April 15, 1957 50 Cents

AVIATION WEEK

A McGRAW-HILL PUBLICATION

Army Hand-Picks Team for IRBM

•

Accessories Next In Systems Concept

Lockheed X-17 With Booster

— but he's working for you

This man is hard to please. Nothing short of optimum accuracy and conformity to specifications satisfies him. We *like* it that way, and are glad we have many more people in the Inspection Departments here at Foote Bros. just like him.

Meticulous and exhaustive inspection is an important part of our production processes. It must be, because quantity production of precision gearing and actuating mechanisms for the aviation industry is our business.

It is men like these who work for you, and, in a very real sense, are the guardians of the Foote Bros. reputation for producing the finest components and assemblies of their type.

Another reason to come to Foote Bros. first, when it comes to aircraft power transmission, actuation, or gearing.

this trademark stands for the finest industrial gearing made

FOOTE BROS. Duti-Rated LIFETIME GEARING

FOOTE BROS.

Better Power Transmission Through Better Gears

FOOTE BROS. GEAR AND MACHINE CORPORATION
4545 South Western Boulevard, Chicago 9, Illinois

Advanced Systems Of Ice Protection Pioneered By Goodyear—already proved in actual Arctic Circle operation on military jet aircraft — Pave Way For New Commercial Jet Airliner.

The Boeing 707, commercial jet transport, will fly with the most advanced type of ice protection on all three leading edge surfaces of its huge empennage:

Iceguard by Goodyear!

Embodying revolutionary electrothermal systems of ice protection — developed through the teamwork of the National Research Council of Canada and Goodyear—one system of the Iceguard has already been in lengthy service above the Arctic Circle on the Canadian Avro CF-100 all-weather fighters.

Now the other has been selected by Boeing for jet transport service.

For information on the erosion-resistant Iceguard—how these two systems of foolproof ice protection can be applied to air scoops, wings, propellers, antennas, pipe, conduit—anywhere ice presents a problem—write: Goodyear, Aviation Products Division, Akron 16, Ohio, or Los Angeles 54, California.

ICE PROTECTION BY

GOODYEAR AVIATION PRODUCTS

Where Research and Development work to Advance America's Global Position In The Race For Air Power

Iceguard – T. M. The Goodyear Tire & Rubber Company, Akron, Ohio

AVIATION CALENDAR

Apr. 15-17—Symposium on Systems for Information Retrieval, sponsored by Western Reserve University, Masonic Auditorium, Cleveland, Ohio.

Apr. 16—Development and Use of the Lycoming Gas Turbine, Lecture by Dr. Anselm Fritz or Fritz Haber, Avco, American Helicopter Society. Ft. Rucker Section, Ala.

Apr. 16-17—Aircraft Ball Bearing Conference, sponsored by New Departure Division, General Motors Corp., Statler Hotel, Hartford, Conn.

Apr. 16-18—Symposium on Nuclear Tests for Nondestructive Testing, Morrison Hotel, Chicago, Ill.

Apr. 22-24—Second Annual Jet Engine Hydraulic Symposium, Hotel Statler, Detroit.

Apr. 23—Missile Session, New York Section, Association of Electrical Engineers, 7:30 p.m., 33 W. 39th St., New York, N. Y.

Apr. 23-25—International Symposium on Role of Solid State Phenomena in Electrical Circuits, Engineering Societies Bldg., N. Y. C.

Apr. 23-25—Annual Convention, International Airline Navigators Council, Piccadilly Hotel, New York.

Apr. 29—Third Flight Test Instrumentation Symposium, Statler Hotel, Los Angeles.

Apr. 29-May 2—16th Annual National Conference, Society of Aeronautical Weight Engineers, Broadview Hotel, Wichita.

Apr. 30—Atlantic Rate Commodity Rate Board Meeting, International Air Transport Assn., Torquay, Devonshire, England.

Apr. 30—Electronics Make the Helicopter Fly, annual section meeting, New York Section, American Institute of Electrical Engineers, 33 W. 39th St., New York.

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

May 2-3—Annual Meeting, Aeronautical Training Society, Mayflower Hotel, Washington, D. C.

May 5-8—1957 Convention American Asso-

(Continued on page 6)

AVIATION WEEK • APRIL 15, 1957

Vol 66, No. 15

Published weekly with an additional issue in December by the McGraw-Hill Publishing Company, James H. McGraw (1860-1948), Founder. Executive, Editorial, Advertising and Subscription offices: **McGraw Hill Building, 330 West 42nd Street, New York 36, N. Y.** Publication Offices, 99-129 North Broadway, Albany 1, N. Y. Donald C. McGraw, President; Joseph A. Gerardi, Executive Vice President and Treasurer; Hugh J. Kelly, Executive Vice President; John J. Cooke, Secretary; Nelson Bond, Executive Vice President, Publication Division; Ralph R. Smith, Vice President and Editorial Director; Joseph H. Allen, Vice President and Director of Advertising Sales; A. R. Venezian, Vice President and Circulation Coordinator.

Subscriptions are solicited only from persons who have a commercial or professional interest in aviation. Position and company connection must be indicated on subscription orders.

Single Copies 50¢. Subscription rates—United States and possessions, $6 a year. Canada $8 a year.

Second class mail privileges authorized at Albany 1, N. Y. Printed in U. S. A.

Subscription: Address correspondence and change of address to Subscription Manager, Aviation Week, 330 West 42 Street, New York 36, N. Y. Subscribers should give old as well as new address, including postal zone number, when changing address. Enclose recent address label if possible. Allow one month for change to become effective.

Postmaster: Please send form 3579 to Aviation Week, 330 West 42 Street, New York 36, N. Y.

AVIATION CALENDAR

(*Continued from page 5*)

ciation of Airport Executives, Shamrock Hilton Hotel, Houston, Tex.

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

May 7-9—Electrical Engineering Aspects of Aircraft and Missiles, American Institute of Electrical Engineers, Biltmore Hotel, Dayton, Ohio.

May 7-9—Aircraft Electrical Equipment Conference, Hotel Biltmore, Dayton, Ohio.

May 7-9—Spring Assembly, Radio Technical Commission for Aeronautics, Ambassador Hotel, Los Angeles, Calif.

May 8-11—13th Annual National Forum, American Helicopter Society, Sheraton Park Hotel, Washington, D. C.

May 13-15—National Conference on Aeronautical Electronics, Sponsored by the Institute of Radio Engineers, Dayton, Ohio.

May 14—Engine Operation & Maintenance Forum, sponsored by Pratt & Whitney Aircraft Division and distributors, Pacific Airmotive Corp., Cosmopolitan Hotel, Denver, Colo. Other sessions, May 17 at Ambassador Hotel, Burbank, Calif.; May 20 at Hotel Claremont, Oakland, Calif., and May 22, New Washington Hotel, Seattle, Wash.

May 15-17—Jet Age Airport Conference, Air Transport Division, American Society of Civil Engineers, Park-Sheraton Hotel, New York.

May 20—Sixth Annual Aviation Fire Safety Seminar, National Fire Protection Assn., Hotel Statler, Los Angeles, Calif.

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

June 1—8th Annual Maintenance and Operations Meeting for Business and Executive Aircraft Owners, sponsored by Reading Aviation Service, Reading Municipal Airport, Pa.

June 1-9—First Annual National Aviation Trade Show, Monmouth County (N. J.) Airport.

June 17-20—National Summer Meeting, Institute of the Aeronautical Sciences, Biltmore Hotel, Los Angeles, Calif.

June 23-25—29th Annual Meeting, Aviation Distributors & Manufacturers Assn., The Broadmoor, Colorado Springs, Colo.

June 24—Soviet National Aviation Day, Moscow.

July 12-13—British Lockheed International Aerobatic Competition, the National Air Races (third round) and the King's Cup Air Race, Coventry Civil Aerodrome, Bagington, England.

Aug. 20-23—Western Electronic Show & Convention, Cow Palace, San Francisco, Calif.

Sept. 1-6—Sixth International Aeronautical Conference, Royal Aeronautical Society and Institute of the Aeronautical Sciences, Folkstone and London, England.

Sept. 2-8—1957 Flying Display, Society of British Aircraft Constructors, Farnborough, England.

Nov. 7-8—Weapons Systems Management Meeting, Statler-Hilton Hotel, Dallas.

Dec. 17—Wright Brothers Lecture, Department of Commerce Auditorium, Washington, D. C.

One of a kind!

Kids still love jacknives, but no longer seem to do much whittling. Like the circus big-top this vanishing pastime seems to be one more casualty of this high-G, triple-carburetion age.

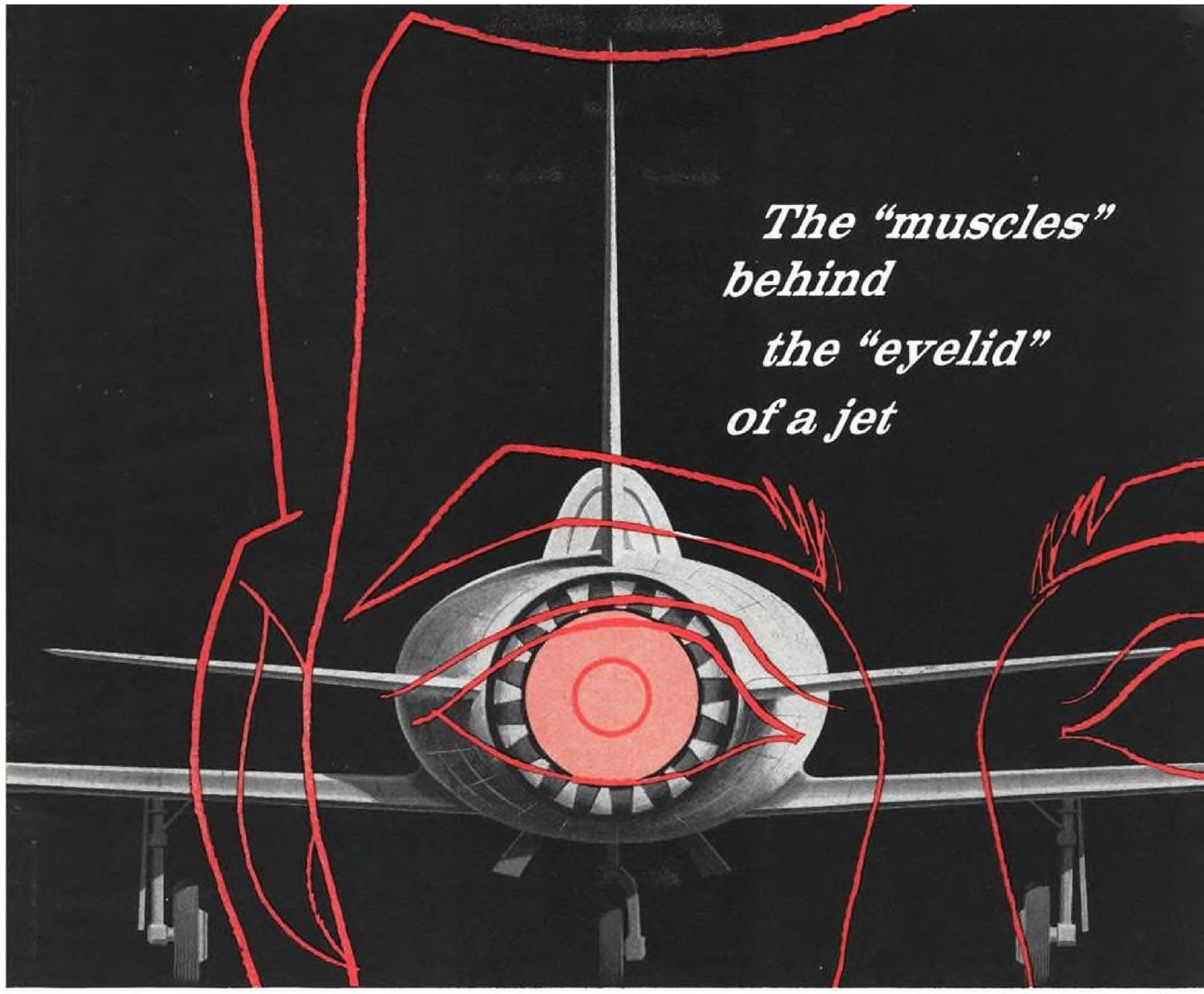
The production engineer also has lost his enthusiasm for whittling metal. Machining from solid bar is still a necessity when making one part or a few prototypes. But, for hundreds of parts, extruded shapes save metal and machining time.

TMCA has pioneered the difficult art of extruding Titanium alloys. Many thousands of pounds of extruded Titanium sections are regularly shipped to jet engine and airframe industries. Seamless extruded tubing is another regular production item at TMCA.

Write today for information on Titanium extruded shapes and tubing.

. . . FIRST IN Titanium

TITANIUM METALS CORPORATION OF AMERICA, 233 Broadway, New York 7, N.Y.



Jet aircraft using the "eyelid" type of variable area exhaust nozzles need actuators—or "muscles"—that respond instantly in temperatures ranging from minus 67 to plus 600 degrees. Ex-Cell-O builds such actuators . . . along with nozzles, blades, rotors, fuel controls, precision parts and assemblies.

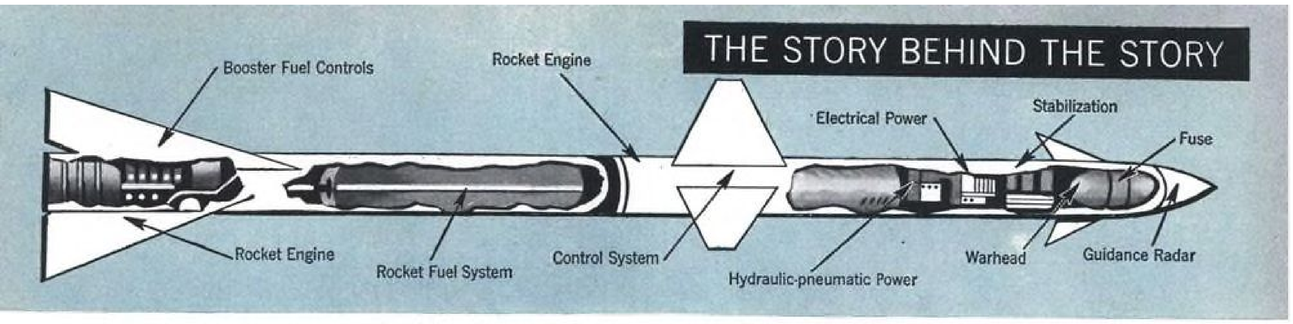
EX-CELL-O CORPORATION
DETROIT 32, MICHIGAN

EX-CELL-O FOR PRECISION XLO

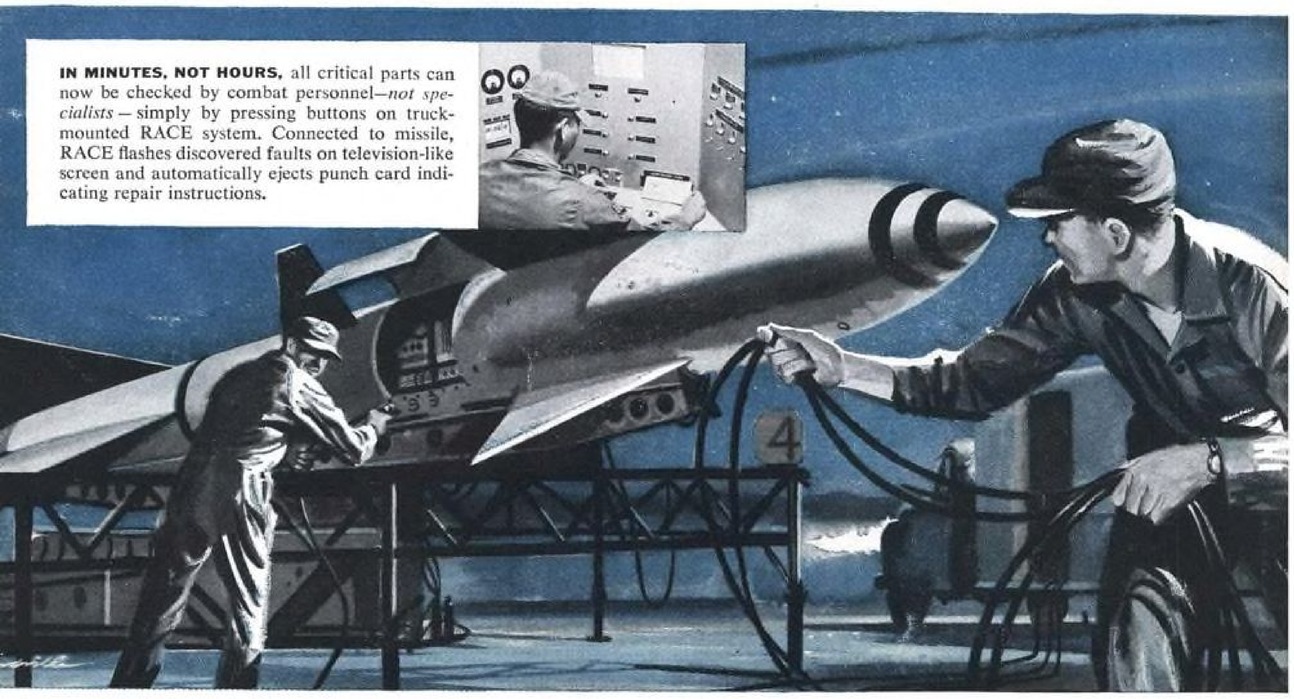
Aircraft Division

MAN AND MISSILES FLY HIGHER, FASTER AND SAFER WITH PARTS AND ASSEMBLIES BY EX-CELL-O.

57-43



THOUSANDS OF "FAULTS" can develop in a guided missile, each capable of causing it to misfire or swerve off-course. Pre-launching check-out takes specialized technicians many hours. Under stress of enemy attack, a small but fatal defect might be missed.



IN MINUTES, NOT HOURS, all critical parts can now be checked by combat personnel—*not specialists*—simply by pressing buttons on truck-mounted RACE system. Connected to missile, RACE flashes discovered faults on television-like screen and automatically ejects punch card indicating repair instructions.

IN FLIGHT, RACE-checked guided missile flashes toward target, performing at the peak capacity engineered into it, with all components functioning to give missile best possible opportunity to reach and destroy objective.

