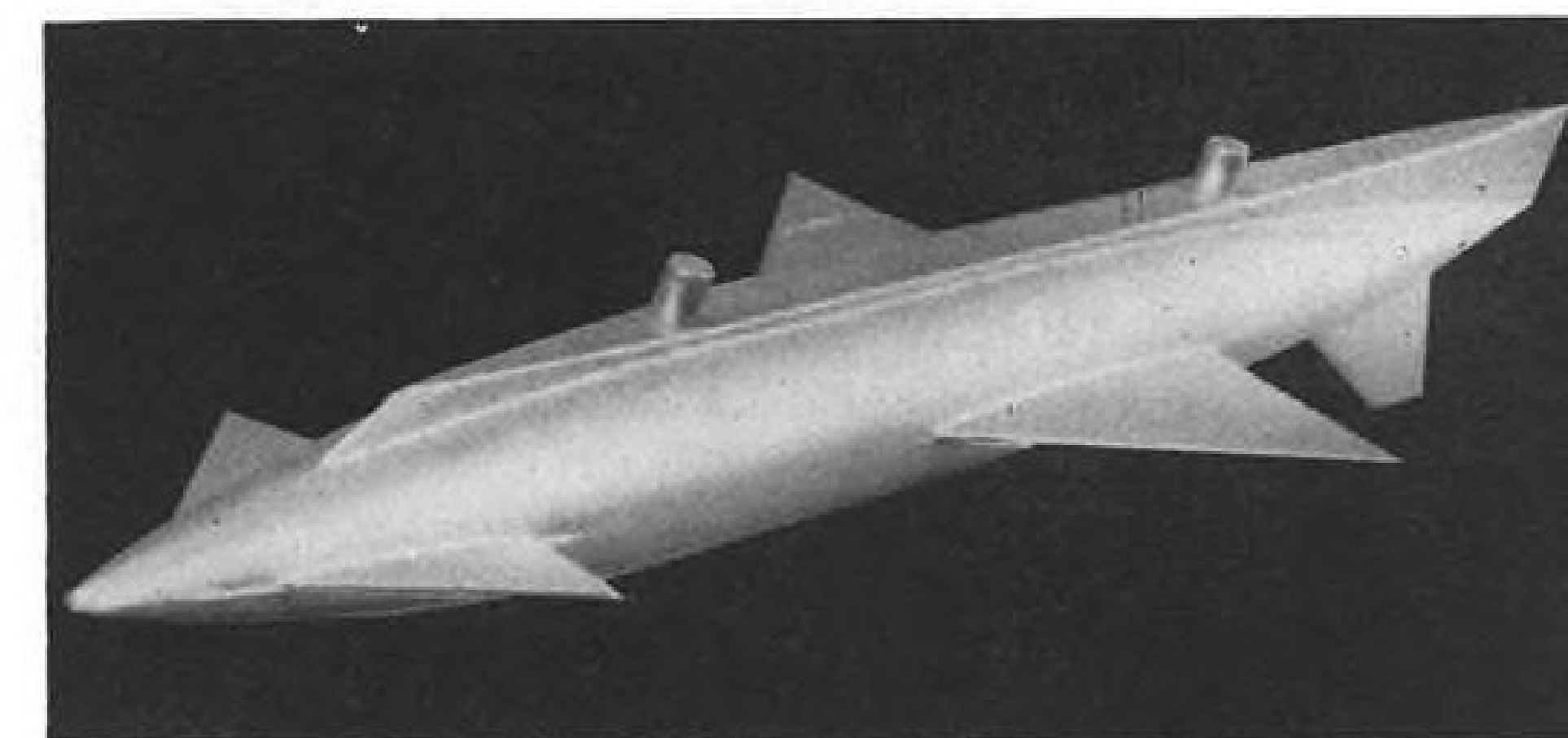
generate 14,000 to 18,000 lb. thrust with afterburner fitted.



MODELS show how main weapon would fit under fuselage.

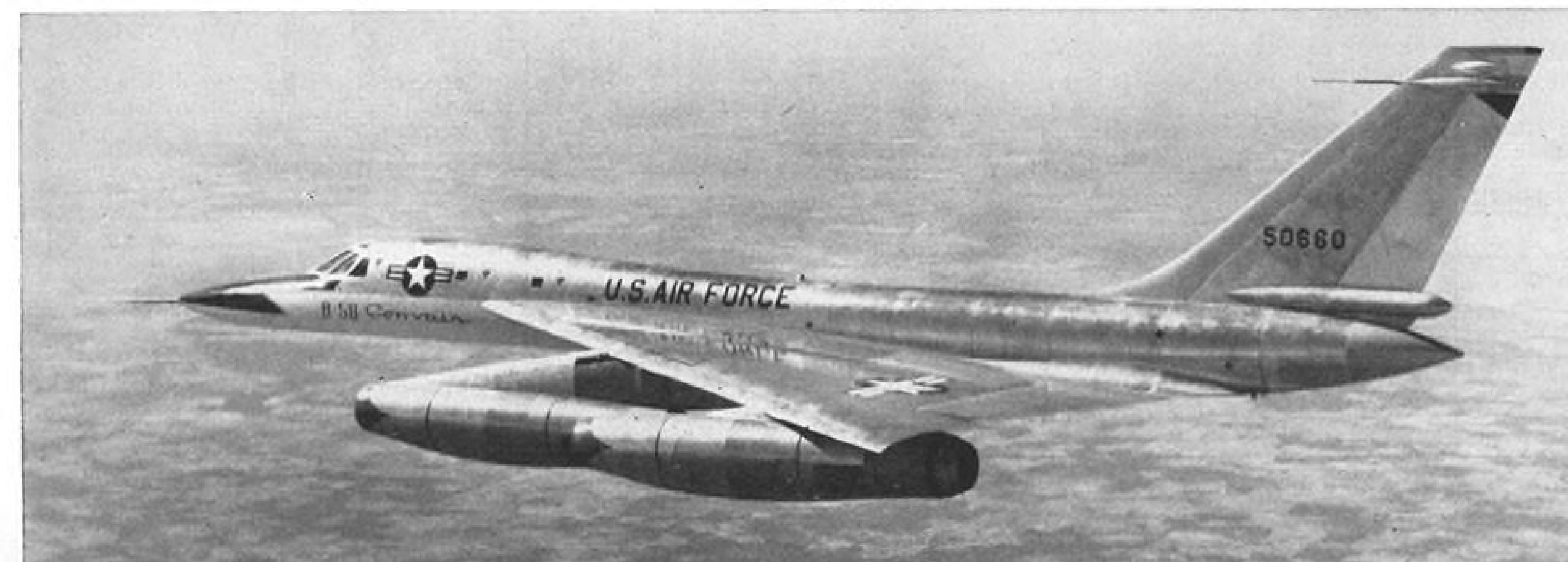


How Hustler Handles Its Payload



POD must not compromise aerodynamic performance obtained by area rule.

CONICAL camber, thin wing, are notable below. Elevons at wing trailing edge control the airplane in roll and pitch.



AIR TRANSPORT

Airlines Reach New Peak, Future Bright

Traffic, revenue increase continue through 1956; expanding economy indicates good year ahead.

By L. L. Doty

Washington—Airline business continued to climb in 1956 and, although gains fell short of the phenomenal growth recorded in 1955, prospects are good for continuing improvement during 1957.

In a year of stable growth, 1956 airline traffic and revenues reflected the expanding general economy and gave no indication that the normal growth factor of the industry is heading toward a plateau.

Only the inability to operate at greater capacity prevented the airlines from repeating their spectacular performance of 1955. Available passenger seat-miles failed to show the marked increase that has distinguished records of previous years.

With few exceptions, the airline fleets were not augmented to any great degree during the year since most re-equipment programs have been keyed to turboprop and turbojet transports. Over the first 10 months of the year, available seat-miles registered a 12% increase over 1955. Revenue passenger-

miles, indicating a load factor increase, rose 12.6% during the same period. With such a load factor, airlines may have reached the maximum capacity obtainable under normal conditions with present equipment and services.

The mid-air collision over the Grand Canyon last June, the prolonged periods of bad weather during the year and the steel strike undoubtedly had some adverse effect upon seasonal traffic.

Airline economists disagree on just how much, but it probably was small.

Passenger-Mile Increase

Revenue passenger-miles for the entire industry climbed from 24.3 billion in 1955 to 27.7 billion in 1956 for a 14.1% increase. The increase in 1955 over the previous year was 19%. The Air Transport Assn. figures are based upon actual data for the first ten months and estimates for November and December.

Passenger revenues for the scheduled airline industry moved from \$1.3 billion in 1955 to \$1.5 billion in 1956. This represents a 12.7% increase as

compared with the 16.3% increase in 1955. Operating revenues climbed from \$1.6 billion to \$1.8 billion for a 13.7% hike. Increase recorded for 1955 was a 16.1%.

Inter-City Traffic

Airlines continued to make inroads into surface transportation services and are responsible for an estimated 3.1% increase in inter-city common carrier passenger-miles for 1956. First-class and coach railroad passenger-miles each declined by .5%. Motor bus passenger-miles declined 4.5% during the year.

Private automobile traffic, a key factor in the railroads' drive to curtail their commuter service, climbed an estimated 6% during the year to an all-time high of 621 billion passenger-miles.

Airline first-class passenger-miles in inter-city traffic reached 14.6 billion in 1956 as compared with 13 billion in 1955, a 12% rise. Coach passenger-miles rose from 6.7 billion to 7.8 billion, up 16.9%.

U. S. scheduled international airlines recorded a 15.4% increase in traffic with a climb from 4.6 revenue passenger-miles in 1955 to 5.3 billion in 1956.

Total revenues for the international carriers climbed from \$413 million to \$480 million, a 16.2% increase.

Overseas Traffic

Airlines averaged about 5,000 crossings a month over the Atlantic. In addition, 22 civil air carriers operating under contract with the military services conducted 3,390 flights over the Pacific and 1,960 over the Atlantic.

Revenue ton-miles for the scheduled airline industry increased from 3 billion in 1955 to 3.5 billion this year for a 17.4% gain. However, 1955 showed a 20% gain in revenue ton-miles over 1954.

Freight ton-miles also declined. In 1956, the climb was 14%, while the increase in 1955 was 19%. Mail ton-miles showed even less gains although air mail revenues improved substantially. The dip in revenue gains during 1955 was due to the mail-rate cut that year. There were no rate changes in 1956.

Mail ton-miles increased 8.7% in 1956 as compared with a 19.9% increase for 1955. Mail revenues, however, jumped 10% from \$56 million in 1955 to \$62 million in 1956. The

increase in mail revenues in 1955 over 1954 was 6.6%.

Mail ton-miles for the domestic industry climbed to 94.5 million in 1956 from the 87.3 million of 1955 for an 8% gain. International mail ton-miles scored the same percentage increase, with 52.7 million ton-miles for 1956 against 52.4 million in 1955. Domestic mail revenues were up 13%, from \$28.3 million in 1955 to \$32.2 million in 1956. International mail revenues rose from \$25.6 million to \$27 million, a 5.6% increase.

The Air Transport Assn. reported a 22.5% increase in revenue passenger-miles for the local service carriers, a 20% increase in mail ton-miles, 28% in express ton-miles and 19.8% in freight ton-miles. Revenue passenger-miles for the local service carriers totaled 641 million for 1956 as compared with 523 million last year. Revenue ton-miles were 67.2 million contrasted to 55 million in 1955.

Total revenues for local service carriers climbed 16.7% from \$57 million in 1955 to \$66 million in 1956. Passenger revenues rose 23.3% to \$40.4 million.

Helicopter Growth

Biggest growth factor in passenger traffic and revenues was recorded by the three helicopter services—New York Airways, Chicago Helicopter Airways and Los Angeles Airways. Chicago Helicopter Airways began passenger service in November so that all three are now passenger carrying airlines.

Passenger helicopter revenues climbed 106% from \$208,000 to \$429,000. Mail revenues were down 10%, but express and freight revenues climbed 36% and 22% respectively.

Helicopter revenue passenger-miles rose 153%, or from 628,000 in 1955 to 1.5 million. Revenue ton-miles showed a 45% gain, although mail ton-miles dropped 8%.

The Civil Aeronautics Administration reported 21.7 million landings and takeoffs during the year, an increase of 12% over the 19.4 million recorded by CAA towers in 1955. En route position reports posted by CAA centers totaled 25.3 million against 20.6 million in 1955 for a 23% increase.

Airways Plan

The CAA also noted that, for the first time, there were more four-engine airline aircraft in operation during 1956 than two-engine aircraft. In 1955, the airlines operated 774 two-engine planes as compared with 702 four-engine aircraft. This year, there were 815 two-engine airliners and 835 four-engine aircraft.

The CAA also launched its three-year airways modernization program during 1956 with a \$75 million grant from

Congress. By the end of the year, \$30 million of this had been allocated for electronics equipment, including 23 long-range radars at a cost of \$9 million, the largest electronics contract in CAA history.

Airport projects under the Federal Airport Program totaled \$51 million in federal funds.

This was matched by a like sum by airport sponsors, cities and counties to improve airport facilities at approximately 400 locations.

The world's scheduled airlines, both domestic and international, also showed a percentage decline from the 1955-1956 gains. The airlines carried a total of 78 million passengers for a 15% increase as compared with a 17% increase in 1955, according to a report issued by International Civil Aviation Organization.

What Future Holds

Dr. Edward Warner, president of the Council of ICAO, said that "experience so far accumulated leads ICAO's statisticians to expect that the airlines of the world will reach the 100-million-passenger per annum mark for the first time in 1958."

He further predicted that, within ten years, passenger-miles performed will be between three and four times as great as in 1956.

The world's airlines as a whole performed 45 billion passenger-miles for a 16% increase in 1956. The increase in 1955 was 17%.

Cargo ton-miles handled in 1956 totaled 1 billion for a 13% increase as against an 18% registered during 1955. Mail ton-miles were 280 million.

Miles flown per passenger averaged 575; number of passengers per aircraft averaged 28. The average speed of the aircraft was 200 mph. as compared with 195 mph. in 1955 and 150 mph. in 1945. Total miles flown in 1956 were 1.6 billion as compared with 1.4 billion in 1955.

Ozark Gains Access To Minneapolis

Washington—Ozark Air Lines has won access to the important Minneapolis-St. Paul air travel market through a Civil Aeronautics Board decision giving the airline a new route in the Quad Cities-Twin Cities Case.

The CAB voted to grant the local airline a new route segment between Davenport, Iowa-Moline, Ill. and Minneapolis/St. Paul, Minn. via Cedar Rapids, Iowa and Rochester, Minn.

Ozark's new operating authority is effective for three years or until 60 days after a final decision is reached by the Board in the Seven States Area Investigation.

AA's Smith Takes Dim View of Small Jets

Los Angeles—The place for the small turbojet transport in short and middle distance airline runs was given a dim view here by American Airlines' President C. R. Smith, before a packed meeting of Lockheed Aircraft Corp.'s Management Club.

Smith underscored the suitability of Lockheed's new Electra turboprop in this distance regime.

Smith said: "There has been a flurry of interest in a smaller pure jet machine for the middle distance runs. But there is less interest in that today than several months ago on the part of manufacturers and on the part of airlines."

"When you get down to the mathematics of short and middle distance runs, it is very difficult to prove that there is a place for the small jet."

"Prospects that the small jet will be built are pretty skinny. I doubt if enough of them can be sold."

American, he said, has no intention of going into the small jet field now. He pointed out that the large turbojet plane will have its best opportunity in long distance operation between large cities. American has ordered 30 of Boeing's 707 jet transport.

Referring to the turboprop-powered Lockheed Electra, of which American has ordered 35 at a total value of about \$65-million, Smith declared that American will end up with the only plane (obviously meaning turbine-powered) that will do the short and middle distance run quite well.

"Since the date of the Electra decision, nearly two years have gone by. There has been plenty of time for reflection, plenty of time to accumulate the wisdom of the Monday morning quarterback. I am glad to say that our confidence in the Electra remains as strong as ever."

"We believe no other airplane will do so well the specific task for which the Electra was designed."

Three Britannias Added to RAF Order

Three more Bristol Britannias have been ordered for the Royal Air Force Transport Command by the Ministry of Supply, bringing the total RAF order to 13.

Commercial and military orders now total 65.

The new RAF order is for the Britannia 250, a mixed passenger and freight version. It is similar to the stretched fuselage long-range 310 series, with a gross weight of 170,000 lb., and capable of carrying 120 troops 3,000 mi. non-stop.

Airline Traffic Revenue Statistics

Following are revenue and traffic statistics for the scheduled airline industry showing percentage of gain in 1956 over 1955:

REVENUES (000)			
Total Scheduled Airline Industry (Including All Cargo)			
	1956	1955	
Passenger	\$1,537,042	\$1,363,578	12.7
Mail	62,141	56,449	10.1
Express	20,468	20,168	1.5
Freight	104,169	93,962	10.9
Other	96,797	66,448	45.7
Operating Revenues	1,820,617	1,600,605	13.7
Public Service	35,614	34,108	4.4
Total Revenues	\$1,856,231	\$1,634,713	13.6
TRAFFIC (000)			
Total Scheduled Airline Industry (Including All Cargo)			
Revenue Passenger-Miles	27,760,992	24,339,695	14.1
Mail Ton-Miles	154,960	142,555	8.7
Express Ton-Miles	55,468	51,066	8.6
Freight Ton-Miles	437,437	383,126	14.2
Revenue Ton-Miles	3,570,904	3,042,390	17.4

Christmas Traffic Crippled by Weather

Washington—Airline traffic over the Christmas holiday suffered a drastic cutback during a siege of bad weather that blanketed the eastern half of the U.S., disrupting the travel plans of thousands of air passengers.

The static air mass settled over virtually the entire area east of the Mississippi Valley on late Dec. 19, bringing dense fog, low ceilings and bad visibility that at one point closed every major airport on the East Coast except Atlanta. The stagnant weather remained motionless until Christmas Eve when a cold front swept the heavily saturated air out to sea. But by that time, most holiday travelers had either canceled their plans or diverted to surface travel.

Cost to Airlines

Although most airlines by late last week had not fully analyzed the effects of the weather siege on overall operations, this much is now known:

- **Medium-haul carriers** experienced the most severe setbacks. While flight delays and route diversions caused some disruption of service, there was no wide-spread curtailment of schedules on long-range routes. Most airline operations' officials place the blame for this situation on the flow control system of air route traffic control centers.

- **Washington National Airport** was closed to landings on Dec. 22 from 2:10 p.m. to 7:59 p.m.—one of the longest stretches that it has been closed since landing minimums were reduced to a 200-ft. ceiling and one-half-mile visibility approximately four years ago. On the same day, LaGuardia was closed from 12:38 a.m. to 9:04 a.m., although the shifting of flights from one airport to another prevented a complete disruption of schedules in the New York area. Idlewild, for example, received 15 diversions from LaGuardia. Later, LaGuardia drew six diversions from Idlewild.

- **Despite the prolonged spell** of bad weather, restrictions issued by air route traffic control centers during the five-day period were not excessive under such conditions. However, periodic reductions in the airport's acceptance rates created a backlog of equipment that caused heavy cancellations of turn-around flights, particularly short-hauls.

While the number of passengers lost has not yet been finally compiled, the operating experience of two airlines offers a clue to the far-reaching influence the weather had on Christmas travel.

American Airlines was forced to cancel 186 flights on Dec. 21 and 382 flights from Dec. 21 through Dec. 25. Capital Airlines operated only 30% of

its scheduled flights on Dec. 21, canceled a total of 214,000 scheduled miles from Dec. 20 through Dec. 23.

Of the 186 flights canceled by American Airlines on Dec. 21, 150 were short-haul operations, a trend that prevailed throughout the five-day period. Most DC-7 flights did operate, however, and American felt the weather pinch most strongly on its Boston-New York-Washington routes, which are predominantly Convair 240 operations.

Eastern Air Lines short-haul schedules also were hard hit. Southbound long-haul flights, although often failing to conform to established schedules, managed to make their runs and contributed substantially to the total of 92,855 passengers carried by the airline from Dec. 20 through Dec. 23, an increase of 14.6% over the same period of 1955.

In addition to ground weather conditions, Eastern's problems were compounded by strong headwinds from the south, causing delays in its peak long-haul southbound operations.

Capital Hardest Hit

Capital Airlines, whose route structure contains no long-haul routes to offset losses incurred by canceled short-haul flights, probably felt the weather impact more severely than most carriers.

With 34 extra sections—the equivalent of 20,000 additional miles—scheduled for the pre-holiday period, the airline had projected gross revenues of \$1 million for the period between Dec. 20 and Dec. 23. Actual figure for the four-day period was \$560,000.

Operations over the eastern routes of Northwest Orient Airlines fell into a similar pattern. On Dec. 21, for example, the airline canceled 25% of its flights on the Minneapolis-Chicago-Detroit segments of its routes, while only one of its transcontinental flights was canceled during the entire five-day period.

There are several reasons why short-haul flights can fly over or around weather areas or by-pass destinations within weathered areas for clear alternates outside the weather zone. Short-haul equipment is generally confined to scheduled operating areas when normal alternates are weathered-in.

Many airline officials also condemn the flow control system as the chief reason for short-haul flights being hit hardest when weather deteriorates on a wide-scale. Flow control restrictions, they say, are often established by control centers on only a one to two hour notice basis. Consequently, long-haul flights already en route are unaffected by such restrictions, since they have

been cleared by centers outside the weather area.

The short-haul airlines feel that restriction notices should be forecast at least eight hours in advance so that short-haul and long-haul flights can be accepted on a "share-and-share alike" basis.

For example, the New York air route traffic control center on Dec. 22 restricted the number of aircraft entering the area to four per hour on each airway through Millville and Dover. This restriction was placed in effect at 4:45 p.m. and lifted at 6 p.m. Long-haul flights already en route filled this hourly quota, while short-haul flights were required to hold at departure points such as Washington, Pittsburgh or Boston.

Chicago's flow control restrictions varied in a similar manner, depending upon the number of aircraft in the stack and the number requesting takeoff from Midway Airport. Chicago issued its restrictions to adjacent centers in Detroit and Cleveland, thus holding air traffic originating at those points while long-haul flights originating at other points presumably were cleared for entry into the area.

Traffic during the five-day period was reported variously as moderate and moderate to heavy. Restrictions from most centers required 30 minutes separation at like altitudes or minimum altitudes ranging from 10,000 ft. to 25,000 ft. for direct flights. Through flights along the East Coast were diverted to the coastal area.

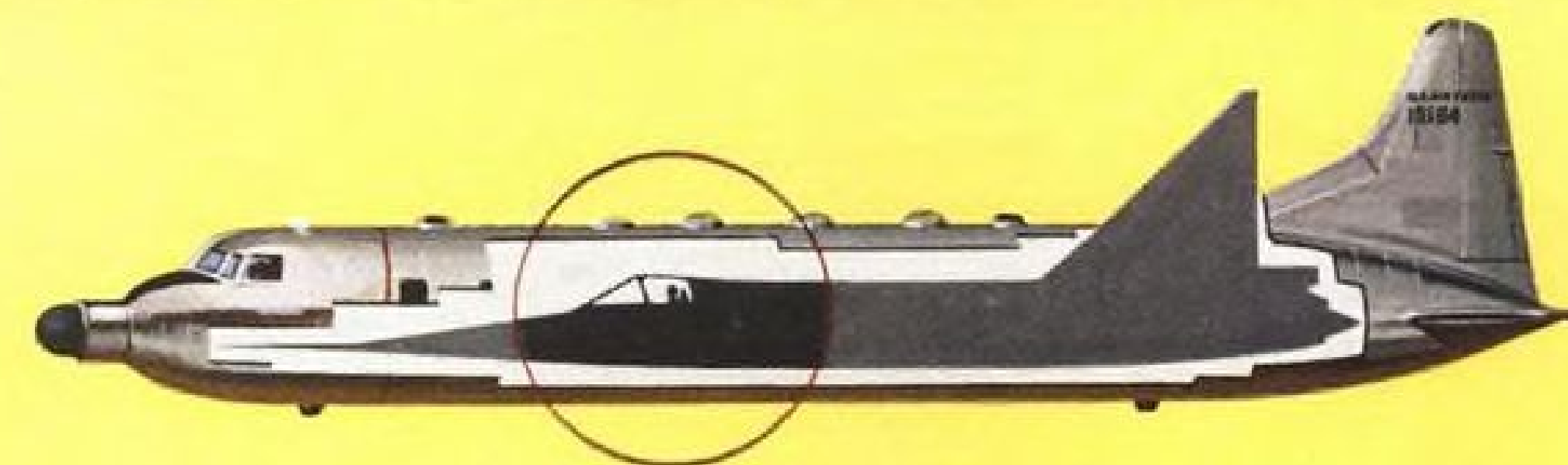
International operations into New York also were disrupted by the East Coast weather. Pan American World Airways scheduled 130 flight arrivals between Dec. 21 and Dec. 24. Of these, 11 flights were diverted, three were canceled and 91 were delayed from one-half to 24 hours. Six departures were canceled by the airline, and weather delayed 52 of 120 scheduled departures.

Pan American estimates that 125 extra flying hours were involved in stacking, and that the 2,500 overtime man-hours resulting directly from the weather reached a cost of \$10,000.

Thomas Wilson Resigns From Commerce Post

Thomas Bayne Wilson has resigned as Deputy Under Secretary of Commerce for Transportation to return to private industry. He leaves the Commerce Department Jan. 5.

Wilson, a former chairman of Trans World Airlines' board of directors, has been elected board chairman of Johnson Motor Lines, Inc., Charlotte, N. C.



Engineering to the Nth power...INSIDE AND OUT!

Installed inside a Convair T-29 is an actual cockpit of Convair's delta-wing F-102A all-weather interceptor. Once aloft, the "back seat" pilot flies the T-29 by performing all the functions of a F-102A interceptor pilot. At the same time, scientists and engineers evaluate system performance and a psychologist checks pilot reaction. This use of the T-29 as a flying laboratory by Hughes Aircraft Company, Culver City, California, flight tests the F-102A's advanced electronic weapon system with far more efficiency than ever before — and at a fraction of the cost.

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RESEARCH and DEVELOPMENT

A major guided missile research and development program has several significant characteristics that are of particular interest to the scientist and engineer.

First, it requires concurrent development work in a number of different technical areas such as guidance and control, aerodynamics, structures, propulsion and warhead. Each of these large areas in turn contains a wide variety of specialized technical activities. As an example, digital computer projects in the guidance and control area involve logical design, circuit design, programming, data conversion and handling, component and system reliability, input-output design, and environmental and mechanical design.

A second characteristic is frequently the requirement for important state-of-the-art advances in several of the technical areas. For instance, the supersonic airframe needed for a new missile may necessitate not only novel theoretical calculations, but also the design and performance of new kinds of experiments.

A third characteristic of missile development work is that such close interrelationships exist among the various technical areas that the entire project must be treated as a single, indivisible entity. For example, what is done in the guidance portion of the system can affect directly what must be done in the propulsion and airframe portions of the system, and vice versa.

These characteristics make it clear why such work must be organized around strong teams of scientists and engineers. Further, for such teams to realize their full potential, they must be headed by competent scientists and engineers to provide the proper technical management. And finally, all aspects of the organization and its procedures must be tailored carefully to maximize the effectiveness of the technical people.

Principles such as these have guided The Ramo-Wooldridge Corporation in carrying out its responsibility for overall systems engineering and technical direction for the Air Force Intercontinental and Intermediate Range Ballistic Missiles. These major programs are characterized by their importance to the national welfare and by the high degree of challenge they offer to the qualified engineer and scientist.

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Foreign Jets Move Into World Market

By Craig Lewis

Washington—Foreign aircraft builders are expanding their prospects in the world transport market now dominated by American manufacturers as the international airline industry lays its plans for the jet age.

Money is the key to the jet equipment problems of many of the smaller nations' airlines, and foreign manufacturers—primarily British and French—are offering such attractive financing that they may well take over a sizeable share of the transport sales that traditionally have been completely dominated by American companies.

Reports from air transport centers around that world indicate that U.S. firms are concentrating on the larger, richer airlines for their sales efforts, leaving the smaller carriers as a ripe market for foreign companies eager to establish themselves as major transport suppliers.

This approach rewards the U.S. manufacturers with the larger, more lucrative orders they need for assurance of profitable production runs, but it leaves market areas with substantial future sales prospects wide open to overseas salesmen.

Foreign Sales Effort

The larger international airlines have committed themselves to U. S. turbine transports. Such carriers as Air France, British Overseas Airways Corp., Sabena and other major airlines have to compete on major airways and they have ordered transports such as the Douglas DC-8 and Boeing 707, that will be flown by their American and Foreign competitors.

But there are myriad other, smaller carriers that must also move into the turbine age. These airlines present less attractive prospects because their orders are small, and they have trouble financing them. These factors seem to have dampened the enthusiasm of U.S. manufacturers and thus brightened the prospects of the foreign transport types.

Latin America is a prime example of this situation. The airlines in this area report heavy sales pressure from British and French salesmen and considerably less effort from American firms.

Because of geographical factors and the relatively recent surge of development in this area, Latin American nations are heavily dependent upon efficient air transportation. Their economies to a great extent depend upon their airlines for vital transportation functions.

Since these nation's airlines are not overly prosperous, they are poor pros-

pects for large, immediate returns on sale efforts, but as they grow, their important air transport industries will grow with them, and they present a potentially rich future market for transport sales.

Money Basic Problem

Money is the basic problem of Latin American carriers when they try to improve their equipment situation. Equity financing does not begin to meet their needs, and they will require aid from sources outside their own area and co-operation from the manufacturers. The transport with the best financial terms will get the orders.

These small airlines hope that such institutions as the Export-Import Bank, the World Bank and, perhaps, the newly organized International Finance Corp. will help them. They also hope to overcome the reluctance of U.S. commercial banks to make money available to them.

It is in these areas that the British, the French and, conceivably, the Russians may score large gains with their willingness to provide easy terms for aircraft sales and help the airlines with their financing. These foreign manufacturers are eager to establish a reputation as transport builders and crack the American monopoly on the field.

With the larger carriers, the U.S. manufacturers are continuing to dominate the scene. With the exception of the highly successful Vickers Viscount, American turbine transports at the present time are garnering nearly

all the jet orders from overseas.

The Douglas DC-8 and the Boeing 707 completely dominate the long-range jet transport field abroad, as they do in this country. They have no competition, and, since they are so similar, the foreign airlines have been thinking primarily of delivery dates in placing their orders.

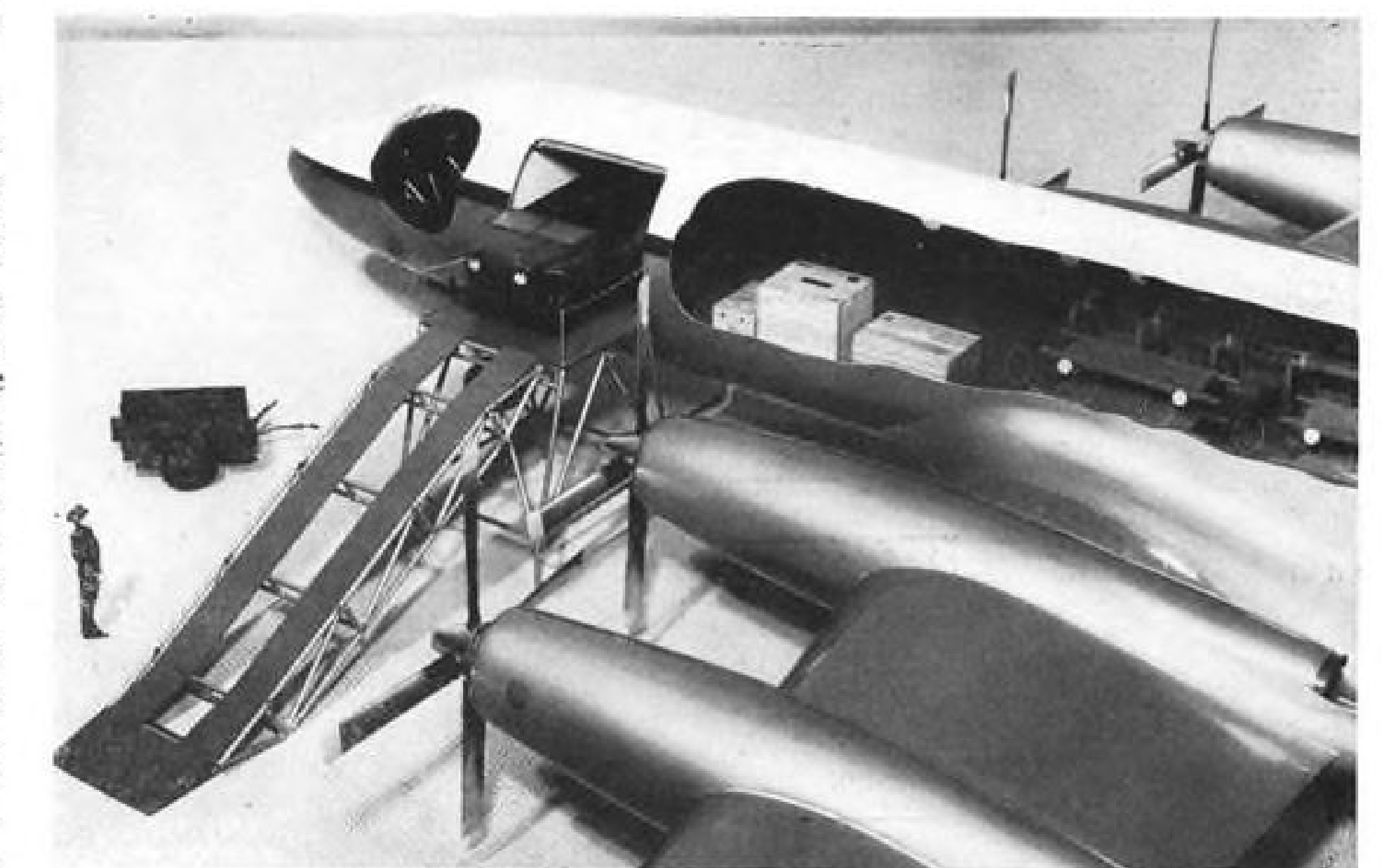
In the shorter range field, the situation is less clear cut. America's Lockheed Electra has been ordered by KLM Royal Dutch Airlines, but the competing Convair 880 still has no overseas orders. Several airlines are interested in the Douglas DC-9 and Boeing 727, but they aren't firm enough designs to promote any sales thus far.

Competing with these shorter range transports are the Viscounts, the Vickers Vanguard, the Bristol Britannia, the de Havilland Comet IV, the Fokker F-27 and the Sud-Est Caravelle. Russian jets are an unknown quantity right now. These transports offer a wide variety of capabilities, but they are competing generally for the short and medium route business, although the Britannia also claims long-range as one of its features.

Long-Range Jets

The need for long-range jets has been clear from the beginning of the order cycle, and the DC-8 and 707 have divided the business between them. But on the shorter routes, there is considerable divergence of opinion and guessing on just what type of aircraft should be used.

In the midst of the small jet vs.