"RACE" TO BOOST MISSILE STRIKING POWER

Electronic System Cuts Launching Time, Ups Dependability

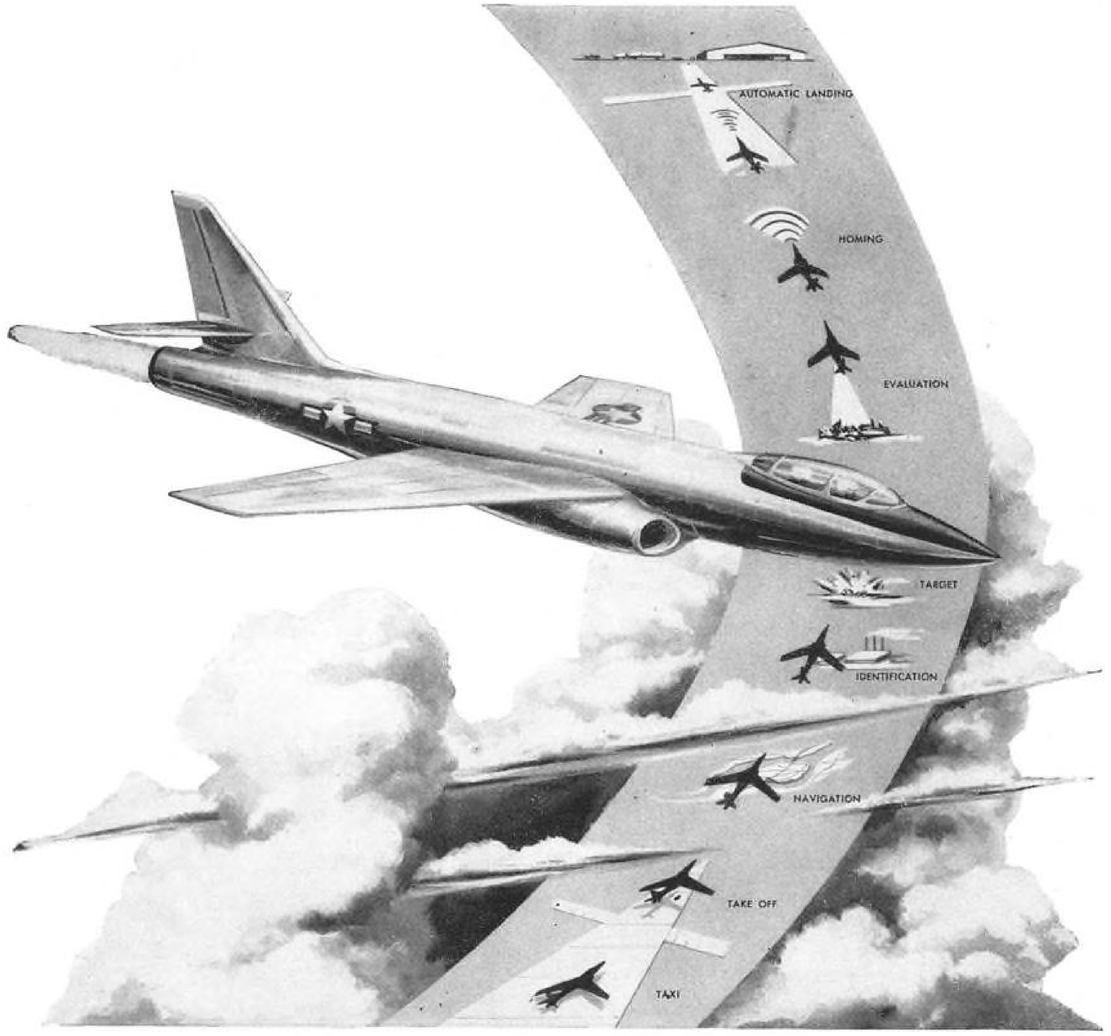
When a rifle bullet misfires you simply fire another. Guided missiles, however, are costly and complex, packed with precision parts in hair-line adjustment. When these "birds" take off, they've got to fly right the first time!

At present, making sure missiles perform properly takes hours, even days, of careful testing by highly trained crews. And under the stress of actual combat, the best-trained crew might neglect an important check-point—and there are thousands of potential trouble-spots in a typical missile.

Sperry's new missile testing system called RACE does the job in only minutes—with little chance for error. RACE (for Rapid Automatic Check-out Equipment) tests all missile components at the launching platform, warns of the tiniest fault, even tells the operator how to fix it. And RACE doesn't make a mistake because it checks itself while it checks the missile. Result is, missiles are ready to launch far quicker and are more likely to perform with full effectiveness.

Designed to test supersonic aircraft as well as missiles, RACE will strengthen our national defense by keeping key weapons fit to fight.

SPERRY GYROSCOPE COMPANY
Great Neck, New York
DIVISION OF SPERRY RAND CORPORATION



AVIONICS . . . *from A not quite to Z*

THE list of products for missiles, aircraft or commercial application with which Bell Aircraft's newly-formed Avionics Division is concerned does not quite span the alphabet. It ends with VHF. But it's all-inclusive and complete—indicating a highly experienced organization capable of dealing successfully with any of the hundreds of electronic, electro-mechanical or mechanical systems and devices which make up the field of Avionics.

It has creative engineering ability for research and development—and efficient manufacturing facilities. It is competent to design and produce complete systems—or independently operating units for such systems—or components for both.

It's an organization with size and experience to qualify it for any avionic project—with many successes to attest to its capabilities. One of its recent developments is the Navy's Automatic Carrier Landing System which makes precision landings possible with zero-zero conditions.

The services of this organization are available to defense agencies, prime contractors and commercial organizations. If you have problems in Avionics, Bell engineering representatives are at your service to help resolve them.

BELL Aircraft CORP.
Avionics Division
BUFFALO, N.Y.

AMP'S NEW straight-action air gun

lightweight • compact • portable

Further information on AMP's New Straight Action Air Gun is available on request.

This new AMP pneumatic hand tool augments our line of high-speed application tooling. Designed for a wide range of AMP terminal, connector and splice applications, its features include:

- Interchangeable die assemblies, with in-line crimping action to assure perfect, solderless wire terminations;
- Safety valve set to bypass when line air pressure exceeds operating requirements;
- Standard "C" type head adaptable to all types of crimping, including small wire terminations in close working quarters;
- Spring and air operated holding device for positive grippage of terminal in tool head prior to crimping;
- Safety engineered to prevent accidental operation of tool during insertion of terminal or connector between crimping dies.

AMP

AMP INCORPORATED

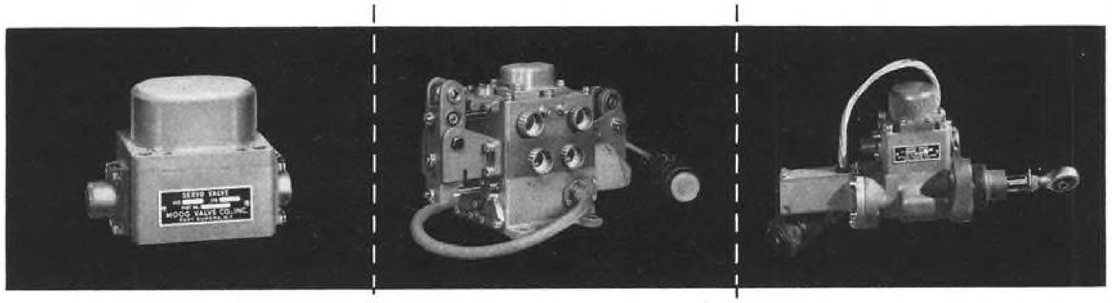
1202 Eisenhower Boulevard — General Office: Harrisburg, Pa.

Wholly Owned Subsidiaries: Aircraft-Marine Products of Canada Ltd., Toronto, Canada
Aircraft-Marine Products (G.B.) Ltd., London, England • Societe AMP de France, Le Pre St. Gervais Seine, France • AMP-Holland N.V. 's-Hertogenbosch, Holland
Japanese Distributor: Oriental Terminal Products Co., Ltd., Tokyo, Japan

From MOOG . . . **Advanced Electro-Hydraulic Servo Components**

Moog is the industry's leading producer of electro-hydraulic servo valves. This leadership has been achieved by advanced valve design resulting in high performance, high quality, reliability and efficient manufacture. The same creative approach applied to industry's newer problems has resulted in the introduction of Moog Dual Input and Servo Actuator units.

These recent achievements in the creation of advanced custom designed electro-hydraulic servo components are evidence of Moog's continuing progress.



SERVO VALVE

• These proportional "dry motor" electro-hydraulic servo valves feature high dynamic response, sensitivity, linearity and reliability. Light-weight and compact, they are also available in custom designed versions for special or advanced applications.

DUAL INPUT SERVO VALVE

• This new component provides for positioning of aircraft control surfaces by summing mechanical and electrical inputs without external use of mechanical linkages. Use of an entirely new concept offers improved performance, system simplification and saving of space and weight.

SERVO ACTUATOR UNIT

• Custom designed integrated assemblies include actuating cylinder, electro-hydraulic servo valve and feedback sensing device. In a closed loop, actuator displacement is a function of input signal.

MOOG

TO THE ENGINEER IN A "HURRY"

Axiomatically, to get somewhere in a hurry, you get aboard something that moves pretty fast.

If your "somewhere" is a career in engineering, consider Moog. From three founders to five hundred employees within five years, we are today the industry's leading manufacturer of advanced electro-hydraulic servo components. Our engineers made this possible by continuous pioneering of the new and successful developments in the field. As our rapid expansion continues, we have many openings at all levels for qualified personnel.

Best time to get aboard is now.

MOOG VALVE CO., INC. PRONER AIRPORT, EAST AURORA, NEW YORK

Research Laboratory, Paramus, New Jersey

Beware of the Snark!

The nation's first intercontinental missile . . . the Air Force's Northrop Snark SM-62. Equipped with a nuclear warhead, the Snark is a so-called air-breathing missile which travels in the earth's atmosphere. Its compact design presents a smaller target for radar, interceptors, or anti-aircraft missiles.

Extremely mobile, the Snark can be air lifted to any site within a few hours.

The pilotless bomber is powered by a Pratt-Whitney Aircraft J-57 turbojet engine equipped with a Holley compressor bleed governor. It flies in near-sonic speeds above the weather over the longest range yet possible by a missile in the free world today.

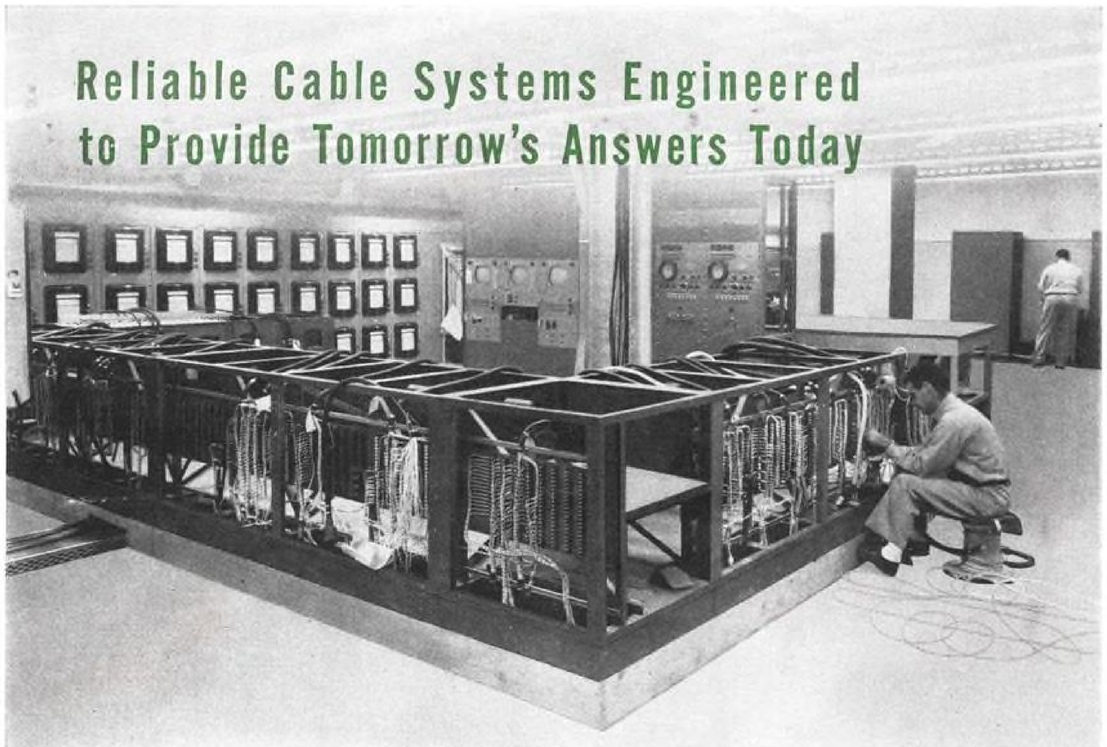
Like all Holley engine controls, the compressor bleed governor is dependable, easy to service, compact and lightweight — four vital qualities for aviation equipment.

HOLLEY Carburetor Co.

LEADER IN THE DESIGN, DEVELOPMENT, AND MANUFACTURE OF AVIATION FUEL METERING DEVICES.

11955 E. NINE MILE ROAD, VAN DYKE, MICHIGAN

A-25

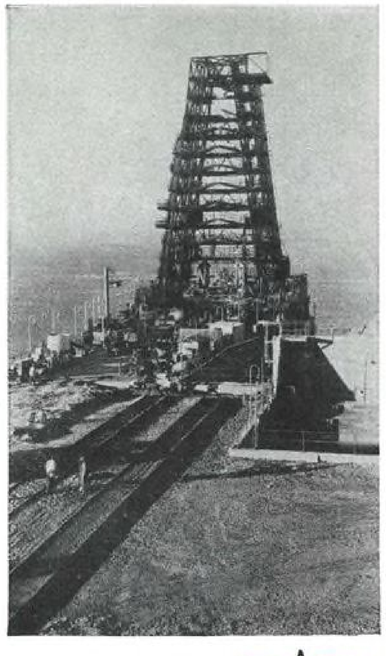


Pacific Automation Products' *systems engineering service*, based on broad missile, aircraft, radiation, communication, computer and allied electronic experience, is available to assist you in your military and commercial projects.
This comprehensive service integrates and coordinates the cabling responsibility for a system in one facility.

PROGRESSIVE STEPS TO RELIABLE CABLING SYSTEMS

ANALYZE	overall system
PROPOSE	engineering concept of cable requirements conceived by the following criteria: combining circuits; minimizing total number of cables; establishing re-usable standard types
ENGINEERING	liaison team supplied to function with customer's engineering staff, designing cables concurrently with development of the overall system
MANUFACTURE	ready-to-install cables to be available as required
INSTALL	prefabricated cable and connect to terminal hardware in schedule with project activities
CHECK-OUT	the cable system to guarantee compatibility of cable installation with the overall function of the system
DOCUMENT	the complete cable system, including drawings, broken down into components covering consideration to segregation of elements that may be used as building blocks for future addition to the system

Reliability is the product of this comprehensive *systems engineering service* . . . achieved only through the thoroughness of the above procedure. For additional information regarding Pacific Automation Products' *systems engineering service*, write for Bulletin 162.



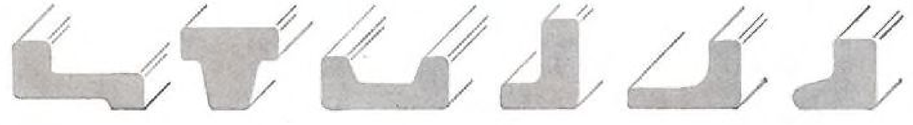
Pacific Automation Products, Inc.
1000 AIR WAY, GLENDALE 1, CALIFORNIA
CHapman 5-6871 • TWX: GLN 7371
137 Walnut Hill Village, Dallas, Texas FLeetwood 2-5806

Engineers and technicians are invited to investigate career opportunities with us. Submit resume for an interview.

AMWELD® HITS YOUR COST TARGET

Value analysis has made cost a prime target for today's industrial buyer. Amweld rings, rolled and flash welded from mill-rolled or extruded sections, have a proven record of cost savings for America's leading manufacturers of jet engines. For example, a ring originally designed as a casting cost $280.00. Purchased from Amweld as a rolled and welded ring, the cost dropped to $59.37.
Contact American Welding to find out how you can cut costs in your plant by using rings rolled and flash welded from mill-rolled or extruded shapes.

THE AMERICAN WELDING & MANUFACTURING COMPANY
420 Dietz Road • Warren, Ohio



AMERICAN WELDING
The World's Leading Manufacturer of Welded Rings

APRIL 15, 1957

AVIATION WEEK

VOL. 66, NO. 15

Editorial Offices

New York 36—330 W. 42nd St., Phone: LOngacre 4-3000 (Night LO 4-3035)
Washington 4, D. C.—National Press Bldg., Phones: NAtional 8-3414, REpublic 7-6630
Los Angeles 17—1125 West Sixth St., Phone: MAdison 6-9351
Dallas 1—1721 Commerce St., Phone: RIverside 7-5117
European Office, Rue du Temple, Geneva, Switzerland

COVER: First picture of the Lockheed X-7 test vehicle with booster shows launch from B-29. Booster has its own tail surfaces which are much larger than the tail section of the vehicle itself. Booster accelerates the vehicle to supersonic speeds, at which point Marquardt 36-in. ramjet cuts in. Vehicle tests the ramjet, destined for Boeing Bomarc air defense missile, and missile components. It is mounted under right wing of B-29 for launch. (Other pictures on page 69.)

Picture Credits:
32, 65—Wide World; 33—Levy-Shipp; 115—Erwin J. Bulban.

69,349 copies of this issue printed
AVIATION WEEK • APRIL 15, 1957 • Vol. 66, No. 15
Member ABP and ABC

EDITORIAL

A Strong Step Forward

Formation of a three man Airways Modernization Board as proposed to President Eisenhower by Edward P. Curtis, his special assistant for aviation facilities planning, is a strong step forward toward ultimate solution of the air traffic control problem.

This board can avoid many of the administrative deadlocks and pitfalls of the previous government machinery that has whirred so long without much positive result. It can also serve an extremely useful function in keeping the development and co-ordination of a joint military-civil traffic control and navigation system going in the interim that will inevitably occur before a major and final overhaul of the government aviation agencies can be accomplished.

Interim Nature

It is necessary to understand the essential interim nature of the Airways Modernization Board if its value is to be assessed properly by the industry and government agencies concerned. The AMB cannot be of any immediate help in untangling the traffic control snarl. That is the job of the Civil Aeronautics Administration.

Improvements during the next 18-36 months are dependent on the program proposed by CAA Administrator James T. Pyle for which appropriation requests are now before Congress. If the Congressional critics of the traffic control snarl want immediate action they can best insure it by full support of the current CAA airways and navigation appropriation requests.

Nor can the AMB insure the emergence of the ultimate automatic navigation and air traffic control system that will be required in another decade to handle the twin problems of a vastly expanded civil air traffic and an infinitely more complicated air defense problem. That can come only after the major overhaul of government aviation agencies has been completed. We expect Mr. Curtis will have more to say about this reorganization in his final report to the President.

Readers of AVIATION WEEK will find no startling surprises in the interim report of Mr. Curtis. He notes, as we have hammered during the past several years, that the air traffic control problem is genuine and will grow worse if not dealt with promptly. "The alarm which has been voiced in the past from many sources is in fact supported by evidence that our airways and terminals are subject to increasing congestion," Mr. Curtis reported to the President. Mr. Curtis also echoes our contention that the principal stumbling block in achieving more progress in this field is not technical development but the administrative snarl of the current inter-agency mechanism of the federal government.

"I found there was no lack of scientific ideas," Mr. Curtis reported. In fact, an over-abundance of electronic systems had been developed in the laboratory to improve our terminal and en route operations. Most of these have been shelved and never used.

"The key to this dilemma may be found in the organizational arrangements in the executive branch which are intended to set goals, to develop and to select the systems and methods which will meet these goals. The problem of modernizing the airways was clearly recognized in 1948 as one that required urgent action. The actions taken since then have not been effective."

The three-man AMB with one representative each from the Department of Defense and Commerce plus a deadlock-breaking, presidentially appointed chairman should avoid the administrative stalemates that wrecked two earlier air navigation development boards and created the bitter Tacan VOR/DME battle. At the same time this new AMB will not interfere with the quick-fix program CAA, under the leadership of Pyle, is already pushing to ease the traffic control pressure during the next few years. There is a "gray area" where the current CAA program ends and the new AMB proposed program would begin to intermesh. But with the present CAA leadership and the will to make progress that must dominate the new AMB, this probably will not become a serious problem.

Technical Forum

The new AMB will not and should not prevent strong arguments over the relative merits of various proposed navigation and traffic control systems. This type of technical debate is vitally necessary to sound progress. What the AMB can do is to provide a universally respected forum for these debates and the mechanism of getting quick, sound decisions on the controversies.

The private pilots, airline passengers, airline managements, USAF and Navy and all of the other elements that want and need a progressively improving solution to the traffic control problems now have a clear cut program that they can support.

First and foremost they should push for complete and speedy execution of the current CAA program that will alleviate congestion in the air for the next two to three years. Second they should push for the creation of the Airways Modernization Board, as proposed by Mr. Curtis and recommended to Congress by President Eisenhower and support this board fully when it swings into action. Third, they should await with interest Mr. Curtis's final report to the President on the major overhaul of government aviation agencies required for the ultimate solution of the problem.