RAF's Bristol Britannia

Layout of Bristol Britannia for Royal Air Force shows large forward door for easy access. Accommodation is for 42 troops, six stretcher cases. -RAF order now stands at 13.



Viscount on the Way to Capital Airlines

Delivery of 60 Vickers Viscounts of Capital Airlines' original order will be completed within two weeks of Jan. 1. Target date set two years ago. Viscount here is parked at Bluie West Airfield, Greenland, on ferry flight from England to Washington.

turboprop controversy and the general indecision on medium range turbine transports, the field is wide open for sales efforts on American, British, French and Dutch jets.

Beside the money problems, manufacturers run into a higher degree of natural conservatism among overseas airlines than they do with U.S. carriers. Many are resisting a full plunge into a turbine re-equipment program and will stick with the proven capabilities of the piston engine transports now flying.

Piston transports will be a vital part of the international airline picture for a long time, and U.S. types are continuing their domination in this field. Foreign airlines have substantial orders for Lockheed Constellation, Douglas DC-6/7 and Convair-series transports, many of which will go into service at the same time as the first of the jets.

What British Offer

The British offer the stiffest competition to U.S. manufacturers with a wide range of turbine transport sizes. They feel that the American monopoly of the world's civil air transport field is ended, and they draw considerable optimism from their breakthrough among U.S. airlines.

Vickers has sold Viscounts to Capital Airlines and Continental Air Lines; Bristol has sold the Britannia to Northeast Airlines, and de Havilland has an order for 14 Comet IVs from Capital. These sales indicate to the British that their aircraft are competitive with similar types the U.S. has to offer.

The British manufacturers know that, as air travel expands, there will be a bigger market for transports, and they feel their aircraft have sufficient advantages to give them a big chunk of the market. They are eager to get

their transports in service and establish a reputation on which they can base further sales.

Biggest success in the British stable has been the Viscount series. More than 350 have been sold, and the prospects are bright for further sales. By 1960, Vickers will have the Vanguard—a turboprop in the Electra class—ready for British European Airways and any other buyers.

Britannia Delays

Bristol has been haunted by unfortunate delays in its Britannia program, the latest of which is an engine icing problem. But 62 of them have been sold, including five to a U.S. carrier, and with its delivery advantage, the Britannia is a good prospect for further U.S. sales.

Bristol's chief, Peter Masefield, figures that Bristol can break even with 100 Britannia sales, but he hopes to sell twice that number. The big turboprop transport is offered in five different versions, and plans are being made to produce a Model 400 powered by 8,000 hp. Orion engines.

De Havilland also has been plagued with misfortune in its Comet program, but the company now has the Comet IV in production for BOAC and Capital and is laying plans to develop a longer range turbojet, the DH-118, for delivery in 1962.

Comet Sales

In plugging Comet sales, de Havilland points out that 10 Comet IIs are proving themselves in service with the Royal Air Force. The company also argues that the Comet is more economical than U.S. jets and will be able to serve smaller airports.

The two British airlines have been

good customers for their country's manufacturers, but BOAC has had to go to American equipment for its high density overseas operations.

BOAC now flies Constellations, Stratocruisers, Argonauts and Yorks, and the carrier is taking delivery on DC-7Cs. The situation becomes more complicated when the Britannia goes into service in 1957, and the Comet IV and the Boeing 707 come in a few years later. This about winds up BOAC's equipment ordering with the possible exception of the DH-118.

BEA is dedicated to the turboprop. The carrier is a big Viscount operator and has ordered the Vanguard, but its management admits that BEA will have to order a turbojet to compete on Blue Ribbon European routes.

BEA Wants New Jet

BEA apparently does not look with much favor on the Comet, feeling that it is too slow to compete. The carrier has in mind a jet tailored to its needs, perhaps a transport with the Caravelle's clean wing design, but with three or four engines.

Admitting that its major competitors will have jets first, BEA thinks these transports will operate over the Atlantic initially and won't be a competitive threat in Europe until early in the 1960s. Thus BEA feels it has time yet to mull over its decision. Inauguration of Moscow-London service by the Russians with the Tu-104 could speed up a decision.

The French are offering the Sud-Est Caravelle to the airline as a medium-range, low-cost turbojet transport. Air France is the only carrier to order it so far, but the company expects further sales and has its eye on the U.S. market. A tour of this country will be made in

April to show the Caravelle off to American carriers.

With low selling price of \$1,850,000 to begin with, Sud-Est has obtained the backing of several French banks to help it offer easier payment arrangements for airlines without a lot of cash.

Three French airlines have ordered long-range jets. Air France bought the 707-320 and will probably order some 707-120s to fill the gap between the intercontinental 707-320 and the smaller Caravelle.

Air France is operating 12 Viscounts, but the chances for further turboprop sales in France seem slim since the carriers seem to want to make the jump directly from piston transports to turbojets.

France's other two long-range operators have both ordered DC-8s. Union Aeromarine de Transport has bought five of the Douglas jets, and Transports Aeriens Intercontinentaux ordered four of them. Air Algeria will probably buy three Caravelles for its routes.

Turboprops for LAI

Linee Aeree Italiane is highly enthusiastic about turboprop transports and has ordered Viscounts. LAI likes the idea of using turboprops to assure a smooth transition from piston to turbojet operations.

Both LAI and Alitalia realize they will need jets to meet competition on long international routes, but both carriers are somewhat dubious of the operating capabilities claimed for the turbine transport being offered. Alitalia will probably order three big turbojets, probably DC-8s, in the next month or so. The carrier is also interested in three to five medium range jets for its South American, African and Middle East routes.

Japan Air Lines

In the Far East, Japan Air Lines has chosen the DC-8 after canceling orders for the early Comet. The airline has just received the first Export-Import Bank loan granted for U.S. jet equipment to help with its DC-8 purchase. JAL reports the British are offering the most attractive financing for turbine equipment for the carrier's shorter routes, but the company doesn't feel it can afford to buy any more jets right now.

JAL is interested in the F-27 as a future prospect, and the airline is also thinking of using Westland ramjet helicopters over short routes. The carrier also is impressed by the economies offered by the Viscount but is undecided whether it will buy turboprops or turbojets for regional routes.

In Latin America, Brazil's airlines are facing an increasingly competitive situation because of the trend toward mergers and fewer, stronger airlines.

AIRLINE OBSERVER

► Independent Military Air Transport Assn., strengthened by the addition of four supplemental carrier members who defected from the Air Coach Transport Assn. (AW Dec. 3, p. 38), will now expand its activities to include civil charter service as well as military charters which, until recently, was its chief source of revenue.

► Travel agents are direct beneficiaries of the No-Show Plan's phase one since many passengers are turning to conveniently located travel agent offices to meet time limits on ticket pick-ups. An indirect advantage of the plan has been faster, more orderly checking-in of passengers because of the pre-flight ticketing requirements.

► More cattle were shipped by air from the U. S. than by boat during Fiscal 1956, according to the Department of Agriculture. Livestock shipments by air during the year were heaviest in history and accounted for 63% of all U. S. livestock moved overseas. A total of 8,990 head of cattle were transported by air during the period as compared with 5,797 by sea. Airplanes handled all but 24 of the 1,302 sheep exported; all but 18 of the 221 goats. Ships moved 560 swine as compared with the 2,727 sent by air.

► Trans-Pacific Airlines (Aloha Airline), anxious to dispose of its DC-3 fleet by 1958, is showing strong interest in the Friendship F-27 turboprop transport. The Friendship should be in service in late 1957.

► United Air Lines has been experimenting with a prototype powered passenger-stand developed by Service Metals Fabricators. The airline thinks increased size and the weight of stands required for jet transports will prohibit manual movement of the ramps. Prototype stand is operated by 24-volt, one horsepower motor with a power supply of four six-volt batteries and trickle charger. The motorized feature does not increase the cost materially.

► Air Transport Assn. is eager to meet with the Civil Aeronautics Board and the State Department to prepare for the forthcoming British-U.S. review of the Bermuda Agreement in February. An important issue to be discussed from the ATA point of view is the Monroney-Smathers Bill which passed the Senate last session and would require, for the first time, airline representation on U.S. delegations negotiating air transport bilateral agreements.

► Caravelle jet transport demonstration flights in U.S. next spring will not be routine junkets but will be conducted over segments of major airline routes to provide practical operational data on the jet transport for potential buyers.

► Capital Airlines has opened its 12th ticket office in the metropolitan New York area in its bid to become a major contender in the New York traffic market. The airline was scheduled to operate 1,581 flights from New York this month as compared with 403 flights during December of 1955. District sales offices will be opened on the second floor of the new office which is located at the corner of Fifth Avenue and 48th Street. New, and larger, quarters are being sought for Capital's reservations offices now located at the East Side Terminal Building.

► Proposals to increase operations and acquire additional equipment are now before stockholders of Compania Dominicana de Aviacion, which is 40% owned by Pan American World Airways and 60% by Dominican Republic. The airline wants to buy DC-4 equipment and start direct flights between Ciudad Trujillo, Caracas and Bogota to supplement present routes to Miami and San Juan. Organized in 1944, the carrier has operated in the black for four years.

► Trans-Canada Air Lines has furnished its employees at Montreal and Toronto airports with a list of 40 Hungarian words and phrases as a means of expediting the handling of refugees of the Hungarian revolution as they arrive in Canada from overseas.

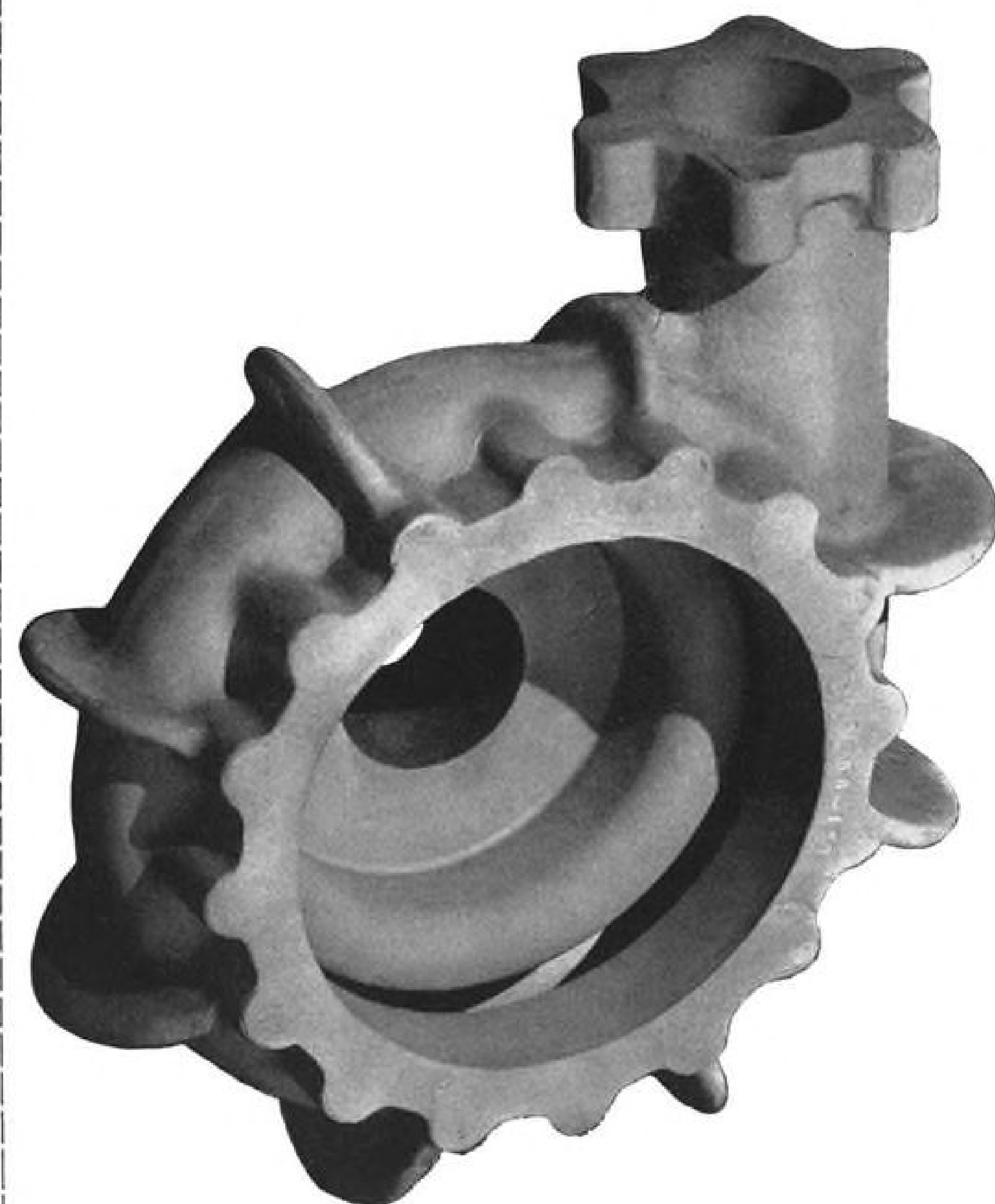
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Varig is very interested in the Viscount as a means of providing turbine equipment quickly on its highly competitive internal routes and will probably order the Boeing 707-120 to serve its long routes to the U.S.

REAL-Aerovias will stick with piston equipment until it can move directly into turboprop operations. The carrier believes that turboprops are just a temporary solution and won't last when the turbojets arrive.

Panair do Brasil has decided to stick with piston equipment for the present, following the cancellation of earlier plans to operate the Comet II. Cruzeiro de Sul is interested in converting to turboprop operations as soon as possible, and the carrier favors the Viscount because of early delivery dates. Cruzeiro is also interested in the Napier Eland conversion of the Convair 340.

Brazilian airline officials report that British and French salesmen are offering very attractive financing in an effort to capture a share of the transport market. Convair is also very active on behalf of the 880.

Mexican airlines are having their typical troubles with money in their planning for jet equipment. They feel that turboprop transports are the only type that it makes economic sense to buy right now. The Mexicans report attractive financial deals being offered by the British and complain of an apparent lack of interest on the part of U.S. manufacturers in the limited orders Mexican airlines can afford.

ICC Examiner Favors Railroad Fare Hike

Washington—A 15% increase in first-class rail fares has been recommended by an Interstate Commerce Commission examiner, a move that could give airlines an additional advantage in the closely competitive passenger market.

The six railroads affected blanket the middle-east area east of Chicago and St. Louis. The railroads are Chesapeake and Ohio Railway Co., New York Central Railroad Co., Norfolk and Western Railway Co., Pennsylvania Railroad Co., Pennsylvania-Reading Seashore Lines and the Pittsburgh and Lake Erie Railroad Co.

ICC Examiner Oren Barber also recommended a 5% increase in the coach passenger fares of these six lines, and two other lines—Lehigh Valley Railroad Co. and Reading Co.

The six carriers petitioned for a 45% increase in first-class fares (AW Sept. 10, p. 43). Barber opposed this as "unreasonable" and said it "could very well" eliminate first-class passenger service of the carriers. The 5% coach fare increase was the amount asked by the eight lines.

Local's Re-Equipment Problems Brighten

Washington—Local service airlines' prospects in solving their re-equipment dilemma have brightened this month as the result of some encouraging action from the Civil Aeronautics Board.

Latest CAB move was an expression of support for a program of equipment loans guaranteed by the government. Earlier this month, the Board launched an investigation into the rate of return allowed in local airline mail cases to see whether the profit level should be raised.

Support for federally guaranteed equipment loans was expressed in a letter from CAB Chairman James R. Durfee to John F. Floberg, chairman of the Conference of Local Airlines.

In the letter, Durfee said the Board "would look with favor on the development of a program of equipment loans guaranteed by the federal government to assist the local service airlines in financing needed modern aircraft under appropriate circumstances."

Capital Gains Proceeding

Durfee also pointed out that the local airlines will have an opportunity at the CAB's Capital Gains Proceeding to testify on the treatment of capital gains on retirement of aircraft "in relation to the re-equipment programs of the various carriers."

The Board is conducting the Capital Gains Case to build a record on which to establish a standard policy for treatment of capital gains in figuring mail pay for subsidized carriers. The airlines would like to keep their capital gains from equipment sales for re-investment in new equipment.

The CAB staff has reviewed the Board's mail rate policies in the light of material submitted by the local airlines in a series of economic presentations. As a result, the Board has decided to adopt a flexible policy on mail rate formulas.

Durfee said the CAB has decided on a general policy of using a mileage formula producing a fixed amount of mail pay in local airline mail rate cases. But the Board will permit use of the sliding scale formula in any case where the carrier wants it and can prove that it is preferable in his circumstances.

Mail Policies

CAB believes that its mail policies are generally sound, according to Durfee. He pointed out that the same policies applied to the local airlines are the policies that helped trunklines, international carriers and territorial airlines make progress toward self-sufficiency.

Durfee said that the CAB is careful

COCKPIT VIEWPOINT

By Capt. R. C. Robson



ALPA's Air Traffic Goals

At last a group of pilots have set forth their operational requirements for an air traffic control system. The ALPA convention in Chicago last November enacted a program for air traffic for the coming years which seems noteworthy.

Readers of this column have read in AVIATION WEEK that one of the chief weaknesses of our present aeronautical structure seems to be that so often people who do not know what the problem is are the very people who are trying to solve it.

Pilots should know some of the problems. Now they have stated the requirements.

Jet Operations Included

The system must provide at least 60 landings and 60 takeoffs per hour on dual runway airports—double this capacity in event of military emergency.

It must provide full, non-interfering use of airports as close together as those used in the New York Area.

It must allow flights to climb, cruise and descend within the normal best performance ranges of the aircraft. It must be capable of feeding jets into the final landing operation from at least 20,000 ft. It must handle aircraft that do not have the necessary airborne end of the system and provide operational advantages in proportion to the number of equipped aircraft.

The system must not suffer loss of capacity, efficiency or safety on reaching saturation, whether it is caused by excess traffic demand or by unexpected reduction of runway capacity.

Jet and piston types must be singled in the landing sequence with no reduction in the landing rate.

When the flow of traffic to a runway has been interrupted by weather or other causes the system should be capable of absorbing flights in safe holding patterns.

When the runway is re-opened for landings, full traffic flow must be re-established in approximately the original order of priority within about four minutes.

Flight Diversions

Provision must be made to divert flights singly or in groups from one airport to another at the request of the pilot or aircraft operator and without advance notice.

Where a single runway must be used for both landings and takeoffs the system must be capable of opening up precise intervals in the landing stream for takeoffs.

It should not require more than four minutes advance notice to open up this takeoff interval.

Overshoots, aircraft needing to return after takeoff and other emergencies must be fed back into the landing stream without delay to such aircraft and without reduction of the full rate of traffic flow to the runway. Whenever a delay in the system is unavoidable and can be predicted in advance the system must allow the pilot to, 1. take the delay on the ground prior to takeoff, 2. take the delay by cruising slower enroute, or, 3. take the delay by cruising at normal speed and holding in a free area near the terminal of destination.

These may seem like ambitious goals. But the multi-million dollar jet program of the airlines also is ambitious. These traffic requirements can be met by use of known techniques. Such a system would be of immeasurable benefit to the aviation industry.

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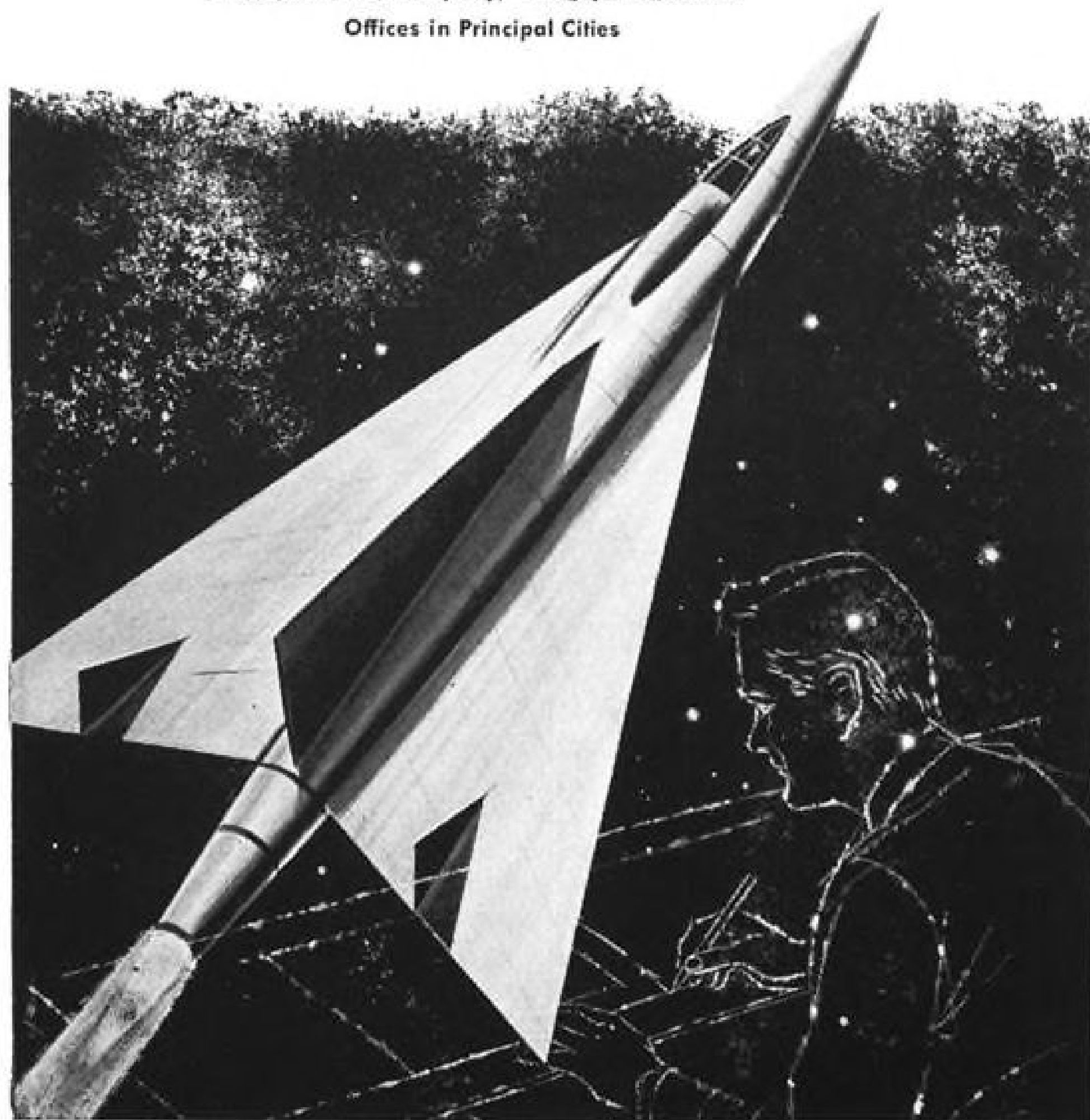
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to determine that its mail rate policies are warranted by the facts in any case, and he observed that past records indicate the CAB is ready to change policies when the facts dictate a change. Durfee said the Board will give full weight to each carrier's situation and its effect on the soundness of general policy.

The CAB chairman also expressed confidence in the present system of individual rate proceedings and informal conferences. He said the individual mail rate cases allow each carrier "to state its own needs in the best and fullest light."

CAB Asks Delay in Large Irregular Case

Washington—Civil Aeronautics Board has asked the U. S. Court of Appeals to stay its judgment in the Large Irregular Case until after the board can reach a final decision of its own.

The court's judgment, scheduled to become effective on Dec. 28, would strip the nonscheduled airlines of their interim status as supplemental air carriers and return them to the irregular air carrier authority under which they have flown for 10 years.

The CAB proposal would maintain the status quo, and the supplemental carriers would continue to fly under their interim authority until the complicated Large Irregular Case is completed. CAB's request for a stay had the support of the scheduled airlines as well as the supplemental carrier.

The supplemental carriers, represented by the Air Coach Transport Assn. and the Independent Military Air Transport Assn., have protected themselves against denial of the CAB petition by securing an extension of the time allowed to ask the Supreme Court to review the Appeals Court decision.

Supreme Court Review?

Chief Justice Earl Warren has granted ACTA and IMATA an extension until Feb. 16 to decide whether to submit the decision for review. If the Appeals Court rejects the CAB proposal, the supplementals will go to the Supreme Court.

These latest steps along the tortuous path the case has followed during its five-year history were triggered by a Court of Appeals decision handed down last July. The court found that the CAB had failed to justify the use of its exemption powers in granting the new supplemental air carrier operating authority issued in November 1955 (AW July 30, p. 42).

The decision did not question the authority itself but the way the authority was granted. The court said the CAB failed to prove that it would

be an undue burden to make the supplemental carrier go through a full certification proceeding. Such a finding is necessary before an exemption can be issued.

After some extensive legal maneuvering, the CAB secured a stay from the Court of Appeals until Dec. 28 while it made up its mind what to do next.

If the court's judgment goes into effect, the non-scheduled airlines lose their authority to operate as supplemental air carriers.

Scheduled Lines' Proposal

Early this month, the scheduled airlines suggested that the best way to handle the situation would be to maintain the status quo and have all issues decided at one time when the Board makes its final decision in the Large Irregular Case. The supplemental carriers concurred, and the CAB has asked for the stay until 60 days after a final decision is reached in the case.

Handling the situation in this manner eliminates the interim operating authority as an issue. Actually, the scheduled airlines are more interested in the kind of authority issued than they are in the way it is issued. They will be able to argue their views on both points before the case is decided.

What CAB Must Decide

The decision still to come from the CAB will deal with the second half of the case. The Board split the case in two in order to deal with general policy first, then deal with individual carrier applications.

The policy decision was reached in November 1955, when the CAB decided to establish a new class of supplemental air carriers. These airlines were permitted to operate unlimited domestic charter flights and cargo flights overseas, and they obtained authority to operate to scheduled flights a month between any two points.

The scheduled airlines had violent objections to the ten flight rule, and when the CAB refused to change its decision, the scheduled flights a month between any two points.

The scheduled airlines had violent objections to the ten flight rule, and when the CAB refused to change its decision, the scheduled carriers went to court. This action led to the Court of Appeals decision in July.

An examiner's report on the second part of the case is expected very shortly, and the case could be finally decided by mid-1957. A significant factor in all the legal maneuverings and in the final decision is the fact that next year all three of the CAB members who carried the split decision in the November 1955, opinion will be gone from the Board.

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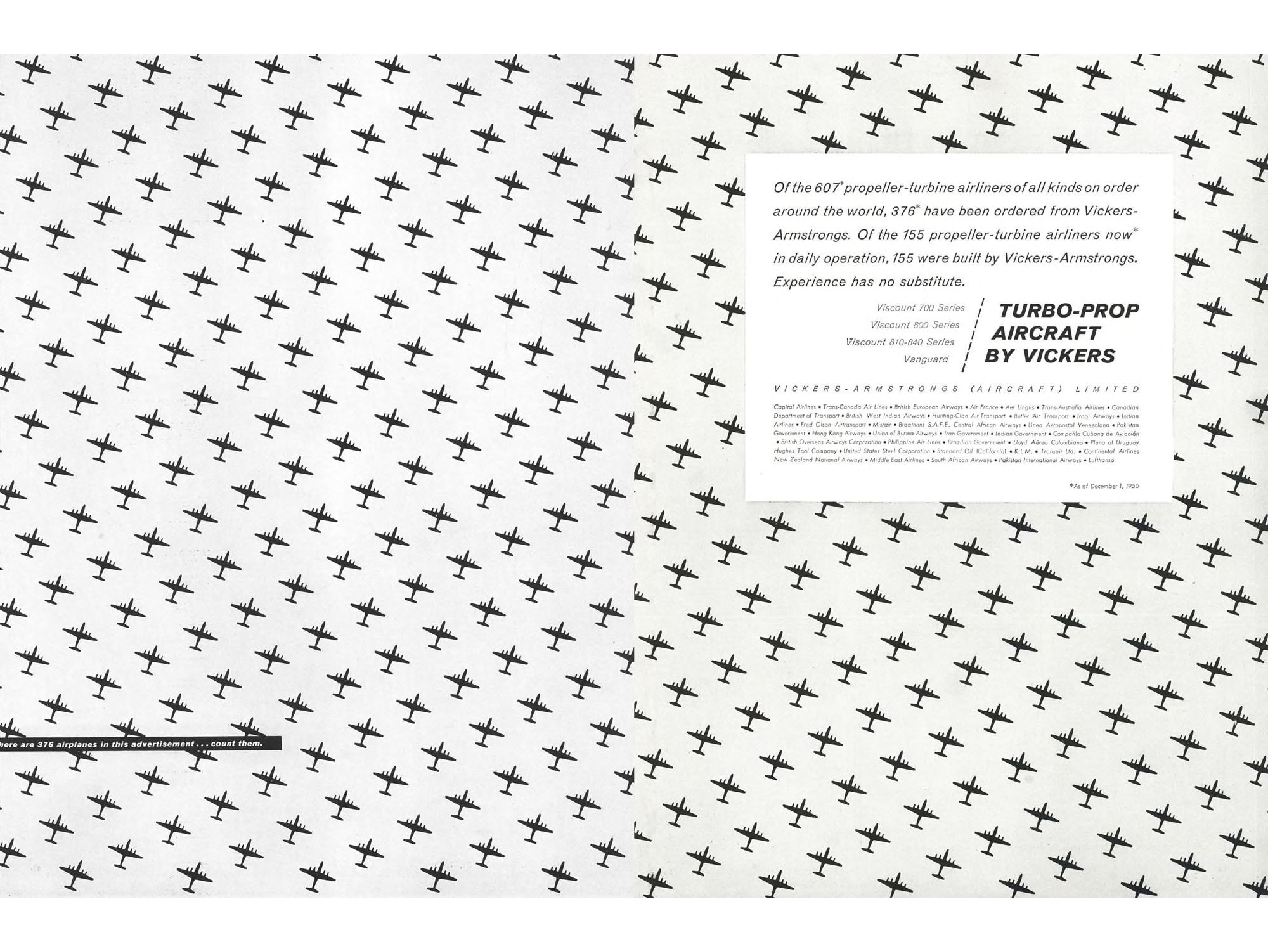
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FOR WM. R. WHITTAKER CO., LTD.

BY MARVIN MILES

When your hydraulic valve specifications arrive at Whittaker, they go first to a young man named James E. DeKlotz.

Jim is Whittaker's assistant hydraulic project engineer and as such his job is basically three-fold: To evaluate the specs, guide the valve design to meet them and assure that the completed unit turns out the desired performance.

A 32-year-old native of Twin Falls, Idaho, Jim has a personal regard for aircraft valves, having been a Navy pilot in World War II — a primary flight instructor who literally spent months on end in Stearman "Yellow Perils," bouncing in and out of training fields and wondering what his cadets would do next.

He spent one semester at the University of Idaho before Uncle Sam beckoned him into Navy blue for two and a half years, then returned to complete his freshman year before going into sophomore mechanical engineering studies at the University of Washington.



James E. DeKlotz
Assistant Hydraulic
Project Engineer

He took his final two years in aeronautical engineering at Cal-Aero Technical Institute in Glendale near Los Angeles and promptly arranged an interview (through a friend) with Dick Deschner, Whittaker's chief of administrative engineering. That was seven years ago and Jim's been with the valve company ever since.

Although he had respect for valves — and their ability to keep an airplane flying — Jim acknowledges they were just another form of electro-mechanical device as far as his knowledge went in 1949.

But things are different today. He knows the field through and through and lives on the constant challenge to ingenuity.

Jim worked with Deschner for a time and his first job was a one-piece gate valve planetary actuator. Then he spent six months with Bill Moore in design before being transferred to the hydraulics section under Vic Larsen.

There are some 20 engineers in the section, a closely coordinated team working mostly from specs through design, prototype fabrication, and development testing to production. At any one time their work load may include seven or eight jobs on the drawing boards, perhaps twice this number being readied for design or just out of design, plus those in prototype fabrication and development test. And there's usually some incidental work going on as well.

Nor are all their valves hydraulic units, for the section is called upon to

develop high pressure pneumatic and fuel valves that parallel hydraulic-type design.

Jim has seen many changes in the business during his seven years at Whittaker. Everything is smaller, lighter, more complex — more challenging and taxing in development. Whereas in past years a set of specs did not necessarily call for major changes in design, today they almost all do.

A mere modification seldom suffices anymore and "shelf items" are practically non-existent. Customers — themselves faced with compounding problems — invariably want changes that require alterations leading to entirely new designs or wholly new concepts.

Jim's responsibility is to keep his finger continuously on the technical aspects of the various jobs and in this task he's helped by the coordinated thinking not only of Vic Larsen, his boss, and his associates in the section, but Whittaker's sharp field engineers and occasionally customer engineers as well.

"There's always the certainty of unknowns," he says. "Situations develop. We re-negotiate with the customer, find out which way he wants to go — and follow through."

Jim pays high tribute to Larsen as an engineer and designer and to the thoroughness of Whittaker engineering in general. Working for the company through several expansions, he says, has made it seem like he has worked for several companies, each larger and better than the last.

Once the owner of a Ryan PT-22, Jim doesn't fly much anymore, although he has some 800 hours in his log book. "It was a good hobby, but a little too expensive . . ."

Today he and his wife, Elise, and daughter, Karen, 4½, are busy getting settled in a new home in nearby Canoga Park.

"That's enough hobby for anyone," he explains. "Like working for Whittaker — it's never boring!"

MATS Will Start With 717 Transports

Washington—USAF's new Military Air Transport Service, operating as the Defense Department's single manager agency (AW Dec. 17, p. 34), will start with a fleet of 717 four-engine transports. Eventually, it is expected to absorb more than 2,000 aircraft in the transport category.

As these facts came to light last week, the Air Transport Assn. made a strong plea for increased commercial participation in the entire Defense airlift operation.

Citing airline plans to invest more than \$2 billion in jet-age equipment during the next five years, Stuart G. Tipton, ATA president, called for "a new partnership with the military—a partnership in which increased airline carriage of military traffic will free Defense Department resources for other tasks and will expand the national airlift without cost to the taxpayer."

Tipton's proposal to augment the Civil Reserve Air Fleet program came one week after USAF Secretary Donald A. Quarles was designated manager for the reorganized MATS.

Directive Loopholes

Text of the Defense Directive (5160.2) disclosed there are some loopholes that may leave selected units and facilities in the hands of the military units now operating them.

The new agency, as the department now defines MATS, will be composed of what Defense designates Controlled Transport Aircraft, along with the personnel, facilities and equipment needed to operate them.

Definitely eliminated from MATS are these transports:

- Those designed for specialized tasks.
- Those required for administrative airlift or combat training.
- Those required outside MATS by "overriding military considerations."

Flogair's Role

It was made clear at the outset that Navy's Fleet Logistic Air Wings will be permitted to retain 30 aircraft. Flogair's contribution to MATS will be 67 transports, 52 of which already are in the USAF organization.

Another 116 aircraft will be Douglas C-124 transports moved from the Tactical Air Command's 18th Air Force. The remaining 534 are USAF aircraft also now in MATS.

In the future, however, a bigger bite will be taken from other commands as the new MATS grows up. There is speculation that transport aircraft operated by the Strategic Air

Command, as well as USAF wings hauling cargo and passengers around Europe, North Africa and west to Turkey, will be included. It is assumed that the new Lockheed C-130, as well as the Douglas C-133 and C-132, will wind up in the new organization.

Spokesmen for the Defense Department were unprepared to explain how the new MATS will be provided with an industrial fund or sufficient personnel to take care of monumental auditing and operations problems. They said savings are expected in such fields as training, standardization and maintenance. But laid no emphasis upon new utilization factors—and manpower requirements—that are certain to result from the single manager concept.

New Money Needed

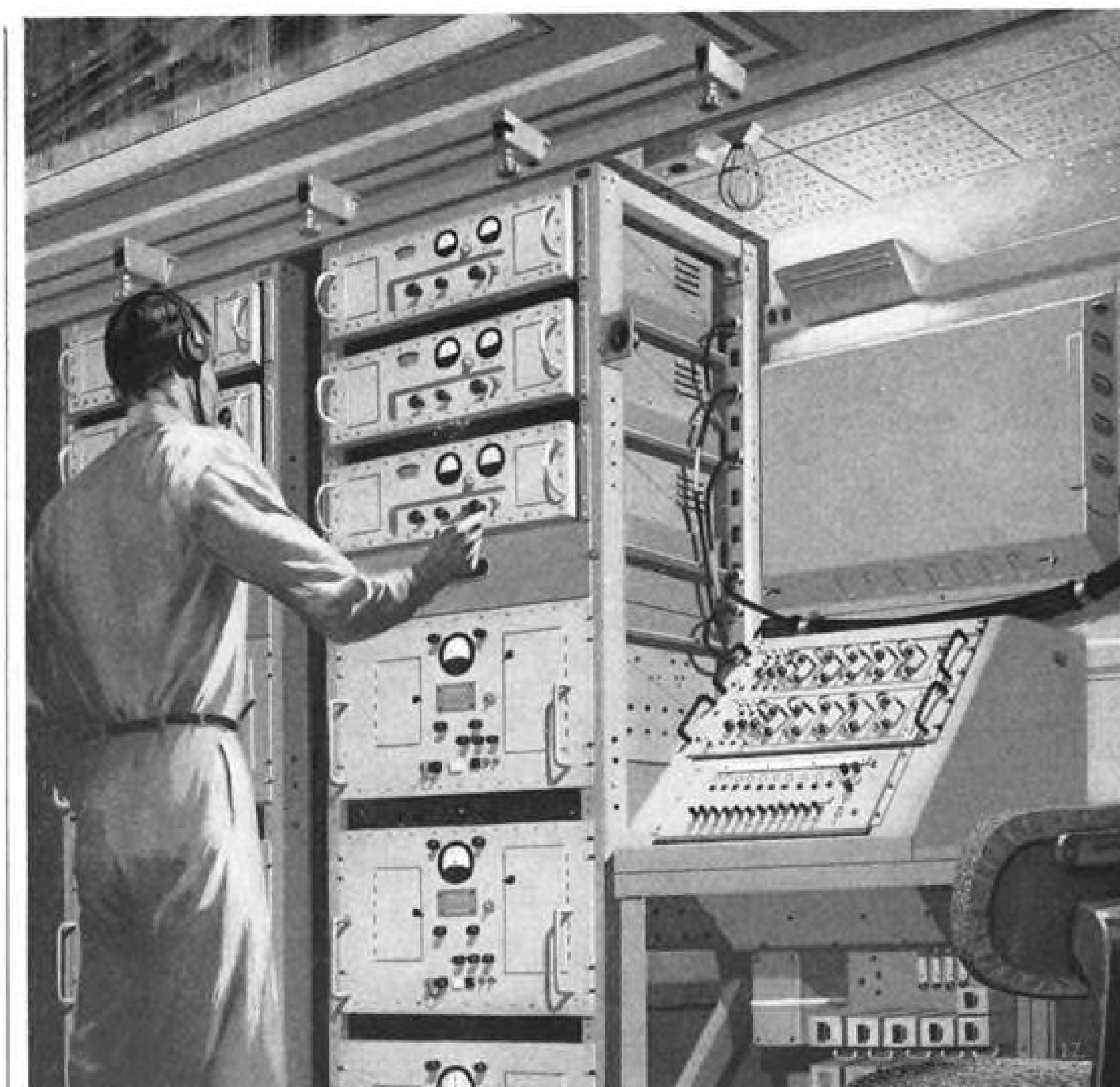
A year ago, the Defense Department estimated it would need a fund of \$155 million, but the money was not granted by Congress. This action still must be taken after Quarles has won approval from Defense Secretary Charles E. Wilson for his terms of reference, the program to carry out the new MATS operation. Quarles has until Feb. 7 to prepare this document.

Details of the controversy that preceded issuance of the Wilson directive were not disclosed, but it was apparent that a number of compromises were made in the top-level Pentagon discussions that led to the action. To USAF, the result is satisfactory, but there is a strong feeling that the Defense Department does not fully realize the problems that will be encountered.

Under the Tactical Air Command, utilization of the C-124s has been poor, averaging less than an hour and a half a day. Utilization of regular MATS planes has been only four hours. The goal is to reach six hours during Fiscal 1958. To do this, more crews, maintenance and support personnel will be needed.

Tipton's proposal for ATA was made in a speech last week before the Wings Club in New York. He argued that wider use of commercial carriers will relieve USAF personnel for fighting arms such as SAC and TAC the Strategic and Tactical Air Commands.

Tipton said the military services have come to recognize the value of shipping men and material by air, realizing economies in manpower and inventory as well as eliminating vulnerable advance supply depots. Tipton added, however, that while the military tends to ship more and more by air, the percentage of military traffic handled by civilian carriers has gone steadily downward.



Interior, mobile Air Traffic Control Station

NEW from Craig! STRONGER, *Lighter* RACKS for electronic equipment

Craig is now manufacturing aluminum racks for electronic equipment. Originally designed and developed for use in mobile and air-transportable installations — where high strength and low weight are of primary importance — they have proven so successful, Craig is now offering these racks to industry. They are equally adaptable to fixed installations and are designed to meet military specifications. Here are some of the outstanding features:

ADAPTABLE — accommodates standard 19" wide RMA panels in standard height increments.

RUGGED — box-type construction supports great weights — including heavy power supplies.

HIGH STRENGTH — extruded aluminum uprights, die cast aluminum corners, heat-treated aluminum cross members and runners.

LIGHTWEIGHT — 72" rack weighs less than 29 lbs.

SHOCK ISOLATORS — provision for mounting shock isolators on all four corners, top and bottom.



Mobile Air Traffic Control Station

ASSEMBLY — easy-to-assemble parts shipped complete with hardware — or factory assembled.

DIMENSIONS — standard: 20¼" wide, 17½" deep, 73¼" high. Other sizes available.

FASTENINGS — lock-type nuts with nylon inserts, permanently attached to the uprights, insure solid fastening of panels to rack.

ACCESSORIES — Spare Parts Drawers of various sizes. Standard runners and hardware available from stock. Provision for attaching metal raceway for housing power and signal wiring circuits.

Write for brochure
giving complete
details and prices.

Craig SYSTEMS, INC.

Dept. C-12, DANVERS, MASS., Telephone: SPing 4-1870

Airline Traffic—October 1956

	Revenue Passengers	Revenue Passenger- Miles (000)	Load Factor	U. S. Mail	Express	Freight	Total Revenue Ton-Miles	Per Cent Revenue to Available Ton-Miles
DOMESTIC TRUNK								
American.....	732,299	440,871	67.85	1,771,451	1,104,463	7,501,120	52,858,507	60.69
Braniff.....	164,029	66,636	62.67	240,012	148,259	376,824	7,154,861	54.51
Capital.....	109,468	109,304	62.94	335,008	250,103	361,062	11,412,796	48.55
Continental.....	67,700	24,677	58.63	76,487	28,083	102,553	2,575,364	49.35
Delta.....	217,530	96,512	56.05	331,781	369,870	694,440	10,677,884	53.06
Eastern.....	625,468	279,291	55.37	935,727	572,649	1,475,527	31,259,425	44.28
National.....	96,898	59,443	58.59	245,499	58,157	412,031	6,778,212	58.99
Northeast.....	50,390	10,063	60.40	10,911	15,678	28,320	993,190	58.40
Northwest.....	118,862	75,594	62.90	379,479	274,692	813,459	8,877,764	55.80
Trans World.....	392,947	295,717	62.43	1,036,981	1,024,794	2,448,336	32,840,950	57.51
United.....	548,745	376,358	68.07	2,262,945	1,332,136	5,416,862	45,169,872	60.39
Western.....	107,871	51,822	60.83	266,149	95,859	207,348	5,530,073	55.37
INTERNATIONAL								
American.....	11,937	8,280	59.11	13,788	655	333,236	1,206,264	60.74
Braniff.....	2,524	5,254	44.73	20,873	.....	73,255	696,502	49.85
Caribbean Atlantic.....	11,967	807	56.59	1,228	.....	5,385	70,560	55.74
Delta.....	4,440	5,160	56.00	7,483	.....	49,112	593,836	46.11
Eastern.....	21,143	28,428	61.00	68,112	.....	101,666	3,175,455	53.71
National.....	6,108	3,545	33.79	7,979	5,208	32,185	412,291	38.14
Northwest.....	10,201	20,221	57.21	940,201	21,812	1,322,732	4,523,096	71.46
Pan American								
Alaska.....	5,921	6,512	54.22	38,262	.....	316,944	1,048,433	50.15
Atlantic.....	86,192	110,661	62.77	980,743	.....	2,382,364	14,821,080	61.56
Pacific.....	26,952	83,962	72.56	972,477	.....	1,375,835	11,224,197	68.37
Latin America.....	91,129	92,583	62.64	363,514	.....	3,587,586	13,107,473	61.97
Panagra.....	11,916	14,145	58.03	58,749	.....	359,095	1,974,286	58.90
Trans World.....	25,350	63,538	60.43	755,135	.....	933,589	8,353,110	67.29
United.....	7,337	18,214	63.60	81,348	.....	56,490	2,015,211	58.00
LOCAL SERVICE								
Allegheny.....	28,713	6,394	48.19	7,406	24,357	10,953	652,433	59.93
Bonanza.....	12,043	2,775	48.31	4,658	2,756	10,116	280,874	47.18
Central.....	10,138	1,974	38.87	4,016	2,652	6,212	201,844	34.78
Frontier.....	18,120	4,903	50.37	17,791	7,595	56,062	554,430	60.02
Lake Central.....	14,608	2,347	51.70	2,302	18,412	.....	233,015	45.06
Mohawk.....	40,547	7,240	52.43	5,863	12,170	15,255	723,210	52.34
North Central.....	55,236	8,735	55.39	20,815	39,422	.....	891,124	49.86
Ozark.....	34,644	5,377	43.18	12,054	20,654	13,190	548,704	44.69
Piedmont.....	36,657	6,897	53.47	14,012	17,398	12,370	704,314	53.63
Southern.....	17,822	3,210	46.03	8,287	15,745	.....	331,079	43.82
Southwest.....	27,136	5,975	55.14	8,728	5,517	7,430	590,614	53.27
Trans Texas.....	21,776	4,957	41.99	14,440	9,351	26,107	523,000	38.76
West Coast.....	19,141	3,412	44.84	3,508	2,534	3,816	318,275	51.44
HAWAIIAN								
Hawaiian.....	30,519	4,198	56.87	3,956	.....	114,629	480,783	56.42
Trans Pacific.....	16,318	2,060	55.12	893	.....	12,418	176,941	57.56
CARGO LINES								
Aerovias Sud Americana.....	.....	.....	.....	.....	.....	772,357	772,357	68.05
Flying Tiger.....	3,712	18,310	98.68	33,323	46,521	6,176,431	8,087,312	75.26
Slick.....	3,686	15,370	100.00	87,437	111,747	6,785,949	8,522,123	74.64
Riddle*.....	.....	.....	.....	.....	.....	.....	.....	.....
Seaboard & Western.....	7,976	34,851	100.00	.....	.....	2,275,841	5,760,963	90.31
HELICOPTER								
New York Airways.....	5,150	101	36.59	1,326	1,548	693	12,971	41.85
Los Angeles Airways.....	2,240	86	45.03	3,340	2,034	.....	13,284	49.89
Chicago Helicopter Airways.....	.....	.....	.....	2,713	.....	.....	2,713	30.30
ALASKA								
Alaska Airlines.....	5,864	1,615	48.70	29,683	.....	235,920	446,738	52.85
Alaska Coast.....	3,784	341	72.55	4,054	.....	3,500	42,477	73.51
Cordova.....	1,519	270	43.83	4,360	.....	186,850	218,912	61.28
Ellis Air Lines.....	5,311	269	60.17	2,008	.....	2,921	32,322	72.51
Northern Consolidated.....	2,207	759	55.93	21,826	262	540,706	646,686	86.60
Pacific Northern.....	8,855	6,488	49.01	69,913	.....	314,552	1,089,052	61.51
Reeve Aleutian.....	674	259	53.73	16,340	.....	41,577	96,198	68.42
Wien Alaska.....	2,594	1,091	20.43	35,431	.....	510,915	659,647	92.11

*Not available.
Compiled by AVIATION WEEK from airline reports to the Civil Aeronautics Board.

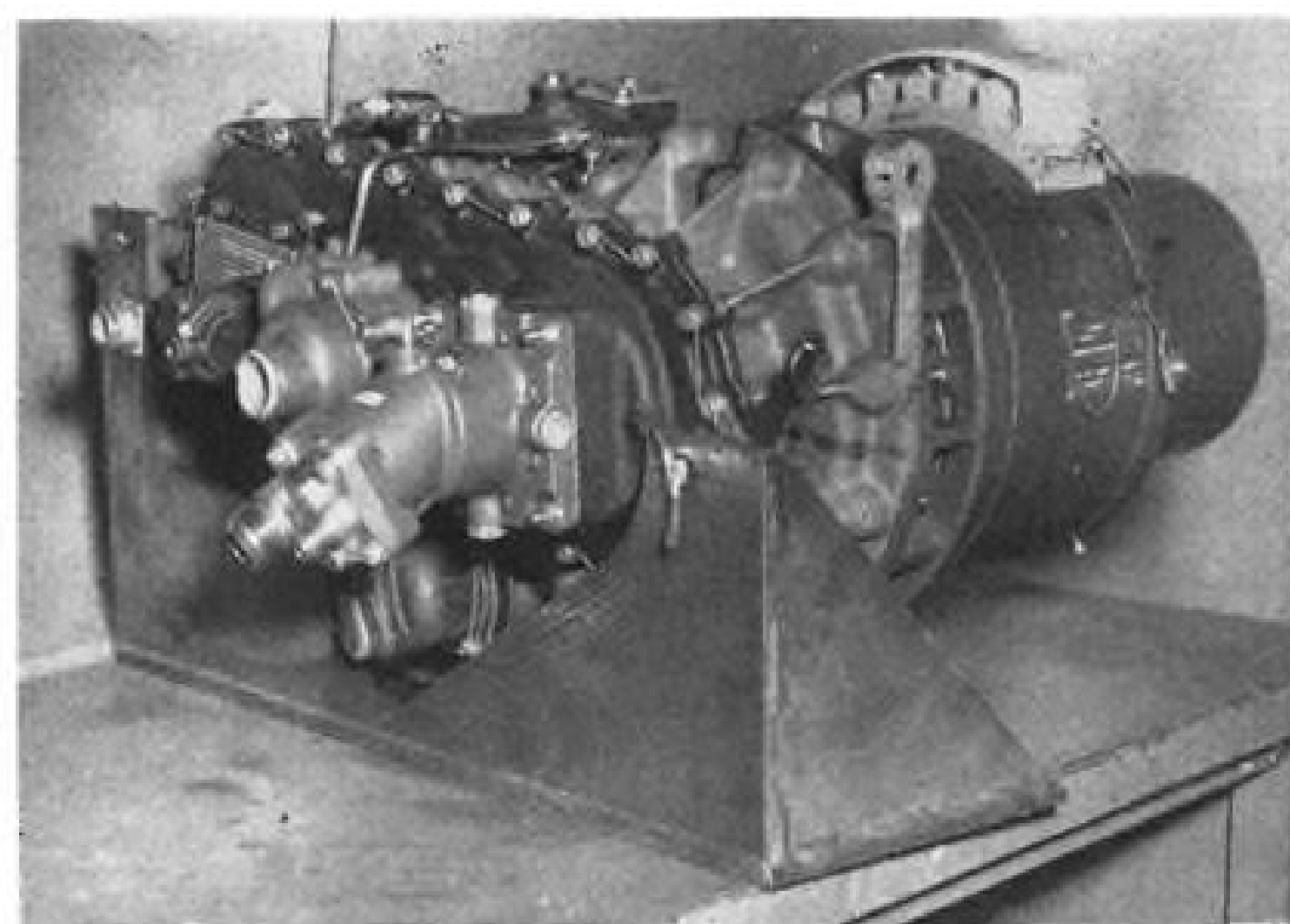
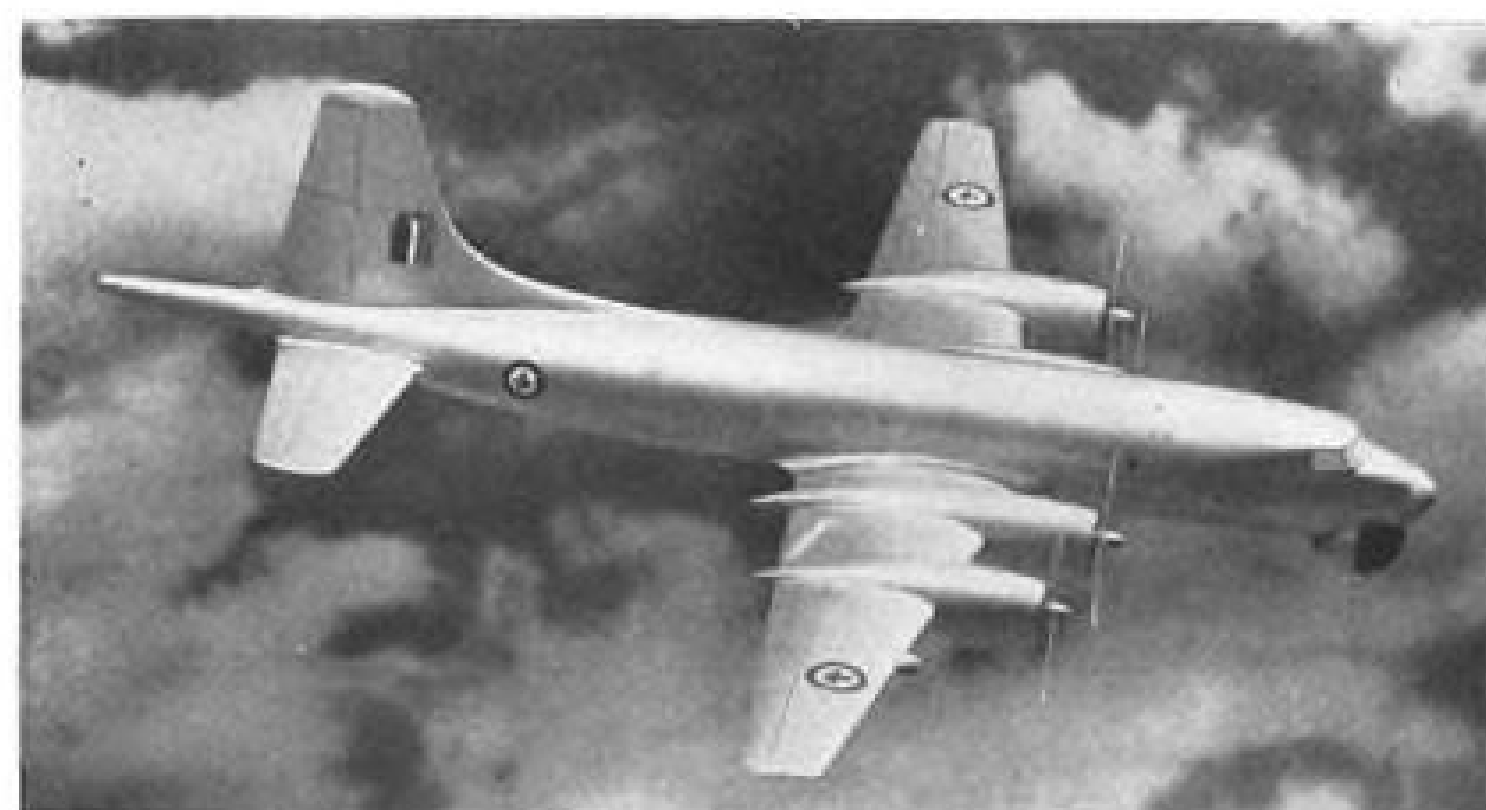


Fuel Drops Tested By Antarctic Unit

Practice petroleum supply drops are carried out by New Zealand Antarctic Expedition members using de Havilland Beaver in Mt. Cook area of Southern Alps. Loading of 33 and 12 gal. drums is performed at Hermitage airstrip (top). Two 12 gal. drums are dropped on firmly compacted snows of Tasman Glacier from 50 ft. at 120 mph. (lower left). Bob Miller (left, below), deputy leader, and Sir Edmund Hillary (right), leader of the expedition, dig out a 33 gal. drum after drop.



EQUIPMENT



CANADAIR'S CL-28 Maritime Reconnaissance aircraft (left) based on the Bristol Britannia design. Radar under nose forced Canadair engineers to reverse nose gear retraction from forward to rearward for clearance considerations. Constant speed drive (right) used on the CL-28 showing the constant displacement hydraulic pump on the front, alternator on the opposite side.

CL-28 Hydraulics Revised for Simplicity

By GEORGE L. CHRISTIAN

The hydraulic system of Canadair's CL-28 Maritime Reconnaissance plane—a design based largely on the Bristol Britannia—has been revamped considerably by Canadair engineers to reduce complexity and make possible a static ground check of the entire flight control system.

Principal changes involved reducing the main hydraulic system's operating pressure 1,000 psi. to 3,000 psi., cutting the number of main pumps from four to two, and redesigning and re-locating several components of the hydraulic system.

Major physical changes to the aircraft

from the hydraulics point of view were the addition of two sets of hydraulically-actuated bomb bay doors, and redesigning the nose landing gear to make it retract towards the rear instead of the front. This was done to avoid interference between the dual nose wheels and the nose-mounted radar.

CL-28 Hydraulic Systems

The CL-28's hydraulic system is made up of a main and emergency system plus a small, separate auxiliary system.

The main system is powered by two Vickers, constant displacement, 30 deg. pumps with a capacity of 8.5 gpm. each. The two pumps are located in the inboard nacelles and are driven by

Sunstrand constant speed drives which also power alternators for the electrical system.

The main system reservoir is mounted on the aft side of the forward bomb bay's rear bulkhead where it is in the most direct line between the two pumps, reducing the suction in the feed lines to a minimum.

The main system operates these services: landing gear retraction and extension; nose gear steering; main wheel brakes; and control surface locks.

The emergency system consists of a single Vickers pump, identical to the main pumps, driven at 3,300 rpm. by a 17 hp., 115/200 v., 400 c. electric motor. The emergency system can supply pressure to lower the landing gear, apply brakes an unlimited number of times (an emergency brake accumulator provides enough pressure for eight brake applications), and open and close the front and rear bomb bay doors.

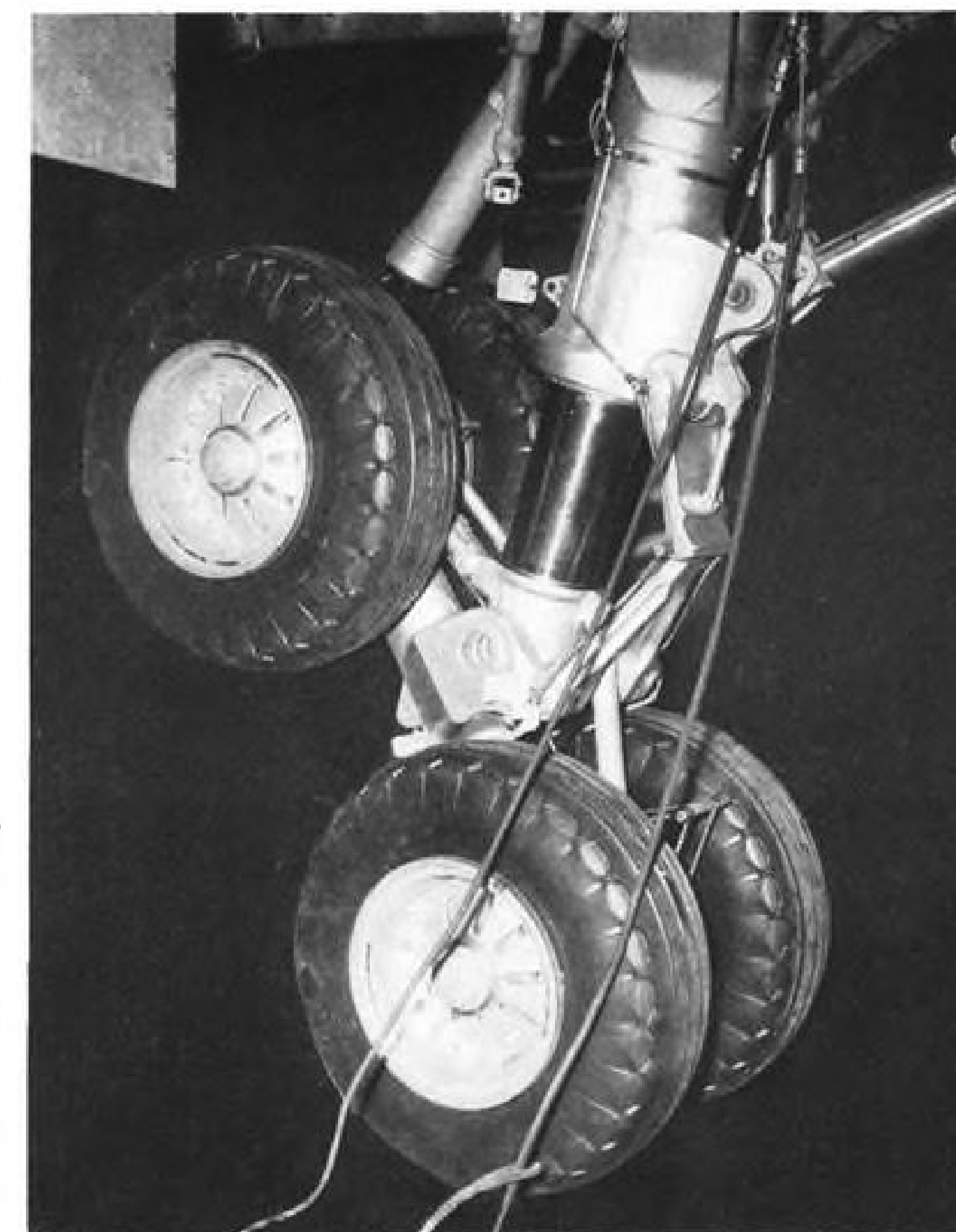
The small, auxiliary hydraulic system is used to supply artificial feel for the elevator control. This is achieved by means of an air speed-sensitive hydraulic valve and actuator powered by its own electric motor-driven pump. Purpose is to give the pilot the feel he needs to avoid over-stressing the airframe.

From 4,000 psi. to 3,000 psi.

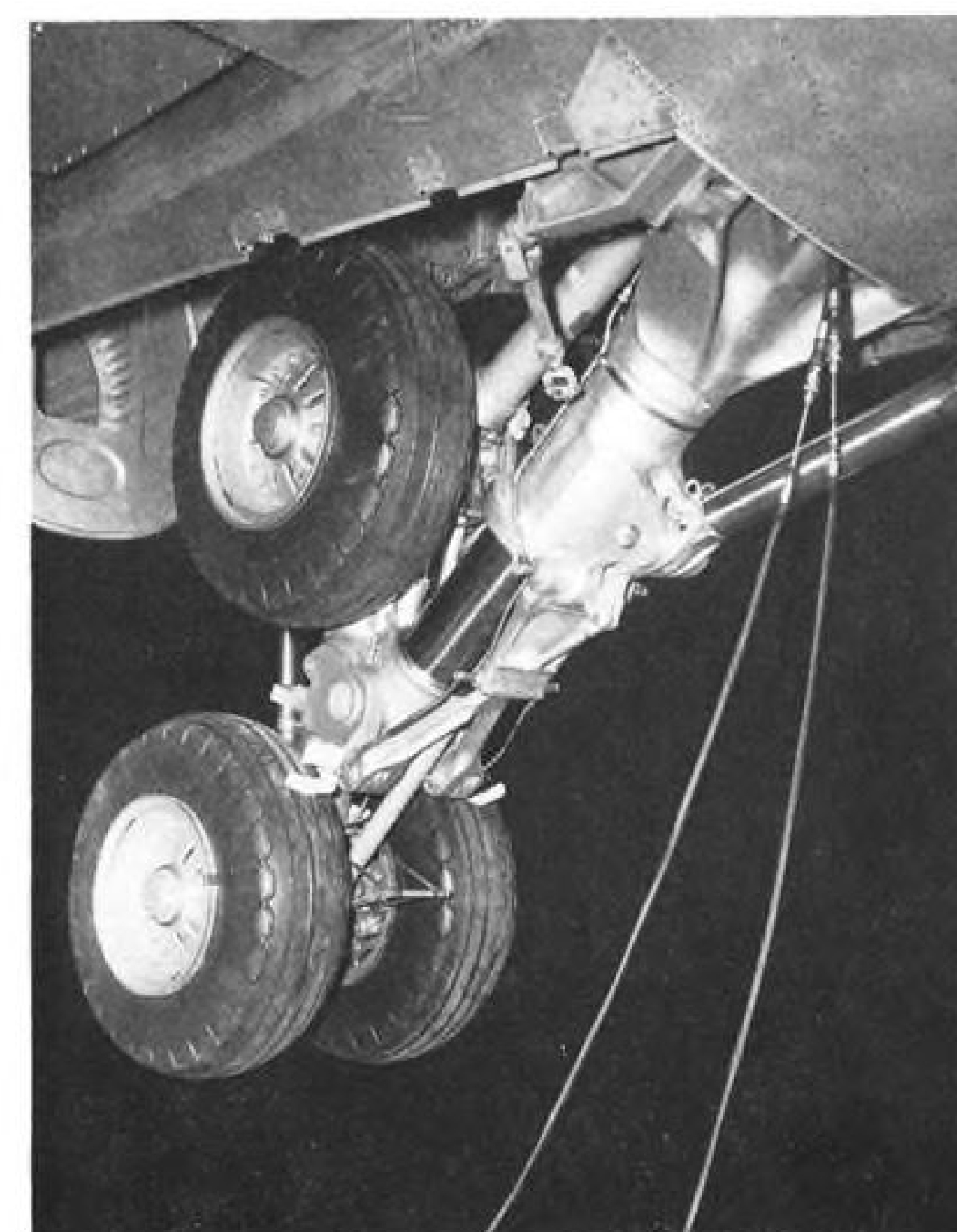
Canadair's decision to incur a weight penalty of about 21 lb. by switching from the Britannia's 4,000 psi. hydraulic system to a conventional 3,000 psi. system was based primarily on the ready availability of 3,000 psi. components such as pumps, regulators, filters, accumulators and all types of valves. The advantage of availability



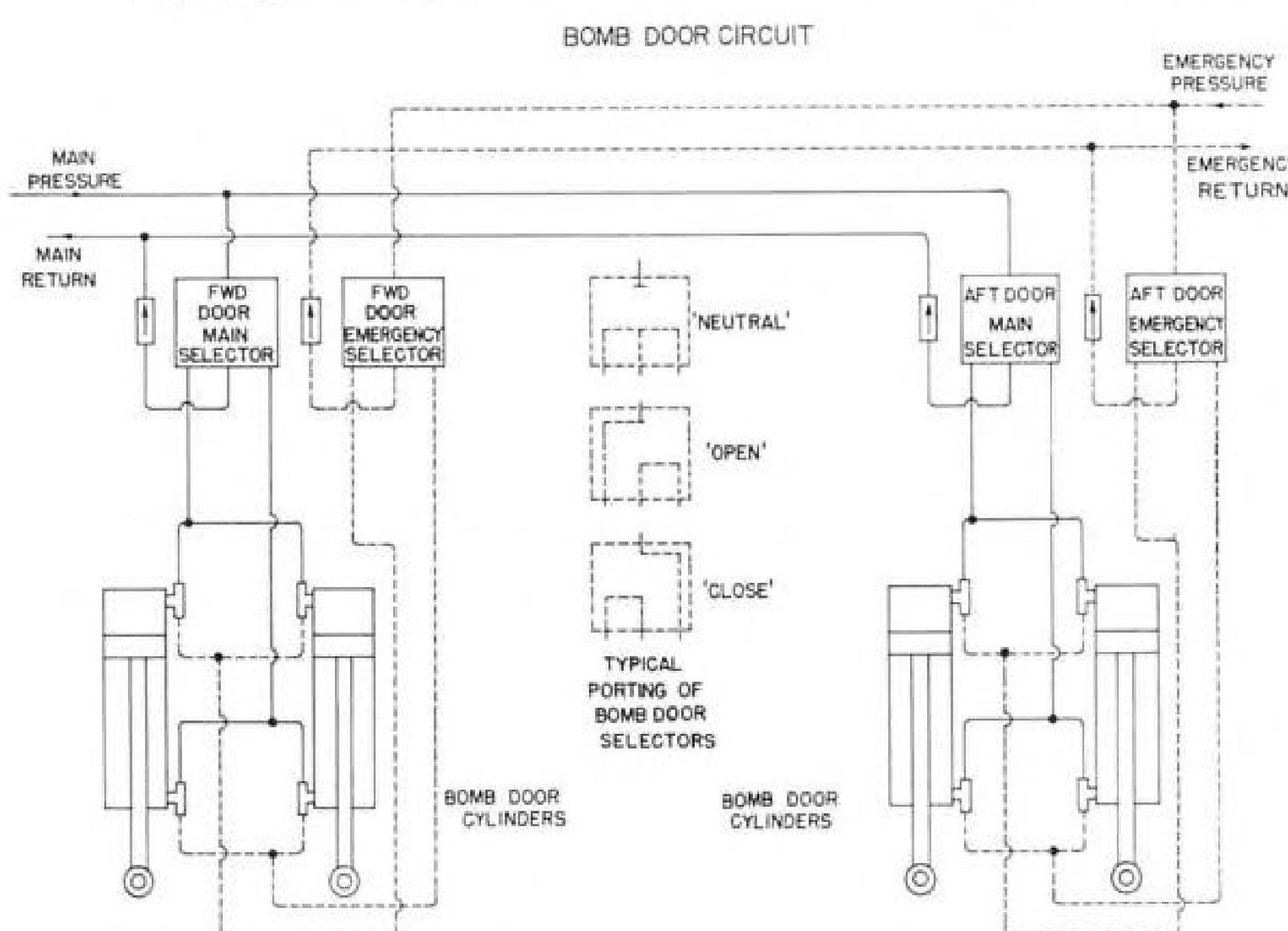
1. CL-28's MAIN, bogie landing gear starts retracting. For storage-clearance considerations, four-wheel bogie is folded through 60 deg.