—Robert Hotz

WHO'S WHERE

In the Front Office

William E. Zander, formerly senior vice president and director of Rheem Manufacturing Co., a director, Kelite Corp., Los Angeles, Calif.

Sherman M. Fairchild, founder and board chairman, elected president of Fairchild Camera and Instrument Corp., Syosset, N. Y. Mr. Fairchild succeeds **John H. Clough,** resigned.

Robert P. Gira, a vice president, Topp Industries, Inc., Beverly Hills, Calif.

Gen. Laurence C. Craigie (USAF, ret.), assistant-Defense Products Group Executive, American Machine & Foundry Co., Los Angeles, Calif.

Andrew H. Bergeson, vice president-Washington, D. C. office, Stromberg-Carlson, a division of General Dynamics Corp., Rochester, N. Y.

Robert P. Williams, Jr., Washington, D. C. representative, Kellett Aircraft Corp., Horsham, Pa.

Col. Norman P. Hays (USAF, ret.), in charge of newly established Washington, D. C. office, Autonetics, a division of North American Aviation, Inc., Downey, Calif.

Honors and Elections

Dr. John T. Rettaliata, president of Illinois Institute of Technology, has been named chairman of the board of visitors for the Air University at Maxwell Air Force Base, Ala. The board, whose membership is at the invitation of Gen. Nathan F. Twining, Chief of Staff, is selected to evaluate curricula, management, and facilities of the Air Force's professional education system.

Richard H. Summerl, electrical design engineer at Douglas Aircraft Co., has been elected president of the Aircraft Electrical Society for 1957. Also: **Peter Duvan,** chief of the Electrical Design Section of Douglas, vice president.

Peter Twiss, test pilot for The Fairey Aviation Co., Ltd., has received the Seagrave Trophy which is awarded annually to the Briton who makes the most outstanding demonstration of the possibilities of transport by land, air or water.

Ross Fleisig, engineering section head-missile guidance systems of Sperry Gyroscope Co., was elected president of American Astronautical Society for 1957.

Changes

Vinko Dolson, factory manager, Convair, a Division of General Dynamics Corp., Fort Worth, Texas. **Gus S. Green** succeeds Mr. Dolson as development manager.

P. M. Prophett, assistant chief engineer-flight test, Convair, a Division of General Dynamics Corp., San Diego, Calif. Also: **C. G. Wolcott** and **Kenneth C. Gordon** have been added to the 880 commercial jet transport sales staff. **K. M. Campbell** succeeds Mr. Wolcott as manager of Convair's Dayton, Ohio office.

John C. Howe, district sales manager-Dayton, Ohio office, Light Military Electronics Equipment Dept., General Electric Co., Utica, N. Y.

INDUSTRY OBSERVER

► Republic Aviation Corp.'s F-105 program includes design projections for seven versions of this basic fighter bomber, including photographic, trainer, low altitude for ground attack and high altitude. The aircraft, which is powered by a P&W J75, can carry three large external stores, one under the belly and one under each wing.

► **Three prototypes of Convair's B-58 supersonic bomber are now being flight tested from the company's Fort Worth Division. Top speed of the aircraft is approximately Mach 1.7.**

► Third-stage rocket motor of Project Vanguard developed by Grand Central Rocket Co. completed pre-qualification tests. Motor is being static tested by Glenn L. Martin Co., prime contractor for Vanguard, at USAF Missile Test Center, Patrick AFB, Fla.

► **Bell Helicopter Corp. has installed a new two-bladed rotor system on its second XV-3 and will test it as a possible alternate to the convertiplane's present three-bladed system. The installation will be shipped to National Advisory Committee for Aeronautics' Ames Laboratory at Palo Alto, Calif., for wind-tunnel testing.**

► Beech and Cessna are considering the Continental T51 600 hp. turbine engine for small twin-engine executive aircraft projects both companies now have on the drawing boards.

► **Convair's Pomona, Calif., missile facility is considering the redesign of the guidance installation in nose of Navy's Terrier surface-to-air missile to eliminate unbalanced condition obtained with cantilevered suspension.**

► Kellett may replace the rotor-tip rocket engines on its KH-15 one-man helicopter with cold-jet type powerplants utilizing kerosene or aviation gas. Primary advantages—increased flight duration and decreased noise.

► **Curtiss-Wright Corp. is looking for new plant acquisitions, particularly equipment companies, with an annual sales volume, or immediate potential, of at least $5 million.**

► Stanford Research Institute is conducting research on skid friction for the Naval Ordnance Test Station, China Lake, Calif. Skid friction of slippers on rails of high-speed research sled tracks is one of the basic problems in sled work.

► **Flame patterns of the burning of stainless steel inserts in sled slippers used on the Convair-USAF rain erosion research sled at USAF Flight Test Center, Edwards AFB, Calif., indicate that the sled actually rides on a molten layer of metal, which acts as a liquid lubricant between the slipper and track rails. Flames extended more than nine feet behind the slippers but disappeared almost completely when the sled entered simulated rainfall on a portion of the track.**

► Work is scheduled to begin next month on the construction of technical facilities at Camp Cook, Calif., in connection with rehabilitation of the site for USAF's ballistic missile training program.

► **Unusual degree of civil-military-industry cooperation is evidenced in the three-way effort to solve the tough airborne proximity warning collision avoidance problem. USAF's Wright Air Development Center, which may soon launch a program at Bendix Radio, is working closely with the Air Transport Assn., and avionics manufacturers are freely exchanging the results of their studies of the problem, releasing data which normally is considered proprietary.**

► Aerojet-General Corp. has completed preliminary planning study for damage potential track recently constructed at USAF Armament Center, Eglin AFB, Fla. (AW Aug. 6, p. 313). Chicago Midway Laboratories is participating in a continuing test vehicle development program for the track.

Washington Roundup

Threat to NACA

National Advisory Committee for Aeronautics' long-standing program of contracting with universities and other institutions for research is meeting strong opposition in Congress.

The House, on the recommendation of Rep. Albert Thomas (D., Tex.), has voted to ban the program. Not only was NACA's request for $770,000 for outside contracting during Fiscal 1958 turned down, but the authority for outside contracting was withdrawn. Thomas heads the House Appropriations subcommittee in charge of the NACA budget.

The matter is now pending before the Senate Appropriations subcommittee headed by Sen. Warren Magnuson (D., Wash.), who favors the program to familiarize college students, professors and scientific personnel with NACA activities.

More USAF Shifts

Major personnel USAF shifts that began with the elevation of Gen. Nathan F. Twining to be chairman of the Joint Chiefs of Staff are continuing. Major job still open is commander of Strategic Air Command left vacant by promotion of Gen. Curtis LeMay to USAF vice chief of staff. Lieut. Gen. Frank Everest, a close associate of Gen. Twining, is expected to get the post although other strong candidates include Lieut. Gen. Emmett O'Donnell and Lieut. Gen. Thomas Power, both of whom have had extensive SAC experience under Gen. LeMay's command. Other shifts include Brig. Gen. Arno Leuhmann to succeed Brig. Gen. Andrew Kinney as USAF information chief; Lieut. Gen. William Tunner to succeed Lieut. Gen. Joseph Smith as commander of Military Air Transport Service, and Lieut. Gen. Francis Griswold to become commander of the Tactical Air Command.

No Funds For OSI

The House of Representatives has refused to authorize positions or new funds for the Office of Security Information in an effort to abolish the controversial agency. There is little chance the Senate will challenge the move. The action was taken in connection with the Fiscal 1958 Commerce Department budget, which becomes effective on July 1. Secretary of Commerce Sinclair Weeks had urged approval of $69,300 for its operations in Fiscal 1958.

Rep. John Moss (D., Calif.), chairman of the House Government Information Subcommittee which recommended abolition of OSI a year ago, applauded the House's action and declared that "the OSI has no clear idea of what it is supposed to do, how it is to go about doing it, and, most important, why." Complaints against OSI's censorship activities, Moss noted, came not only from the press and industry "but also from military and intelligence experts within the government."

Railroad Anti-Trust Suit

Aircoach Transport Assn. has filed a $45 million, triple-damage anti-trust suit against 42 railroads for allegedly monopolizing commercial transportation of military personnel. The group charged the railroads with "predatory rate practices" in allegedly offering below-cost rail transportation to official military traffic and claimed in an affidavit accompanying the complaint that unless the injunction is granted, the supplementary carrier industry will be "defunct."

The group accused the railroads of reducing rates from 10 to 50% below first class fares when competing in bids for traffic with air carriers. It also charged that when a particular troop movement is not likely to bring a bid from supplemental air carriers, the railroads "generally charge the military establishment the maximum price allowable."

Four carriers joined ACTA in the suit—Aviation Corp. of Seattle known as Westair, Regina Cargo Airlines, S. S. W., Inc., and Air Cargo Express.

Intelligence Information

Senate Appropriations Committee is expected to study the basis for U. S. intelligence information on Russian military capabilities before approving defense or foreign aid appropriations. It has been requested to do so by one of the committee's members, Sen. Allen Ellender (D., La.), in a report based upon Ellender's trips to Russia over the past two years. Ellender's position is that U. S. intelligence over estimates Russian strength.

At a committee session, after noting the down-grading of Russian strategic air power by U. S. intelligence over the past year, Ellender commented that "I believe we are getting bum intelligence information. . . . I think that ought to be looked into before we proceed to expand as we are and spend all the money we are. . . ."

Dr. James Doolittle, chairman of National Advisory Committee for Aeronautics, replied: "We would like to have more accurate information. But I would not write off the information what we have as being wholly inaccurate."

Supplemental Proposals

Proposals for two new types of supplemental scheduled air service are encountering vigorous opposition.

• **Stuart G. Tipton,** Air Transport Assn. president, objected that Civil Aeronautics Board's plan to award "supplemental" certificates with limited frequency specifications to irregular air carriers would prove "hopelessly confusing," in testimony before the Senate Commerce Aviation Subcommittee headed by Sen. A. S. Mike Monroney (D., Okla.).

• **Capt. Eddie Rickenbacker,** Eastern Air Lines' chairman of the board protested that "flexible certificates" permitting scheduled airlines to shift operations to handle heavy seasonal loads "would simply create a wind-blown web of gypsy air carriers chasing 'fair weather traffic'." Rickenbacker's protest was contained in a letter to Sen. George Smathers (D., Fla.), a member of the subcommittee who suggested this type certificate to CAB.

Air Coach Transport Assn. and Independent Military Air Transport Assn. testified in support of the CAB proposal for limited certificates. Tipton warned that with authority for limited certificates, CAB could re-write the certificates of local services lines, helicopter operators, and all-cargo carriers, limiting their frequency of operation and type of equipment.

Rickenbacker told Smathers that his suggestion of "flexible certification"—particularly to handle heavy Florida winter traffic—"has already had serious repercussions."

—Washington staff

Scientists Clash with Newbury on Policy

Defense Department advisors fear oblivion under new regime, some see trend as security threat.

By Claude Witze

Washington—The Pentagon's six-month-old Defense Science Board charged with the overall guidance of the long-range military research program is threatened with oblivion under the regime of Frank D. Newbury, new Assistant Secretary of Defense for Research and Engineering.

AVIATION WEEK learned from reliable sources that a crisis in the life of the board, which is presently composed of 20 top U.S. scientists, came at a closed meeting on April 4 where a substantial number of the members heard Newbury outline his program.

The board members left the Pentagon late in the day, following what was described as an "explosion" in which some of the members bluntly told Newbury that they had no desire to serve on the board if they were not wanted.

The board cancelled its regularly-scheduled May 15 meeting and will not reconvene until, and unless, Newbury calls a session.

Queried by AVIATION WEEK, Newbury expressed amazement at a suggestion that any of the board members were disturbed. He said there was no discussion on his part concerning the board's future agendas and that the move to cancel the May 15 session "was their idea."

Newbury Not Impressed

Newbury indicated, however, that he was not impressed by the board's organization and its preparations to consider the scientific program. He said it appeared "they do not know what to do" but insisted that "I have injected nothing into the situation" to alter the board's standing.

Newbury said he will reconvene the board "when I have some problems for them to consider."

From other sources, AVIATION WEEK learned that Newbury's "tone and attitude" toward scientific research leave "most of us unhappy."

Scientists 'Deeply Worried'

Said one of the country's leading scientists who took a prominent part in the April 4 session:

"The leadership of the scientific corps is deeply worried. We fear that this Pentagon trend may result in serious damage to America's storehouse of knowledge and menace the safety of our country in the future."

Another member, equally prominent in the research field, said it was clear to him that Newbury "wants to make all the decisions and not let the board help steer the program."

In this regard, Newbury is considering the appointment of a single advisor on research matters. At the outset, the board approved of his plan to have such an aide, but it later became obvious that Newbury and the aide would make the decisions on what projects held promise and what projects should be dropped.

Several Defense Science Board members are convinced the board never will meet again. Another said he feels Newbury himself will determine the board's future and that he fears the group never will carry the weight and influence it was intended to have.

Board's Origin

The board was created in September, 1956, by Dr. Clifford C. Furnas, last occupant of the now-defunct office of the Assistant Secretary for Research and Development. Like the amalgamation of Furnas' old job with that of the Assistant Secretary for Applications Engineering, which brought about Newbury's elevation, the origin of the board can be traced to the Hoover Commission report of May, 1955.

The Hoover Commission's subcommittee on research and development recommended that the Secretary of Defense "wisely and fearlessly" use his authority over appropriated funds to wipe out duplication and promote effectiveness of the program.

At the same time, the commission said it was alarmed over the lack of "daring and imagination" in the military approach to radically new weapons. It cited the fact that it was the old Research and Development Board, not the military services, that made most important World War II contributions.

The report then pointed out that the most valuable approaches made since the war have resulted from the prodding of civilian scientists and technologists.

For this reason, it recommended that a committee be organized to "canvass periodically the needs and opportunities presented by new scientific knowledge."

Newbury/Wilson Philosophy

The viewpoint of the present Pentagon administration, repeatedly made clear by Newbury and Defense Secretary Charles E. Wilson, is that there should be no financing for a scientific research project unless it holds promise of providing concrete results directly applicable to the department's mission.

The board's charter, authored by Dr. Furnas, is not incompatible with the Newbury-Wilson philosophy. It says the board "shall devote major attention to delineating the scientific opportunities which hold promise of radically outdating present-day concepts of warfare."

The charter also calls on the board to give specific advice on research and development. It cites "the program and administration of basic research, component research, advancement of the state of the art . . . and the effectiveness of research and development in providing combat worthy weapon systems."

Advisory Power Only

The board's power is advisory only, but the high calibre of its membership makes it clear that Dr. Furnas, like the Hoover Commission, planned for the Defense Department to lean heavily upon the capability of its members and to implement their recommendations.

Newbury told AVIATION WEEK he has no intention of changing the board's charter. He also has asserted that, far from neglecting basic research, he plans to favor larger appropriations in future years (AW April 1, p. 27).

Why the Concern

On the other hand, it was learned from a reliable source that several important members of the board are seriously concerned over the decisions that might be made by Newbury and a single research advisor working in the current Pentagon atmosphere. One expert said:

"The members of the board feel that the assistant secretary should want their services and that he should give them real problems and act on their recommendations. This does not appear to be his intention at the present time.

"What we are most concerned about is the general area of cutbacks in view of the constant emphasis on economy. Some terrible mistakes can be made here—mistakes that will endanger our country's future national security."

One of the faults Newbury found with the board's organization was that it lacked a permanent chairman. Actually, Dr. Furnas failed to appoint a permanent chairman because he knew he would be leaving the Defense Department to return to his post as chancellor of the University of Buffalo early this year. He left the chairmanship open so that his successor would be free to make the choice. At that time, Dr. Furnas did not suspect that his office would be abolished and the duties turned over to Newbury.

What Board Accomplished

Prior to the April 4 session, which was called as an extraordinary meeting by Newbury to explain his program, the board had held three other conferences.

A well-informed observer said a "great deal was accomplished in terms of background work and pointing up the trends in research and development." There has been some work done on the draft of a program to improve integration of programs carried on by the military services.

So far, DSB had given no consideration to the question of which projects should be eliminated from Defense Department sponsorship.

R&D vs. Development

Washington—Frank D. Newbury, Assistant Secretary of Defense for Research and Engineering, believes it is administratively impractical to divide a project into its research phase and development phase in deciding whether it is worthwhile to the Defense Department for its potential contribution to national security.

On the other hand, he told the National Security Industrial Assn. last week, he has found it psychologically or politically impractical to handle the review and evaluation of a research and development project as a single package.

The reason: The research office, while important, would be small in numbers.

From his experience in industry, Newbury feels that, "when research and product development are responsibilities of the same working groups, the more intangible research activity usually suffers."

Defense Science Board Members

Washington—Acting Chairman of the Defense Science Board at its Pentagon meeting on April 4 was Dr. Frederick L. Hovde, President of Purdue University, Lafayette, Ind. Dr. Hovde is also Chairman of the Army Scientific Advisory Panel.

Other members of the committee present included:

- Dr. J. A. Stratton, chancellor of the Massachusetts Institute of Technology and chairman of the Naval Research Advisory Committee.
- Dr. James H. Doolittle, vice president of Shell Oil Co. and head of the Air Force Scientific Advisory Board. He also is chairman of the National Advisory Committee for Aeronautics.
- Dr. Alan T. Waterman, director of the National Science Foundation.
- Dr. Allen V. Astin, director of the National Bureau of Standards.
- John W. Crowley Jr., associate director for research of NACA, serving as alternate for Dr. Hugh L. Dryden, NACA director.
- Dr. Clifford C. Furnas, former Assistant Secretary of Defense for Research & Development and chancellor of the University of Buffalo.
- Dr. Frank L. Horsfall, vice president and physician-in-chief of the Rockefeller Institute.
- E. Root, vice president and general manager of missiles systems, Lockheed Aircraft Corp., acting as alternate for William Littlewood, vice president of American Airlines.
- Duer Reeves, executive vice president, Esso Research & Engineering Co.
- Dr. Elmer W. Engstrom, senior executive vice president, Radio Corp. of America.
- Dr. W. J. Sweeney, vice president, Esso Research & Engineering Co.
- Dr. Zay Jeffries, vice president (ret.), General Electric Co.
- Dr. Howard P. Robertson, California Institute of Technology, as alternate for Dr. L. T. E. Thompson, vice president, Norden-Ketay Corp.
- Harry A. Winne, vice president (ret.), General Electric Co.
- Dr. R. W. Cairns, director of research, Hercules Powder Co.
- Dr. Paul M. Fitts, Ohio State University.

Also members of the board but absent at the April 4 meeting are:

- Dr. Richard A. Kern, Temple University.
- Dr. Wilbur Schramm, Stanford University.
- Dr. Detlev W. Bronk, president, National Academy of Sciences.

Air Force Accepts Coleman Cleaner

Coleman Engineering Co. Cole-Vac, one of two prototype runway cleaners built under contract for evaluation by Wright Air Development Center, will be accepted by WADC. The other unit, built by Wayne Manufacturing Co. (AW Dec. 10, p. 97), will be rejected.

AVIATION WEEK learned that WADC will announce the decision this week, and that the Cole-Vac prototype now is in operational use at the center.

Boeing Airplane Co. has ordered the first production model Cole-Vac, AVIATION WEEK also learned. It will be used at Boeing's Transport Division plant at Renton, Wash., where the 707 and KC-135 are in production.

Sandy's Defense Policy Criticized

London—Criticism of Defense Minister Duncan Sandy's new defense policy favoring guided missiles over manned aircraft has been widespread, especially among British aircraft manufacturers.

It is charged by many that the Defense Minister may be writing off manned fighters and bombers a generation too soon. Sir Frank Spriggs, managing director of the Hawker Siddeley Group, asserted:

"In my opinion there certainly should be one more generation of fighters after the English Electric P.1 and another generation of supersonic manned bombers after the Vulcan and the Victor."

May Sell Fighter

Hawker has announced that it will continue with its own funds the supersonic fighter it is developing. A company spokesman says: "We are going on with it for two reasons—first, we may sell it abroad. But I think the main reason is that the government is known to change its mind and we think it is going to change its mind over that and come and ask us for it."

Sandys also has been praised. The gamble seems to be whether there is a war within the next five years. If there is, he will go down as the man who left Britain unprepared in the crisis, equipped with obsolete manned aircraft and not yet equipped with the guided missiles to replace them. If not, he will go down as one of Britain's most brilliant defense ministers for a far-sighted program.

The new British defense policy also is expected to be hotly debated at the meeting of the North Atlantic Council in Bonn, Germany, May 1. Members of the North Atlantic Treaty Organization may apply Britain's reasoning and conclude that nuclear power can largely take the place of manpower, and expect the United States to take up the slack.

Meanwhile, Gen. Lauris Norstad, Supreme Allied Commander in Europe, is expected to reassess the NATO strategic problem.

Deep Budget Slash

The British Defense Ministry disclosed that the economy drive will cut defense expenditures from $4.5 billion this year down to $4.2 billion in the coming fiscal year. The actual cut is

even larger than this since advance planning had called for spending of $4.8 billion in the coming year.

Sandys told Parliament that present medium bombers of the V-class will be supplemented by ballistic missiles. He confirmed that an agreement had been reached with the United States to supply medium-range missiles of this type.

Britain's fighter force will be reduced and assigned the task of defending bomber and missile bases. Fighters will be progressively equipped with air-to-air guided missiles. Sandys said fighter aircraft in due course will be replaced by a ground-to-air guided missile system.

The Ministry did not confirm reports that the United States also will supply antiaircraft missiles as well as ballistic rockets, leaving the question still unanswered.

Sandys reported that nuclear warheads are being evolved for defensive guided missiles. He said high priority also will be given to development of British nuclear weapons suitable for delivery both by manned bombers and ballistic rockets.

Troop Reduction

Britain will make large reductions in the number of troops stationed overseas. It will maintain a central striking force in the British Isles which can be quickly airlifted to trouble spots throughout the world. A substantial fleet of transport aircraft is being built up for this purpose, Sandys reported.

Britain's Second Tactical Air Force in Germany will be cut in half by March of next year. NATO light bomber squadrons stationed in England also will be reduced.

The Royal Navy will be formed around a small number of carrier groups, each composed of one aircraft carrier and a number of supporting ships. "Apart from carriers, the number of large ships will be restricted to the minimum," Sandys said.

Sandys' statements confirmed AVIATION WEEK reports that the English Electric P.1 would be the last of the British fighters and that the supersonic bomber program probably would be dropped also.

Commercial Effect

Cancelation of the supersonic bomber project at Avro may affect Britain's chances of competing in the civil market with a successful supersonic jet transport. There is little doubt that lack of government support for the military project will seriously affect research and development effort by the seven-firm consortium formed to develop a supersonic airliner.

Fact that Sandys has abandoned any hope of defending the entire nation from nuclear attack will, of course, mean smaller production orders for the P.1 and the missiles which follow it. This is a blow to English Electric which had hoped for a better future for its new fighter.

On the other hand, any decision to extend the life of manned fighters will find English Electric in an extremely favorable position.

Third U-2 Crash

A third Lockheed U-2 high-altitude research plane has crashed in eastern Nevada. Cause of the accident, in which Lockheed test pilot Robert L. Seiker was killed, has not been determined. The aircraft was stationed at Watertown Strip, Nevada, an Atomic Energy Commission facility.

First crash of a U-2 near Kaiserlauten, Germany, killed Howard Carey, Lockheed employe; second crash, Dec. 19, in Arizona, pilot R. J. Everett escaped.

ARDC Reorganizes Managerial Offices

Baltimore—USAF's Air Research and Development Command today reorganized a number of offices under the Deputy Commander for Research and Development, abolishing one directorate and creating four others.

The reorganization is strictly managerial, ARDC said. It is designed to give Brig. Gen. M. C. Demler, the Deputy Commander for R&D, closer control over activities for which he is responsible and to utilize manpower more efficiently.

Directorate of Development, headed by Col. J. R. V. Dickson, has been abolished. Col. Dickson becomes the new Assistant Deputy Commander for Research and Development Programs Control. Directorate of Research and Directorate of Engineering remain unchanged.

New Directorates are:

- **Air Weapons,** headed by Col. B. G. Holzman, former chief of the Air Weapons Division in the old Development Directorate. This incorporates his old division and the Guidance and Control Division, except for its Test Instrumentation Branch.
- **Aeronautics,** headed by Col. P. F. Nay. This is made up of the old Aeronautics and Propulsion Division, the former Geophysics Division, and the old Equipment and Materials Division, except for its Photographic Branch.
- **Communications Electronics** headed by Col. G. T. Gould Jr., former chief of the old Communications Electronics Division. This directorate absorbs the Photographic Branch of the old Equipment and Materials Division.
- **Human Factors,** headed by Col. P. H. Mitchell, chief of the old Human Factors Division.

Col. Dickson's responsibilities will include coordination between the six directorates, coordination with the other two deputy commanders and advising Gen. Demler on the status and products of the research and development programs.

Trans American Prepares to Quit

By L. L. Doty

Washington—Trans American Airlines will bring its controversial aircoach operations to a virtual halt next month with the delivery of five of its DC-6Bs to Eastern Air Lines under the terms of a five-year lease filed with the Civil Aeronautics Board last week.

The decision to dispose of its entire fleet of DC-6Bs climaxes a long, bitter struggle by Trans American to stay in business despite a CAB order almost two years ago revoking the authority of the four irregular carriers that operate within the Trans American combine.

The action does not necessarily mean the end of the airline since a pending Supreme Court decision could prolong its corporate existence. If this should happen, the airline will continue service with its remaining fleet of three DC-4s and one DC-3 in charter and commercial air movements (CAM) operations.

Plans to lease the DC-6Bs were taken as a hedge against a possible adverse decision by the high court. In addition to the initial five aircraft, two DC-6Bs which Trans American has on order will be leased to Eastern for four years following delivery in early 1958.

Lease Terms

The lease agreement was signed by the four partners of the Trans American group on behalf of Twentieth Century Aircraft Co., one of the corporations associated with the combine.

Terms are $32,500 per airplane per month or $12.8 million for rental of the seven aircraft over the five year period.

A Trans American official told AVIATION WEEK that the decision to lease the aircraft to Eastern at this time was made while the company's "bargaining powers were not yet weakened" by a possible upholding of the CAB revocation order.

Eastern Airlines plans to use the seven DC-6Bs as high-density, low-seat-cost per mile aircraft in replacement of other aircraft not generally suited to Eastern's route pattern.

Curtis Recommendations Go to Congress

By Philip J. Klass

Washington—President Eisenhower moved quickly last week to obtain congressional authority to create a new Airways Modernization Board in line with the recommendations of Edward P. Curtis, the President's special assistant for aviation facilities planning.

As forecast by AVIATION WEEK (April 8, p. 26), the bill sent to Congress calls for the creation of a new agency to "develop, modify, test and evaluate systems, procedures, facilities and devices" needed to provide "safe and efficient navigation and traffic control to all civil and military aircraft except for those needs . . . peculiar to air warfare and primarily of military concern."

The new agency would be responsible for selecting the systems, procedures and facilities which best meet Common System needs and which "will promote maximum coordination of air traffic control and air defense systems."

The bill provides that when there is "any substantial question as to whether any need is properly a matter of primary military concern, the board is authorized and directed to determine whether it or the appropriate military agency shall have responsibility."

Interim Agency

The new Airways Modernization Board would have a statutory life of three years (to June 30, 1960) and is the first step in what Curtis terms "far more sweeping changes" in the organization of government aviation activities which he expects to recommend in his final report to the President next month.

Curtis believes current traffic control problems are already too pressing and that the lead-time between necessary engineering decisions and full-scale use is too long to let systems planning wait for this major re-organization. The proposed interim agency is "the most expeditious and effective way to commence the long-range development of our air traffic systems," Curtis says in his interim report.

He adds:

"The tenure of three years is . . . sufficient to establish the permanent functions of joint test, evaluation and selection of air traffic systems. This period of time will also permit the Executive Branch to plan further organizational adjustments into which the functions of this new Board will logically fit."

After a Congressional briefing by Curtis on the new agency, Sen. A. S. Mike Monroney (D., Okla.), chairman of the Senate Commerce Aviation Subcommittee, told AVIATION WEEK that he found the proposal "disappointing." Monroney says the "admitted crisis" in air traffic control calls for an "action plan and not the formation of still another study group or board." Congressional hearings on the bill are not scheduled to begin until late this month or early May.

Three-Man Board

The proposed AMB would be headed by a three-man board, consisting of:

- **Chairman,** appointed by the President, not affiliated with any other government agency. Salary would be $20,500. Curtis says the man selected should have a solid background in avionics and operations and adds that he is neither qualified for, nor interested in, the new post.
- **Secretary of Commerce.**
- **Secretary of Defense.**

Board actions and policies will be determined by a majority vote of its three members or their designees. This should eliminate impasses that frequently blocked action in the Air Navigation Development Board where Defense and Commerce Departments each had equal votes, and there was no third member to resolve deadlocks.

The new agency is expected to assume some of the functions of the Civil Aeronautics Administration's Technical Development Center, the Air Coordinating Committee, military research and development centers and probably all the duties of the Air Navigation Development Board. Transfer of such functions and/or facilities from other government agencies will require the unanimous vote of the three-man board plus Presidential approval.

In addition to the three-man board, the Airways Modernization Act of 1957 would authorize the new agency to assemble a staff of scientific and professional personnel from the following sources:

- **Civil Service** up to Grade 18 which has a starting salary of $14,800.
- **Outside consultants** can be hired as needed at rates up to $100 per day.
- **Uniformed military personnel** assigned on a tour-of-duty basis.

Funds for operating the new agency would be appropriated without fiscal year limitations under the proposed bill. The board would be authorized to "construct, improve, renovate laboratories and other test facilities and to purchase or acquire real property" for such purposes. This is to provide a major facility for experimentation and evaluation of new procedures, techniques and systems, a recommendation predicted by AVIATION WEEK. Intricate problems of procedure and equipment can be tried and pilots and traffic controllers can experiment together, bringing the skills of science to bear to resolve their problems," Curtis says.

Common System Procurement

Procurement of ground equipment used in Common System operation will remain the responsibility of the Civil Aeronautics Administration and not be transferred to the new agency. Curtis wholeheartedly backs the present CAA program for immediate facilities improvement—en route traffic control radars, increased pilot-to-controller communications—and does not want to take any action that might disrupt or delay this program.

The new agency will direct its efforts primarily toward the period of 1960 and beyond. Curtis says that initial efforts will be directed toward developing and evaluating computers and data processing equipment suitable for air traffic control and a data link system for relieving present radio spectrum congestion, also confirming AVIATION WEEK's prediction.

The bill provides that technical information on military research and development programs which might find Common System application "shall be furnished to the board to the maximum extent appropriate to insure that Common System application potential is properly considered." This is intended to prevent a repetition of the Tacan situation where the CAA claimed that military security prevented it from learning about the military competitor to its own DME program.

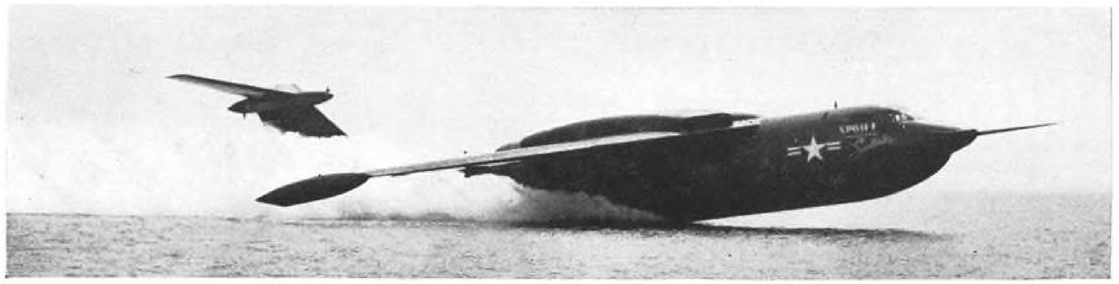
Turbo-Rocket Motor

A turbo-rocket motor is being developed by Marquardt Aircraft Co. The motor uses the by-pass principle to increase the rocket's propulsive efficiency.

The rocket exhaust is directed through a turbine wheel which drives a compressor to compress ram air taken into the system through a conventional inlet. This high pressure air is ducted around the rocket unit and combined with the exhaust from the turbine.

The mixture is then exhausted to the atmosphere to provide thrust. The final rocket exist velocity is brought nearer the vehicle velocity, increasing propulsive efficiency and providing better fuel consumption.

Thrust is lowered somewhat by the system, but it could possibly make the rocket more attractive for propelling long-range aircraft at high speeds.



ATOMIC POWERPLANTS could be incorporated in an aircraft the size of the Martin P6M SeaMaster according to Navy estimates. Initial objective of the Navy nuclear aircraft development program is a low-power, low-performance anti-submarine, radar early-warning seaplane. Hull design similar to the SeaMaster's would be used for maximum rough water capability.

Navy Aims At Low Power Atom Seaplane

By J. S. Butz, Jr.

New York—Magnitude of nuclear aircraft engineering problems has led the Navy Bureau of Aeronautics to concentrate on its program on a low power, low-performance seaplane as holding the best hope of early success.

Such a seaplane with practically unlimited range and endurance would greatly increase the Navy's anti-submarine and radar early-warning capability. It would also provide invaluable experience for the design of an atomic-powered high-speed attack plane.

Engineering considerations which affected the Navy's decision were broadly outlined to the recent Society of Automotive Engineers National Aeronautic Meeting in New York by Commander A. D. Struble, Jr.

Shielding Distribution

One of the major problem areas concerns proper shielding to protect the flight crew and aircraft. Shielding can be concentrated around the atomic powerplant or around the crew or divided between the two areas. Exact distribution of the shielding material has a profound effect on the aircraft's mission, performance capabilities, and stability. It also regulates the radiation dose received by crew and structure.

If the shielding is all placed around the reactor, the crew radiation doses and structural radiation damage may be held to a negligible value. However, weight of such an installation becomes prohibitive when large amounts of power are desired, as for a high-performance attack aircraft.

Shielding weight may be substantially reduced, while still keeping the aircraft safe for a crew, by locating half the shielding material around the crew and half around the reactor.

This approach has some serious problems associated with it. However, it allows the most power per pound of aircraft and consequently the fastest configuration. Heavy concentration of weight at the nose of the plane around the crew compartment is very undesirable structurally and for stability. Accelerations can be high at the bow of a seaplane landing in rough water and heavy structure will be required to support the shielding cage around the crew. Inertia of this heavy cage and structure located a great distance from the center of gravity will make damping of the airplane's motions very difficult.

Lessened Value

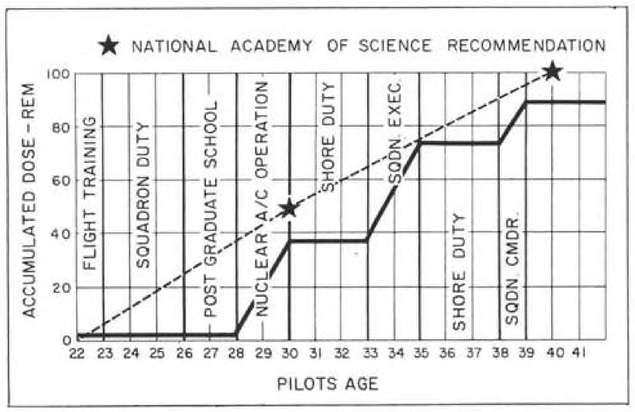
Reduction in shielding around the reactor and resulting rise in material radiation damage could increase maintenance time and lower reliability to the point that the atomic-powered aircraft would not be an acceptable operational weapon.

The compromise facing designers is between high performance, radiation contamination and reduced operating life on one hand, and low-performance and greater reliability on the other.

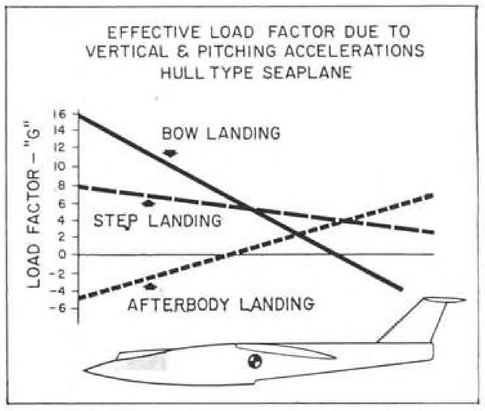
Nuclear radiation will damage organic materials much more rapidly than inorganic. Lubricants, hydraulic oil, rubber, leather, plastics, and many electronic components are all highly susceptible.

In some cases a simple substitution of materials can replace the organic parts of proven aircraft systems and not reduce their efficiency. This is not possible for all organic substances vital to aircraft operation and in these cases completely new systems must be devised to eliminate organic materials or additional shielding weight used around the system.

Amount of radiation damage to any given component is a direct function of the distance and quantity of shielding between the component and the reactor. Therefore, any transfer of shielding from the reactor to the crew's compartment will have a great effect on the efficiency of organic materials which of necessity must remain near the reactor.



PROPOSED Navy program for scheduling an aviator's time in an atomic-powered aircraft with a radiation level that is possible using today's shielding materials. This program of alternating tours of duty would be satisfactory for high-performance aircraft using the divided shield.



LOAD DIAGRAM of the effective Gs that can be experienced at various locations along a seaplane hull during landing. Effective weight of a heavy shielding cage around the crew could be 16G during a bow landing.

Probable Configuration

Navy disclosed a year ago that an aircraft approximately the size of the P6M SeaMaster could be adapted for nuclear power. Subsequent bits of information strongly imply that the Navy will develop an aircraft somewhat similar in size and planform to the P6M, propelled by a low-power atomic engine delivering less thrust than the four J71 turbojets in the prototype SeaMaster.

There is little reason to use a high-performance configuration similar to the SeaMaster if the top-speed of the atomic seaplane was to be considerably less than Mach 1. An obvious conclusion is that some form of auxiliary power would be provided to give the atomic seaplane very high speeds for short periods. The auxiliary power could come from conventional turbojets or rockets.

Resulting combination of almost infinite range and endurance with high-speed capability could give the Navy aircraft wide capability, from radar patrol to bombing any target in the world. It could be a first-line weapon until the completely nuclear-powered, high-performance aircraft was developed.

The task of engineering a workable atomic engine for an aircraft is emphasized by the fact that the power loading (pounds of vehicle weight per horsepower) of the atomic submarine is more than 150 and that of a sonic bomber must approach 4. Lightweight shielding and engine components are therefore mandatory in aircraft.

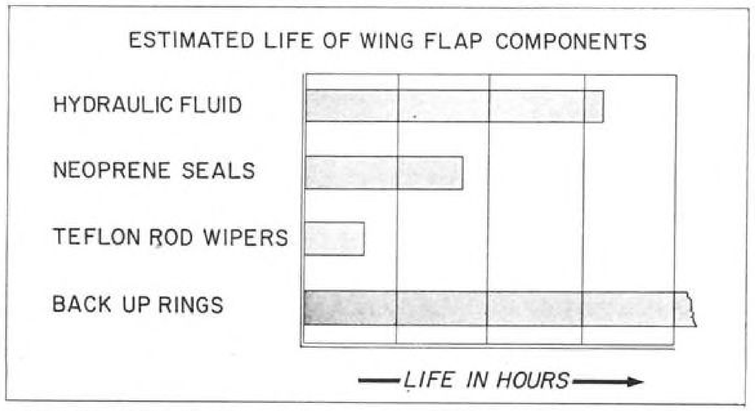
Atomic Heat

Current method of using atomic heat to power an aircraft is to pipe high temperature material from the reactor into a radiator in a modified turbojet engine to replace the conventional burner cans. This was successfully accomplished as long ago as January, 1956, at Idaho Falls, Idaho, using General Electric's experimental aircraft reactor. Keeping this network of hot pipes light and leakproof is a major problem.