2. BOGIE FOLDING on Britannia is accomplished hydraulically, on CL-28 mechanically. Changeover saved Canadair 21 lb. per plane.



3. AS LANDING gear nears fully retracted position, bogie folding is almost complete. Main and nose gear on CL-28 fold rearward. 4. HERE MAIN LANDING gear is almost completely retracted with four-wheel bogie tucking into aft part of inboard engine nacelles.



seemed to far outweigh the weight penalty, in Canadair's opinion.

As a company spokesman put it, "We decided to use a standard system pressure of 3,000 psi. and endeavor to recover as much of the resultant weight penalty as possible by redesign of the Britannia's systems involved."

"This type of redesign was made possible by, in some cases, making use

of factors not then available to Bristol designers."

The four-wheel bogie main landing gear of the CL-28 is folded through 60 deg. for storage-clearance considerations, as it is on the Britannia. On the British plane, the bogie folding is accomplished hydraulically. This necessitates the use of sequence valves to have the folding precede the down lock

release (which is also done hydraulically) and retraction operations.

Canadair thought a weight saving would be possible if the hydraulic actuating cylinders, sequence valves and associated plumbing were replaced with a mechanical means of folding the bogies. This was accomplished by using a suitable linkage to act on the upper scissors link to rotate the bogie

around the main strut trunnion.

Resultant weight saving was 12 lb. per gear for a total of 24 lb. Thus the 21 lb. weight penalty of reducing the system's pressure 1,000 psi. was made up.

When the nose gear was redesigned for rearward rather than forward retraction, the locking mechanism was revised to permit a single lock to secure the gear in both the up and down positions.

On the Britannia, the 4,000 psi. main

system hydraulic pressure was lowered, through a reducing valve, to 2,000 psi. for the nose wheel steering circuit. Reason given was to give smooth steering characteristics.

System Features

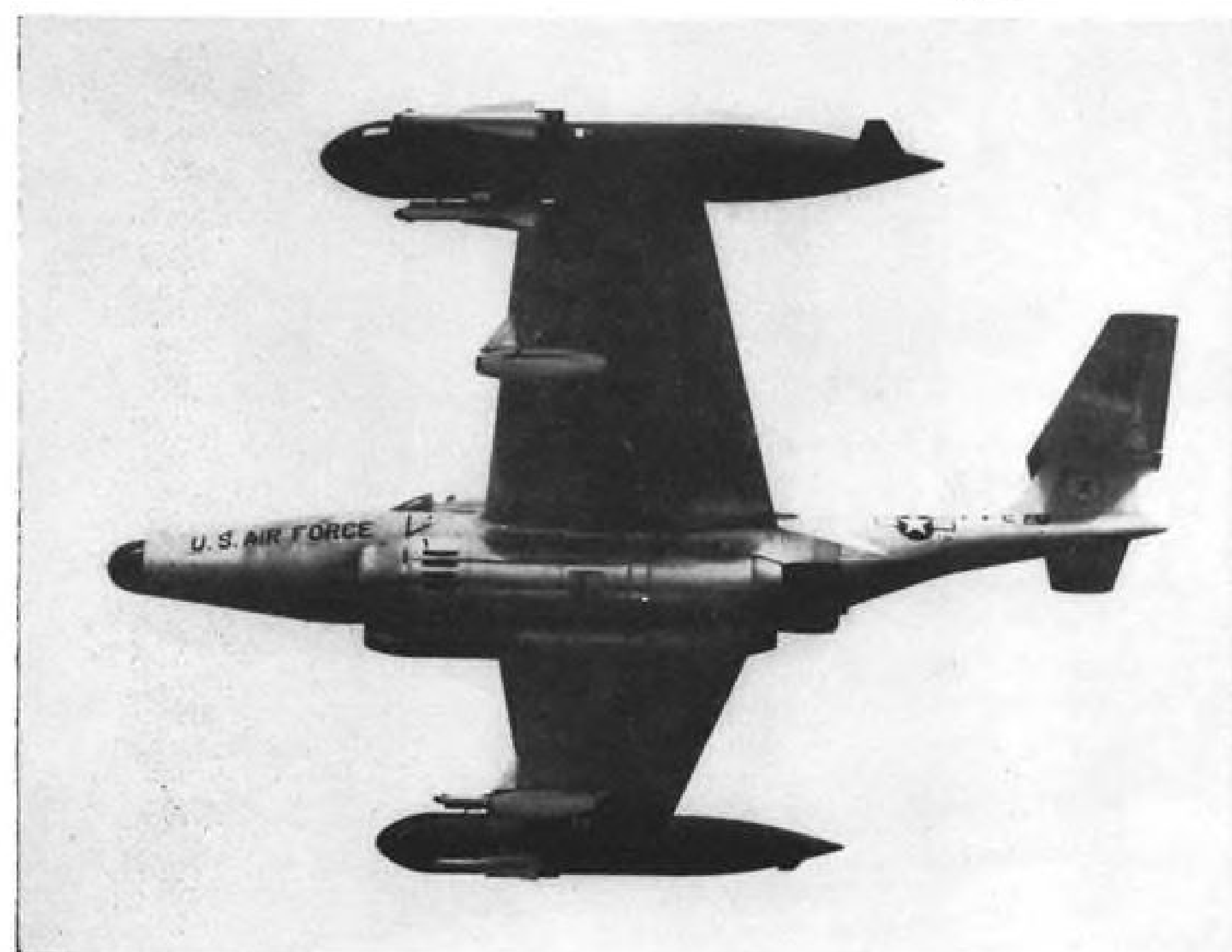
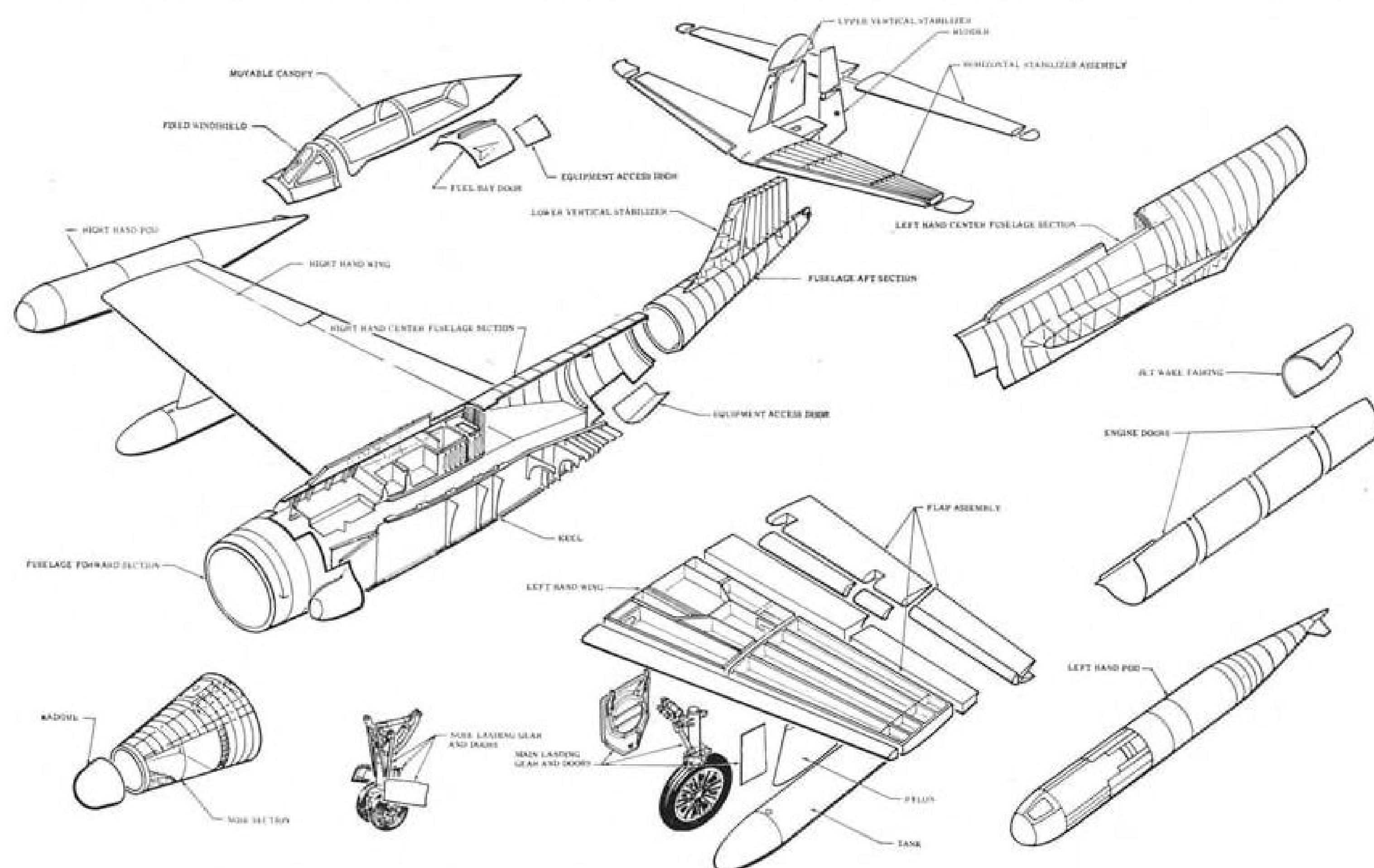
The plane's flight engineer has a three-way selector switch allowing him to select any of the positions: "Main System On", "Both Systems Off", or "Emergency System On".

The hydraulic system reservoir is pres-

surized to 12 psi. from the ship's 3,000 psi armament pneumatic system, through a reducing and control valve.

The system has been so designed that all emergency control components operate partially or fully during normal system operation. This is to keep emergency units in fully serviceable condition at all times.

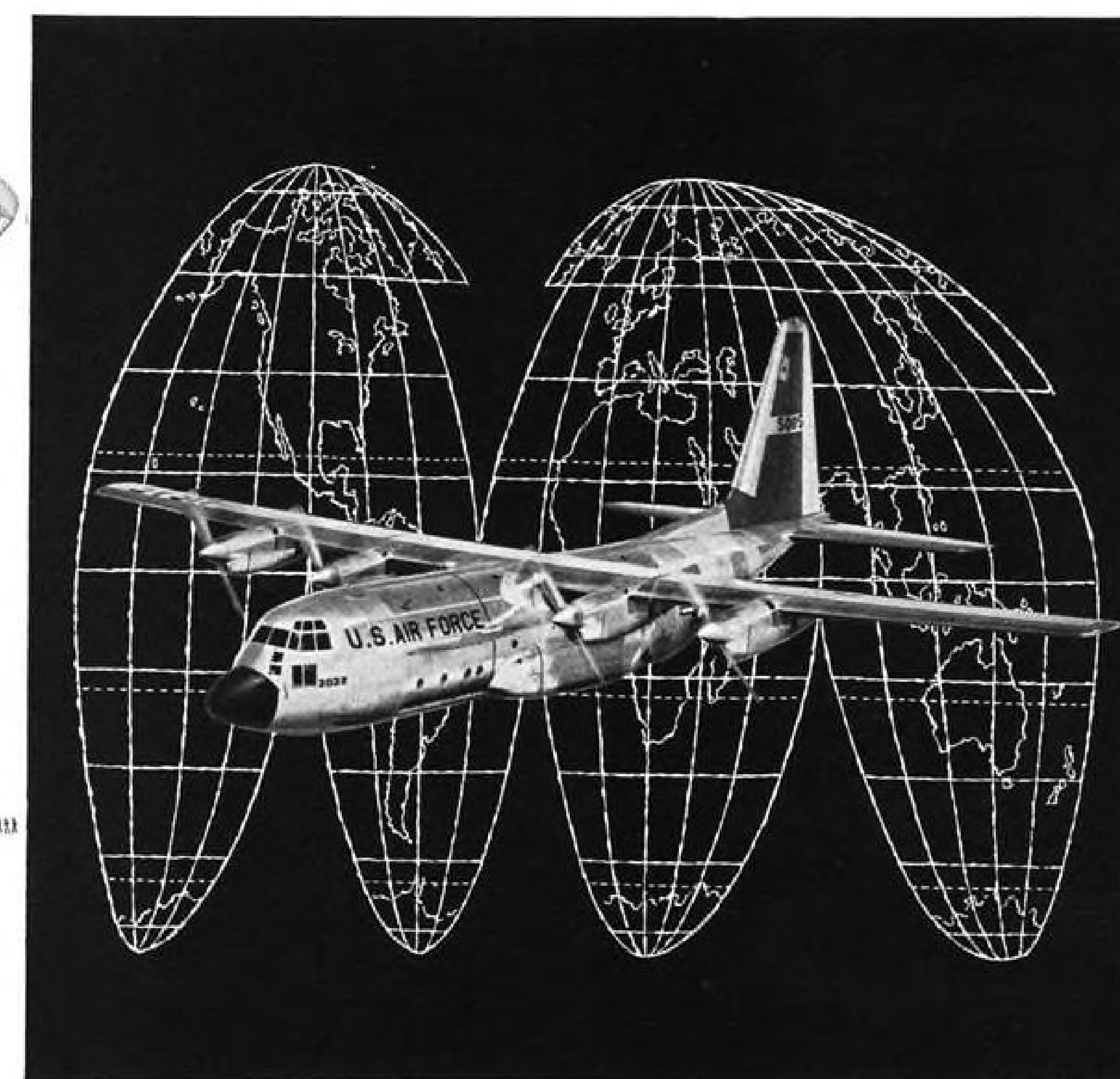
All electrically-operated hydraulic valves are accessible when the plane is in flight, and they are provided with over-ride controls so that they may be



Falcon-Carrying Scorpion

Internal details of latest of Northrop Scorpion series, F-89H, which carries Hughes Falcon air-to-air missile. F-89H decelerons—combination speed brakes and ailerons—enable it to make rapid, steep descents. Fuel is carried in wing tip pods, wings, jettisonable pylon tanks and main fuselage tank. Tip pods also carry six Falcon missiles and 42 2.75 in. folding fin rockets. F-89H is operational with Air Defense Command. Inboard pylon mounts on F-89 in flight (left) contain firing error indicator cameras to assess missile hits and miss distances.

New Propjet Global Mobility for TACTICAL AIR COMMAND



C-130 HERCULES

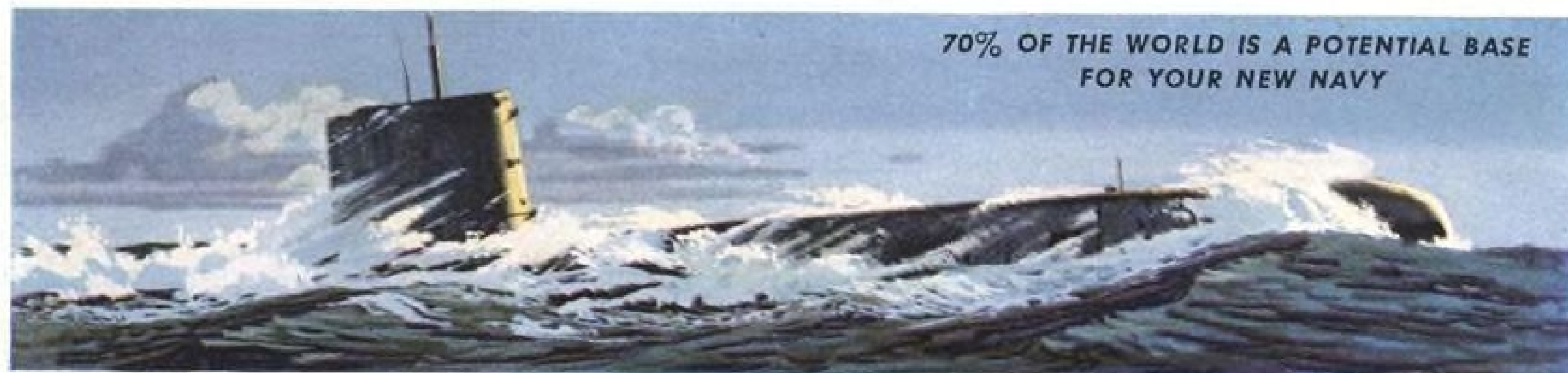
Delivered to 18th Air Force, Ardmore AFB

Moving anything, any time, any place on earth is the responsibility of Tactical Air Command's 18th Air Force. The new Lockheed C-130 Hercules—propjet "strongman" of the USAF, first assigned to the 463rd Troop Carrier Wing—does this job faster, better, at lower cost than any other combat carrier now in service. The Hercules is powered by four Allison T-56 propjet engines.



LOCKHEED LOOK TO LOCKHEED FOR LEADERSHIP

LOCKHEED AIRCRAFT CORPORATION, GEORGIA DIVISION:
U.S. Air Force Plant No. 6, Marietta; Georgia Nuclear Laboratory, Dawsonville



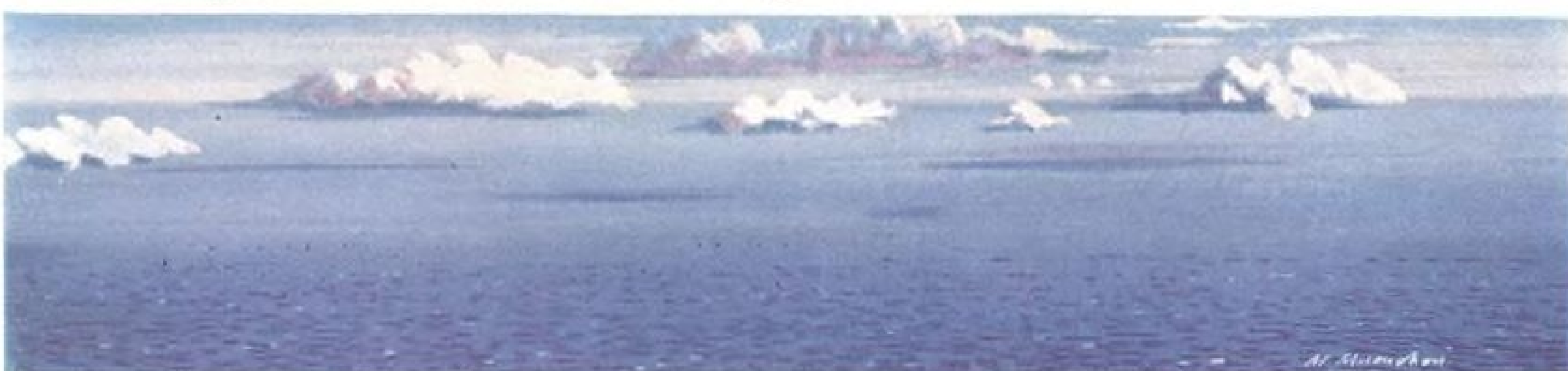
1 Submarine surfaces near enemy coast...



2 ...launches Regulus guided missile...



3 ...Regulus streaks toward target...



4 ...submarine dives, no trace remains.

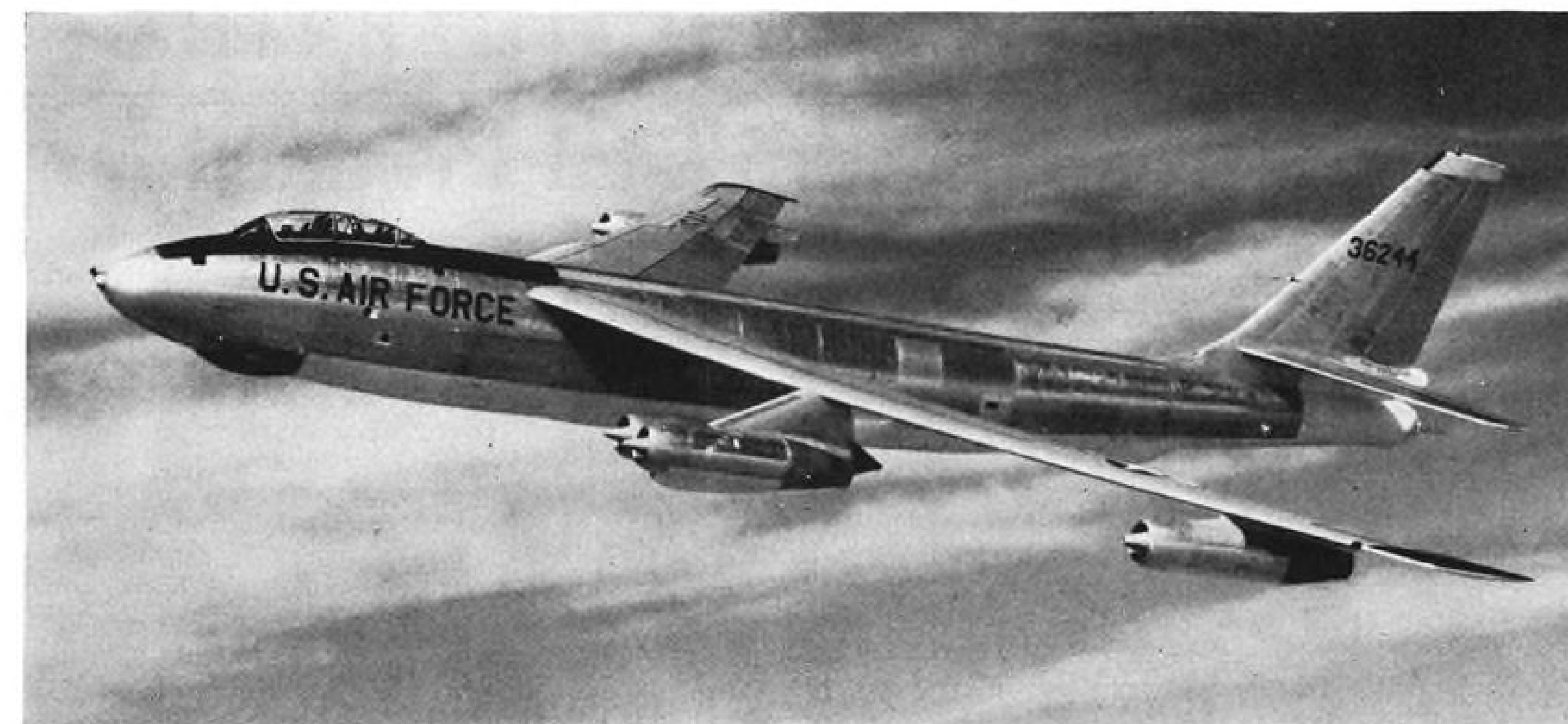
Airborne Thunder

for the Silent Service

Regulus guided missiles now make aircraft carriers out of Navy submarines. This new weapons team is typical of Navy's Nuclear Age tactical power. Carried invisibly to enemy shores, launched against a target far inland, Regulus gives your New Navy an *intercontinental capability today!* Designed and built by Chance Vought Aircraft, Regulus is a prime example of the dependability and accuracy that makes new Navy weapons and techniques increasingly important to a strong U. S. Defense Team.

Scientists and Engineers: There is a challenging place for you on Vought's creative team now. For details write: J. W. Larson, Assistant Chief Engineer, P. O. Box 5907, Dallas, Texas.

CHANCE VUGHT AIRCRAFT
INCORPORATED - DALLAS, TEXAS
DESIGNER AND BUILDER OF HIGH PERFORMANCE MILITARY AIRCRAFT SINCE 1917



Last Boeing B-47

Last of more than 1,300 B-47s is B-47E turned out by Boeing Airplane Co.'s Wichita, Kan., plant, has gone into service with Strategic Air Command. However, it's expected that six-jet, swept-wing, medium bomber will be around for some time to come. At end of production, material for B-47 was being funneled to Boeing from 3,800 suppliers and subcontractors.

manually actuated in case of electrical system or component failure. Main and emergency landing gear valves are included in this category.

All hydraulic components, circuits and panels have been located to make them easily accessible for maintenance. Examples are the main hydraulic power circuit panel which is mounted on the forward face of the forward bomb bay rear bulkhead, and the emergency system panel, which is mounted on the rear wing spar. Both panels also are accessible in flight.

MS flareless, Ermeto-type fittings are used throughout the CL-28's hydraulic system.

Canadair engineers report that after being used extensively in testing operations, the fittings have given completely leak-proof service.

Material Withstands 3000F for 10 Min.

New high-temperature resistant material—a homogenous mixture of a modified phenolic resin and asbestos—has been developed by Haveg Industries, Wilmington 8, Del.

Test firings on rocket motors using the material as a liner have subjected the material to 3,000F temperatures for ten minutes without failure. Shorter runs at 5,000F temperatures have also been made without failure.

Haveg currently has 15 development projects with Redstone Arsenal and a production contract with Raytheon. The company has made some molded liners for Atlantic Research Corp.,

builders of spin rockets for the Vanguard satellite vehicle.

The Haveg material is molded over a form in an autoclave. There is no restriction on the shape that can be formed, and the autoclave capacity will handle pieces up to a 10-ft. diameter and 12-ft. height.

The material is quite easily machined, the company says. Feeds and speeds are those used for brass, but carbide tipped tools are needed. Cutting is done with diamond saws.

Tensile strength of the material is relatively low—estimated at about 30,000 psi. with glass reinforcing. The material can be pre-stressed. Dimensional stability is still a fabrication problem, although not much of one. Specific gravity is 1.8.

Cost of a typical fabricated piece—a tube liner of 5½-in. diameter and 8 ft. long—would approximate \$200.

West Germany Orders 225 Sabre 6 Fighters

West Germany has ordered 225 Canadair Sabre 6 fighters powered by Canadian Orenda 14 turbojet engines of 7,275 lb. thrust. Described as the largest export order ever sold by a Canadian manufacturer, it comes to about \$75 million including spares and ground equipment.

Deliveries by Canadair Ltd., Montreal subsidiary of General Dynamics Corp., will begin in October 1957 and continue for a year.

The Luftwaffe already has received 75 Sabre 5s, an earlier, slower version of the North American Aviation F-86 design.

Royal Canadian Air Force will train 360 German pilots in Canada to fly the Sabre 6.



Martin Plant Near Completion

Transfer of employees has begun to the new plant 20 mi. southwest of Denver which the Glenn L. Martin Co. is constructing. This is the engineering and administration building which office equipment and staff members have started to occupy. The \$10½ million factory (behind completed building) is to be ready in February.

Bulova Streamlines Crystal Production



CRYSTAL blank X-ray sorter checks 43 pieces per minute, can be operated by unskilled worker. Blanks arrive in plastic cartridges and are sorted into similar marked cartridges.

By Russell Hawkes

Woodside, N. Y.—Techniques are being developed by Bulova Research and Development Laboratories to streamline the manufacture of the quartz crystal units which control radio frequencies.

At present, much highly skilled manual labor is needed for the precise, complicated steps used in the production of the important crystal units. But if and when all-out mobilization comes, the highly specialized manpower, even if available, would not be able to turn out the units in the quantity required.

Army Contract

The effort to reduce by mechanization the skill and manpower needed is largely being carried on under an Army Signal Corps contract by Bulova. The last phase of the contract, construction of a pilot plant, should be completed in about two years.

Production rate will be 10,000 units per shift or 200,000 per month with

51 operators and 112 machines. This represents about an 85% saving in manpower.

Total value of the program will be about \$4.5 million. A small pilot line should be in operation within five months. Some other crystal-producing machines are being designed by different companies under separate Signal Corps industrial preparedness contracts.

Industry members, aware of the mobilization problem and concerned over competition from a government-sponsored mass producing plant, recently met defense officials to urge government to tool up mechanized lines for all government suppliers (AW Dec. 3, 1956, p. 107). Defense money is needed for the task because low peacetime demand will not pay for the costly machines needed in such fine-scale, precise operations.

Bulova officials say that they retain patent rights on the machines they develop under a clause of the Signal Corps contract. They say that the Bulova techniques are not designed for the production of all types of crys-

tal. The pilot operations will produce only CR-18/U and CR-23/U crystals.

Bulova engineers say that one benefit of mechanization will be a higher yield of acceptable units per pound of raw quartz. They predict that output may exceed 100 tested units per pound or roughly twice present yield. This has great strategic value as chemically pure quartz is seldom found in usable sizes on this continent. By far the greater part of the world's raw quartz comes from Brazil.

Synthetic Crystal

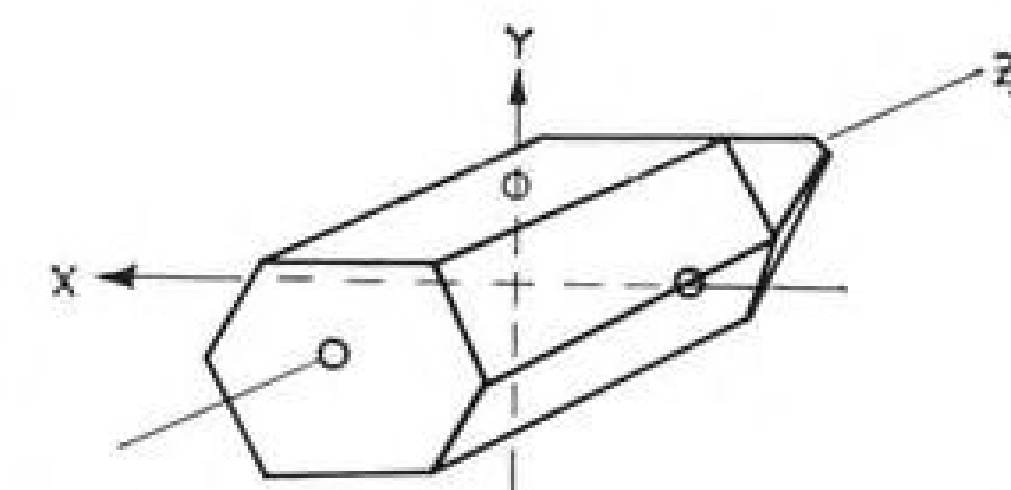
Synthetic crystal growing methods may some day free us of this dependence, but in the near future most of our supply must come by sea.

A systems engineering approach based on thorough operations analysis was used in the mechanization effort. Whenever practical the product was changed to meet the limitations in the state of the producing art.

A system of individual machines was chosen in preference to a single fully automatic machine. The purpose of this decision was to reduce development time and cost and to make separate mechanical techniques available to the industry in case war broke out before the complete system was ready. Many engineers believe the fully automatic plant is still outside the state of the art. One factor adverse to the single unit configuration is the opinion of engineers that some operations can be done more economically and just as fast by unskilled hand labor.

The major operations include:

- Optical and X-ray prepositioning of the mother stone for sectioning. Purpose of prepositioning is to get the



ANGLES at which blanks are cut from mother stone control their electromechanical characteristics. When current is passed parallel to crystal axis X, mechanical vibration is set up parallel to axis Y generating AC equal to the mechanical natural frequency of the stone. Angle of flow relative to optional axis Z decides how frequency will deviate with temperature.

correct orientation of the pieces relative to the crystal axes.

- Sectioning with ganged diamond saws.
- Optical and X-ray prepositioning of the section before cutting into wafers.
- Wafering of the section with ganged diamond saws.
- Dicing to shape of crystal blanks from wafers by ultrasonic cutting.
- X-ray sorting of the blanks according to crystal orientation.
- Thickness sorting.
- Frequency sorting.
- Lapping to a desired thickness and shape.
- Final etch to remove disturbed layer caused by sawing and lapping.
- Vapor plating of an electrode base.
- Mounting and cementing connections to the unit plug-in base.
- Frequency adjusting by vapor plating one side of blank with gold.
- Canning of unit in an inert gas to reduce aging in service.
- Final testing of unit.

Precision Required

Problems in machine design were posed by the great precision required and the small size and fragility of parts.

Manual workers are obliged to handle crystal blanks with their fingernails. Tweezers might scratch the crystal and change its frequency. Because they are used as frequency standards, the crystals must meet a tolerance of $\pm 0.005\%$ of nominal frequency throughout the military temperature range from -55°C to $+90^{\circ}\text{C}$. Cleanliness of the blank is so important that

in some operations they are scrubbed with a toothbrush.

Correct performance of quartz crystal units depends on accurately orienting the blank relative to its crystal axes. The peculiar electro-mechanical characteristics which give quartz its special value are controlled by this orientation.

An electrical current passed along any true crystal axis except the optical or Z axis (perpendicular to the plane of the crystal hexagon) causes perpendicular mechanical strains produced by the absorption of the current. The elastic return of the material regenerates the electrical energy, thus producing AC with a frequency related to the mechanical natural frequency of the crystal blank.

The true crystal axis along which current is passed (from one angle of the crystal hexagon to the opposite angle) is called the X axis. The perpendicular axis of the mechanical movement is called the Y axis and is not a true crystal axis. Angle of the blank relative to these will depend on the mode of vibration used. In the units to be made by the Bulova pilot systems, the angle relative to the Z axis determines deviation of frequency with temperature and varies depending on the nominal frequency of the crystal and the reference temperature about which it is expected to operate. To stay well within the frequency tolerance of $\pm 0.005\%$, tolerance on the angle is ± 3 min. of arc.

Little Training Needed

First operations on the mother stone and its sections remain largely manual

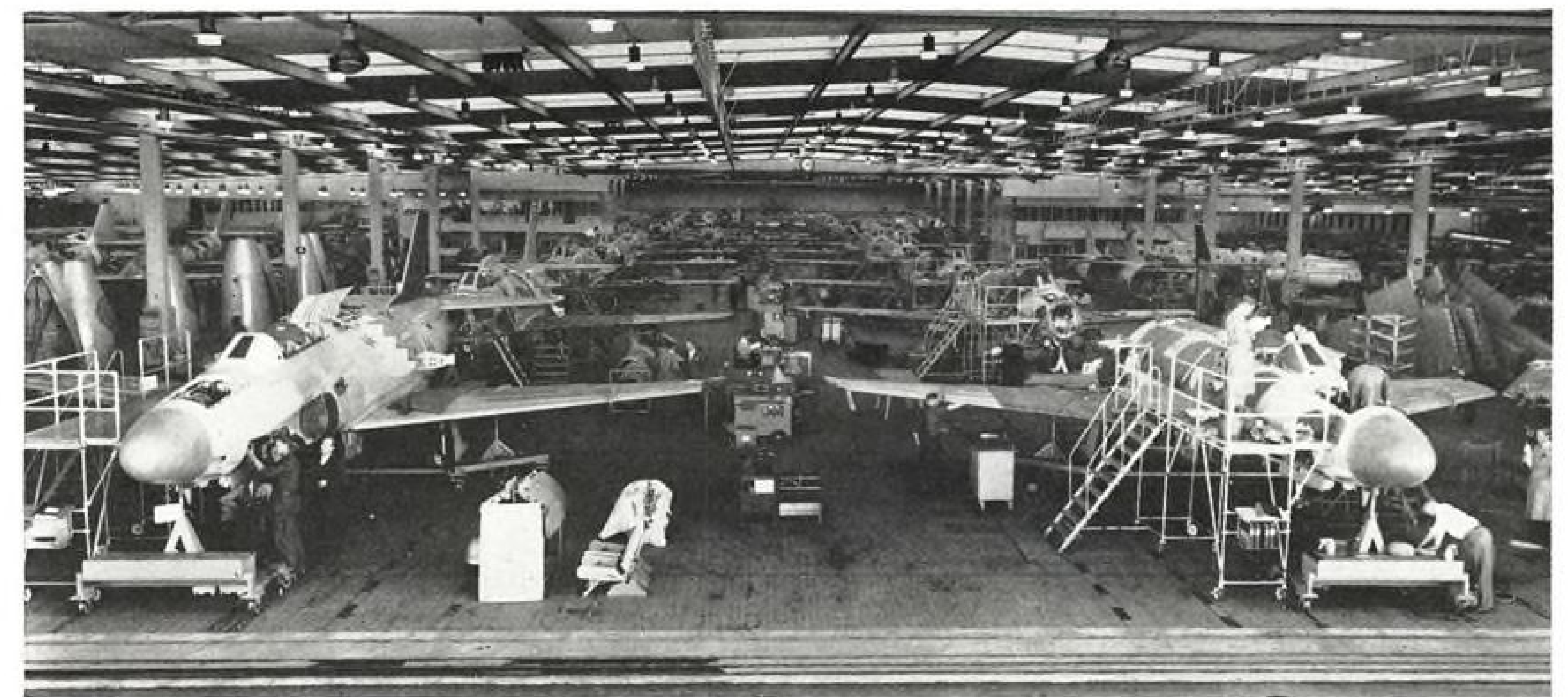
because its irregular shape does not lend itself to machine handling and because the number of judgments involved makes it more economical to use a human inspector. Bulova engineers do not believe these inspectors need more than the two week training period set as the maximum for operators in the mechanized plant. In present laboratory scale manufacturing, operators are not considered to be competent with less than 12 weeks of training.

The effort in these early operations is merely to reduce the operator's responsibility. In X-ray positioning before sawing operations the piece is mounted in a transfer jig in which it can be rotated relative to reference edges on the jig to find the angles of maximum X-ray diffraction which bear a fixed relation to the crystal axes. The jig is then locked and carried to the saws which have jig-mounts identical to those on the X-ray table. The X-ray operator's judgment is exercised only in recognizing the peak indication from the X-ray detector.

Even this may be eliminated by rotating the piece with an electric motor controlled by the signal from the detector.

The skill that is needed by the saw operator is small as saw feed is automatically sequenced and the piece is jig positioned.

All X-ray orientation and sorting operations use the double crystal X-ray goniometer. This is a device which collimates the rays by diffraction off a standard crystal. Although it requires a more sensitive detector than other



Saab's in Production

Two parallel assembly lines at Saab's main plant at Linköping, Sweden, are used to speed up delivery of Saab-32 Lansen two-seat all-weather attack airplanes to Royal Swedish air force. Powered by Flygmotor-built Rolls-Royce Avon of the RA.7 type with large afterburner, Lansen has 700 mph. top speed, is supersonic in shallow dive.



Shop With Wing

Wingspan of Lockheed Aircraft Company's 1649A Super Constellation transport has grown so much—from 123 to 150 ft.—wing is extended into the outdoors while tank-seal work is going on. Shop is located at Lockheed's Burbank plant.

types of X-ray projection, recently developed scintillation counters with high gain amplifiers have been found to serve.

The same goniometer is used to position the stone and the section.

Fragility of the crystal is the problem in cutting wafers from the sections. The thickness of the wafers is often less than that of the saws used in the work. The saws used in the Bulova systems are expected to be useful in cutting wafers thinner than .020 in.

These have 30 blades ganged on one arbor so that a section can be wafered in one pass. The arbor can be removed from the spindle as a single assembly and replaced by another. This saves time in maintenance work and reduces the thickness spread in wafers cut by the same saw. The maximum acceptable spread is .0005 in. Tolerance on specified thickness is $\pm .003$ in.

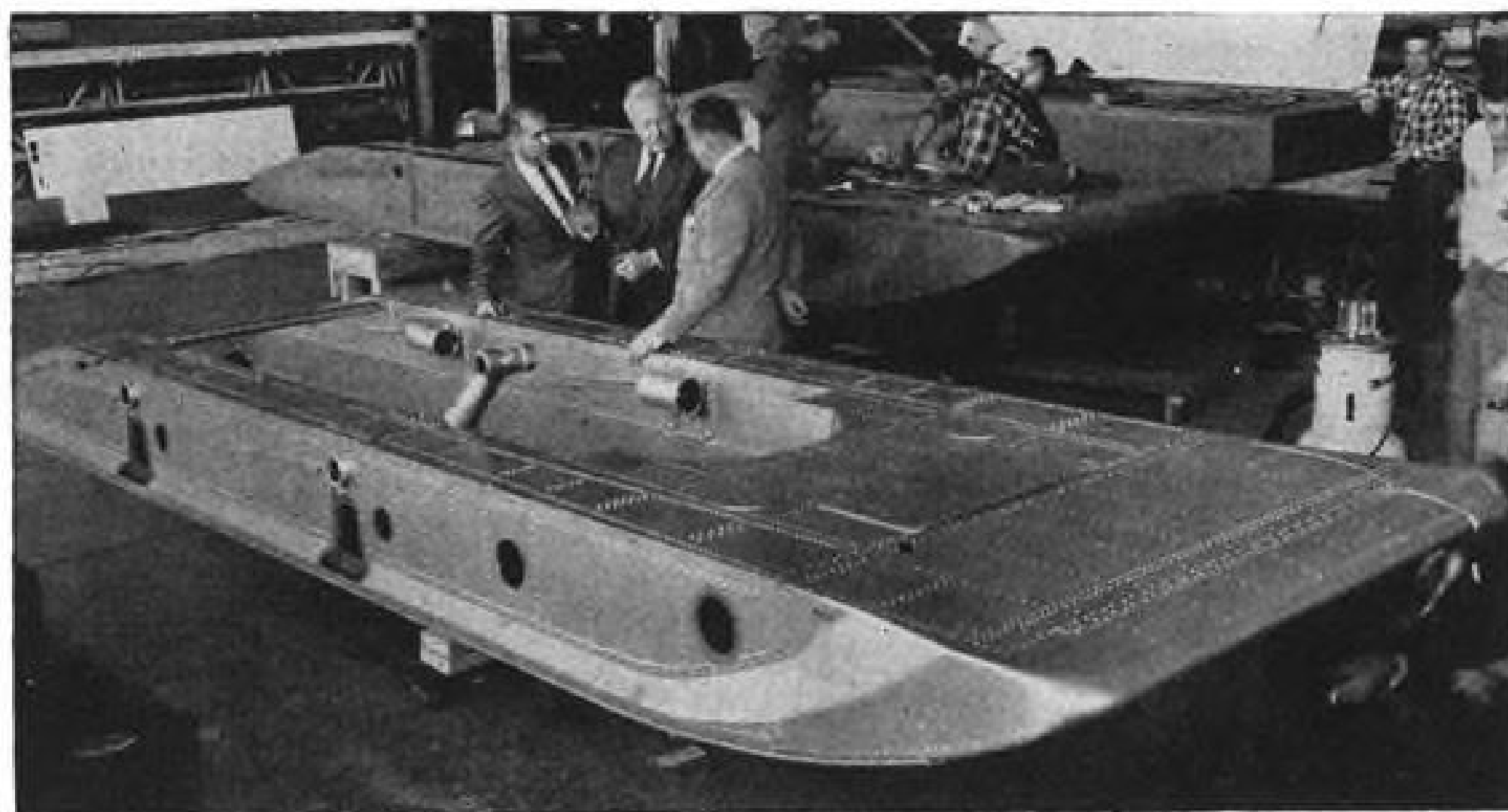
Saw Blades

Restricting lateral vibration of the saw blades is a vital part of engineering a saw for this type of work. The blades used by Bulova are six inches in diameter with four and half inch diameter stabilizing reinforcements. Cutting compound is a 50 concentration of 80 grit diamond dust. Ordinary rolling mill oil is used for cooling. Saw speed is 1750 rpm. Down-feed and cross-feed are automatic so that once the transfer jig is locked and the start button is pushed, the operator has only to remove the cut wafers. Etching in a 48% solution of hydrofluoric acid follows all sawing operations to remove the saw grooves.

The etched wafers are mounted on glass plates for ultrasonic dicing of blanks.

Notches in one edge of each wafer indicate correct orientation for mounting. These are created earlier by serration of one side of the section to a depth of $\frac{1}{8}$ in. In unskilled or mechanized operations, such a simple, foolproof reference to the orientation of the piece is essential.

The ultrasonic dicing process is semi-automatic with the mounted wafers hand fed to the machine, and the cutting is automatic. A four-station turntable carries the wafers. At the first station the mounted wafers are loaded; at the second the ganged cutting tools



C-130 Skis

Skis are being developed for the Lockheed C-130 Hercules for cold-weather testing by the Air Force this winter. Col. Bernt Balchen USAF (ret.) is shown (center), talking it over with Robert Stoessel, sales engineering manager of Lockheed's Georgia Division and Paul Holloway, Lockheed sales, during visit to Marietta plant. C-130 may one day become a supply transport for Arctic operations such as DEW line.

are lowered against the wafer and agitated at 630 kc. as a slurry stream is squirted under the cutting edges; at the third the diced wafers are ejected; and at the fourth the alignment jig and clamps are washed and scrubbed.

Target production time is 10 or 11 seconds per wafer. Tool life is estimated at 500 wafers per tool. Yield is expected to be at least 2.5 diced blanks per wafer. No wafer will be diced unless it will yield two or more blanks. The blanks are circular with a reference flat cut in one edge to preserve orientation relative to the crystal Z axis.

Batch Handling

In the operations following dicing the advantages of mechanization become increasingly obvious because being fairly uniform in size, shape and orientation they are more adaptable to batch handling by machines. Blanks are stored and transported in polystyrene cartridges similar in operation to a trolley car operator's money changer. Tiny vacuum chucks on the ends of moving mechanical fingers pick single blanks out of the bottom of the gravity feeding cartridges for sorting and repackaging. A $2\frac{3}{4}$ in. cartridge will hold at least 100 diced blanks. The cartridges are automatically loaded by a vibrating hopper.

Sorting Speed

Blanks are first sorted according to fine increments of angle relative the Z axis at a rate of 43 per minute by a double crystal X-ray goniometer similar in principal to those in the positioning operations. Sorting differs in that it must be carried on at a much higher speed because of the greater number of pieces to be analyzed. The

vacuum chuck carries each blank to a rotating head where it is turned by rollers until the reference flat comes into contact with a fixed surface. When it reaches the aiming point of the goniometer it is rocked once through the range of possible Z angles. The rocking mechanism generates a square wave signal for each three minute angular increment. When the X-ray peak is superimposed on the angle increment pulse, the amplified combined signal is strong enough to open the appropriate sorting gate.

Using the cartridge and vacuum chuck handling techniques, the blanks are then sorted according to thickness and lapped to the closest desirable value. The friction in lapping causes the crystal to vibrate mechanically and generate a frequency which is controlled by thickness. This frequency is picked up by a frequency counter and is used to indicate when the blanks are approaching the desired thickness.

Frequency Sorter

A frequency sorter is used which can check about 120 blanks per minute.

A good manual operator can do only two or three per minute. The automatic device uses the vacuum chuck handler to feed blanks into a gap in an oscillator. The crystal controls its frequency which is measured by a standard frequency counter.

Final etching is done in a fully automatic process to remove the disturbed layer caused by lapping. An overhead conveyor carries baskets of blanks between cleaning, etching and rinsing tanks.

This is done in 16 two minute cycles. Etching goes on during three consecutive cycles. A 16% solution of hydrofluoric acid is used and the baskets are agitated to get an even spread of the etch.

An electrode is placed on the quartz blank by vapor plating it with aluminum. Pressure in the plating chamber is brought down to 0.3 micron Hg to lower the vaporization point of the aluminum. The B B-sized aluminum ingot is then heated by induction in a small tantalum crucible. The entire base plating cycle takes 4.5 minutes. Each chamber will plate about 50 blanks per cycle.

Baseplating Effect

The effect of the baseplating is to lower the crystal frequency and create a capacitance between the electrodes on opposite sides of the blank. In cutting and lapping a margin is allowed for the frequency change and for fine adjustment of frequency by gold plating in a later operation.

Still in development are mechanical

F-84s for NATO



F84Fs AND RF84Fs are deprocessed after shipment by Sud-Est Aviation Co. for French and Norwegian air forces under Military Defense Assistance Program.



DE-COCOONING (removal of heavy plastic coating), washing down of aircraft to arrest corrosive effects of sea spray, are done before modification work starts.



PROCESSING of the aircraft includes complete disassembly of major components, checks and tests, reassembly, before being turned over to NATO forces.

handling fingers to insert the blanks into their strip mounts automatically. These must handle the blanks by their edges because of the sensitivity of the baseplate to scratches. The strip mounts are inward acting springs that hold the blank without crimping. A conductive cement secures the connection. This will be applied mechanically.

Final frequency adjustment by gold plating one side of the blank is made after the blank is all ready mounted on its base. The blank is oscillated during the vapor plating and as frequency approaches nominal the apparatus is automatically shut down. In the pilot line the whole final plating may take no more than 30 seconds.

The units must be hermetically

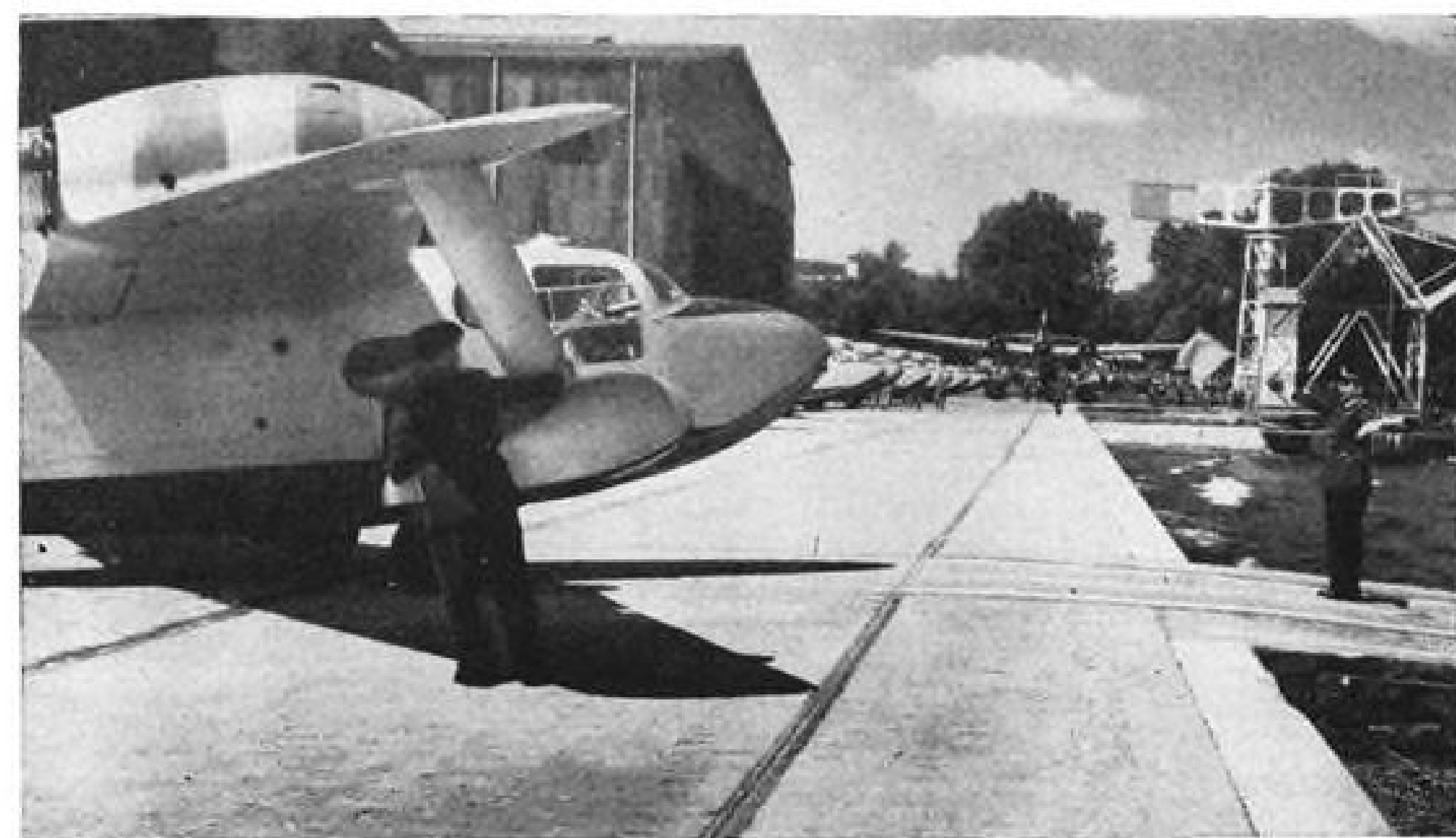
sealed in an inert gas to prevent aging and frequency drifting in service. Bulova engineers decided that the best way to do this was to carry on the entire operation in a sealed chamber with an atmosphere of nitrogen or helium rather than first canning the unit and then pumping gas into the can. The covers are pre-soldered and fluxed and fitted to the base manually before the units are placed in the sealing chamber.

The chamber is evacuated and flushed twice with the inert gas to make sure that all oxygen is removed. A conveyor unit carries the assemblies through an induction heater which seals the pre-soldered edges. One sealing cycle takes 20 minutes, and 400 units can be sealed in one cycle.

Italian Air-Aid Squadrons



Cant Z.506 tri-motored seaplane, on the step, is one of major members of Italian air aid squadrons. Plane is used for long-range rescue missions, such as flying to pick up injured or sick crewmen on a tanker in the Mediterranean. Designed in 1936, the Cant is all-wood, and grosses about 27,000 lb. Wingspan is 87 ft.; powerplants are Alfa Romeo 126 R.C.34 engines rated at 750 hp. each. Cruise speed is about 200 mph.



Piaggio P.136 is member of air-sea rescue team. Powered by a Franklin O-648 engine of 215 hp., the P.136 cruises at 137 mph. Air rescue squadrons work out of Vigna de Valle, Taranto, Augusta and Elmas, using the P.136 and Cant 506 for over-waterwork. American-built Fairchild C-119s, Beech C-45s and North American T-6s are used to make drops of food and medicine in emergencies.

THRUST & DRAG

"Captain Audio jammed the throttle of his space ship forward and the rocket lurched into accelerated flight. The needles of the gyroscopic-relativator went wild. A sudden reddish glow played about the leading edge of the control surfaces and the nose. He had done it!

"He was slyling at hyperthermantic speed!"

There may never be a gyroscopic-relativator, but if a couple of men of science have their way, we will have splight at hyperthermantic speed.

Splight is a coined word proposed by David Greenfield to describe non-terrestrially referred motion; in short, space flight. Greenfield, writing a note in the Nov. 1956 issue of *Jet Propulsion*, journal of the American Rocket Society, discusses the use of fly and flight, concludes they are inaccurate and proposes the new verb and noun.

Hyperthermantic is the top region of a thermal Mach number spectrum, defined by Maury Sulkin, chief thermodynamicist for North American Aviation, Inc.

Subthermantic, Sulkin says, should run from zero to Mach 2; thermantic, from Mach 2 to Mach 4; superthermantic, from Mach 4 to Mach 8. Hyperthermantic begins at Mach 8 and goes on, presumably as far as Capt. Audio wants to take it.

* * *

It's small comfort, in these days of complex living and more complex engineering, to read that it has finally been necessary to make a test stand to test a test stand.

It seems that Lear built a number of mobile test stands for North American's Rocketdyne division for rocket engine checkout of pneumatic and electrical systems. The stands themselves were such high-performance items and so complex of necessity that Lear had to build a test stand to check out the test stand.

One remembers the doggerel about "Big fleas have little fleas upon their backs to bite 'em, and little fleas have lesser fleas and so ad infinitum."

"We wish to give to the younger generation of Japan a strong confidence and a proud that our country had the ability to turn out splendid aircraft at one time."

This sentence from the preface of Baba Kazuo's *General View of Japanese Military Aircraft in the Pacific War*, sets the scene for one of the most fascinating technical books to come along.

Kazuo has gathered from dozens of pilots, designers, technicians and plain aviation buffs a tremendous wealth of engineering data on the many fighting

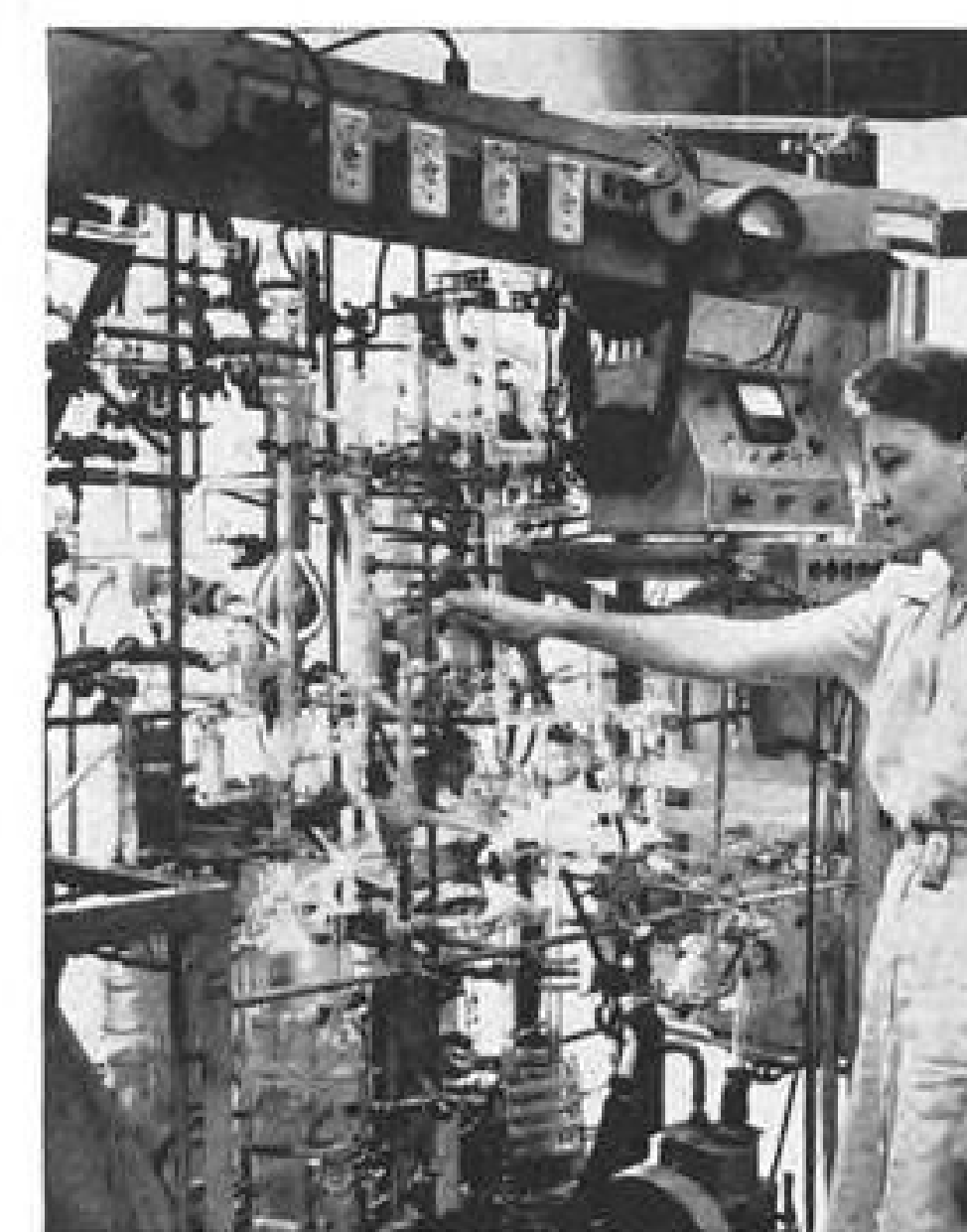
aircraft designed and built in Japan during World War II.

Typical examples: The Ki-44 "Tojo" fighter required highly skilled pilots, says the book, because of its heavy wing loading of 38.4 psf. . . . Ki-56 "Thalia," was modified from the Lockheed Super Electra because the Fowler flap required advanced skill to operate, the wingtip stalled and the wing loading was too high. . . . N1K1 "George" had a flap operated automatically when a higher lift coefficient was needed during accelerated turns. . . . E15K1 "Norm" high-speed reconnaissance seaplane had a jettisonable single float to improve its getaway. . . . Ki-77 Asahi A-26 made a 10,271 mi. distance flight non-stop around a triangular course in Manchuria in July 1944 at an average speed of 180 mph. and at altitudes between 13,000 and 20,000 ft. . . . The Ki-115 Tsurugi, designed as a suicide fighter, had a welded-steel pipe jettisonable landing gear and no shock absorbers. During its first test landing, "it made quite a scene."

The book has hundreds of illustrations, drawings and cutaway views of the planes, plus a Japanese text. There is a mimeographed volume of English translation of the text boxed with the book. It's available from Hampton Books, Hampton Bays, N. Y., for \$5 plus postage, packing and duty charges of \$1.35.

Hydrogen Control Is Titanium Cracking Aid

Rejection of titanium alloy parts used in the aft end of the Chance Vought F8U because of cracks due to hydrogen embrittlement dropped from 17% to 0.5% in the first year of use. Low reject rate has continued through 1956 with considerable cost savings. F8U uses about 650 lb. of titanium.



HYDROGEN STILL determines hydrogen contamination in titanium sheet samples.

In the first airplanes the tendency to crack in the detail stage and after assembly seemed to be caused by an inherent characteristic of the metal. Improvement was made by combined effort in manufacturing, engineering and quality control.

Detail manufacturing and assembly techniques were improved and hydrogen content was carefully controlled in initial milling and rolling. A requirement of 150 ppm was set as maximum acceptable hydrogen content for alloy titanium sheet.

Previously, only research laboratories had apparatus capable of measuring such minute quantities of hydrogen gas. However, Chance Vought quality control engineers devised gas analysis equipment to permit sample checking of hydrogen contents of this order in new receipts and partially processed work.

PRODUCTION BRIEFING

The National Bureau of Standards, Washington 25, D. C., reports that while under some conditions a ceramic protective coating on a metal can reduce high temperature creep 50%, under other conditions a reverse effect occurs. For more information see N.B.S. Summary Technical Report No. 2065, or forthcoming article, "The Effect of a Ceramic Coating on the Creep Behavior of some High-Temperature Alloys," by J. R. Cuthill, J. C. Richmond, and N. J. Tighe, in the *Journal of the American Ceramic Society*.

The third Western Plant Maintenance and Engineering Show will be held June 11, 12 and 13th 1957 at the Civic Auditorium, San Francisco, according to the San Francisco office of Clapp & Poliak, Inc.

The Bullard Co., Bridgeport, Conn., producers of large metal cutting machines whose vertical turret lathes are important to aircraft gas turbine engine manufacturing, will add the Hydra-Feed line of automatic and tracer-controlled lathes to its products. Bullard indicated that the Hydra-Feed Machine Tool Corp., South Norwalk, Conn. and Detroit, Michigan intends to liquidate in 1957.

Norton Co., Worcester 6, Mass., opened an electric furnace plant at Huntsville, Ala., to produce boron carbide, fused zirconia, fused magnesium oxide and fused alumina. Because of their ability to withstand very high temperatures and resist wear, Norton said, the materials are finding increasing use in grinding tools, rocket nozzles and (referring to Boron) neutron absorbing control rods for atomic reactors.



Chicago Pneumatic Tool Co., N.Y., makes this one-pass close-tolerance Broach Puller which operates off shop air. The Company claims that this tool will permit tolerances of plus-or-minus .0005 in. in one pass, even through sandwiches of dissimilar materials such as aluminum and steel.

Linear, Inc., which has developed hydraulic and pneumatic seals that will withstand temperatures in excess of 500F, is scheduled to move from its Philadelphia plant into a new lease, a 125,000 sq. ft. plant at Dallas, Pa. This represents a step in the expansion and diversification program of the 600 employee firm.

United States Steel Corp. is adding 95,000 tons of electric furnace ingot capacity in the expansion of its Duquesne Works, Pittsburgh, Pa. Electric furnace steel is needed to produce high quality raw material for uses such as turbine and rotor shafting, bearings and aircraft and guided missile parts.

Alcoa method of providing clad impact extrusions is applicable either for conventional corrosion protection or for brazing assembly. For the latter, Alcoa will supply impact extrusions with a thin layer of brazing alloy on either the inside or outside of the impact extrusion so that the fabricator need only join and heat. Alcoa is able to punch out cup-shaped objects by this process as large as 18 in. deep by 6 in. dia.

Sanborn Co., makers of pen writing recording equipment, has completed its new \$1,600,000 home in Waltham Research and Development Park, Waltham, Mass. The firm, owned by its 750 employees, says that it has successfully practiced profit sharing for 38 years; 1956 sales volume will top \$10 million.

Computer Simulates Response of Pilot

By Philip J. Klass

New York—Analog computer which was able in limited tests to simulate the dynamic response of a human operator in a complex control system, a feat heretofore considered impossible, has been developed by Goodyear Aircraft. In the process, the computer has added to knowledge of pilot behavior.

Computer so realistically simulates non-linear human response that experienced pilots have trouble telling whether they or the computers are controlling a flight simulator, i.e. whether the simulator is responding to their control stick motions or to signals from the human analog computer, according to Dr. Anthony J. Cacioppo. Cacioppo, an engineer psychologist

in Goodyear's Aerophysics Dept., reported the development at the recent meeting here of the American Society of Mechanical Engineers.

However, Cacioppo cautioned that Goodyear's tests have been limited to a handful of subjects. Further tests are necessary on a wider number of subjects to confirm the preliminary test results, he said.

If subsequent tests confirm that analog simulation of human operator motor behavior is feasible, it will open the way to quantitative measurement and analysis of such behavior for the first time, Cacioppo indicated. This could lead to radical changes in the design of aircraft control systems and flight instruments.

New Knowledge

Goodyear's tests produced sidelights that added to knowledge about pilot control behavior, as a function of pilot experience, Cacioppo said. For example:

- **Dither:** Highly skilled pilots introduce, unconsciously, a continuous, small-amplitude oscillation of the control stick (dither), at a frequency of about 1.4 cycles per second. This appears to be a subconscious testing of the airplane and its control system which the experienced pilot performs to be sure everything is working properly.

- **Rate & Acceleration:** Moderately experienced non-jet pilots appear to be more responsive to rate-of-change of flight instrument information than do jet pilots, but the latter are more responsive to acceleration (second derivative) flight instrument information than non-jet pilots.

Goodyear used nine subjects. Five had more than 1,000 hr. of jet experience, three had at least 50 hr. in prop-driven aircraft only, one had no piloting experience.

Raised Questions

Despite the many interesting findings turned up by Goodyear's human analog computer tests, Cacioppo said that the tests so far have "raised more questions than they have answered."

For example, the anticipatory action of pilots in moving the control stick before his flight instrument indicator calls for such action is an enigma, according to Cacioppo. It appears to be a reflexive action, "but why, and what cues are used, we do not know," he told the ASME.

Equipment used in Goodyear's tests

originally was built under Navy Bureau of Aeronautics sponsorship to investigate the effects of different stick feel forces on pilot control and tracking. The equipment consists of a dynamic mock-up, capable of pitch axis movement, and associated analog computer which simulates the flying characteristics of a jet.

Pitch axis motions of the dynamic mock-up were simulated by a pitching motion of the pilot's seat plus vertical deflection of a gyro-horizon type indicator.

Air turbulence was simulated by a random-wave generator which produced signals that were combined with the output of the aerodynamics computer to operate the dynamic mock-up.

Pitch Angles

The aerodynamics computer, a Goodyear GEDA analog machine, generated pitch angles for the gyro-horizon indicator and seat movement, providing a pitch rate proportional to elevator deflection, a short period oscillation, and damping typical of a jet interceptor, Cacioppo reported.

The subject under test sits in the dynamic mock-up and moves the control stick to keep the horizontal trace zeroed to the level flight marking on the artificial horizon. Stick movement provides a signal to the aerodynamics computer, which in turn feeds the dynamic mock-up, thereby providing a closed pilot-airplane loop. Portions of the same GEDA computer were set to simulate the human operator's behavior pattern.

Human Analog

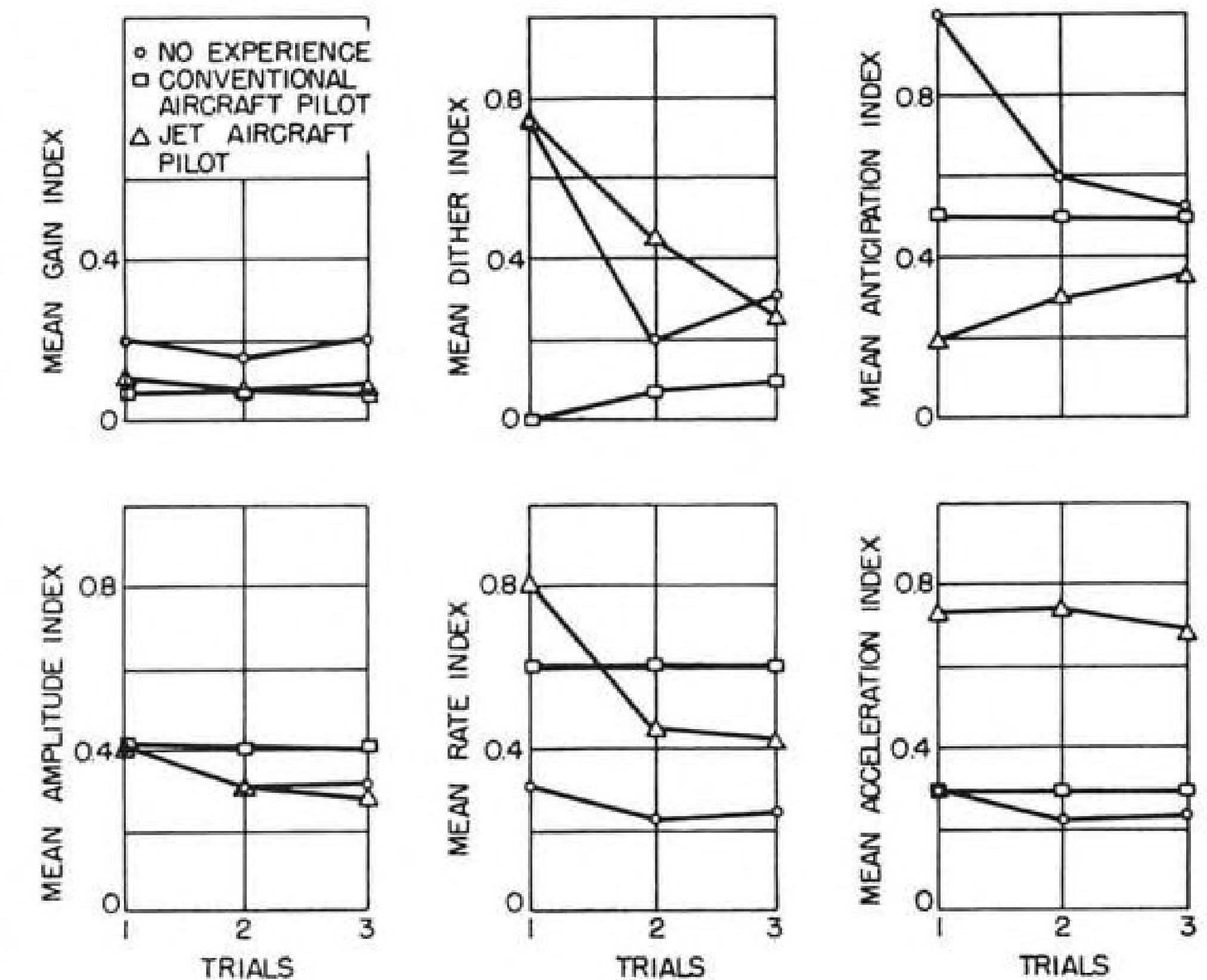
The human analog was designed to permit adjustment of key parameters so that its output signal, corresponding to human operator movement of the control stick, could be varied as a function of:

- **Amplitude** of dynamic mock-up deviation from level flight.
- **Rate** of dynamic mock-up deviation from level flight.
- **Acceleration** of dynamic mock-up deviation from level flight.