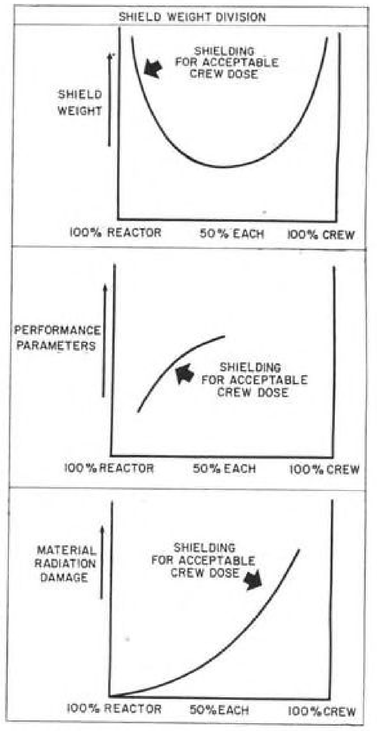
Engine maintenance centers around the question of whether trouble-free reactor operation can be achieved. To make this possible, component reliability must be developed to a new high with all types of malfunctions, leaks, burn-outs, etc. eliminated. If this is not possible, then the reactor must be readily replaceable with a minimum of supporting equipment so that the work could be done at a mobile base. Some of the problems associated with reactor removal are:

- **Designing** a structure with a door to remove a large object.
- **Hoisting** a heavy object while maintaining a continuous flow of coolant to that object.
- **Disconnecting** heat transfer lines and structural attachments while maintaining coolant flow.

It is desirable that this could be done quickly at sea without swaying so that the heavy reactor would not damage the aircraft.



RELATIVE EFFECT of radiation damage on conventional wing flap components is shown. This gives indication of the amount of preventive maintenance that would be necessary to keep the high performance atomic seaplane's availability rate at an acceptable level. Sometimes change of materials will alleviate problem.



LOCATION of the radiation shielding on an atomic-powered aircraft greatly affects the design. General trend of the major effects is shown in the curves.

Reactor starting and stopping is also a problem because some reactors build up Xenon poisoning, which must be transmitted to other elements before the reactor can be started again. This takes considerable time and is not tactically desirable.

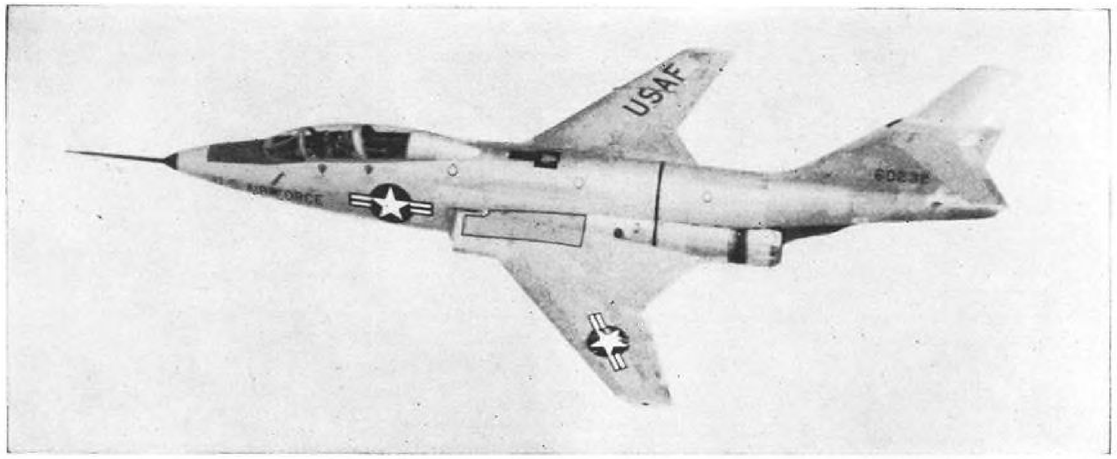
Development of an atomic aircraft was recently described as more than 90% an engineering job and less than 10% research. One of the research problems remaining is to reduce the rate of fuel element failure. Reducing thermal stresses and allowing for differential thermal expansion of the fuel are described as the most difficult problems in this area.

Crew Program

The naval aviator would fly a divided-shielding, high-performance nuclear aircraft for 5 or 6 years out of a total flying career of possibly 18 to 20 years.

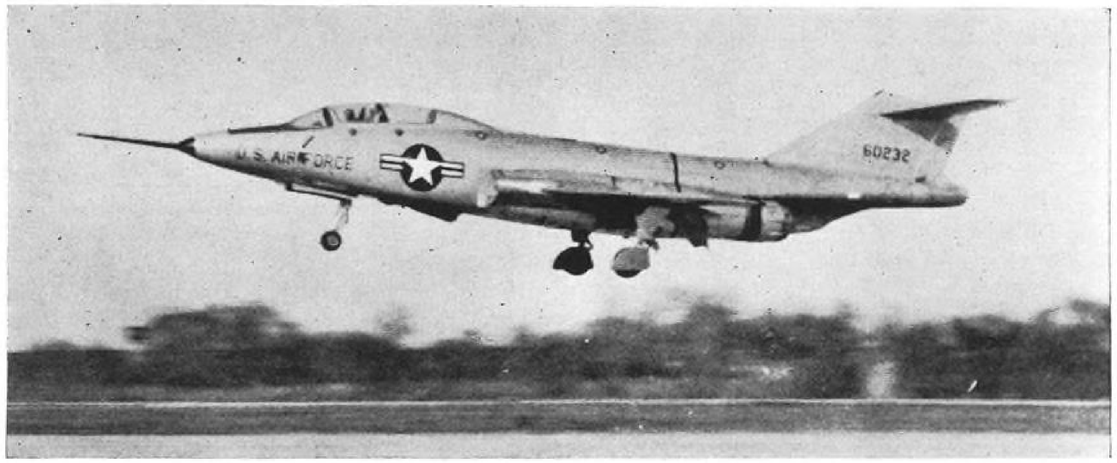
This period in atomic aircraft will be broken up into short tours of duty. Pilot's total radiation absorption will not exceed 90 roentgen/equivalent/man during his service. The safe limit is 100 REM at age 40.

This reduction in the amount of time



McDonnell F-101B Makes First Flight

McDonnell F-101B two-seat all-weather version of the supersonic F-101 made its first flight at Lambert-St. Louis Municipal Airport. Powered by Pratt & Whitney J57 engines, F-101B is designed to achieve high rate of climb and to operate at extreme altitudes. Second crewman is a radar observer. McDonnell said additional USAF orders had been received for F-101B, one of three versions of Voodoo series.



that each crew member will spend in the atomic plane allows a higher crew dose rate to be used in the design. Lower shielding weight and higher performance are then possible.

Nuclear radiation has both immediate (within 30 days) and long-range effects. There are five effects which are considered dangerous on an atomic aircraft:

- **Degradation** of performance.
- **Incidence** of cataracts.
- **Incidence** of leukemia.
- **Shortening** of life span.
- **Genetic** mutations.

First three are immediate effects and require a definite threshold to occur. Radiation on the atomic seaplane will be kept well below this threshold level, thereby preventing these effects.

The last two items are the result of the total radiation absorption experienced over a lifetime. They can never be reduced to zero.

National Academy of Sciences and the Bureau of Standards recommend a maximum total absorption of approximately 100 REM at age 40. If this limit is observed the effect of radiation in shortening the atomic aviator's life will be less than his other occupational hazards. Predicted life span of a military pilot is 8 to 12 years less than the average.

New Dual Ignition Installed in J79s

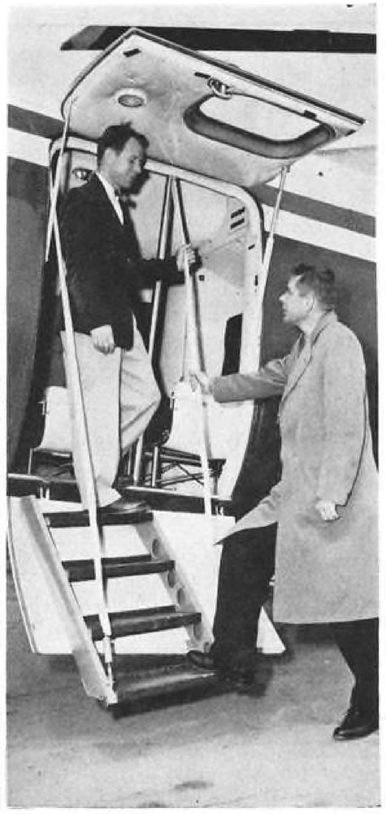
Burbank, Calif.—New dual ignition system is being installed in General Electric J79 engines which power Lockheed Aircraft Corp.'s supersonic F-104A Starfighter.

General Electric is handling the engine improvement program, which will require approximately two weeks.

Installation of the new ignition devices forced a temporary interruption of F-104A flight operations at Palmdale. As soon as improved engines can be reinstalled in the Starfighters, the flight program will be accelerated to meet its previous schedule, according to Lockheed officials.

Last fall, USAF acceptance test pilot R. G. Browne was killed while attempting a deadstick landing after the J79 flamed out during an F-104A acceptance test flight. Last week, another USAF pilot, E. C. Pratt, bailed out of an F-104A after flame-out during a test flight. Early in the XF-104 test program, Lockheed test pilot A. W. Levier successfully landed a prototype after flame-out of the Curtiss-Wright J65 engine used in the XF-104 Starfighter models.

All flameouts occurred over the Antelope Valley test flight area.



VERTOL COMMERCIAL HELICOPTER demonstrated last week at Philadelphia seats 15 passengers in airline version. Two model 44 aircraft displayed bear French markings (top left above). Cabin features soundproofing, carry-on baggage rack, clam-shell loading door.

Vertol Commercial H-21 Certificated

Philadelphia—Tandem Vertol Model 44 commercial helicopter formally received its Civil Aeronautics Administration type certificate here last week after public demonstrations at Philadelphia International Airport. Model 44 is a version of the military H-21 Work Horse (AW April 1, p. 34).

Vertol is offering the seven-ton, single-engined helicopter in three models for summer, 1957 delivery. Basic price of the 15-seat airline configuration is $290,000. Another version, designed for utility passenger-cargo use, will sell for $275,000 in basic form, and a third, executive version will be custom appointed for its buyers with price dependent on the equipment.

Model 44s demonstrated at International Airport are the 44B 15-passenger version. The units are being delivered to the French government for eventual military VIP transport use. Their decor is chocolate brown and gold thread on the seats, beige deep pile carpeting on the floor.

Cabin is soundproofed for noise level comparable to current fixed wing transports.

Model 44 features oval windows, clam-shell main cabin door on left side, carry-on luggage rack plus rear cargo hold for checked baggage. Seats fold against the walls for full or partial conversion to cargo configuration.

Cabin is 20 ft. long, 5½ ft. high, 5 ft., 8 in. wide. Second door at front of the cabin on the right side is used for handling cargo.

Model 44's useful load is 5,345 lb. It cruises at 100 mph., and range is 360 mi. with standard fuel reserve.

Vertol estimates the operating cost of the 15-seat model at 11½ cents per seat-mile with an 800-hr. minimum annual use and based on 100-mi. block operation.

At same block distance but with a 2,000-hr. annual utilization, seat-mile cost will be slightly more than seven cents, Vertol says.

Utility version, Model 44A, is designed to carry 19 passengers or cargo with a 6,000-cu. ft. capacity.

Executive version is Model 44C.

Empty weight of the basic aircraft is 8,655 lb. Emergency flotation gear, by Vertol's figures, would add 213 lb. to

FORWARD CARGO DOOR is feature of Model 44. Cabin accommodates 600 cu. ft. of cargo; 2½ tons can be handled by an external cargo sling. Delivery of new civil copter could start next year. Airliner price will be about $290,000.

Vertol 44 Specifications

PERFORMANCE:

Maximum Speed (At Sea Level)	126 Mph.
Cruising Speed	100 Mph.
Maximum Rate of Climb (Sea Level)	1,050 Fpm.
Effective Range (Standard Fuel Reserve)	360 Mi.
Fuel Consumption (Cruising)	75 Gph.
Hovering Ceiling in Ground Effect	5,000 Ft.
Hovering Ceiling Out of Ground Effect	3,500 Ft.

SPECIFICATIONS:

Gross Weight	
Normal	14,000 Lb.
Military	15,000 Lb.
Useful Load	
Normal	5,345 Lb.
Military	6,345 Lb.
Weight Empty (Standard Equipment)	
Normal	8,655 Lb.
Military	8,655 Lb.
Seating Capacity	
Crew	2
Passengers	15 to 19
Litters	12
Engine Ratings (Wright Cyclone)	
Takeoff (at 2,700 Rpm. at 2,000 Ft.)	1,425 Bhp.
Normal (at 2,500 Rpm. at 3,500 Ft.)	1,275 Bhp.
Maximum Cruise (at 2,400 to 2,500 Rpm.)	900 Bhp.

the empty weight, while flotation landing gear would add 335 lb.

A 1,425-hp. Wright engine powers the Model 44, and Vertol says the engine can be replaced with twin turbines with only minor modifications. Present engine is equipped with two-speed superchargers that allow takeoff from 12,000 ft. elevation with 3,000-lb. payload for 100 mi.

Vertol H-21s have flown more than 100,000 hr., according to the manufacturer. This record helped cut Model 44 certification time to seven months.

House Cuts CAA, CAB Requests

By Katherine Johnsen

Washington—Funds for substantial increases in the activities of the Civil Aeronautics Administration and the Civil Aeronautics Board during Fiscal 1958 were approved by the House of Representatives last week despite present economy drive that resulted in sharp cuts in the requests of the two agencies.

The Fiscal Year 1958 budgets approved were:

• **CAA, $328.3 million.** This is $82.9 million above CAA's Fiscal 1957 appropriation but $82.2 million less than requested.

• **CAB, $44 million.** This is $23 million more than the Board's Fiscal 1957 allocation but $4 million below its request.

The increased budgets will permit CAA to hire approximately 3,350 additional technicians to handle the increasing traffic on the federal airways and staff new navigation facilities, provide 48 additional CAB employes.

On CAA's budget, the Appropriations Committee reported to the House:

"Despite the urgent demand for economy in federal appropriations, there appears to be no alternative but to provide additional funds for this agency. The assurance of maximum safety in flight for the people of the nation must be the primary consideration. . . . New and improved air navigation facilities which will be ready for operation in 1958 must be properly manned if they are to be put into use. Further, adequate personnel must be provided to handle the additional air traffic on the safest possible basis. This is made increasingly difficult due to the speed and range of the modern aircraft coming into use."

In a speech on the House floor, Rep. Prince Preston (D., Ga.), chairman of the Commerce Appropriations Subcommittee, called on airways users to bear a portion of the increasing airways cost.

"The time has come when commercial aviation must pay a user charge for the airways," he declared. "The cost is terrific. It is getting to be so, more and more every year . . . . and commercial users and private fliers should be made to compensate for some of this expense that the taxpayers are having to bear." Military aviation responsible for 45% use of the airways, he added, should transfer funds to CAA for airways' support.

Controller Pay

The Appropriations Committee urged the CAA to study the compensation of airways personnel and said it is "concerned as to whether or not controllers and similar persons who have direct control over and responsibility for the safety of aircraft at airports and in flight are being paid adequate salaries to assure maximum competency."

Of the 48 new CAB employes, 15 were allocated to expedite actions on the Board's backlog of 700 route cases, 25 for auditing activities, seven for studies of airline rates and one to edit Board decisions. Additional auditors are needed, Preston said, "to enable the CAB to cope with the fine accountants and the brilliant lawyers that the large airlines can employ."

CAA Budget

Details of CAA's budget are:

• **Operation and regulation,** $177.7 million. This is $40.9 million above the Fiscal 1957 allocation, but $17.2 million below CAA's request.

• **Establishment of air navigation facilities,** $116.5 million, an increase of $41.5 million over the current year but $58.4 million below CAA's request. The Appropriations Committee also recommended that the Defense Department transfer $21.5 million to CAA to finance the "azimuth" portion of the Vortac system, since military aircraft will be the sole users. The $30.6 million request for air route surveillance radar was reduced to $15.5 million with the explanation that "the program should proceed at a slower rate than proposed to prevent possible duplication between the extensive radar network of the military establishment and that proposed by CAA."

• **Airport construction, $30 million.** A $5 million reduction was made in CAA's request because, the House Appropriations Committee said, Secretary of Commerce Sinclair Weeks believes that airport appropriations "have been too high."

• **Air navigation development,** $1.5 million. This is the same allocation made for the current year but $500,000 below the request.

CAB Appropriations

The two categories of CAB's appropriation are:

• **Administration, $5.2 million.**

Painting by Chesley Bonestell from the book *The Exploration of Mars* by Willy Ley, Wernher Von Braun and Chesley Bonestell, published by Viking Press ($4.95). © C.B.

Manufacturers Push to Meet Jet Deadlines

Aviation Week surveys progress, design changes being made in U. S. commercial turbine transports.

Report beginning on this page on the progress of U. S. aircraft manufacturers toward the production of their respective turbine-powered transports was gathered and prepared by Richard Sweeney and Irving Stone of Aviation Week's Los Angeles bureau.

Los Angeles—U. S. turbine transport manufacturers are pouring men and money into meeting deadlines for first flights, certification and customer deliveries of turbojet and turboprop airliners. An AVIATION WEEK survey of progress thus far shows that:

• **Douglas** has completed 95% of DC-8 engineering, with close to 100% done on the airplane; interiors 69% done; has released 8,519 drawings of the plane into the system. Tooling is well advanced, as is the subcontractor program. New manufacturing facilities at Long Beach for DC-8 final assembly are 97% finished, with some of the 1,079,500 sq. ft. already in operation. First flight target date is now March, 1958, with the first nine airplanes participating in the Civil Aeronautics Administration type certification program. Fabrication of the first airplane has begun.

• **Lockheed,** with earliest deadlines, has virtually completed engineering on its Electra turboprop transport, has 75% of its tooling built, is well into the fabrication of the first airplane, has parts of the second in the works and has more than 50% of the necessary basic research completed.

• **Convair** engineering has reached drawing release stage for the 880 turbojet transport despite the aircraft's late entry into the field. Tooling is under construction, hand-made parts are being tested, and production assembly is scheduled to begin soon.

• **Fairchild,** with operations geared to production of an already designed and certificated aircraft, has 60% of its tooling done for the F-27 Friendship turboprop; has fabrication under way on the first airplane tail sections and wings.

• **Boeing** has completed engineering on its 707 turbojet transport except for varying customer interior furnishing requirements. Tooling is completed for the 707-120 and 220 and is well along for the larger 320 intercontinental model. Fabrication of the first aircraft is well under way, and parts of the second are being formed for subassembly. Some flight testing has been accomplished with the 707 prototype, especially in systems and automatic flight controls.

Start of the turbine transport programs marked the entry of two engine manufacturers, Allison and General Electric, into the commercial field. Both are giving the airframe builder extensive support in developmental and operational testing programs. Pratt & Whitney already is well established with major orders on hand for commercial versions of the J57 and J75 powerplant for Douglas DC-8s and Boeing 707s.

Allison already has installed two Lockheed Electra power packages in its converted Convair-Liner transport. Packages necessitated rework to take the Electra nacelle along with the 501-D13 turboprop engine and Aeroproducts 606 propeller.

Lockheed began test flights March 1 on an Electra nacelle installed in the right outboard position of its flying test bed, Constellation No. 1691. In addition, the company will have a Super G Constellation flying early in July with four Electra power packages.

Although the Allison 501-D13 is a commercial adaptation of the military T56 which powers the Lockheed C-130 military turboprop transport and will have seen extensive service before the first Electra deliveries, the additional flight test program has been established in order to have more than 800,000 flight hours on the engine by the time it enters commercial service.

Supporting Convair, extensive ground testing is now in progress at General Electric's Evendale plant on the CJ-805-1, commercial version of the J79. Convair plans similar runs at San Diego. Meanwhile, Convair and General Electric are piling up increasing flight experience with the J79 in Convair's USAF B-58 supersonic bomber, and the CJ-85 is essentially the same powerplant minus afterburner.

Independently, General Electric is conducting extensive flight tests with the J79 in the F-104, F-101 and F4D at Edwards AFB, Calif.

Smaller medium-haul jets have been under study by Boeing and Douglas.

The Douglas plane, tentatively designated the DC-9, would be a scaled-down version of the DC-8. This is a potent sales factor in that much equipment would be interchangeable, maintenance would be similar and a lower overall investment in spares, training and equipment would be necessary.

Powerplants considered for use in the DC-9 include the Pratt & Whitney J52—a Navy development scheduled to go in the A4D-3—General Electric's CJ-805 and several foreign engines.

Many industry observers, however, feel that the DC-9 will not progress beyond the design study stage. Even today, several sets of specifications for the DC-9 are in existence and powerplants in the desired thrust-weight ratio are limited.

Boeing also has stressed the financial advantages of physically similar, or identical, transports for medium and short-haul route segments.

Boeing has proposed two medium-

NEW DRAWING of Lockheed Electra turboprop revises nacelle shape to conform with Allison engine-Aeroproducts propeller combination, now flying on Super Constellation.

short haul jet transports, the 717 and 727. The 717 will have the same physical size as the 707 but will have lighter material and lower gross weight. The 727 will be smaller, have a lower gross weight. Both are in the design study stage and, like the DC-9, probably will not be built. Powerplants such as the J52, J79, and possibly the Bristol Olympus, are still being investigated.

Douglas

To build its DC-8, Douglas has constructed two new buildings at its Long Beach plant. Engineering, nearly completed except for interiors, is well along at Santa Monica, where other transports are built and all transport engineering is accomplished. Fabrication on the first airplane is under way, first assembly work on the nose section having started on Feb. 18, wing spars assembly beginning in March and main fuselage work beginning on April 1. A second shift has been put on DC-8 major assemblies at the new Long Beach facility.

Parts for the DC-8 are being fabricated at several Douglas Southern California plants and fed into assembly at Long Beach.

Subcontractor parts have started to arrive at Long Beach. Major subcontractors are Ryan, power packages; Cleveland Pneumatic Tool Co., landing gears, and American Seating Co. which is doing some machining work.

Engineering status on the airplane shows that wing, fuselage and powerplant are 99% complete, air conditioning and hydro-mechanical system are 98% completed, avionic and electrical systems 97% done and interiors, where customer requirements dictate progress on this last section of the airplane to be designed, are 69% finished.

The new Long Beach facilities include a structures fabrication building, where subassemblies are built, and the final assembly building for the airplane, which is physically the same size for both domestic and intercontinental models, but with differing powerplants, gross weights and performance.

DC-8 Orders

Douglas now holds 120 firm orders for the DC-8 in both configurations. Customers, number of airplanes, type and engines specified are:

- **Pan American,** 21 intercontinentals with the Pratt & Whitney J75.
- **United Air Lines,** 30 domestics, 12 with the J57, 18 with the J75, a ratio which may change soon.
- **National Air Lines,** six domestics with J75.
- **Eastern Air Lines,** 20 domestics with J75.
- **Delta,** eight domestics, six with the J57, two with the J75.
- **Panagra,** four intercontinentals, J75.
- **Trans-Canada Air Lines,** four intercontinentals with Rolls-Royce Conways.
- **KLM,** eight intercontinentals with J75.
- **Japan Air Lines,** four intercontinentals with J75.
- **Scandinavian Airlines System,** seven intercontinentals with J75.
- **Swissair,** two intercontinentals with J75.
- **UAT French Airline,** three intercontinentals with J75.
- **An unannounced order** for three intercontinentals with J75.

Specification Change

Douglas has issued a new set of specifications for the DC-8 covering two changes in physical characteristics and several performance alterations due to powerplant changes.

Physical characteristic changes from earlier specifications (AW Feb. 20, 1956, p. 103) are an increase in fuselage length from 148 ft., 10 in., to 150 ft., 6 in., and a reduction in lower cargo compartment volume from 1,445 cu. ft. to 1,415 cu. ft.

In powerplants, the Pratt & Whitney J57 commercial engine formerly specified for DC-8 was the JT3C-4, which has been changed to the JT3C-6, with some performance figures changed. There also have been changes in the Pratt & Whitney JT4A-3, the commercial version of the J75, which have resulted in performance specification changes. The same holds true for the Rolls-Royce Conway bypass engine.

For the J57-powered domestic first-class airplane, changes are:

- **Maximum usable takeoff weight** increased to 264,400 lb. from 250,000 lb.
- **Manufacturer's weight empty,** to 115,839 lb. from 114,489 lb.
- **Operating weight empty,** to 121,034 lb. from 119,726 lb.
- **Capacity payload,** space limited, to 33,620 lb. from 34,280 lb.
- **Number of passengers,** to 118 from 122.
- **Range,** statute mi. to 3,940 from 3,550.
- **Cost per airplane mile,** to $1.56 per statute mile from $1.54.
- **Cost per seat mile,** to 1.33 cents from 1.26 cents.
- **CAA field length required** for takeoff, maximum takeoff wt., to 9,869 ft. from 9,440 ft.
- **Range** with 6,500 ft. CAA takeoff field length, to 2,040 statute mi. from 1,830 statute mi.

Tourist Changes

In the tourist version, capacity payload space limited, changes are:

- **Range,** to 3,680 statute mi. from 3,290.
- **Cost per seat mile** to 1.09 cents from 1.07 cents.
- **Range with 6,500 ft.** CAA takeoff field length, to 1,790 statute mi. from 1,770.

For the J75 domestic first class airplane, changes are:

- **Capacity payload,** space limited, to 33,620 lb. from 34,280 lb.
- **Number of passengers,** to 118 from 122.
- **Range,** to 4,060 statute mi. from 4,030.
- **Cost per airplane mile,** to $1.74 per statute mile from $1.72.
- **Cost per seat miles,** to 1.48 cents from 1.41 cents.
- **CAA field length required** for takeoff, maximum takeoff weight, to 7,300 ft. from 8,640 ft.
- **Range with 6,500 ft.** CAA takeoff field length, to 3,470 statute mi. from 2,650.

For the domestic J75 tourist version, only changes are in capacity payload space limited cost per seat mile, which is now 1.21 cents as compared with 1.19 cents for the earlier specifications, and range with 6,500 ft., CAA takeoff field length is now 3,220 statute mi. as compared with 2,495 on former specifications.

International Changes

For the J75-powered first-class intercontinental airplane, changes are:

- **Range, under capacity payload** space limited, to 4,490 statute mi. from 4,470.
- **Cost per airplane mile,** capacity payload space limited, to $1.98 per airplane mile from $1.93.
- **Cost per seat mile,** capacity payload space limited, to 1.50 cents from 1.46 cents.
- **Range with 6,500 ft.** CAA takeoff field length, to 3,070 statute mi. from 3,060.

Tourist version, J75 intercontinental changes are an increase in capacity payload space limited range, now 4,360 statute mi. formerly was 4,330 statute mi; a cost per seat mile increase under capacity payload space limited condition from 1.34 cents per seat mile to a new figure of 1.37 cents; a 6,500 ft. CAA takeoff field length range decrease of 10 statute mi. from 2,960 to 2,950.

Conway Version Changes

Changes in the Conway bypass-powered intercontinental first class airplane are:

- **Manufacturer's empty weight,** to 117,423 lb. from 115,877 lb.
- **Operating weight empty,** to 125,272 lb. from 123,726 lb.
- **Capacity payload** space limited range, to 4,850 statute mi. from 4,810.
- **Capacity payload space** limited cost per airplane mile to $1.80 from $1.835.
- **Capacity payload** space limited cost per seat mile, to 1.36 cents from 1.39 cents.
- **Level flight maximum cruise thrust** at 30,000 ft. at 220,000 lb., to 590 mph. TAS from 582 mph. TAS.
- **CAA field length required** for takeoff at maximum takeoff weight, to 8,870 ft. from 9,000 ft.
- **Range with 6,500 ft.** CAA takeoff field length to 3,330 statute mi. from 3,280.

For the tourist Conway intercontinental, capacity payload space limited cost per seat mile has decreased from 1.27 cents per seat mile to 1.25 cents per seat mile, and range with 6,500 ft. CAA takeoff field length, has increased from 3,190 statute mi. to 3,210.

Lockheed

Lockheed is well along toward meeting its Electra first flight date next Jan. 31.

Basic structural engineering is 100% released to production and tooling, basic functional design is 99% completed, with release expected by the end of the month.

Lockheed has completed test programs in structures, windshield and fire systems. Still ahead are landing gear drop tests, and systems environmental tests.

Lockheed, which already has signed contracts for $125 million for materials for its own use in the Electra program, will fabricate the entire aircraft except for power packages from Rohr, landing gear from Menasco and wing leading and trailing edges from Temco.

Fabrication of the first airplane, which will go to Allison Division of General Motors for additional testing of the 501-D13 powerplant and the Aeroproducts 606 propeller, began last January. Mating of the first wing-fuselage sections is scheduled for Aug. 1; rollout is set for Dec. 1, and first flight for 62 days later.

Wings for the first plane are structurally complete, wings for the second aircraft are in panel assembly jig. First empennage is in assembly at Bakersfield, Calif., where a new 68,000 sq. ft. plant was recently completed for Electra tail construction, along with other subassembly operations for the turboprop Electra.

Major Design Changes

Major differences between early and present Electra are:

- **Tail section** has been redesigned for greater strength.
- **Entire aircraft reappraised** in weight reduction program. Refinements included shortened tailpipes on all four engines.
- **Maximum gross weight** for the aircraft has increased from 110,000 lb. to 113,000 lb. Maximum takeoff payload has been increased by 2,600 lb. to a present total of 21,638 lb.
- **Maximum landing gross weight,** controlling factor for using an airport in the short-medium haul classification without refueling at every stop, is 95,650 lb.

Airliner innovations to be introduced on the Electra include:

- **"Living room" interior,** in which passenger seating is informalized by compartments containing seats distributed around tables with individual and table lamps, arranged in a style similar to a living room. Proper utilization of the compartments results in no loss in the number of passengers the plane can carry. The new atmosphere interior is worth enough to American Airlines for it to accept the six months delivery delay it will cause. Because of this, Eastern Air Lines will be the first to place Electras in service, although American placed the first order.
- **Faster baggage handling procedures,** in which common destination luggage is put into a bin at the check-in counter. The bin is loaded and unloaded on the airplane mechanically, and a greater in-cabin space for passenger carry-on baggage is provided for short distance passengers with smaller bags.

A new luggage handling system was the first manufacturer's move to help reduce delays attendant to today's baggage systems which is practically the same as it was in DC-3 era. Still to come are airline speed-up contributions to go with higher turbine-transport speeds.

The Electra will use a self-contained starting system developed by the AiResearch Division of Garrett Corp. The system provides compressed air bottles for starting one engine, then bleed air starts the other three powerplants. Bottles recharge in 20 min.

Ground Handling

In ground handling and equipment, Lockheed has developed a nosewheel unit that slips the wheel into a free swiveling condition when towing pressure is applied and returns it to its normal controlled position when towing pressure ceases.

The Electra will need auxiliary power units of greater output than those used for today's airliners.

For customer service, Lockheed already has initiated a spare parts program, with a spares contract representative attached to each Electra customer to help plan spares ordering and stockpiling and to coordinate with the factory to insure that adequate spares are always available.

Announced Electra backlog is 133 airplanes worth $245 million with spares. First airline delivery will go to Eastern in September, 1958, the first of 40 on order. Other airlines, their orders and first delivery dates are American, 35, January, 1959; National, 23, April, 1959; Braniff, nine, May, 1959; Western, nine, June, 1959; KLM, 12, September, 1959, plus four others for as yet unannounced customers.

Convair

Entering the jet transport picture late, Convair Division of General Dynamics Corp. is pushing hard to make up for lost time and is making excellent progress.

With 44 of its medium-range 880 jet transports on order—30 for TWA, 10 for Delta and four for Transcontinental S. A.—Convair has scheduled the first delivery to TWA for November, 1959. This initial plane also will be used for pilot training, ground handling surveys and servicing experience. Delta is scheduled to get its first 880 in January, 1960.

By September, 1960, Convair hopes to have completed the first 40 of the medium-range jets based upon a production rate of up to six per month.

Engineering and tooling schedules accomplished to date indicate that Convair may beat the November, 1958, rollout target. This, in turn, accelerate completion of flight test schedules.

880 Progress Survey

A progress survey on the 880 jet transport, powered by four General Electric CJ-805-1 engines, reveals that:

- **Configuration is finalized,** based upon essentially complete wind tunnel data obtained from the National Advisory Committee for Aeronautics' Ames Laboratory installation, the Southern California cooperative wind tunnel and Convair's tunnel at San Diego. Well over $1 million has been spent thus far for model and tunnel tests.
- **Approximately 90% of design thinking** is jelled. Engineering drawings on wing and fuselage structure are scheduled for release next month. This includes all belt frames in the constant section of the fuselage, many of the nose section structural elements, wing spar rails and bulkhead details.
- **Pod, pylon and engine installation** engineering is on schedule at Rohr Aircraft Corp. Rohr is engineering the details under Convair's design concept and will also produce the hardware.
- **Banding gear engineering** is now being carried out at Cleveland Pneumatic Tool Co. under Convair design cognizance.
- **Long lead time procurement items,** such as hydraulic, electrical, fuel and control systems, are getting engineering's top emphasis.
- **Production tooling jigs** for wing and fuselage are now being installed in the area allotted to 880 production. These tools were built at Convair's Plant 1 outside area and were completed about one month ahead of schedule. Installation, however, had to await clearance of plant area previously allotted to

Navy's R3Y turboprop and 440 piston-powered transport production. Technicians will index locating points optically as soon as wing and fuselage jigs are installed.

• **Forming tools and assembly tables** for structural elements are scheduled for construction between time of drawing release next month and August, when wing bulkheads and fuselage belt frames will be fabricated and started through assembly. Pilot's floor and forward fuselage section are scheduled for assembly in January, 1958; first major wing assembly in February, 1958.

• **Hand-fabricated structural elements** are being tested to confirm design criteria. This covers fatigue testing of skin and stringers, system checks on high-pressure bleed air ducting, fuel system tank calibration—using transparent plastic scale models—and acoustic analysis of structural panels. Convair is using the philosophy of employing acoustic mass attenuation by applying thick skins to the fuselage—.062 forward to .10 aft. With this approach, structural skin elements function at a reduced stress level, essentially equivalent to Convair's 440 transport, and, at the same time, provide some of the mass required to satisfy the acoustic damping requirements.

Already complete is the balancing of the cabin interior ventilation system proved in the main mockup.

Scheduled soon is a cold-chamber check on the thermal capacity of the aircraft heating system and insulation. Fuselage section, 228 in. long, encompassing skin, stringers, windows, acoustic and thermal insulation and representative furnishings already are complete and they are waiting for the cold-chamber run.

• **Cockpits** for TWA and Delta have been mocked up in all details and accepted by both customers with no significant changes.

• **Rain clearing** of pilot and copilot windshields is based upon a scheme used on Convair's F-102 interceptor. It uses a jet of hot bleed air across the outside windshield face. In addition, windshields are electrically anti-iced and anti-fogged.

• **Four crew seats** in cockpit are Convair-designed, adjustable for tilt as well as for fore-and-aft and up-and-down positions. Seats are contoured for body comfort for long extended periods of operation. Prototype seats, built by Weber Aircraft Corp., are now installed in the mockup.

AVIATION WEEK has learned that TWA may specify these seats for installation in the cockpits of the Boeing 707s it has ordered.

• **Mockup of cabin interior** is expected to be complete in all respects in the standard 84-passenger version by June 1. This standard version will be convertible quickly to the mixed version or all-coach version.

A mockup module has been styled by Harley Earl, Inc. and decorated by Dorothy Draper Associates in an initial presentation for Convair and customer review.

• **General Electric progress** in sound suppression and thrust reversal for the CJ-805-1, commercial version of the GE J79 turbojet engine, has been followed closely by Convair engineers. Considerable advances have been made, they report, to satisfy operational requirements.

• **Complete engine mockup** of the CJ-805-1, including configuration of the cascade-type reverser, is now at Convair and will be used to demonstrate maintenance features, ease of installation and removal, firewall features, fire detection and extinguishment, plumbing and structural attach points.

Allowable time between overhauls on the CJ-805-1 is expected to reach 1,500 hr. in the first five years of utilization.

Weight Factors

Maximum taxi weight of the Convair 880 is 180,000 lb.; maximum takeoff weight 178,500 lb. Maximum landing weight is normally 130,000 lb. It can be increased to 130,000 lb. with change of wheels and brakes. Maximum zero-fuel weight is 113,000 lb. Space payload limit for the standard 84-passenger version totals 22,360 lb., 13,860 lb. for passengers, 3,360 lb. for baggage—40 lb. per passenger—and 5,140 lb. for cargo at 10 lb. per cu. ft. For the 109-passenger coach version, the space payload limit is 26,525 lb., allocated 17,820 lb. for passengers, 4,032 lb. for baggage and 4,468 lb. for cargo.

Capacity for cargo, mail and baggage is 850 cu. ft. Fuel system capacity is 10,770 gal. for a weight of 72,159 lb. at 6.7 lb. per gal. for kerosene.

880 Dimensions

Dimensions specified for the 880 include wing area 2,000 sq. ft.; span 120 ft.; height 37 ft., 5 in.; length 124 ft., 2 in.; fuselage depth 149 in.; fuselage width 138 in. and interior width 128 in.

In the standard first-class configuration with four-abreast seating, the 128-in. inside width of the fuselage allows 50 in. for each of the two seats abreast and a 28-in. aisle between. Seat spacing is 38 in. center-to-center. Spacing between rows of five abreast seats in the coach version is the same. For two seats abreast in the coach, 45.1 in. is allowed; for three seats abreast 64.4 in. is allowed, with 18.5 in. for the aisle between.

Various combinations of four and five-abreast seating is possible with a quick-change modular feature. Compartment dividers, with additional coat storage, can be placed in five positions in the cabin without additional fittings.

Alternate Seat Plans

Alternate arrangements include: First-class 88 seats; first class with divider, 84 seats; coach 114 seats; coach with forward lavatory, 112 seats; coach with forward lavatory and buffet, 109 seats. Five mixed-class versions vary from combinations of 24 standard and 74 coach seats to 56 standard and 34 coach seats.

Convair reports another arrangement in which the entire plane is laid out in a compartmented club-lounge style, seating up to 98 passengers.

Block times calculated by Convair for some of the typical routes for the 880 include: New York-Los Angeles, 2,468 miles, four hr., 41 min.; Chicago-Minneapolis, 347 mi., 40 min.; Chicago-New York, 729 mi., one hr., 32 min.; Dakar-Lisbon, 1,737 mi., three hr. 15 min.; New York-Shannon, 3,074 mi., six hr., 29 min.; Miami-Panama, 1,156 mi., two hr., 15 min.; Miami-New York, 1,091 mi., two hr., nine min.

At 117,000 lb. landing weight, with no compromise in the payload of 22,360 lb., the 880 can land at more than 150 domestic airports.