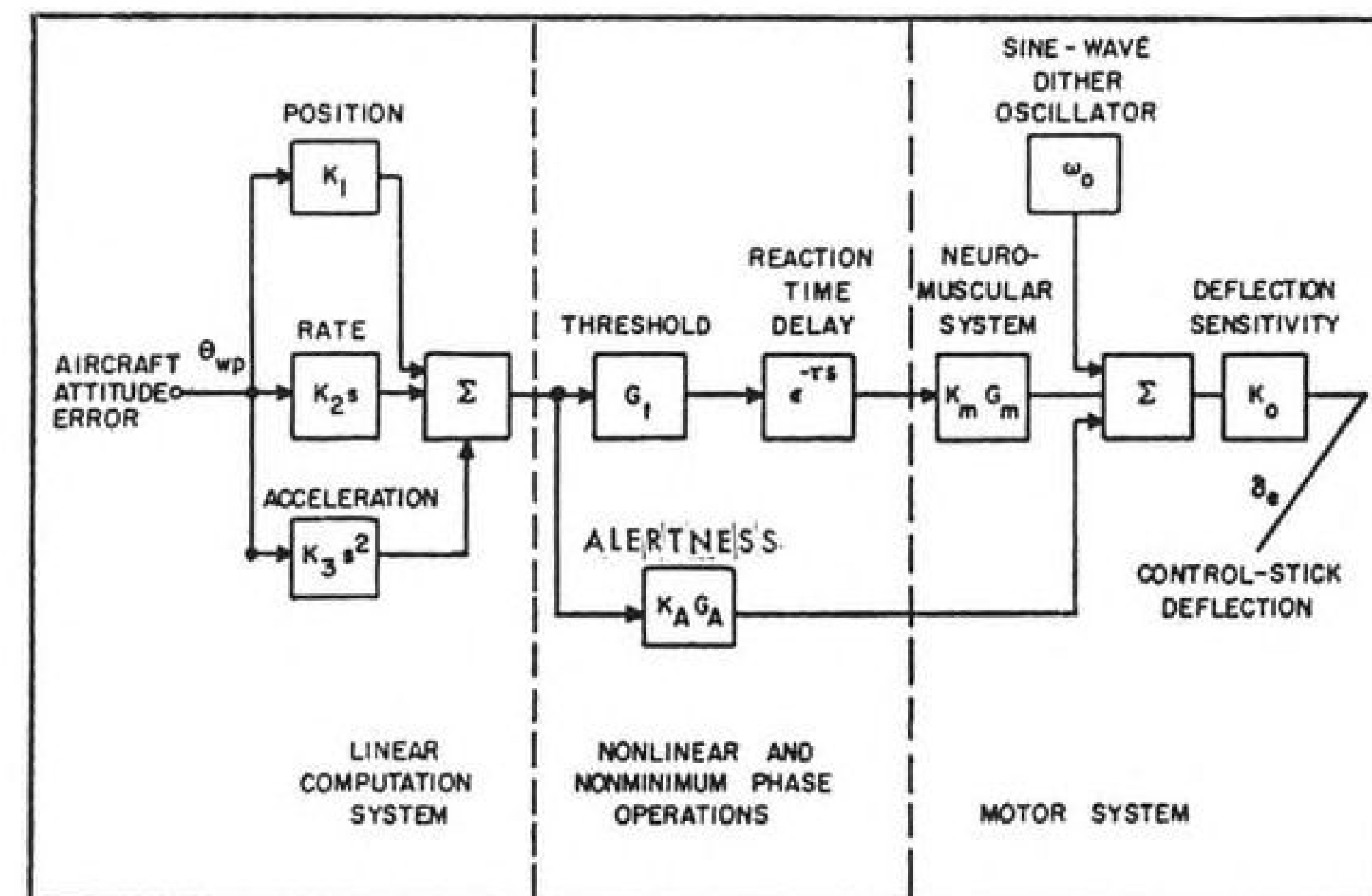
There are several other human analog parameters which can be adjusted to tailor performance to that of a specific human operator. These include the following:

- **Dither**, the small amplitude sine-wave oscillation (which simulates stick motion) whose amplitude and frequency is adjustable.
- **Alertness**, a step-generator which develops a fixed voltage whenever there is a deviation of the dynamic mock-up from level flight condition.
- **Sensitivity**, which adjusts the output signal level of the human analog to match the human operator's sensitivity level.

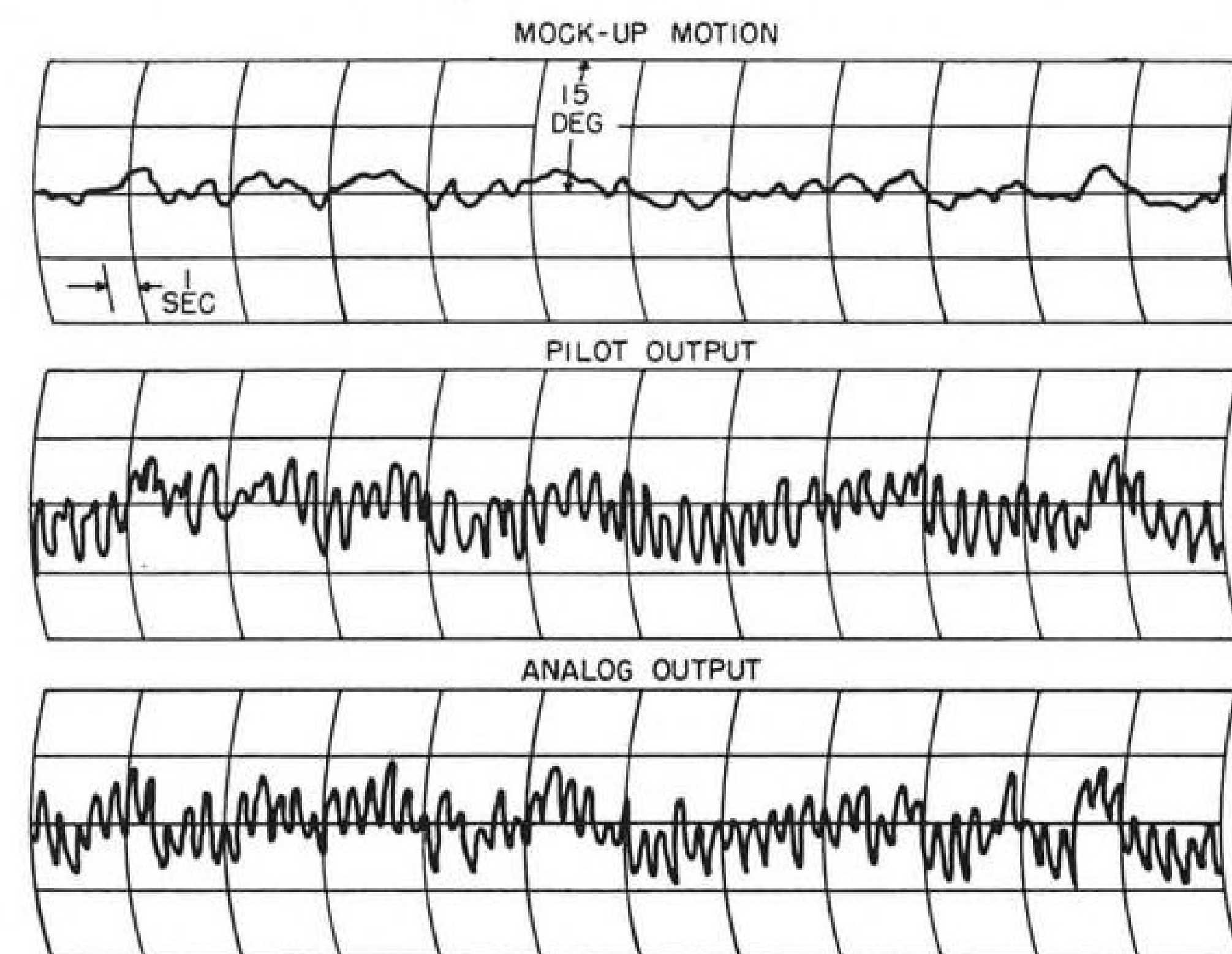
The human analog computer cir-



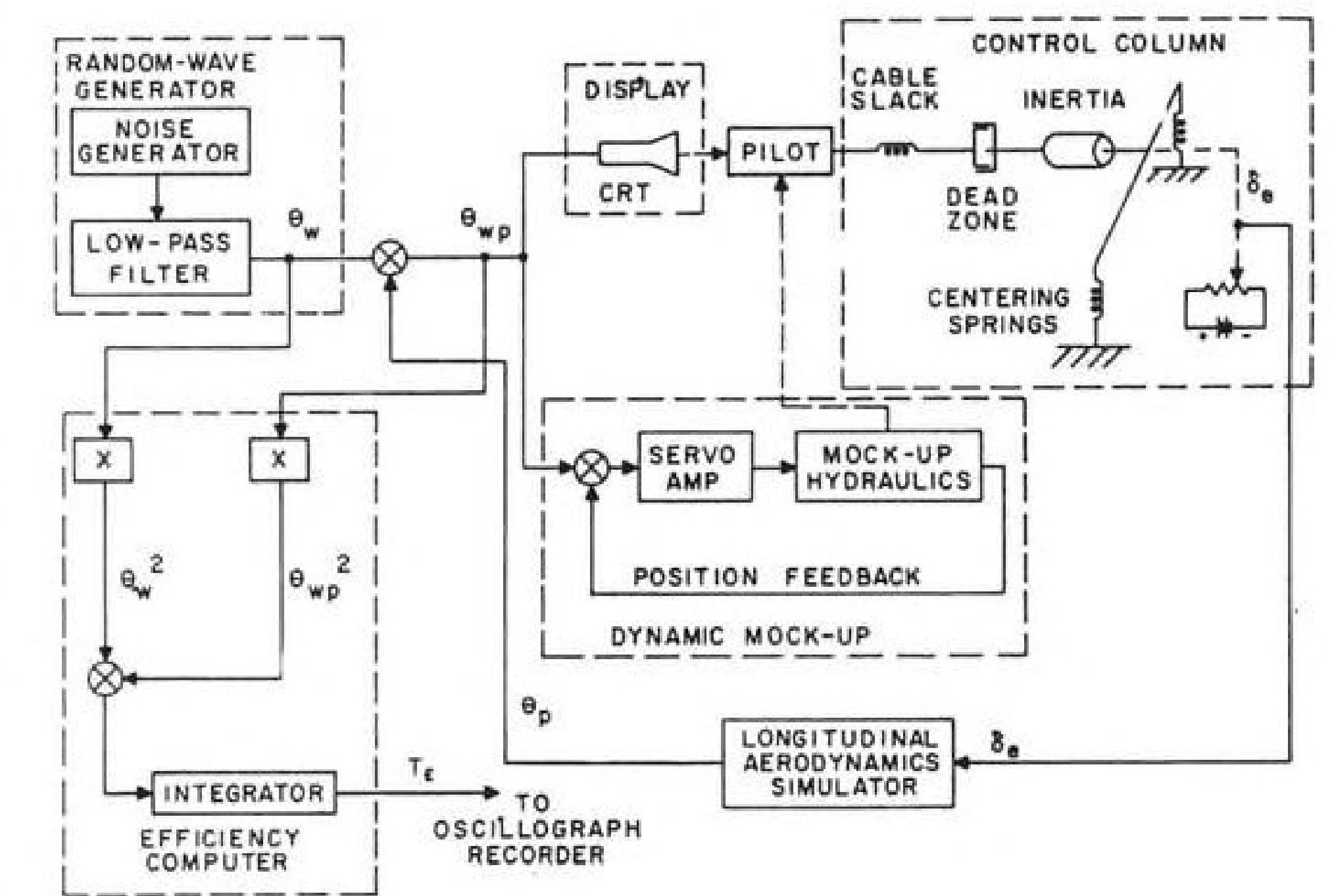
QUANTITATIVE studies of human pilot performance as function of experience can be made by varying different parameters in human analog computer. "Gain index" above corresponds to "deflection sensitivity" in block diagram, below, and "anticipation" to "alertness."



HUMAN analog computer, shown in block diagram form, effectively simulates reactions and response of human pilot flying jet airplane. Device was developed by Goodyear.



SIMILARITY of analog computer response to that of human pilot in counteracting pitching motions of dynamic jet mock-up is shown above in two oscillograms.



BLOCK diagram of complete Goodyear test set-up, including airplane simulator.

cuitry (block diagram, see above), was developed by N. D. Diamantides of Goodyear's Aerophysics Dept.

Goodyear's tests indicate that the characteristics of the human analog depend upon the experience of the human pilot it is attempting to simulate. In order to match the analog and pilot characteristics, an oscillograph is connected, through a switch, so that it can record either the output signal of the analog or the human pilot's control stick. (See oscillograms, p. 6.)

With a little experience it is possible

to adjust the analog parameters to a realistic match in a matter of 5-10 minutes, Cacioppo reported.

To check the realism of the human analog simulation, Goodyear can switch control of the dynamic mock-up from human pilot control to analog control without the pilot's knowledge. Thus the human analog computer actually is flying the dynamic mock-up although the pilot is moving the control stick in the belief that he is flying the mock-up.

Cacioppo told the ASME that it



Guidance for Terrier

Radar aboard Navy's first guided missile destroyer, the U.S.S. Gyatt, provides guidance for beam-riding Terrier anti-aircraft missile as well as aiming shipboard guns. Reeves Instrument Corp. modified design of shipboard fire control radar to permit its use for Terrier guidance.

normally takes a pilot from 30 to 120 seconds to discover that control of the dynamic mock-up is coming from the human analog and not from his own control stick motions.

Effects Of Experience

By observing the parameter settings required to match the analog to the pilot response, Goodyear was able to establish quantitative values for the dither, amplitude, rate, acceleration and sensitivity responses of the pilot under test.

By comparing these quantitative measurements for a jet pilot, propeller pilot, and novice, Goodyear reached some interesting conclusions, which, Cacioppo emphasizes, are preliminary and require further substantiation. For example:

- **Sensitivity** (gain) of the novice pilot is considerably higher than that of experienced pilots. That is, he reacts more violently to deviations of the dynamic mock-up from level flight.
- **Dither** appears to be greatest for the experienced jet pilot, with the novice second and the propeller pilot lowest. With succeeding trials, as the jet pilot became familiar with the mock-up, his dither decreased, but the propeller pilot dither increased. (See graphs, p. 63.)
- **Alertness** (anticipation) of the novice pilot is high during the initial trial, then decreases with experience, while the jet pilot has a reverse characteristic—increasing with the number of

mock-up trials. The propeller pilot alertness factor held essentially constant.

Equal Response

All three types of subjects proved almost equally responsive to amplitude of deviation from level flight. However, the novice and less experienced pilots find rate of deviation information more useful than the jet pilot. The latter, accustomed to flying a hot and very responsive airplane, leans more heavily on acceleration information. (See graphs, p. 63.)

Cacioppo emphasizes that much larger samples must be tested before any firm conclusions can be drawn. However, if such tests should reveal characteristic behavior patterns for pilots (or other types of operators) as a function of experience or other factors, it could open new scientific avenues to human engineering. For example:

- **New airplane control system** could be tested in a closed-loop dynamic mock-up of the system, using the human analog computer set to match the characteristics of the pilots who will be flying it. Such tests could reveal whether pilots can satisfactorily handle the new airplane, and what corrective measures are needed.
- **Design of flight instruments**, in terms of the relative amounts of displacement, rate, and acceleration information used, might be determined by the experience of pilots who would be using them.
- **Quantitative knowledge** of the response requirements for successful jet, transport, and helicopter pilots should make it easier to select pilot trainees for each category.

Organizations that desire to obtain more details on the human analog computer and Goodyear's tests may write to Dr. A. J. Cacioppo, Aerophysics Dept., Goodyear Aircraft Corp., Akron 15, Ohio.

Expansions, Changes In Avionics Industry

Raytheon Manufacturing Co. has formed new avionics laboratory at Maynard, Mass., which will specialize in design and development of Doppler navigation instruments, airborne intercept radar, altimeters and surface radars. New laboratory, housed in 65,000 sq. ft. leased area, will employ about 275 and will be headed by Homer C. Knauss, former airborne systems branch manager at Raytheon's Wayland Laboratory radar department.

Other recently announced expansions and changes in the avionics industry include:

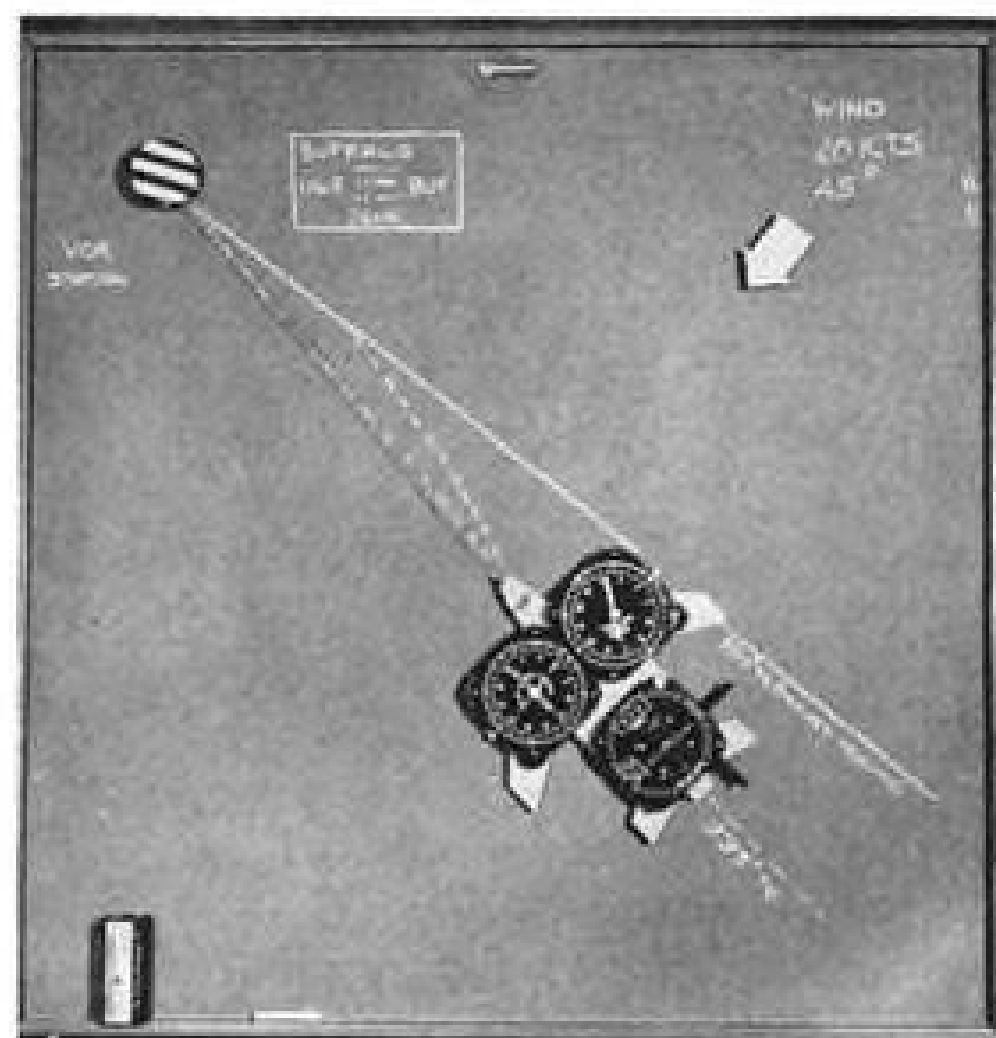
- **Link Aviation, Inc.**, will open a West Coast laboratory at Palo Alto, Calif. in January for design and development

of advanced computing systems, transistor circuits and guided missile test systems. Facility, to employ about 75 initially, will be located at 530 University Ave. in Palo Alto.

- **Curtiss-Wright (Research Division)**, Clifton, N. Y., Hycon Manufacturing Co., Pasadena, Calif., International Business Machines Corp. (Military Products Div.), Kingston, N. Y., and Wickes Engineering and Construction Co., Camden, N. J. have been elected to membership in the Radio Technical Commission for Aeronautics.

- **Daystrom, Inc.**, Elizabeth, N. J., will purchase Ford Engineering Co., Inc., Upland, Calif., manufacturer of potentiometers. New acquisition, which will complement activities of Daystrom's Potentiometer Division in Santa Monica, will be headed by its founder, Alfred S. Voak former president.

- **NYT Electronics, Inc.**, Burbank, Calif., has merged with Essex Electronics, North Hollywood, producer of RF and IF transformers, coils, chokes,



Orientation and Approach Trainer

Orientation and Approach Trainer 4x4 ft. square is one of a series of low-cost (\$200-\$300) off-the-shelf types of training device being built for the Defense Department by Carmody Corp. Over 200 units of several types have been delivered during the last two years. The device, which is similar to the Carmody Capsule Trainer (AW April 18, 1955, p. 101), is used in two ways. It serves as a briefing aid in all phases of aerial navigation where radio facilities are used and it is used for debriefing students to review any errors they might have made in navigational procedures and techniques while the training flight is still fresh in their minds. The trainer incorporates four instruments—radio compass, radio magnetic indicator, slaved gyro magnetic compass, and an ID 249 course indicator. The device, called Model 305, has collapsible aluminum legs to simplify transportation and weighs 47 lb.



Memory Machine

United Air Lines will keep running inventory of reservations for each of 300 daily flights for 100 days in advance on this Random Access Memory Accounting Machine (RAMAC) to be installed in September at UAL headquarters in Denver. RAMAC, which can store approximately 600,000 reservations, is expected to reduce processing time by 60%. UAL is renting two of the RAMACs, one for standby, from International Business Machines Corp.

filters and delay lines. NYT Electronics is an affiliate of New York Transformer Co., Alpha, N. J. New acquisition will be headed by W. J. Hirschberg, vice president and general manager of the Essex Division.

- **Servo Corporation of America**, New Hyde Park, N. Y., has begun construction of new addition which will increase assembly-testing area by 50%.

- **Consolidated Electrodynamics Corp.**, Pasadena, Calif., has acquired R. A. Castell & Co., Glendale, Calif., manufacturer of miniature high-altitude connectors. New acquisition, to be known as CEC's Glendale Division, will be headed by R. A. Castell as general manager.



- **Improved SAGE Computer**—International Business Machines Corp., which designed SAGE air defense computers, is working on improved versions with computation speeds "many times" faster, according to Brig. Gen. Stanley T. Wray, Chief of the Electronics Defense Systems Division of the Air Materiel Command. The improved models, expected to be available in a few years, will be installed in sector and sub-sector SAGE stations where air space is very congested and where first enemy blows might be directed, Wray says.

- **Handy Reference**—New edition (fourth) of "Reference Data for Radio

Engineers" has been published by International Telephone & Telegraph Co. The 1,100 page book is an unusually complete collection of a wide variety of data of use to engineers in all phases of electronics—not merely radio. Book is priced at \$6.00.

- **Radar For Air France**—Air France's 10 new Super Constellations (1649A), scheduled for initial delivery next June, will be equipped with Radio Corporation of America's AVQ-10 (C-band) weather radar.

- **Simulator Patent Suit**—Curtiss-Wright has filed suit against American Car and Foundry Corp., Erco Division, "to prevent threatened patent infringement resulting from the offer for sale by Erco of flight simulators and other flight training equipment covered by patents owned or controlled by Curtiss-Wright," according to a C-W announcement.

- **Radar For Viscounts**—Capital Airlines will install Bendix Radio's RDR-1 (C-band) airborne weather radar on its entire fleet of Viscounts. Some of the sets will be shipped to England for installation at the Vickers-Armstrong factory, remainder will be installed by Capital in Washington.

- **Infrared With French Accent**—French Air Ministry has taken delivery of an airborne infrared monochromator to be used to analyze infrared radiation of airborne targets. The device, built by Servo Corporation of America, measures magnitude of infrared radiation and its spectral (wavelength) distribution.

- **Calling All Authors**—The 1957 Electronic Components Symposium, to be held at the Morrison Hotel, Chicago, May 1-3, is seeking prospective authors to deliver papers. Subject should deal

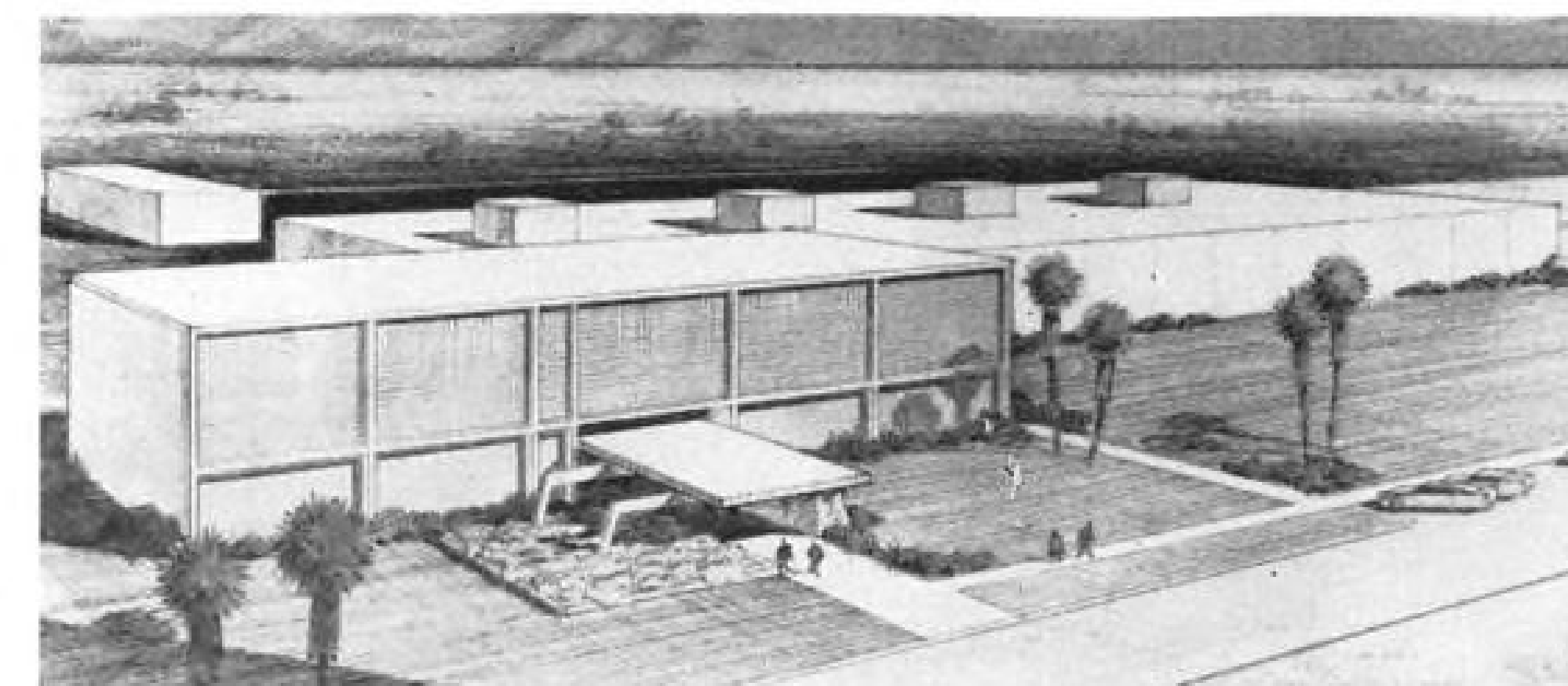


Spray-Etching

Automatic spray-etching machine for making printed circuit boards permits simultaneous etching of both sides of board to reduce etch time. Prototype model is now undergoing field tests. Robertson Photo-Mechanix, Inc., Dept. LF, 7440 Lawrence Ave., Chicago 31, Ill.

with components, materials, radiation effects, reliability, or instrumentation-measurements. If interested, submit 150-200 word abstract (20 copies) to Mr. V. H. Disney, Electrical Engineering Dept., Armour Research Foundation, 10 West 35th St., Chicago 16, Ill.

- **High Temperature Wire**—New enameled aluminum-clad copper wire which combines high electrical conductivity of copper and the superior oxidation resistance of aluminum with added protection of enamel insulation, has been developed by Westinghouse Electric Corp. New high temperature wire has extremely thin aluminum coating, measuring only about 0.0025 in. thick on a wire measuring about 0.25 in. in diameter.



New Sperry Plant

Architect's drawing shows 81,000 sq. ft. manufacturing plant which Sperry Phoenix Co. has started on a 480-acre site at Phoenix, Ariz. Sperry Rand division expects to have expandable \$3 million facility operating by August for manufacture of flight and engine control components. About 500 persons will be employed.

USAF Contracts

Following is a list of unclassified contracts for \$25,000 and over as released by Air Force Contracting Offices.

SHELBY AIR FORCE DEPOT, Wilkins Air Force Station, Shelby, Ohio.

Kay Industries, Inc., Detroit 16, Mich., trailer, aircraft engine; designed for transportation C124 aircraft power package, type MC-8 IAW USAF dwg 55J110, 693 ea., \$1361052, technical data, 1 set, \$825, total \$1361877, (IFB 33-602-56-144).

Victor Equipment Co., 844 Folsom St., San Francisco 7, Calif., regulator-oxygen type C1 MIL-R-6125B (ASG) dated 19 Aug 53 AM #1 dated 12 March 1954, 500 ea., appl: USAF type E1, E2, and E3 oxygen servicing tir., (IFB 33-602-56-200) \$27550.

Davidson Rubber Co., 50 Brighton St., Charlestown, Mass., nipple-electrical ter-

minal IAW AFNS STD dwg AN781 dtd 6 Jan 54, 235800 ea., \$68286, (IFB 33-602-56-209).

Thomas M. Handley dba The Handley Co., 11430 W. Jefferson Blvd., Culver City, Calif., extension assembly, fire extinguisher, type A-1 IAW USAF dwg 49D6328, 4386 ea. (IFB 33-602-56-194), \$74386.

American Electronics, Inc., American Electric Motors Inc., 2112 N. Chico Ave., El Monte, Calif., air conditioner, type MA-3, 100 ea., \$1281832, spare parts, 1 lot, \$256366, (PR MH 693223), 57 ea., \$730644, spare parts, 1 lot, \$146773, (PR MH 718168-1), total \$2414971.

The Selby Shoe Co., 1020 7th St., Portsmouth, Ohio, helmet, flying protective without visor assy, with H-75A/AIC headset, type MB-4 spec MIL-H-25037 (USAF) dtd 1 Dec 54, 2500 ea., \$89040, (IFB 33-602-56-205).

The Berger Bros. Co., 135 Derby Ave., New Haven 7, Conn., coveralls, high altitude and anti-G, type MC-4, Berger Bros.

Co. part nr BB-MC-4, 953 ea., \$208895, gloves, high altitude, type MC-4, Berger Bros. Co. PN BB-GL-2, 572 pr., \$25654, 953 pr., \$17087, total \$351637, (RFP 33-602-56-3089).

United States Rubber Co., 6600 East Jefferson Ave., Detroit 32, Mich., services to retread and/or repair aircraft casings, (PR DF dated 16 Feb 1956/D.D. Teacle/MHMSWM) call contract.

The General Tire & Rubber Co., 1708 Englewood Ave., Akron 9, Ohio, services to retread and/or repair aircraft casings, (PR DF dated 16 Feb 1956/D.D. Teacle/MHMSWM) call contract.

TOPEKA AIR FORCE STATION, Topeka, Kans.

E. I. duPont de Nemours & Co., Polychemicals Department, 10th and Market Streets, Wilmington 98, Del., methanol—4822725 G1—\$1900652, (IFB 14-604-56-828).

Missouri Solvents & Chemicals Co., 419 Desoto Avenue, St. Louis 7, Mo., methanol—34600 G1—\$121446, (IFB 14-604-56-828).

Spencer Chemical Co., 610 Dwight Bldg., Kansas City 5, Mo., methanol—900000 G1—\$297000, (IFB 14-604-56-828).

Sargent & Greenleaf, Inc., 24 Seneca Ave., Rochester 21, N. Y., padlock—6000 ea.—\$31092, (RFP 14-604-56-5242).

Cummins Kansas City Sales Corp., 3527 Gardiner, Kansas City, Mo., special tools—345 ea., \$76208, (RFP 14-604-56-5280).

Operating & Maintenance Specialties, 300 West Third Street, P. O. Box 188, Charlotte, N. C., manifold piping snubber—6300 ea., \$31689, (RFP 14-604-56-5201).

WRIGHT-PATTERSON AFB, Ohio, June 26.

Park Construction Co., 602 West Stroop Road, Dayton, Ohio, modification to Building Nr. 169, Hazardous Test Area, Building 169, Area "C", (IFB 33-601-56-645), for the job, \$76995.

The Flinke Engineering Co., 114 South Perry Street, Dayton, Ohio, replacement of damaged slabs and repairs of pavement joints runway 5L-23R, Area "C", (IFB 33-601-56-625), for the job, \$144854.

Hughes-Simonson, Inc., 20 North McGee Street, Dayton 3, Ohio, removal of existing and installation of new fuel pumping equipment, tank farm "F", Area "B", (IFB 33-601-56-387), for the job, \$48822.

Electrical Constructors, P. O. Box 2178, Columbus 16, Ohio, construction of A/C laboratory high temperature test sub station "E" at Area "B", (IFB 33-601-56-667), for the job, \$471458.

SACRAMENTO AIR MATERIEL AREA, McClellan Air Force Base, Calif.

Chicago Pneumatic Tool Co., 855 Bryant Street, San Francisco 3, Calif., air compressor and accessories, 1 ea; (P/R 36498), \$29372.

Wolverine Diesel Power Co., 12600 Mansfield, Detroit, Mich., kits for modification of B-10B generator sets, 2 ea; (P/R 5244), \$30314.