For trip lengths of 2,000 mi., a block speed of 556 mph. and average airspeed of 612 mph. under zero wind conditions can be realized, according to Convair calculations. For a trip length of 1,000 mi., block speed is 515 mph. and average airspeed is 615 mph. under zero wind conditions.

Runway Needs

Considering range as limited by runway length, a 5,350-ft. runway will be adequate for landing and takeoff to operate in ranges up to 2,050 mi. with the CJ-805-1 engine. The advanced engine—CJ-805-3—will permit operation to approximately 2,450 mi. with the same runway length under standard conditions at sea level, calculations show. Information is that the CJ-805-3 may permit this distance to be stretched to 2,800 mi.

First-class space payload, Convair says, can be carried to a range of 3,790 mi.; tourist to 3,460 mi., and a maximum weight payload to 3,300 mi., without restriction by maximum structural takeoff gross and carrying reserve fuel for three-quarters of an hour, plus 230 mi., under zero wind conditions.

Maximum speed of plane is 615 mph. true airspeed at 22,000 ft. at 130,000 lb. gross. Limiting Mach number is .85 at 23,000 ft.

Operating Costs

Convair's studies of direct operating costs versus range with zero-wind and engine material costs based upon the engine manufacturer's guarantee of $22 per engine hour for the first two years of operation show that:

• **Direct operating cost per seat mile** in the 88-passenger first class version is 2.1 cents for a 300 mi. range, 1.79 cents for 500 mi., 1.63 cents for 200 mi., 1.575 cents for 1,000 mi. and 1.5 cents for 1,500 mi. where the curve begins to flatten out.

• **Direct operating cost** per seat-mile in the 114-passenger tourist class is 1.6 cents for 300 mi., 1.385 cents for 500 mi., 1.26 cents for 800 mi., 1.215 cents for 1,000 mi., 1.158 for 1,500 mi.

• **Direct operating cost per airplane mile** is $1.85 for 300 mi., $1.58 for 500 mi., $1.43 for 800 mi., $1.385 for 1,000 mi. and $1.32 for 1,500 mi.

Boeing

First production model of Boeing's 707-120 is now being assembled and will be rolled out in October, with the first flight scheduled for December. The aircraft, scheduled to go to Pan American World Airways, will first be used for Boeing flight test work. It will enter its Civil Aeronautics Administration's type certification flight test program by next spring. By the time the first production model begins its CAA test program, additional planes will be available for the CAA program. At the same time, additional new sound suppressor, thrust reverser and other developments will be in flight test on the present prototype, enabling this work to be accomplished without slowing down the certification program.

Boeing has scheduled mating of forward body section and wing of the Pan American plane for next month. Power packages from Rohr are due soon, to be followed by aft fuselage sections subcontracted to Ryan.

Northrop is building the outer 20 ft. of wing panels; Cleveland Pneumatic Tool Co. the landing gear, and the Twin Coach Division of General Motors is fabricating vertical tail control surfaces. Parts from these subcontractors are now arriving at Boeing's Renton, Wash., plant.

Powerplant Proposals

Boeing is offering several planes in two physical sizes with various powerplants. The 707-120, 220 and 520 are the small airplane equipped with J57, J75 and Conway bypass engines respectively. The large inter-continental airplanes are the 320, 420, using the J75 and Conway respectively. Tooling is complete for the 120, 220 and 520, nearly complete for the 320 and 420.

New specifications call for increases in the Boeing 707-120 capacity from 80 first-class passengers version to 124, and from 130 to 150 in the tourist configuration. Maximum gross weight was increased from 230,000 lb. to 248,000 lb. The same changes were made in the 707-220.

The 707-320 and 707-420 models show increases from 124-146 passengers to 131-162 configurations. Maximum gross weight is raised to 296,000 lb. from 280,000 lb.

In the larger airplanes, additional length is gained by adding to the constant cross section part of the fuselage; increased wingspan is gained by adding to a new center section to the wing, with outer panels remaining identical to those of the smaller jets. This has meant little additional tooling for the larger planes.

Boeing has a full scale mockup in New York. Another, in the Renton plant, is of the "basic" airplane in which various interior arrangements and designs can be tried. There also are four cockpit mockups and many 60-ft. typical sections for customer interior tryouts. In addition, there is a full-scale "class 3" mockup of the 707 used as an engineering working tool for final fixer on subassemblies, wiring bundles, tubing runs and accessory installations.

On the 707 prototype, which Boeing has been flying for some time now, CAA is permitting only flight tests of systems, sound supressors and thrust reversers toward type certification. Already tested on the 707 is an incomplete prototype of a Lear automatic flight control system. A production model of this system is being used in the KC-135. Also being evaluated on the 707 is a Bendix Eclipse-Pioneer flight control system. Scheduled for flight test in the future is a Sperry flight control system.

It also is tentatively planned that the prototype 707 will be used by Boeing, the CAA and individual airlines for air traffic control investigations and route familiarization work along with other test programs.

Production Area

Currently, Boeing's Transport Division, which is building USAF's KC-135 as well as commercial jets, utilizes 2.5 million sq. ft. of covered area for production. It has an additional 750,000 sq. ft. under construction, portions of which already are being used.

All mockups, as well as fuselage final assembly, are to be moved into this new area within the next several months.

Total employment for the Transport Division now stands at 15,000 and is expected to rise to 20,000 by the end of the year.

Delivery Dates

Customers for 141 jets worth $638 million including spares, number of planes ordered and date of first delivery:

• **Pan American,** six 120s and 17 320s due in December, 1958, and August, 1959, respectively.

• **American Airlines,** 30 707-120s, February, 1959.

• **Sabena,** four 320s, December, 1959.

• **Air France,** 17 320s, November, 1959.

• **Air-India,** Three 420s, January, 1960.

• **British Overseas Airways Corp.,** 15 420s, December, 1959.

• **Braniff,** five 220s, October, 1959.

• **Continental,** four 120s, May, 1959.

• **Lufthansa,** four 320s, December, 1960.

• **Qantas,** seven 120s, May, 1959.

• **TWA,** nine 120s and 20 320s, due April and November, 1959, respectively.

Fairchild

Fairchild plans call for production only on the Fokker F-27 Friendship, powered by two Rolls-Royce Dart engines rated at 1,680 eshp. Type certification and flight test of the 36-passenger plane will be accomplished at the Fokker factory in Holland, with U.S. CAA officials in attendance.

Tooling for production of the aircraft, for which Fairchild has 62 firm orders from local service airlines and corporations, is 60% complete. The company also has orders for 14 Friendships from foreign customers who will pay in foreign currency.

Materials for outer wing panels, vertical and horizontal tail surfaces have been cut and are in assembly jigs at the Shawnee, Okla., plant of Jonco Aircraft. Fairchild's wholly owned subsidiary. Fairchild's Hagerstown, Md., plant is now being arranged and tooling constructed to accommodate the F-27 production line.

Lockheed's Marietta, Ga., plant has a subcontract to build the F-27 fuselage. Pressurization and air conditioning is being handled by Fairchild's Stratos Division.

Fairchild is now waiting for completion of the type certification, expected in July, before entering a heavy production schedule. Present plans call for two production models to be completed by the end of this year with heavy production buildup from there.

No unorthodox manufacturing techniques will be required for F-27.

BEA Starts Comet Training in June

London—British Overseas Airways Corp. will start crew training this June with two modified de Havilland Comet IIs. The airline is scheduled to take delivery of its Comet IV's late next year.

The modified Comet IIs will each have RA 29 Avon engines in the outboard position, with less powerful Avons inboard.

Capital President Says Viscount Slandered by Competing Airlines

By James Dailey

New York—Capital Airlines' Viscounts have been subject to "vicious and unethical attacks" by competing airlines, Capital President J. H. Carmichael asserted.

"Since the first arrival of the Viscount in June of 1955," Carmichael charged, "its operation has been subject to the most vicious and unethical attacks on a continuing basis concentrated on places that the attackers thought would do the most harm. I was thoroughly shocked and disturbed by these attacks when I first learned of them and I still am. . . .

"I want to say here and now that neither Capital nor I as president, will ever lend ourselves to this type of program used against us. We will never employ such unethical tactics."

Carmichael said the competition, which he did not name, went so far as to have its pilots deride the Viscount to their passengers over their airplane's public address systems.

He quoted one pilot as telling the passengers:

"Look sharply now and you'll see us fly past the Viscounts. If you want dependable service, steer clear of Viscounts."

Viscount Defended

Carmichael told of the attacks during a luncheon at the Society of Automotive Engineers' National Aeronautic Meeting and made a defense of the turboprop airplane manufactured by Vickers-Armstrongs, Ltd.

Capital now has 60 of the medium-range, 44-passenger airplanes in operation and 15 more on order. Carmichael said financing now has been arranged for the 15 and delivery is scheduled to start soon.

The company lost $2.8 million last year, but Carmichael said the Viscounts operated at a profit.

"The Viscount carried Capital in a year of transition," he said. "The Viscount is a good airplane and we're not going to go broke operating it. We fly DC-3s, DC-4s and Constellations and we didn't make a profit on any airplane but the Viscount."

Transition was one of the major expenses incurred by the Viscount innovation. Carmichael said the transition into the Viscount itself was less complicated and required less time than that into the DC-4s and Constellations.

"That's another feature that people don't realize," Carmichael said. "Our pilots moving into the Viscount required pilots to move up into other airplanes."

Altogether the chain reaction involved 1,595 flight personnel, 613 of them on Viscounts. Personnel trained for maintenance numbered 885.

Carmichael said the Viscount program wasn't particularly difficult, that the turboprop is a relatively simple power-production system and the major thing the pilots had to learn and completely understand was its fuel management.

Viscount Problems

Reaction of pilots to the Viscount has been favorable, Carmichael said. "I myself have never flown anything I like better. The airplane is maneuverable; its response is instantaneous. The airplane feels even smaller than it is, and there are no mags to check. You just taxi out and take off."

The airline president admitted that the Viscount had its problems. It was found that the cabin conditioning system was inadequate; it wouldn't cool sufficiently on the ground in summer nor heat in the winter. Janitrol air conditioning licked the problem.

Brake troubles were Capital's own fault, he said. The original steel lining was switched to copper to save weight, but the copper heated up and the steel was reinstalled.

Because of the BEA Viscount crash in England recently, the Capital Viscounts were withdrawn from service to replace flap attachment bolts. Carmichael said there was no actual grounding, and the program was completed in 72 hours.

"And despite the rumors," Carmichael said, "we have had no trouble with our landing gear. It's not the fault of the airplane when the pilot lands with the landing gear retracted."

Spar Criticism

Carmichael said criticism of the Viscount has centered on its single-spar wing construction; that it was a fair-weather airplane and had insufficient range.

Defending the single spar, Carmichael said there are a lot of theories on such construction and no one has yet proved anything wrong with it.

"I notice that the competition's attacks in this area fell off when cracks were found in his own airplanes' main spars."

Carmichael blamed some of the Capital's weather flying problems last winter on the high minimum weather requirements voluntarily imposed on all pilots newly checked out in the aircraft. This consisted of a 100-hr. requirement in the aircraft the pilot was flying.

"Anyone familiar with the equipment could have operated," Carmichael said. "When you have 1,500 pilots operating under high minimum requirements you are going to spend a lot of time on the ground, and as you know last winter was one of the toughest we've experienced. But now we've got one winter of flying under our belt. Watch us next year. We'll have the Big Four airplanes looking down our tailpipes all winter."

Carmichael said the Viscount was the best possible airplane for Capital, whose longest route is 1,000 mi.

"We don't contend that at the best altitudes we're as fast as the DC-7, but gate to gate we're better because we're easier to operate and more maneuverable."

In Europe, he said, BEA is flying Viscounts daily on routes 1,000 mi. or better, but there is too much traffic and congestion to do it in the U. S.

"We've found the ideal range is 600 mi. and we can do 750 mi. very nicely. We didn't buy them to operate any longer than that. We'd just as soon land at Pittsburgh and refuel than wait for hours in a stack over New York."

Carmichael told of a friend who complained of being forced to exchange his ticket from Capital to another airline for a Washington to Chicago flight because the Capital airplane wouldn't fly in the prevailing weather.

"We turned 44 passengers over to the opposition on that flight," Carmichael said, "and we were sort of glad he was able to take them. My friend took off, flew over Chicago for two hours and then landed at Tulsa."

TWA Cuts Are Begun As Burgess Promised

New York—System-wide cuts in Trans World Airlines personnel have begun under a tightening-up program instituted by Carter L. Burgess, the carrier's new president. Burgess told AVIATION WEEK that as many as 10% of TWA's people might be released temporarily to bring about a more balanced work strength (AW Feb. 4, p. 41).

Reductions so far have amounted to less than half of that percentage, AVIATION WEEK has learned. Between 500 and 1,000 employes will be affected during a period which began late last month and will end by the middle of this month. TWA's personnel total is about 20,000.

Cuts have been mostly in TWA's "housekeeping" units. Little or no reduction in operational or maintenance

personnel has been made or is planned. The airline is expecting delivery of new equipment, and the approaching summer high-traffic season will call for some expansion of operating work force.

Service functions within the airline are included in the housekeeping category which has felt the brunt of the cuts. For example, TWA's industrial relations department, which formerly consisted of the Atlantic, Central and Western regions, has been pruned to two units, with the Central region eliminated.

Any further cuts are unlikely until after the peak season.

SHORTLINES

► **Middle East Airlines,** an affiliate of British Overseas Airways Corp., will inaugurate four new services and increase flight frequencies on three established routes as features of its summer flight schedule. The new routes—Beirut-Rome-London; Beirut-Istanbul-Vienna-Frankfurt; Beirut-Bahrain-Doha (Persian Gulf), and Beirut-Athens-Zurich-Paris. Flights between Beirut and Cairo and Beirut-Kuwait will be increased from three to five; the Beirut-Baghdad-Teheran flights from one to two.

► **United Air Lines** and Quebecair have signed an interline agreement permitting each carrier to issue a single ticket or waybill for passengers or cargo on the other airline. United now has a total of 164 interline agreements.

► **International Civil Aviation** Organization has transferred its North American and Caribbean regional office from Montreal to Mexico City in order to put the office nearer the states it serves. The region covers Canada, the U. S., Mexico, the Dominican Republic, El Salvador, Cuba, Guatemala, Honduras and Nicaragua.

► **Swissair** will begin non-stop flights from New York to Lisbon on May 8. The airline will offer two flights a week in DC-7C aircraft. Flights will continue on to Geneva and Zurich. Swissair will be the first European carrier to offer service between the U. S. and Lisbon. The service will be part of Swissair's summer schedule, which also features non-stop flights from New York to Cologne/Bonn and Switzerland and others routed via Shannon, Ireland.

► **United Air Lines** has added special menus for babies on all flights, with a choice of four entrees, three fruits, dessert, crackers and milk.

AIRLINE OBSERVER

► Civil Aeronautics Board is forecasting a subsidy-free year for domestic trunkline, transatlantic and transpacific operations for the first time in its history. Subsidy estimates for 1958 are confined to $28 million for 13 local service carriers, $4 million for three helicopter airlines, $6 million for eight carriers serving Alaska, $283,000 for two airlines operating within Hawaii and $1.7 million for Braniff and Panagra Latin American services. Pan American's previous accrual estimate of $7.3 million for 1957 has been cut to $2.5 million, and the subsidy accrual of $5.5 million originally estimated for 1958 has been eliminated.

► **Air Transport Assn. has warned that "bomb hoaxes" are covered by public law and that such a hoax, as well as actual attempts at destruction of an aircraft, would bring in Federal law enforcement agencies. Latest in a series of crank notes was received by Southern Airways.**

► Majority of air route traffic control centers and towers are now operating on at least a 48-hour week because of the shortage of trained controllers. Civil Aeronautics Board says that, in some instances, controllers are working 60 to 70 days without a day off.

► **Trans-Canada Air Lines will reduce fares on its Canadian routes where there are no competing airlines. The carrier also wants to retain its monopoly on transcontinental Canadian routes and increase its service to the U. S. with routes from Montreal to Boston, Winnipeg to Minneapolis and Vancouver to San Francisco.**

► International Civil Aviation Organization is calling for an improvement in air traffic control and navigation facilities in Central and South America. The group has labeled the deficiency "the largest gap in the world-wide system of flight information" and attributes lack of sufficient trained personnel in government service as the chief cause of the problem.

► **Air Traffic Controllers Assn. has been granted permission by the CAB to participate in all accident investigations involving air traffic control.**

► Air Line Pilots Assn. reports that 17 pilots flying commercial airlines are over 60 years of age. ALPA president Clarence Sayen told the Senate Commerce Committee that "in air transport, mature men of good judgment are required more than daring" in emphasizing his point that the relation between chronological age and physical fitness is vague.

► **Assessment of airlines to cover regulatory costs of the CAB in rate making and route certification was suggested again in recent hearings of the House Appropriations Committee. M. C. Mulligan, CAB secretary and comptroller, testified that levying of charges against individual carriers or applicants before the Board had been studied as a means of recouping regulation costs. Study was suspended, however, in compliance with a request from the Senate Interstate and Foreign Commerce Committee pending an investigation to determine whether such a plan would require statutory authority.**

► Civil Aeronautics Administration is devoting 35% of its engineering staff to jet transports and related problems.

► **Civil Aeronautics Board is authorized only five supergrades in its 625 personnel complement. They include general counsel at GS-17, associate general counsel at GS-16, director of the Bureau of Air Operations at GS-17, associate director of the Bureau of Air Operations at GS-16 and executive assistant to the chairman at GS-16. Board Chairman James Durfee told a House appropriations subcommittee that he believed the CAB to be the smallest independent regulatory agency within the federal government.**

► Aeronaves de Mexico purchased two Bristol Britannia 302s for July or August delivery. Aeronaves expects to get a Mexico City-New York route where it will operate the turboprop transports. The airline now operates Convair 340s and Douglas DC-4s and DC-3s on its Central American routes.