North American Aviation, Inc., P. O. Box 95, Fresno, Calif., maintenance of TF-86D type aircraft, 18 ea; (p/R 34469), \$130000.

Beech Aircraft Corp., 9709 East Central Ave., Wichita 1, Kans., \$210-TO-35c2-3-1-536 kits spares, TCTO's and handbook data C-26 and MD-3 generator sets, 3692 ea, (p/R nr. 5242), \$35541.

SAN ANTONIO AIR MATERIEL AREA, Kelly Air Force Base, Tex.

The B. G. Corporation, 321 Broad Avenue, Ridgefield, N. J., spark plug, 4708-RB916S, 10160 ea. (P.R.: 03H-56-62-ORDJR-ORC, R-56-62-1-ORDJR-ORC and R-56-62-2-ORDJR-ORC), \$31496.

General Motors Corp., AC Spark Plug Div., Flint 2, Mich., spark plug, 4708-LA47, 31500 ea. (P.R.: 03H-R-56-9091-TCSMC and R-56-9091-1-TCSMC), \$61425.

Electrical Engineering & Mfg. Corp., 4612 West Jefferson Blvd., Los Angeles 16, Calif., spare parts for electrical equipment (see attached) (P.R.: 03CL-SA-663565 and SA-663565-1), \$46607.

The Loudon Machinery Co., 1607 Jefferson Avenue, Houston 3, Tex., crane bridge system consisting of 5 non-interlocking bridge cranes on 4 primary rail runways, \$220-56SAS028, 1 ea. (IFB-41-608-56-282), \$36450.

MANAGEMENT

Venture Capital Supports New Air Firms

By William H. Gregory

New York—One measure of aviation's financial maturity is the demand for venture capital in the industry—that is, the number of new enterprises seeking money to establish themselves.

Most aviation research and development is paid for by the well established companies with their own funds or by the government, directly or indirectly. But individuals or groups who want to go out on their own still are a factor in the industry.

How necessary these relatively few enterprises are to the vitality of the industry, and how important it is for them to obtain backing is a subject of disagreement:

• **Aeronautical engineer and consultant:** "They are signs of an adolescent industry. Nobody leaves the Bell System today to start his own telephone company." (By this analogy, no one will leave Douglas either to go out and build his own DC-8.)

"An engineer with a technical idea in aviation is a lot better off to stay with the big company, and let the big company finance him. He's an SOB if he doesn't, unless the idea is something that's out of the big company's line."

• **Large corporation official:** "Ninety per cent of these small outfits contribute very little. The same competent people supported by a big company probably would contribute a great deal more. Administrative, sales, and money raising efforts cut deeply into the time needed for research and development.

"The remaining 10% do contribute. One problem for big companies is to try to decide which are which before dealing with them."

Small Company

Those who answer that there is a place for the small, new company in the industry would find a typical representative in David Fulton, who formed the Fulton-Irgon Corp. to develop an idea for a rocket-tube ejector for high speed airplanes. Fulton believes his device would never have reached the stage of development it has if it had to compete with other projects at Reaction Motors, Inc., which he left to start the new firm.

The case for such individuals, and for those who provide the funds, was stated by Harper Woodward of the Laurance Rockefeller organization in a recent speech at Pennsylvania State University. Though Woodward re-

ferred to research and development in general rather than aviation specifically, the Rockefeller organization has specialized to a large degree in aviation projects.

"... Venture capital investment in research, although sizable in amount, is a mere drop in the bucket when compared to the overall total of corporate investment in research," he said. "This being the case, are the efforts of these venture capital groups so insignificant that they might be waved aside as a form of boondoggling by people of means."

Woodward's answer is, "No," that private venture capital does have real social, economic, and industrial value, that the private investor has a significant role. "This, stated simply," he said, "is the concept that the individual or group of individuals who think they have new and pioneering concepts that they want to develop and exploit (in the best sense of the word) will have a fair chance of achieving their objectives without being 'sold down the river' in the process."

It is these creative individualists "who are far too restless to be content as part of a large corporation's happy, but sometimes over-administered R & D people" that the Rockefeller organization believes play an essential part in the growth of the nation.

New Money

From the viewpoint of the individual, how hard is it to find money today for new enterprises? Fulton said that he did not find it difficult to raise funds for his initial start in the way most such embryonic groups do—by using their own personal funds and from loans of personal contacts.

This is corroborated by J. H. Whitney & Co., a venture capital organization which has dealt more with oil and chemicals, but which has some aviation connected investments.

More venture capital is available today, the firm finds, than there are good ideas to put it in. Good is a word that cannot be emphasized too strongly, for the Whitney company also provides these figures: Of the 5,750 proposals



Flight Safety Foundation Awards

Plaques representing the 1956 Flight Safety Foundation awards for distinguished service in achieving safe utilization of aircraft were presented on behalf of Aviation Week, at a Flight Safety Foundation dinner at Palm Beach Shores, Fla., recently. The recipients were Melvin N. Gough, head of flight research, National Advisory Committee for Aeronautics, Langley Field, Va.; Arthur E. Jenks, chief of flight inspection, CAA; William Littlewood, vice president, equipment research, American Airlines, and Dr. Edward P. Warner, president of the council, ICAO. In the photograph are (left to right) Littlewood, Gough, Jerome Lederer, director of the foundation; Jenks, and Paul Norman of ICAO who accepted the plaque for Dr. Warner. Laurance Rockefeller (see story above) has been an important backer of the foundation.

marion

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considered in the last ten years, the company has bought only 60, just over 1%.

Low as this percentage seems, the situation is not that discouraging for the individual. About 75% of the proposals were rejected immediately as lacking in merit or because of general policy of the firm. Of the 25% investigated in varying degrees, about one in twenty-five resulted in investments. In addition a few proposals were approved, but the deals did not materialize for one reason or another.

Besides the careful selection of investment choices, there is another explanation of why there is a relatively

large amount of venture capital available today compared with its scarcity ten years ago. These investments have tended to be profitable and advantageous in the light of taxes.

American Research and Development Corp., a firm surveyed by AVIATION WEEK, was started ten years ago to provide just such capital and has survived as a publicly owned, dividend paying organization. Atlas Corp., whose aviation investments are well known, also is in the same category. Most recent Atlas investments, however, have been in the uranium mining field.

Some figures provided by J. H.

Whitney and by American Research indicate the profit potential of this "high risk" investment:

• **J. H. Whitney.** Of its 60 investments, 31 or 52% have been or show signs of being profitable; 23 or 38% show signs of being unprofitable, and 11 have been total losses. Six are uncertain at this time.

• **American Research.** Losses as of last summer totaled \$643,863 against gains of \$1,142,973. However, the value of the securities in the company portfolio was almost \$6 million.

No comparable figures are available from the Rockefeller group, but its aviation portfolio indicates just as good or better a record. One example is Vertol Aircraft Corp., of which Rockefeller owns about a third. In the last year the market value of the Vertol stock has almost doubled, standing now at \$45 to \$50 a share.

Neither the Rockefellers nor any of the other groups make any apology for what appears to be large profits. Profits have to be large in the field to cover the inevitable losses, they believe. Furthermore the original owners of the company also profit by this increase in value; though they might have profited even more if they had retained full ownership, there might have been no company at all if financial assistance had not been available at the right time.

Insistence on an equity interest in a company in return for their investment is pretty much a common denominator for venture capital groups. Sometimes they will accept debentures, promissory notes usually convertible later into common stock, but stock ownership is the standard operating procedure.

Other common policies include:

• **Capital appreciation.** None of the firms surveyed is vitally concerned with dividends as a rate of return. Increase in the value of their holdings is the major consideration. Tax advantages are one reason for this, for increases in value of holdings are taxed at the lower, long-term capital gain rate. (The Rockefeller organization has shown a preference for stock instead of cash dividends; this offers tax advantages to the investor and prevents a cash drain from the company in times of "tight money.")

• **Management.** All insist on a significant voice in the operation of the company, though not necessarily on control. Preferably this voice is expressed through representation on the board of directors, but American Research has placed officers with companies in a few cases.

• **Eventual liquidation.** Liquidation theoretically is the way the return is realized. In practice, this may be modified to suit the situation. Rockefeller

decisions are an example. The organization invested in McDonnell Aircraft Corp., when the company was pioneering the concept of jet-based carrier planes. With McDonnell well-established, the Rockefeller interest has been sold. On the other hand, Vertol, which also is approaching or perhaps at maturity, still has the Rockefeller interest, and Rockefeller may stay with the company even if the merger with Northrop Aircraft Corp. is consummated.

• **Merger** is one standard by which venture capital groups use to mark the maturity of an enterprise. (None favor or oppose merger generally; all three consider it in the light of the prevailing situation.)

Another standard of maturity, quoted by American Research, is the establishment of a market value for the company stock, either in over-the-counter trading or as a listed stock on one of the exchanges.

• **Long-term.** The Rockefeller organization uses ten years as a rule of thumb for the development of a new enterprise, and other firms follow similar premises.

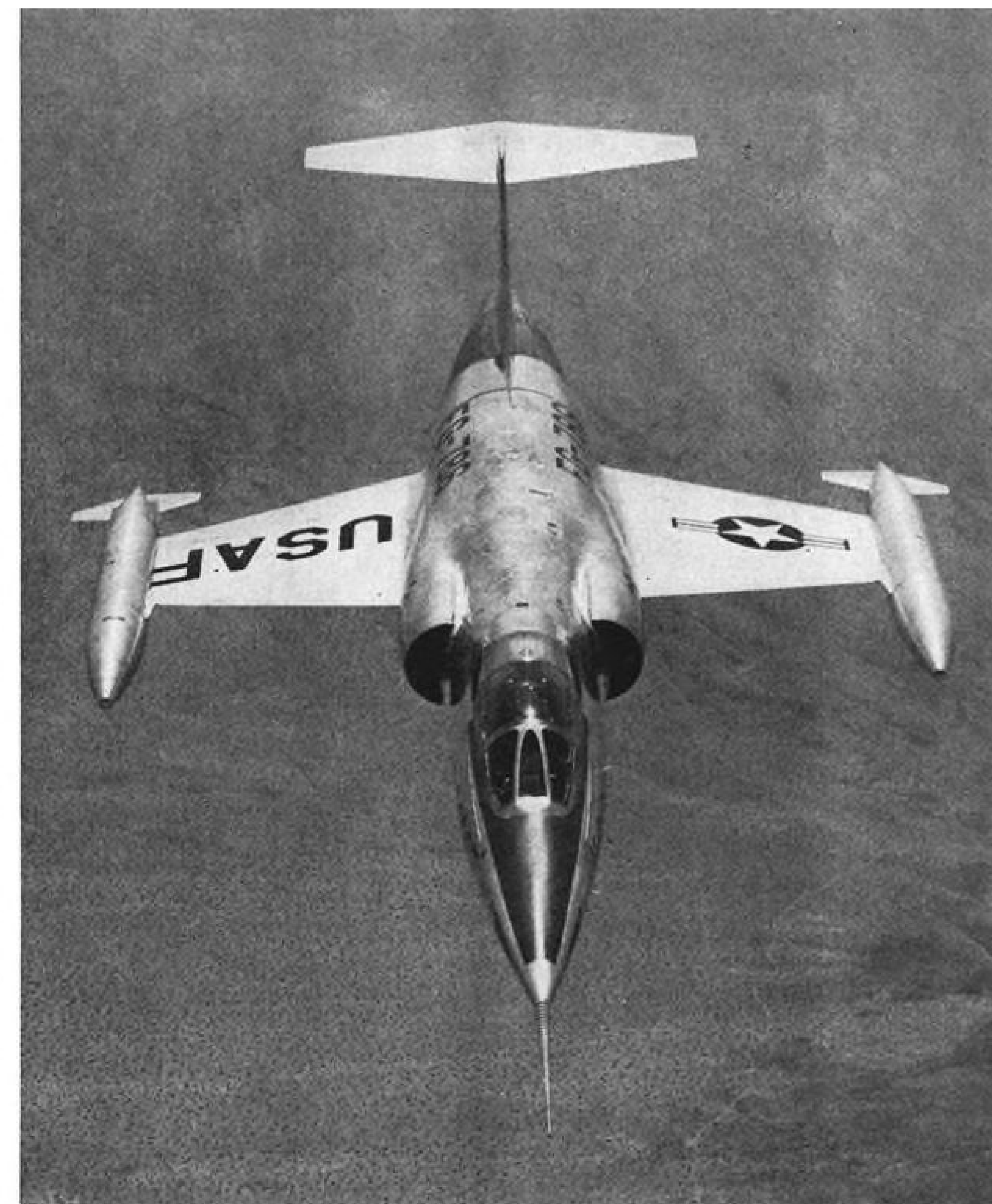
• **Objectives.** All have the basic goal of making money, but in various ways each tempers this purpose with more or less altruistic aims as well. The Whitney organization is not interested in gadgets. The article must be a useful product. American Research was organized in response to urgings of New England university and political leaders to alleviate the scarcity of risk capital for new ideas and technical developments in the early postwar years rather than purely to make money.

Money Not Yardstick

Of the three, the Rockefeller organization makes the strongest pronouncement on making money. It will not consider an investment that does not offer hope of return, but on the other hand disavows any interest in a project solely to make money. Laurance Rockefeller places the social or defense value of a development on equal footing with its financial potential.

One of the most intriguing aspects of the Rockefeller aviation portfolio is its high degree of success. However, William Elfers, vice-president of American Research, points out that this firm has not lost any money on its aviation-connected investments.

Detractors of the Rockefeller organization are prone to point out coincident element of defense spending support in this success. Though true, this may miss a more essential point, which is the parallel between the Rockefeller investment chronology and the technical progress of the aviation industry, that is, the ability to pick



F-104 Head On

Front view of F-104 prototype shows fat fuselage necessary to contain General Electric J79 engine and short 7½ ft. wings. Two seat fighter designated F-104B is going into quantity production, and RF-104 reconnaissance version is being readied for production. Inlet wedges are not on prototype model.

the right direction to pioneer in.

Rockefeller went into Eastern Airlines prior to World War II, before the real growth of the airlines had begun.

Since the war his investment has passed through McDonnell, Marquardt Aircraft (ramjets); Wallace Aviation (turbine blades); Flight Refueling; Airborne Instruments Laboratory and Aircraft Radio; New York Airways; Horizons (titanium); Reaction Motors (rockets), and Nuclear Development Corp. of America (propulsion).

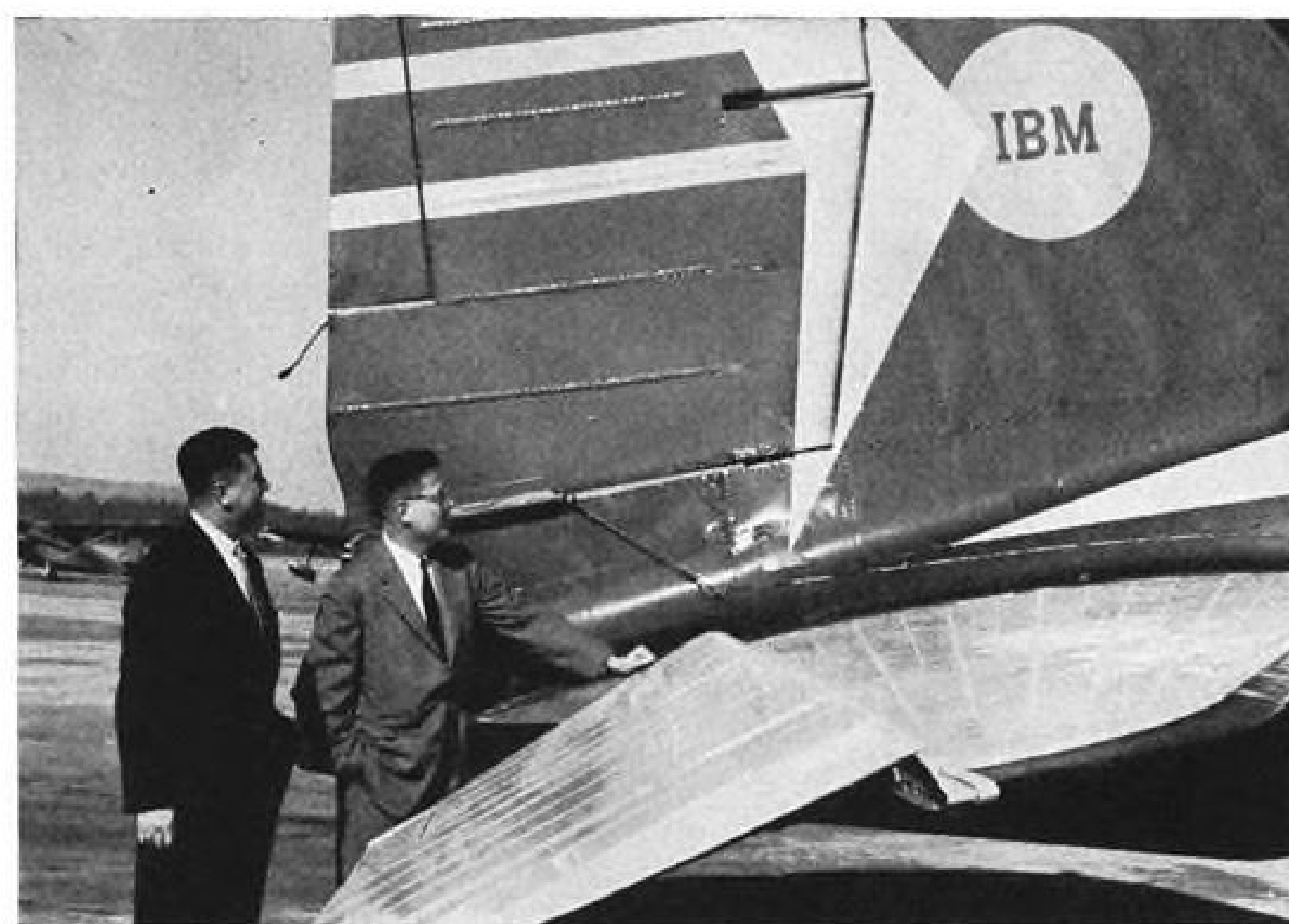
(Marquardt and Reaction Motors have been combined in the Omar combination with Olin-Mathieson Chemical Corp. Rockefeller is an Olin-Mathieson director.)

One of the characteristics which has been very valuable to Rockefeller, his associates add, is his ability to sense

not only when to go into a field, but also when to get out.

Evaluating a company for investment takes a generally similar pattern with all three investment organizations. Information on prospective companies come from sources such as bankers, lawyers, the Wall street investment houses, journalists, sometimes from each other. All three organizations, for example, have invested in Nuclear Development Associates, a White Plains, N. Y. nuclear development firm formed by a group of nuclear scientists who wanted their own business.

Various informal arrangements exist. The Rockefeller organization often works with Smith, Barney, a Wall street investment banking firm, and each will pass along to the other word of a company one or the other might be interested in. W. B. Harding, of



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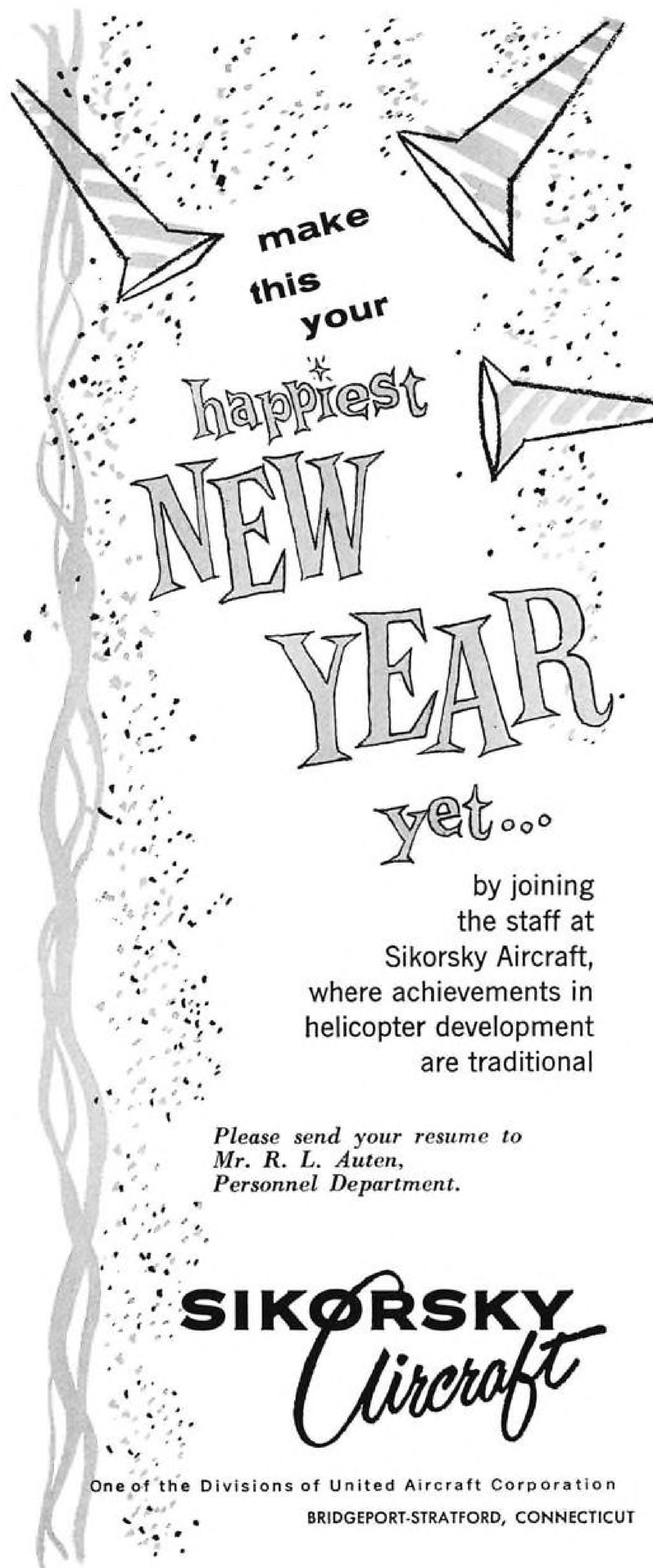
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Smith, Barney, chairman of the Harding aviation advisory group which studied traffic controls, first told Laurence Rockefeller about Vertol.

At the end of World War II, one group in the Navy department believed that the company, then Piasecki Aircraft, was not a reliable contractor in the procurement sense of the word and should be dropped from Navy support in the fund cutback to follow the war's end. However, a technical group in the Navy was interested in Piasecki and his tandem rotor ideas.

When Rockefeller became interested, Navy laid down specifications for what it would take to make Piasecki a reliable contractor. Besides financing, Rockefeller helped the company find a plant to replace its quarters that were to be torn down for a Curtis Publishing Co. plant, and also to find talent to staff the company.

Money and advice to solve business and technical problems were made available.

Touchy Problem

The subsequent acidulous dispute in which Piasecki left the company to form a new one under his own name underscores what is perhaps the touchiest problem for the investment firm and the hardest pill to swallow by the founders of the new enterprise. This is the subject of control.

Some loss of ownership, sometimes merger, is the price a new enterprise must pay for financial support. In the speech at Pennsylvania State University, Woodward stated the Rockefeller policy as avoiding dominion of a company. The ideal, Woodward said, is one-third ownership each by the founders of the enterprise, by the Rockefeller interests and a third independent group. This prevents any one group from exercising arbitrary control.

No matter how tactfully handled, the new enterprise must resign itself to accepting this outside voice in management. As the Whitney organization points out, of all business failures in 1955 analyzed by Dun & Bradstreet, 42% resulted from lack of management experience and 46% because of management incompetence. Obviously the venture capital firm will not accept any avoidable risk along this line.

It does not follow that engineers and technicians are poor managers. Of eight companies in which the Rockefeller organization invested, six were founded by engineers or scientists, four remain as chief executives and two others retired for reasons not connected with their ability. Only two lost confidence of the stockholders.

It does not follow either that engineers and scientists are good businessmen or administrators. Not that they have any aversion to business. Ameri-

A MESSAGE TO AMERICAN INDUSTRY • ONE OF A SPECIAL SERIES

Financial Aid to Higher Education

A Fine Start, But...

This editorial has two purposes. The first is to salute American business for the fine start it has made in helping to relieve the financial plight of our colleges and universities. The second purpose is to stress the importance of having business provide more financial aid, and soon.

How Business Helps Higher Education

Business contributions to higher education doubled between 1950 and 1955. They jumped from \$40 million to \$80 million. Preliminary figures indicate they will be even higher this year.

Business firms have also shown a lot of ingenuity in devising different ways of making their contributions. The methods range from a matching of an employee's contribution to his particular alma mater to wide diffusion of the money through state and regional money-raising associations of colleges and universities. Thanks to this ingenuity, business firms now have a wide choice of ways by which to give effective aid. The way most appreciated by college administrators is the making of gifts unrestricted as to the purpose for which the money is used.

Imposing as it is, however, what business has done thus far is only a good start. Only a tiny fraction of the total number of business firms in the country are giving direct financial help to our colleges and universities; and this fraction includes fewer than half of the hundred largest corporations in the country. Also, the amount of financial help being provided by business constitutes only a very small fraction of what is needed.

Why Colleges Need More Aid

Right now our privately endowed colleges and universities need about \$350 million more in operating income a year than they are receiving to enable them to pay decent faculty salaries and be in tolerably good working order otherwise. The reasons, including a severe decline in the purchasing power of their endowment income because of price inflation, have been dealt with in the previous editorials in this series.

In addition, these institutions, together with the tax-supported schools, are faced with a tremendous increase in enrollment over the years ahead. With both a rapidly increasing population of young people and an increasing propor-

tion of them going to college, this year's enrollment of 3.2 million students is expected to reach 4.0 million by 1960, and to be doubled by 1970.

For the next ten years our privately supported colleges and universities must have an average of about \$400 million a year above what they can be expected to collect from tuition fees, income from endowment funds, etc.

This figure of \$400 million does not include what is needed for new buildings and equipment. It also does not include help for tax-supported schools above what they get from taxes, fees, etc. Business has given and will continue to give these schools substantial aid. Indeed, almost 25% of the financial help from business for our colleges and universities went to tax-supported schools in 1955.

If aid from business met their needs for increased operating income, the privately supported colleges and universities would be given a decisive lift in performing successfully their part in our system of higher education. They would still have large needs of capital equipment — buildings, dormitories, laboratories — but help from other sources, such as that provided by devoted alumni, where they are well organized, could be expected to go far toward meeting these needs. Also some companies prefer to concentrate on meeting needs of this type.

What 1 % of Profits Would Do

But do business firms have the capacity to fill the gap in adequate operating income for our privately endowed colleges and universities without putting an excessive financial burden on themselves? Those who have studied this capacity carefully say that the answer clearly is yes. If, of its profits before taxes — this year an estimated \$43 billion — business were to devote 1% to helping our privately en-

dowed colleges, it would take care of present operating needs of about \$350 million a year. And the balance of \$80 million would be a big step in meeting their needs for new buildings and equipment, too.

About one half of a 1% contribution of this sort would, in effect, be made by the federal government. Up to a limit of 5%, contributions of this type are exempt from the federal corporate income tax. For corporations with incomes above \$25,000 per year this tax is 52%.

It is clear that not all business firms are in shape to devote 1% of their profits to aid to higher education. Even in this year of record-breaking prosperity, many of them will have no profits at all. But if business generally would take 1% of pre-tax profits as a target or benchmark for financial help to our privately endowed colleges and universities these institutions would again have sturdy financial foundations.

Relatively this is a very small price to pay (1) to insure a continuing supply of competently trained young men and women and (2) to buttress our freedom by assuring the successful survival of the privately supported sector of our system of higher education.

This is one of a series of editorials prepared by the McGraw-Hill Department of Economics to help increase public knowledge and understanding of important nationwide developments of particular concern to the business and professional community served by our industrial and technical publications.

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Donald C. McGraw
PRESIDENT

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can Research finds one of its big problems how to keep first rate engineers from turning themselves into third rate businessmen.

In evaluating a proposal, the investment men consider management key a consideration.

As William Elfers, vice-president of American Research, points out, this firm is seldom wrong technically, but it has made mistakes on people.

How to evaluate the people devolves into a matter of personal, empirical judgment. The Rockefeller group has laid down some general rules that help: • Technical excellence in a promising field. This is considered the important element, and growing even more important as the complexity of problems increases. Eliminating needed technical skills because of tight budgets is easy to do in a small company, but the Rockefeller staff looks upon it as a fatal move. When the best engineering staffs cannot be hired full-time, the organization recommends utilizing technical advisory boards part time, scientific members of the board of directors, or university faculty members.

• Business and financial management. This is something seldom present when the new enterprise is born, and is considered one of the hardest to stir into the works later. Introducing skilled administrators in the face of the natural reluctance of creative persons to accept such "strangers" into the family has been one of the most difficult problems of the Rockefeller organization.

• Confidence and optimism. This is essential because there will be inevitable set-backs and discouragements.

• Maturity and judgment. Growing with the company, another intangible, has also been another problem, though not so severe perhaps as the introduction of administrators. A mature man, the organization finds, must recognize that the pond is becoming bigger, that he must turn over responsibilities in some areas with growth. Most people with whom the staff has worked have been able to grow with the company, becoming policy shapers and not spreading themselves so thin the stockholders and associates must intervene.

• At least one executive. This may not be the president of the company, but top management must have one man who is an executive in fact, not name.

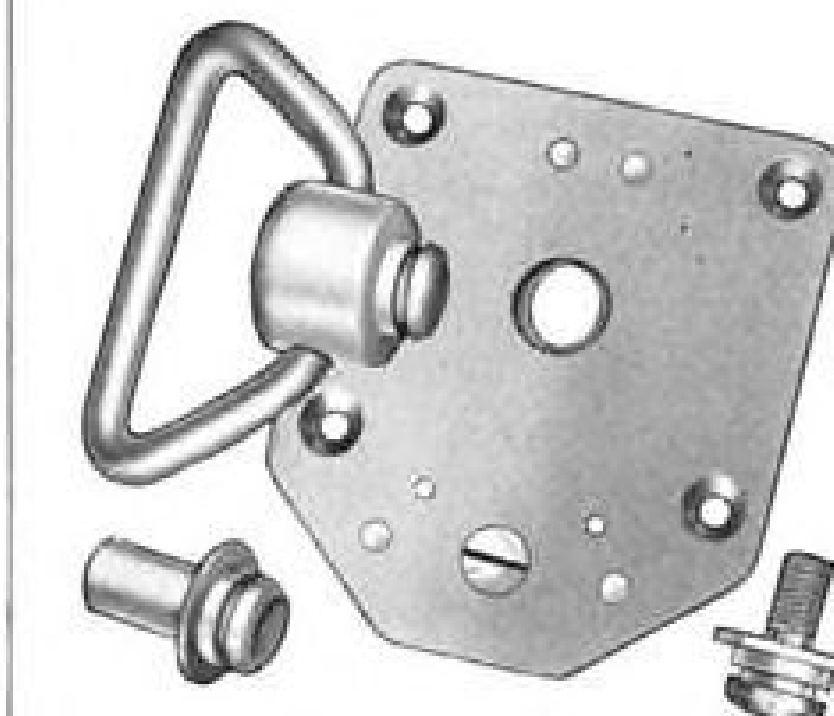
• Management incentives. This means, through bonuses, profit-sharing stock option plans or otherwise, the management of the new company must have an opportunity to have a substantial share and stake in ownership and growth of the company.

The Rockefeller organization considers that the management advice it can provide is equally as important as the financial help.

Flexibility is the rule as far as types



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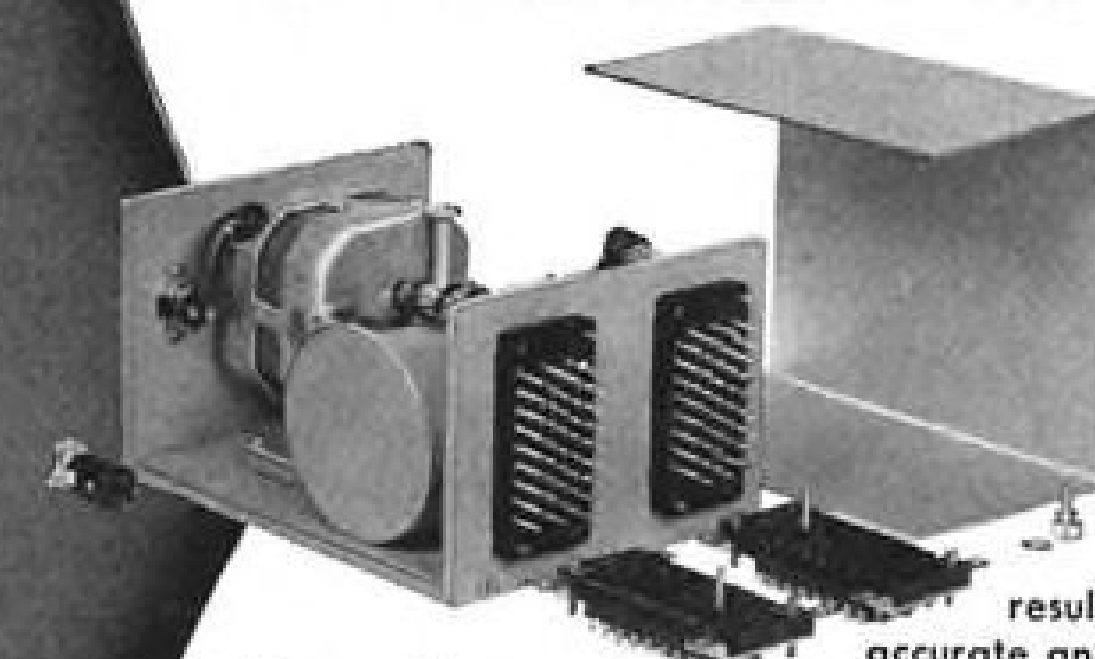


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of companies, products and size of investments are concerned. The Whitney organization has a convenient classification for investments as a criterion:

- Class 1—Primary capital needed to develop, test and launch new ideas, inventions or services.

- Class 2—Secondary equity capital needed to expand a new business after it has been successfully launched or to enable an established business exploit a new product.

- Class 3—Additional equity capital needed by successful business with competent management, with an established position in industry and whose securities are publicly and privately owned.

The class 3 investments are those handled through the normal investment channels. The others fall into the venture capital field, either because the company can't get its foot in the door in Wall Street or is afraid to try.

Though all three groups will consider investments in the embryonic research stage, the Whitneys and American Research prefer a product ready for commercial exploitation. The Rockefeller group may be more receptive to research stage enterprises, but it also lays down a goal of eventual production.

These groups tend to stick to fields in which they have acquired knowledge—the Rockefellers in aviation, American Research in electronics, the Whitneys

in oil and chemical ventures.

Relatively small investments are the specialty of these groups, for small amounts are the hardest to obtain in the regular channels in Wall Street. The Whitneys have a rule that if more than \$500,000 is required, the firm will seek other sources for assistance.

This explains the dealings of firms with each other, and with informally aligned groups. In the case of the Rockefellers, they may turn to Smith, Barney in Wall Street or to the Chase Manhattan bank, where one of the Rockefeller brothers is an officer and Laurance Rockefeller a director.

Very small investments, below \$100,000 for example, begin to lose attractiveness even to the venture capital groups because of the lessened opportunity for a high return. A general range, as prescribed by the Whitneys, of \$150,000 to \$1 million, makes a good rule of thumb. There is no real ceiling, since the organization will seek to obtain larger sums from others.

In describing a frequent approach made by the capital-needing companies, Elfers of American Research pointed out what such companies should avoid.

"We'll get a telephone call," Elfers said. "They'll tell us, 'We need money, lots of time, though—tomorrow night will do.' Then they ask if they can come up to Boston to see us. Usually we can hear the sound of airliner engines warming up in the background."

American Research asks the group to put the situation on paper.

"We want to know what they make, where they make it, to whom they sell, what is their position in their field, what is the budget, who is the management, what the money is needed for," Elfers said.

American Research doesn't want an elaborate brochure. It does want a paper that gives a concise, clear picture of the situation. A bad set of figures aren't necessarily fatal if there are good reasons why they got that way.

This gives the investor a chance to make an initial decision on whether the company fits the basic policies of the investment firm, and a preliminary judgment of the management.

If the company offers promise and interests American Research, the organization then will make a technical analysis. If the technical picture is sound, then the process goes into the final stage where a detailed technical and economic study will be made to form the basis for a final decision.

This process, followed more or less by the other groups, can be lengthy. In one case it took the Rockefeller organization two years to complete an investment. However, much of this time was consumed in waiting for others to make decisions so that the Rockefellers could make their decision.

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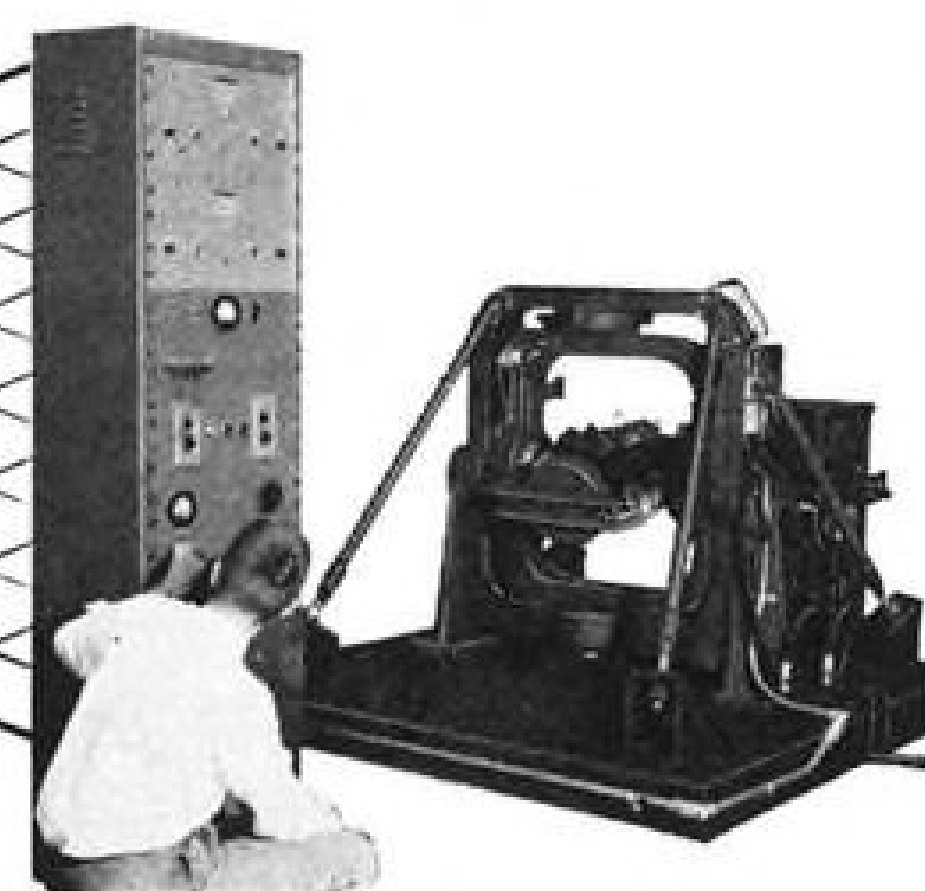
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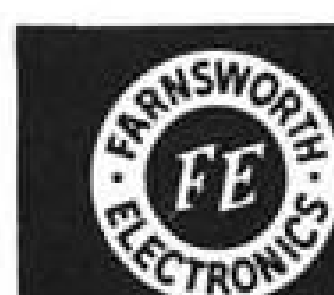
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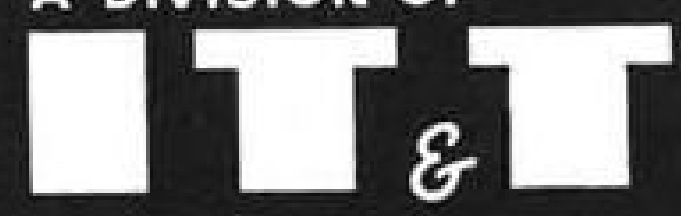
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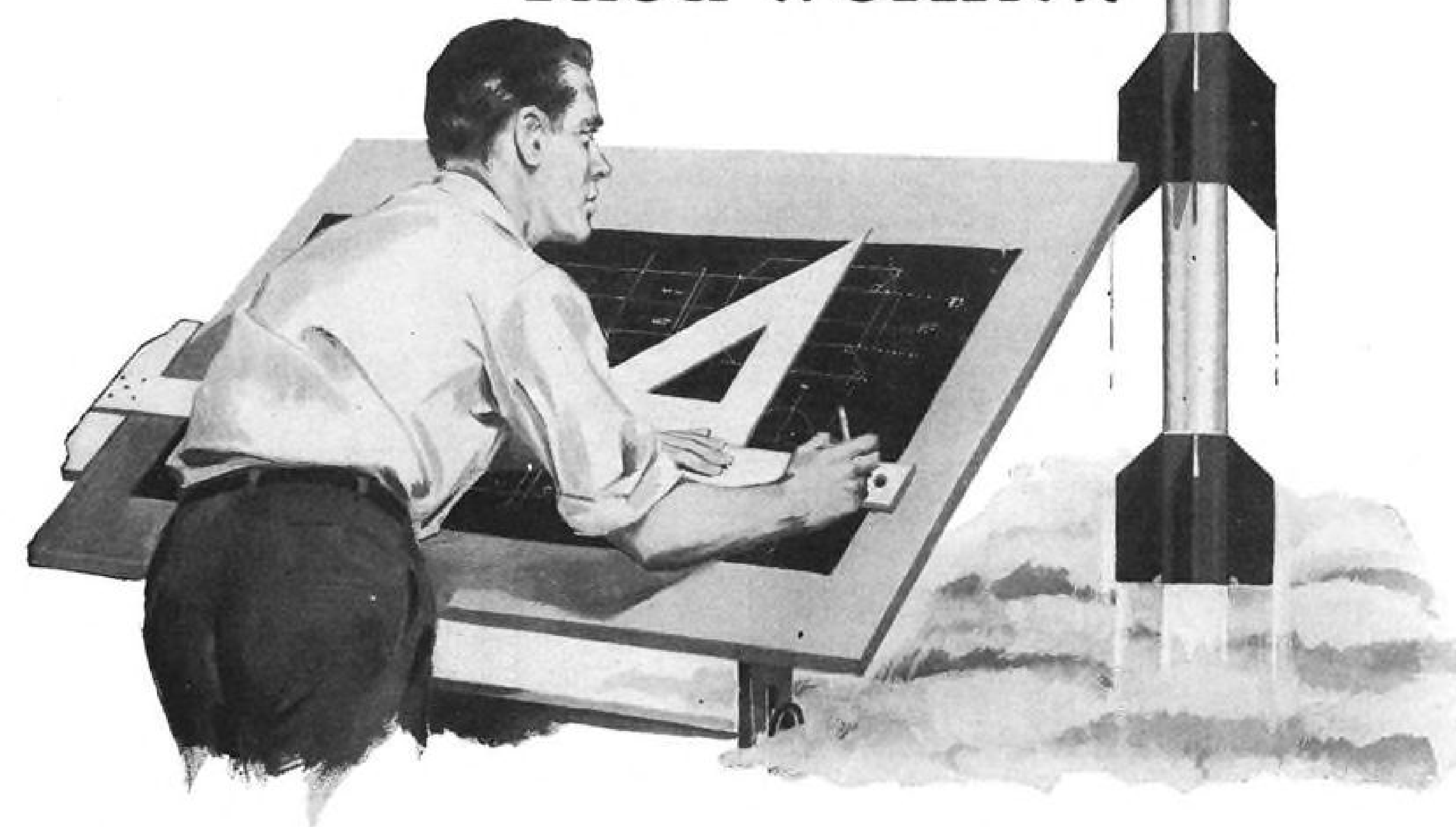
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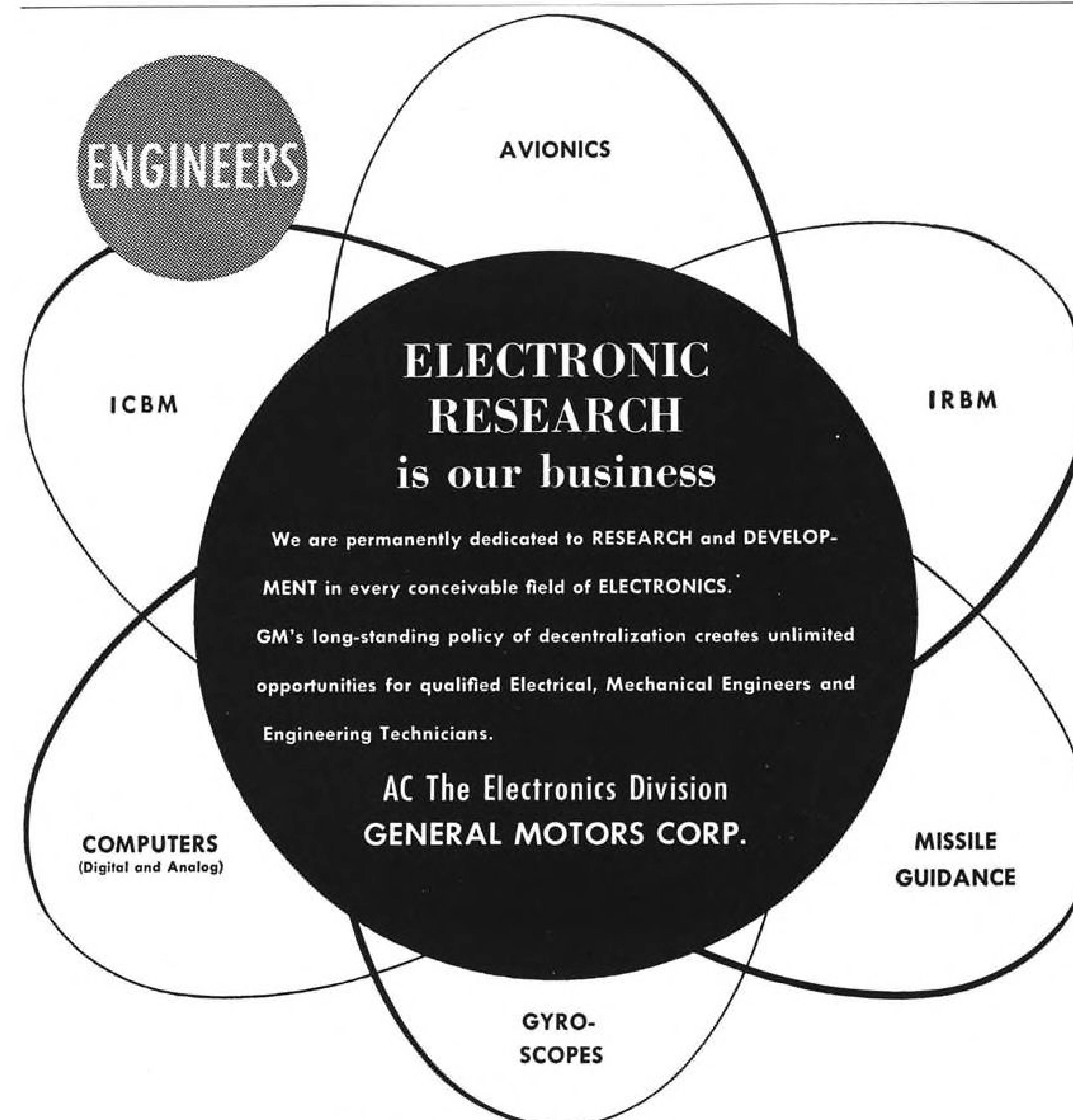
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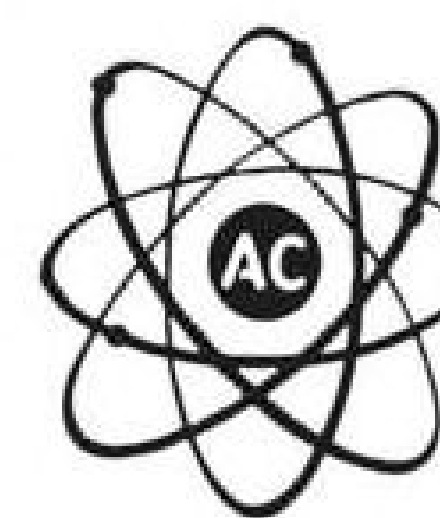
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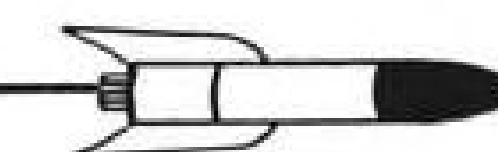
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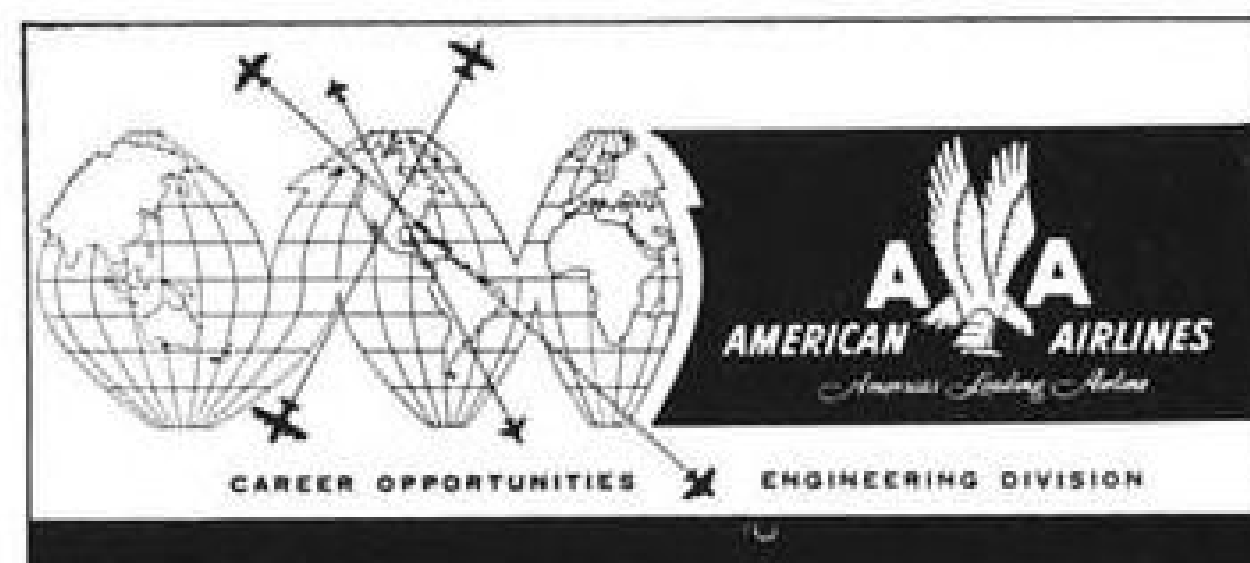
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☐ **Check contents** and locations of first-aid kits. Be sure they're adequate and up to date. Here, again, your

CD Director can help. He'll advise you on supplies needed for injuries due to blast, radiation, etc.

☐ **Encourage personnel** to attend Red Cross First-Aid Training Courses. They may save your life.

☐ **Encourage your staff** and your community to have their homes prepared. Run ads in your plant paper, in local newspapers, over TV and radio, on bulletin boards. Your CD Director can show you ads and official CD films or literature that you can sponsor locally. Set the standard of preparedness in your plant city. There's no better way of building prestige and good community relations—and no greater way of helping America.

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ADVERTISERS IN THIS ISSUE

AVIATION WEEK, DECEMBER 31, 1956

A. C. SPARK PLUG DIV., GENERAL MOTORS CORP. 14	GRUMMAN AIRCRAFT ENGINEERING CORP. 11	WHITTAKER CO., LTD., W. R. 46
Agency—D. P. Brothier & Co.	Agency—Fuller & Smith & Ross, Inc.	Agency—Mogge-Privett, Inc.
AIRWORK CORPORATION 68	HYDRO-AIRE, INC. 9	WIGGINS OIL TOOL CO., INC., THE E. B. ...2nd Cover
Agency—Gene Wyble Advertising	Agency—Bryon H. Brown & Staff, Inc.	Agency—Byron H. Brown & Staff
APPLIED SCIENCE CORP. OF PRINCETON 73	KAHN, ROBERT J. 74	CLASSIFIED ADVERTISING
Agency—Paul M. Healy	Agency—Hening & Co.	F. J. Eberle, Business Mgr.
AXELSON MFG. CO., DIV. U. S. INDUSTRIES INC. 3	KAMAN AIRCRAFT CORP., THE 6, 7	EMPLOYMENT OPPORTUNITIES 75-81
Agency—Charles Bowes Advertising	Agency—Charles Palm & Co.	EDUCATIONAL
BENDIX PRODUCTS DIV., BENDIX AVIATION CORP. 3rd Cover	LAVELLE AIRCRAFT CORP. 5	Schools..... 83
Agency—MacManus, John & Adams, Inc.	Agency—The Roland G. E. Ullman Organization	EQUIPMENT
BRIDGEPORT BRASS COMPANY (ALUMINUM DIV.) 42	LOCKHEED AIRCRAFT CORP. GEORGIA DIV. 53	Used or Surplus New..... 83
Agency—Hazard Advertising Company	Agency—Foote, Cone & Belding	For Rent..... 83
CHANCE VOUGHT AIRCRAFT, INC. 54	MARION ELECTRICAL INSTRUMENT COMPANY. 66	For Sale..... 82-83
Agency—Ruthrauff & Ryan, Inc.	Agency—Culver Advertising Inc.	WANTED
COLOR TELEVISION INC. 74	McGRAW HILL PUBLISHING CO. 71-72	Equipment..... 83
Agency—Sturges & Associates	MONADNOCK MILLS DIV., UNITED-CARR FAST-ENER CORP. 73	ADVERTISERS INDEX
CONVAIR—DIV. OF GENERAL DYNAMICS 35	Agency—H. B. Humphrey, Alley & Richards, Inc.	Axico Airlines, Inc. 82
Agency—Buchanan & Co., Inc.	MORRIS BEAN & COMPANY 40	Aerojet General Corp. 80
CRAIG SYSTEMS INC. 47	Agency—Odiorne Industrial Advertising	American Airlines 82
Agency—Larson Randall Advertising, Inc.	PACIFIC DIV., BENDIX AVIATION CORP. 20	Carter Aviation 82
CURTISS WRIGHT CORP. 12	Agency—The Shaw Company Adv.	Cessna Aircraft Co. 75
Agency—Burke Dowling Adams, Inc.	RAMO-WOOLDRIDGE CORP. 36	Civil Air Transport 63
DALLAS AIRMOTIVE, INC. 16	Agency—The McCarty Company	Department of Airports, City of Los Angeles..... 82
Agency—Jack Kemp & Associates	REYNOLDS METALS COMPANY 4th Cover	East Coast Aviation Corp. 83
DOW CORNING CORPORATION 18	Agency—Clinton E. Frank, Inc.	Engine Works 83
Agency—Church & Guisewite, Adv.	ROBINSON CO., RALPH C. 85	Farnsworth Electronic Co. 76
EDISON, INC., THOMAS A. 22	Agency—Chapin-Damm Adv.	Flying Tiger Line 81
Agency—Gaynor, Colman, Prentiss & Varley, Inc.	ROHR AIRCRAFT CORP. 10	Friendship Airport 82
ELECTRONIC DIV., OTIS ELEVATOR CO. 13	Agency—Barnes Chase Company	General Electric, Inc. 78-80-81
Agency—Krate-Basch Associates Inc.	SARGENT ENGINEERING CORP. 4	General Motors Corp. 79
FAIRCHILD ENGINE & AIRPLANE CORP. (AIRCRAFT DIV.) 24	Agency—Darwin H. Clark Co. Adv.	General Precision Lab, Inc. 77
Agency—Gaynor, Colman, Prentiss & Varley, Inc.	SIKORSKY AIRCRAFT DIV., UNITED AIRCRAFT CORP. 70	Goodyear Aircraft Corp. 81
FORD INSTRUMENTS CO. DIV. OF THE SPERRY RAND CORP. 8	Agency—G. P. Sweet	Kellett Aircraft Corp. 81
Agency—G. M. Basford Company	SPENCER THERMOSTAT DIV., METALS & CONTROLS CORP. 43	Leeward Aeronautical Sales, Inc. 83
FOSTER MFG. CO., JOHN J. 15	Agency—Sutherland-Abbott Adv.	Minnesota Airmotive, Inc. 82
Agency—Rhea Advertising Agency	VICKERS-ARMSTRONG CO. 44, 45	National Surplus Sales Co. 82
	Agency—McCann-Erickson, Inc.	Navco, Inc. 82

Aircrafts' Who's Who Reports

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LETTERS

Glide Slope Error?

I read in your Oct. 29 edition (p. 79) the CAB report on the Constellation accident at Imeson airport, Jacksonville, Fla., last December. The verdict evolving therefrom prompts me to question the existence of a condition not mentioned anywhere in the analysis. The proposition is formulated as a question because I am not sure enough of my ground to make a positive statement. Be that as it may:

Is there any possibility that the underlying factor in the mishap is a peculiarity of the glide slope presentation which manifests itself in damp surroundings?

In some test work on ILS at Patuxent River, Md., a year or two ago it became evident that the glide slope was severely affected by precipitation. In particular, a coat of frost on the ground was seen to cause a sharp dip in the pattern a short distance from the transmitter. This is most apparent when the glide path is descended slowly, as was the case in our helicopter work.

However, it is conceivable that a severe anomaly developed under light frost conditions that night. I would be very interested to know whether it was cool enough to produce frost there (in the interval between the preceding ILS approach and the fateful one).

The dip in the glide slope has never been thought prominent enough to be detected in a fast-moving airplane, but did the investigation take into account the outside chance of a 200 ft. error of meteorological origin?

IRA C. GUNNING
Claremont, Calif.

(It is standard procedure of the CAA to flight-check all navigational aids in areas in which an accident occurs immediately following the accident. This procedure was followed in the case of the subject accident.—Ed.)

Technical Books

In the present shortage of aeronautical engineers it seems to me that the government would be acting wisely if it were to give financial assistance to the publication of technical books.

In our own experience we have needed a complete and authoritative book covering the practices of landing gear design and have been unable to find one. This is understandable, because the sales quantity of such a book would be small and its economic life would be short. It could not be published at a profit.

There are plenty of intelligent, industrious and ingenious Americans with valuable general experience in other fields who are separated from a productive career in aeronautical engineering only by their lack of the specialized aeronautical know-how which has never been assembled in book form. A series of practical, but rigorously accurate and thorough books available to these men at low cost, with the authors, editors and publishers protected

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against loss by the government, would be a good investment for the country as a whole. Competent men from the outside would begin almost at once to contribute to the net output of our profession.

Could something of this sort be done?
RAY HOLLAND, JR.
President
Aeronautical Engineers
Roswell, N. M.

Rebuttal

Bitter Engineers I and II and Angry Engineers (AW Letters section 6-4-56, 7-2-56 and 6-11-56 respectively) prompted this reply.

To fully cover every point, contradiction and rationalization contained therein would require, unfortunately, a lengthy dissertation.

Anonymous declarations are, of course, worthless hearsay statements and only prove that the "men" who wrote same do not even have the strength of their own convictions.

To be blunt, I say they have no guts and I believe they are possibly poor engineers to boot!

As for the 35 year old retired "engineer" it is herewith reported that I shall soon be 35 and not only am I a very active, employed engineer but I intend to request that I be considered for another rightful pay advancement.

If the Douglas engineer feels the way he does then he can easily find many companies where he could work on many and varied challenging projects with intelligent, sincere and hard working engineers. In fact most companies would be most pleased to hire good engineering talent that is willing to work for less and less money and drink no coffee, eject no rubber bands, or take no trips to the men's room. I do not work for Douglas and wouldn't care to work for such a large company, but they do build some fine airframes and any organization of such magnitude is bound to have certain lulls and crash programs alternately which, accordingly, affect the work loads.

Our company is rather small by aviation industry proportions and thank goodness our engineering supervisor, an ex-naval officer, is intelligent and recognizes the fact that engineers must be treated like men and not chained to their desks or drafting boards. Some of my assignments for electrical and electro-mechanical designs require a varied amount of thought and deliberation before "work" begins. Therefore, on occasion, if the Douglas genius happened into our engineering offices across town, if I'm not at the post office or the bank, he might look at me and surmise that

I was doing nothing because I do not necessarily move a muscle to think. In fact, I might be having a second cup of coffee, gazing at the ceiling or going to the toilet (my kidneys work well when my brain works well).

No one in this business will deny the fact that there is, in some instances, too much time wasting, but who is this man that writes anonymously and adjudges the value other men have as engineers and yet is not smart enough to go out and line up a more challenging position? If he's worth his salt, many new companies will greatly appreciate and reward such devotion to duty with pay raises as per usual or with pay cuts as he might prefer.

The bitter engineer who could not relocate with his company "... due to personal obligations and family considerations ..." answers his own plight. Certainly most companies try to give all possible considerations to their employee's personal problems, but could they stop relocating because someone could not arrange his own life to relocate with them? If this man is as good an engineer as he implies then I submit he would not, indeed, have to be selling dresses.

The angry engineer who says in the plural that we should give an honest day's work for our money and quit milking the taxpayer with senseless overtime: if he has any truly workable solutions he can make a fortune by presenting same to manufacturers who sometimes are faced with the task of meeting "impossible" schedules. I have had projects where we had to work overtime—but I also went home with the family and found myself continuing to work out said problems, on my own time, until I went to sleep. Many engineers who take their assignments seriously find themselves doing this and serious thought and ideas do not stop flowing at the end of the paid working day.

Leslie W. Ball (AW 6-1-56, p. 79) covers the engineering career motivation subject almost eloquently.

In summation, I am not what is loosely referred to as a "company man." In fact, I am about as independent an engineer one will find in the business. But I still am concerned with the practicality, cost and workability of the designs I am paid to create and if I do not agree with some of the other engineers or the "wheels" and they feel that they are far afield and are wasting company time and money I send in an ANVO (memo form printed "Accept No Verbal Orders") expressing my views and possible solutions to the problem(s) and sign my name to the report.

True, where there is no difference of opinion there is no thought, but also true: where a man has no engineering talent and the strength to stand up and state his convictions he might well have gone into the dress business or work for Douglas and send in anonymous letters, all the time secretly worrying for fear he is pointed out for the coward he truly is!

JAMES WILSON
Sr. Design Engineer
Los Angeles, Calif.

AVIATION WEEK, December 31, 1956



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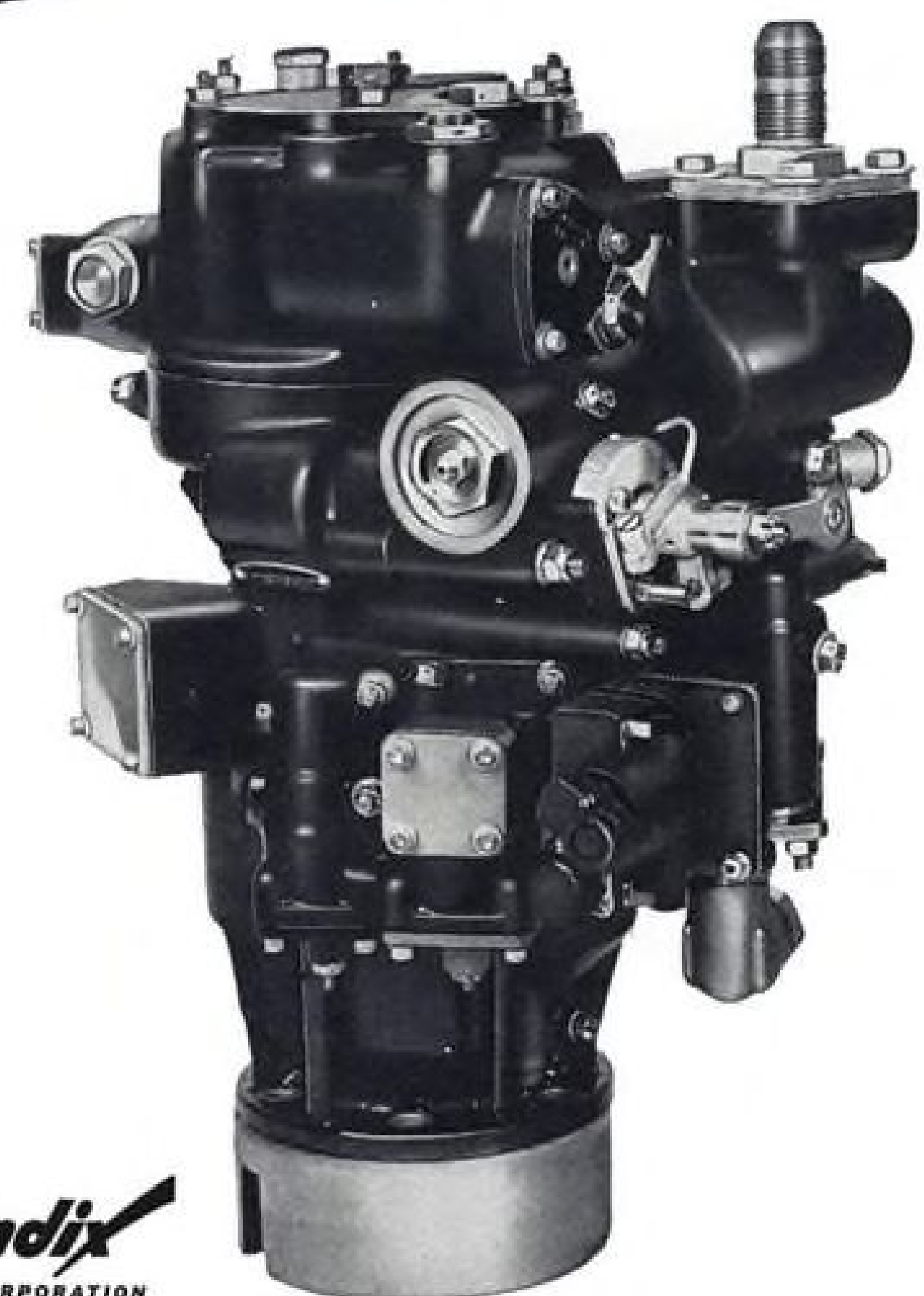
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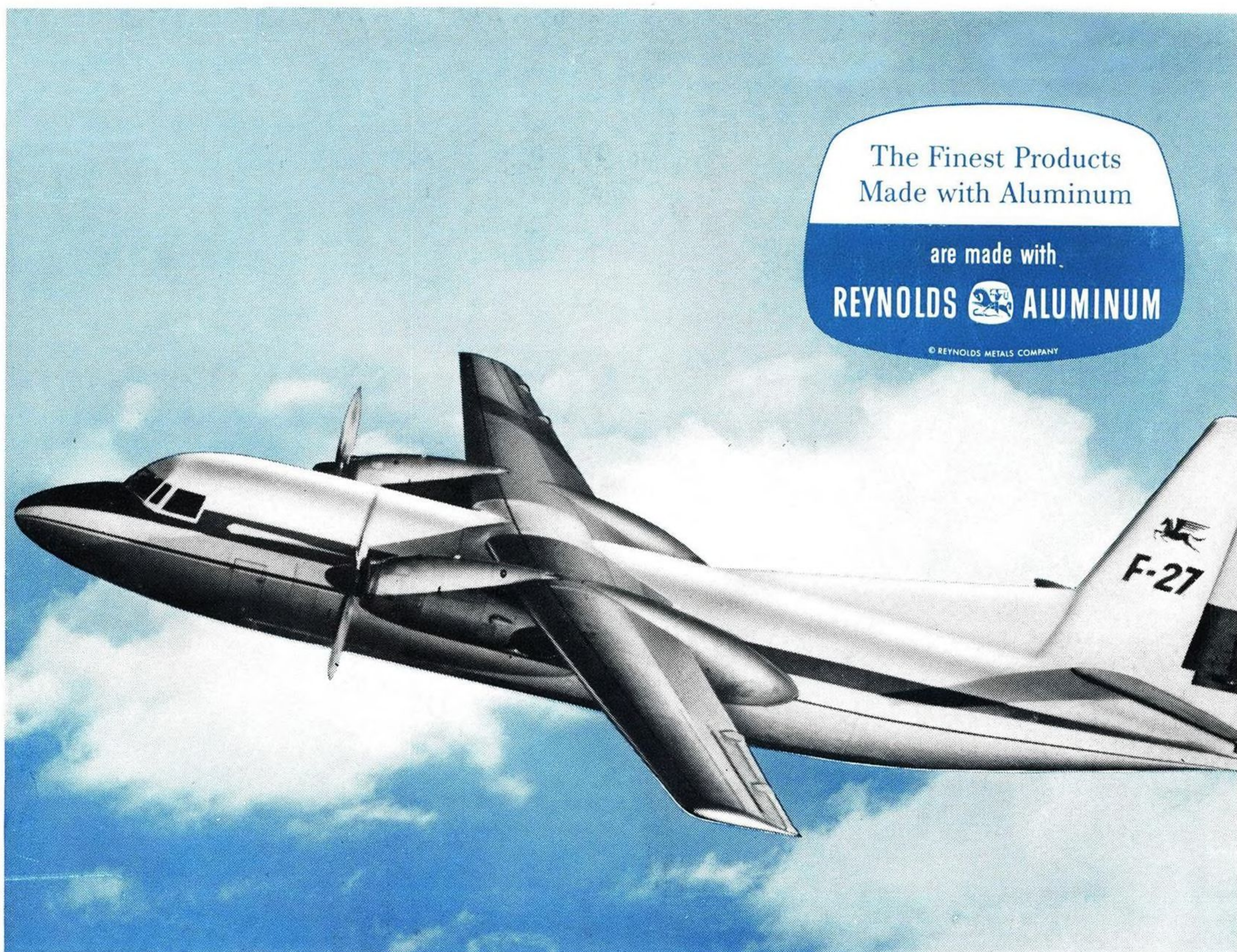
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