Airline Traffic — February 1957

	Revenue Passengers	Revenue Passenger Miles (000)	Load Factor Per Cent	U. S. Mail	Express	Freight	Total Revenue Ton-Miles	Per Cent Revenue to Available Ton-Miles
DOMESTIC TRUNK								
American	514,830	340,907	61.1	1,581,680	761,747	5,682,657	40,852,927	57.0
Braniff	143,624	59,890	56.2	227,153	109,605	297,431	6,377,312	45.8
Capital	253,378	94,900	56.1	294,663	161,416	207,015	9,762,546	45.3
Continental	53,914	19,844	53.2	67,345	21,972	94,733	2,091,337	45.1
Delta	195,125	99,599	59.76	330,988	239,975	540,131	10,709,082	54.75
Eastern	598,111	377,458	59.88	857,847	396,243	1,090,214	38,867,285	43.68
National	138,704	101,758	65.1	332,493	67,538	484,370	10,793,834	54.5
Northeast	38,755	9,942	49.7	11,592	14,914	44,077	1,021,681	45.2
Northwest	82,505	52,636	49.21	352,808	194,833	593,949	6,207,899	44.04
Trans World	285,099	212,173	55.5	971,967	663,886	1,830,123	23,827,654	50.6
United	409,388	288,392	59.84	2,141,726	881,674	3,615,956	34,363,538	52.97
Western	96,987	46,784	63.5	226,812	88,351	189,198	4,982,005	59.3
INTERNATIONAL								
American	12,633	9,983	75.4	10,778	338	290,480	1,365,511	78.8
Braniff	2,811	5,859	51.5	24,071	.....	63,610	732,195	56.2
Caribbean Atlantic	20,821	1,490	56.68	1,377	.....	3,940	162,716	61.95
Delta	5,478	5,905	68.34	7,125	.....	45,024	709,220	59.37
Eastern	20,760	27,460	68.96	83,119	.....	78,262	3,090,985	59.77
National	9,856	6,216	61.9	9,681	3,967	24,183	694,690	61.1
Northwest	6,737	14,969	46.46	923,075	19,772	579,151	3,119,724	61.37
Pan-American								
Alaska	3,045	3,481	39.1	28,385	.....	136,636	531,978	38.8
Atlantic	52,953	68,787	55.0	1,077,772	.....	190,900	10,697,033	58.7
Pacific	19,241	69,276	71.7	904,602	.....	1,348,782	9,498,682	65.8
Latin America	94,096	86,322	63.3	338,558	.....	3,576,479	12,622,832	65.7
Panagra	11,096	14,925	65.7	55,363	.....	350,855	2,008,110	65.8
Trans World	11,355	28,792	54.5	700,814	.....	730,390	4,543,507	64.4
United	6,250	15,573	65.87	77,633	.....	62,444	1,737,631	59.66
LOCAL SERVICE								
Allegheny	26,128	4,479	37.7	7,351	16,670	8,350	459,544	39.3
Bonanza	10,889	2,469	47.8	4,127	1,924	4,363	246,772	45.8
Central	6,436	1,327	26.6	3,767	2,383	.....	.....	.....
Frontier	14,196	3,940	43.6	18,127	6,361	46,735	448,255	52.1
Lake Central	10,611	1,682	43.4	2,364	10,182	.....	173,333	39.2
Mohawk	27,370	5,114	48.6	4,879	11,004	13,165	517,195	49.2
North Central	42,981	6,922	43.7	18,092	26,229	4,363	246,772	45.8
Ozark	22,160	3,465	35.9	8,925	13,247	.....	701,839	46.7
Piedmont	22,291	4,606	44.4	10,294	9,630	8,392	469,468	44.4
Southern	14,305	2,552	42.5	8,753	8,687	.....	262,053	40.2
Southwest	21,483	4,693	50.0	8,185	3,951	5,817	465,055	48.4
Trans-Texas	17,593	4,016	39.9	13,289	7,497	19,310	423,248	35.2
West Coast	16,620	2,998	43.41	3,680	1,677	3,799	295,158	42.74
HAWAIIAN								
Hawaiian	29,378	4,505	34.2	3,829	.....	95,888	494,350	55.3
Trans-Pacific*	.....	.....	.....	.....	.....	.....	.....	.....
CARGO LINES								
Aerovias Sud-Americana	.....	.....	.....	.....	.....	595,991	595,991	82.6
Flying Tiger	9,000	25,721	99.1	32,788	51,315	4,733,615	7,389,807	80.1
Riddle*	.....	.....	.....	.....	.....	.....	.....	.....
Seaboard-Western	720	3,219	100.0	.....	.....	1,275,841	1,597,742	60.9
Slick	3,850	15,994	94.37	72,768	80,616	4,698,121	6,450,845	72.30
HELICOPTER								
Chicago Helicopter	1,146	18.3	30.9	2,360.5	.....	.....	4,114.3	35.1
Los Angeles Airways	2,483	82	45.5	2,941	1,804	.....	12,660	57.3
New York Airways	3,192	59	29.4	1,155**	864	588	8,298	36.1
ALASKAN								
Alaska Airlines	243	375	15.9	17,944	.....	133,112	191,686	35.4
Alaska Coastal	2,140	189	60.1	3,090	.....	2,274	24,640	63.8
Cordova	946	180	51.4	2,709	.....	20,174	41,111	44.0
Ellis	2,317	150	54.3	1,518	.....	1,788	18,614	67.6
Pacific Northern	5,164	4,672	39.2	62,278	.....	161,356	728,623	49.5

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

MORE ABOUT BRISTOL'S "WHISPERING GIANT"

Noise-level tests prove that the Britannia WHISPERS!

World's largest, fastest, quietest turboprop airliner reduces noise levels to a new low

Official noise-level tests at a large international airport have underlined the amazing quietness of Bristol's Whispering Giant. With a ground noise-level of 81 decibels when taking off, the Britannia was 50 decibels quieter than jet transports flying today, 20-25 decibels quieter than current four-engined airliners . . . and quieter even than twin-engined airliners.

The Britannia carries up to 133 passengers at amazingly low operating costs. She is the world's most versatile airliner because she maintains her matchless standards of efficiency and economy on an extremely wide variety of stage-lengths . . . from 5,500 right down to 200 miles.

Powered by four 4120 h.p. Bristol Proteus turboprop engines, the 175,000-lb. Britannia cruises at a guaranteed 400 m.p.h. with all the smoothness and whispering luxury associated with turboprop flight.

The Britannia has been more thoroughly pre-operationally tested than any airliner ever before. Her structure has undergone over 54,000 simulated flying hours in a pressure tank . . . while her engines have been proved in more than 74,000 flying and bench hours.

She is the latest product of a company long renowned for progressive ability, achievement and reliability in aviation techniques.

The Britannia has met with worldwide recognition and demand. She is now in commercial service with British Overseas Airways Corporation and has also been ordered by Northeast Airlines, Canadian Pacific Airlines, El Al Israel Airlines, Hunting-Clan Air Transport, The Royal Air Force and The British Ministry of Supply.

BRISTOL
Britannia
BRISTOL AIRCRAFT LIMITED • ENGLAND

UNITS IN SIZE from small valves to complete combustion chambers are tested in the components test building of the Army Ballistic Missile Agency at Redstone Arsenal. The cold calibration test stand is in the background (top and left of center).

Hand-Picked Team Develops Jupiter

STREAKS on ground left by rocket blast mark site of powerplant test stand.

COLD CALIBRATION stand permits tests under simulated operating conditions.

By David A. Anderton

Huntsville, Ala.—Development of ballistic missiles for Army Ordnance Corps is assigned to a hand-picked outfit with a top priority: The Army Ballistic Missile Agency.

The Agency's work load is currently proportioned between two major missile efforts:

• **Redstone XSSM-A-14,** a surface-to-surface tactical missile that doubles as a development vehicle for the intermediate range ballistic missile. Redstone range approximates 200 miles. The missile is in production at the Chrysler Corp. in Detroit. Troop training and weaponization has begun with Redstone and it will soon become a field weapon with the Army.

• **Jupiter,** a surface-to-surface intermediate range ballistic missile (IRBM). Range requirement for this missile is 1,500 nautical miles. Jupiter was originally planned for eventual use by both Army and Navy, but the recent directive issued by Secretary of Defense Wilson took operational responsibility for missiles of IRBM range from the Army and gave it to the Air Force. Jupiter will be evaluated technically later this year (1957) against the Air Force-sponsored, Douglas-developed Thor IRBM and the better missile probably will go into service with Air Force and Navy.

Commander of ABMA since February 1956 is Maj. Gen. J. B. Medaris, who organized the Agency in November 1955. Chief civilian scientist on an operating level is Dr. Wernher von Braun.

ABMA's organization is unique within the framework of U. S. missile development programs. On a chart, it is a single box with a single line connecting it to the Office of the Chief of Ordnance. There are no other echelons, no other levels of responsibility or authority.

Autonomous Group

It is an autonomous, self-contained organization with the capability to oversee the ballistic missiles program from basic research right through to the issue of missiles to troops. The Agency does research and development, design and prototype manufacturing, testing and firing of ballistic missiles. It trains individuals and units for ballistic missile operations.

It directs and controls the ballistic missile pipeline between industry and battle use.

ABMA operations are along the lines of two concepts basic to Army Ordnance:

• **Mission arsenal** concept, which places responsibility and authority for development and procurement of classes of material with a single arsenal: automotive at Detroit, ammunition at Joliet, weapons at Rock Island and missiles at Redstone. ABMA is an Agency, not an arsenal. It is not, as many mistakenly think, a part of Redstone Arsenal, although it is housed and otherwise supported by that arsenal.

• **Weapon system concept,** which places responsibility for development and integration of a new weapon into the hands of a single authority. This concept has been part of written Ordnance Corps policy since 1947. One of the first such systems was the Army's Nike anti-aircraft missile with Western Electric Co. carrying the complete responsibility.

To operate within these conceptual boundaries and to carry out its defined mission, ABMA has developed an organization partly classical and partly new. Gen. Medaris has the usual mission staff and service staff common to most military establishments. But the strongest line on the ABMA chart runs between Medaris' office and the three operating divisions:

• **Development Operations Division,** consisting of nine laboratory groups and a technical liaison group.

• **Industrial Operations Division,** made up of the procurement operations and production engineering branches.

• **Support Operations Division,** embracing maintenance engineering, supply and distribution and training branches.

Biggest of the three units is the Development Operations Division, headed by Von Braun. Here is concentrated the research and development skill that goes into the life cycle of a ballistic missile. Theory and practice, fabrication and firing comes under the purview of this division.

The nucleus is formed of ex-German scientists—now U. S. citizens and thoroughly Americanized—who came to this country after a hectic roundup of technical personnel at the end of World War II.

Each of the nine laboratories under Von Braun, plus the technical liaison group and the research projects office, is headed by one of these men.

Ballistic missiles are an old experience to these developers of the A-4 rocket, father of the Redstone and grandfather to Jupiter. Individual experience with these types of weapons extends back about 20 years for most, longer for some.

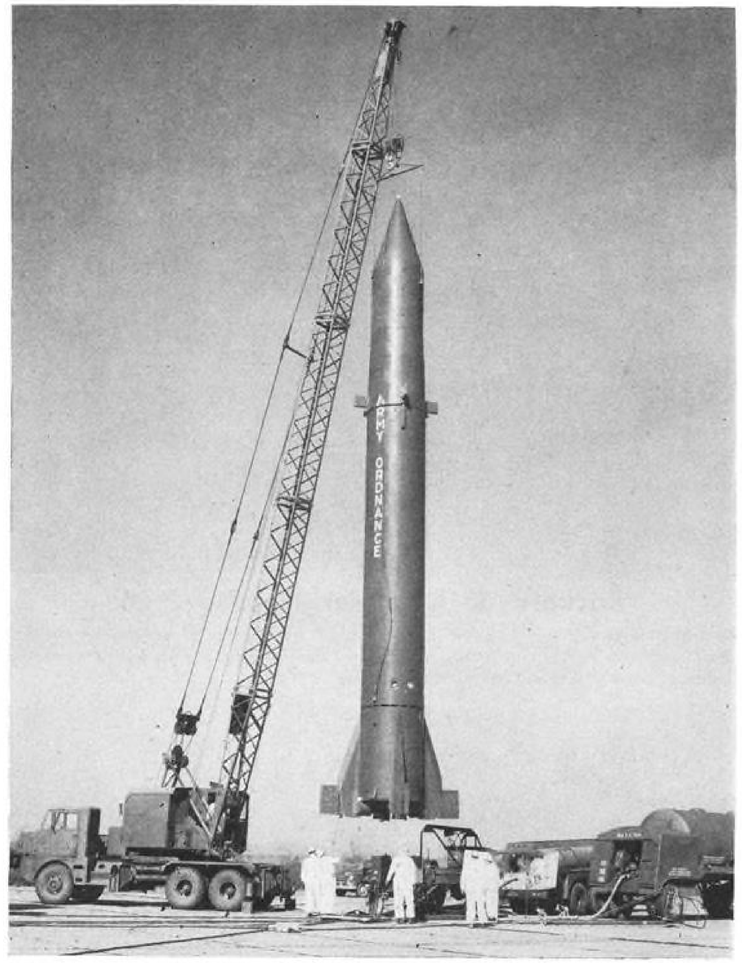
Technical backup for these scientists and engineers is a collection of available facilities—with additional ones being built—that most of the men believe to be the finest anywhere. Digital and analog computers, a Mach 6 wind tunnel with a 14-in. square test section, and a new structure and mechanical laboratory with capacity to test missiles in a vertical attitude under simulated loads, are all part of the extensive laboratory equipment.

But the outstanding portion of the facility is the test stand area.

Test Area Two

The protruding towers of Test Area 2 stab the flat skyline south of ABMA's modern headquarters building. Dominating the grouping is a 140-ft. high concrete tower capable of clasping two Jupiters in pre-flight test runs of the complete missile system.

In its present state the test area represents about $12 million in structures



ARMY REDSTONE is dual-purpose tactical missile and development vehicle for Jupiter IRBM project at Army Ballistic Missile Agency. Redstone is two-piece missile; separation line of warhead is just below upper control surfaces. Thrust unit has rectangular control surfaces on trapezoidal fins.

and equipment. It was designed and laid out with the idea of complete flexibility in mind, so that any foreseeable missile, any system, sub-system or component, could be checked out under simulated operating conditions—cold or hot—at any stage of its development.

To do this, the ABMA scientists planned four test stands:

• **Component test,** where units ranging in size from small valves and regulators to complete combustion chambers can be tested under environmental conditions. This is the first stage of any proving operation.

• **Cold-flow stand,** where powerplant components can be checked either as individual pieces or as a complete system under simulated operating conditions. But as the name indicates, these are "cold" tests—without combustion—to establish the basic flow parameters of the system.

• **Powerplant stand,** where a complete missile powerplant system—tanks, pumps, lines, combustion chamber—can be positioned in a vertical frame and run through a complete flight cycle. System performance, starting reliability, consistency of performance are just a few of the major results from tests in such a stand.

• **Static test tower,** where a complete missile—ready otherwise to be delivered—is pre-flight tested in a captive attitude. This huge concrete tower is the first of its kind to be designed. Instead of being anchored to a mountain, it clings to the earth, resisting thrusts that could go as high as half-a-million pounds. It's an Erector-set kind of tower, whose platforms and servicing arms can be repositioned to accommodate new configurations. In three weeks time, the stand can be completely altered to take any new shape of missile; it was designed to handle any foreseeable shape and size that the mission might demand. Nearby is a standard 45-ton Navy shipyard crane which hoists the missiles in and out of the tower.

The stand can test two complete missiles at once because of its double-sided design. Near its base are a pair of giant angled buttresses that are the blast deflectors. Down their inclined faces water rushes during the tests to protect the concrete surface and the footings. The stand water system has a capacity of 12,000 gallons per minute.

The static test stand, the powerplant stand and the cold-flow stand are all tied into a single data-gathering system.

Other Laboratories

Names of the other laboratories in the ABMA complex define their missions. Aeroballistics operates the wind tunnel and devises new techniques for model and flight testing. The Computation laboratory, in addition to its obvious task, also develops and operates simulators.

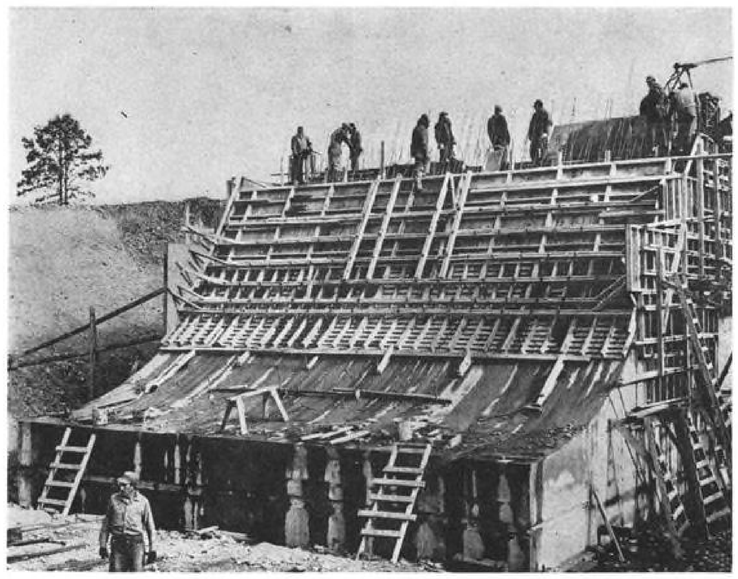
Missile prototypes are built by the Fabrication laboratory, which also is charged with the responsibility for guiding production of the missile on its release to industry.

Guidance and Control laboratory continues the inertial navigation system work that began with the rudimentary system used in the V-2. A major contribution of this lab has been its work on air-bearing gyros with extremely low drift rates.

Launching and handling apparatus and its development is the responsibility of that laboratory. The nine mobile units that comprise a Redstone battery were planned and developed in this unit.

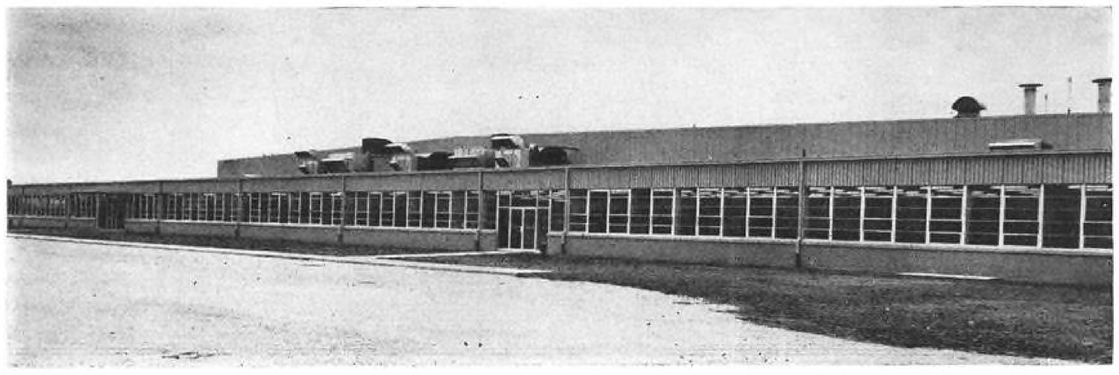
Pride of the Structures and Mechanics laboratory hasn't been built yet, but it's a multi-million dollar three-story structure that will give the lab much-needed space to carry out its job of structural development and test. Part of the new building will be a vertical structure that will take a complete missile for carrying out simulated flight load tests.

System Analysis and Reliability labo-



Rocketdyne Occupies Neosho Plant

Construction of rocket engine test stand (above) at new facility of Rocketdyne Division, North American Aviation, at Neosho, Mo., moves ahead as employes occupy manufacturing building (below). Building has 40,000 sq. ft. of floor space.



Olin Mathieson
Chemical Corporation
one of the world's largest
suppliers of Chemicals, Metals and
Packaging Products, announces

an important new source of Aluminum

OLIN ALUMINUM

A MAJOR NEW OLIN MATHIESON DIVISION — WITH A DYNAMIC NEW CONCEPT OF QUALITY AND SERVICE

Important news for users of Aluminum and other metals is the full-scale entrance of Olin Mathieson Chemical Corporation into the primary Aluminum field.

Right now, limited quantities of Olin Aluminum are being produced at four locations, and soon an initial annual capacity of 240 million pounds will be a reality.

Benefiting from Olin Mathieson's already extensive experience in the metals field, Olin Aluminum will become a major source of unusually fine-quality Aluminum. And as a result of its full integration—from Bauxite to rolling mill—Olin Aluminum will be in a position to assure its customers a *dependability* of delivery that will be of vital importance.

A New Concept of Service Standards

Of equal significance is Olin Aluminum's new concept of service standards. Its new plant facilities will be the finest, most modern in existence—thus assuring the ultimate in production quality and economy. Its technical staff is composed of men of broad and extensive experience—ready to work side by side with your own engineers toward the one best solution to any of your Aluminum problems. And Olin Aluminum's new sales team consists of men with a minimum of five years of thorough experience in the Aluminum field.

The combination of these three things—new plant, experienced technicians and imaginative service personnel—will result in Aluminum of competitively superior metallurgical quality, tolerances and finishes.

A $300 Million Investment

Behind the birth of Olin Aluminum lies an exciting industrial drama. Recognizing the growing world need for Aluminum, Olin Mathieson—already greatly experienced in the production of non-ferrous metals through its Western Brass Mills Division—joined with Revere Copper and Brass to organize the Olin Revere Metals Corporation. The purpose of this united effort was to construct and operate the complete facilities necessary for the production of primary Aluminum. The Olin Revere Shipping Corporation was formed to import the huge quantities of Bauxite needed, and keels were laid for its three giant new 16,000-ton ore ships of revolutionary design.

Simultaneously, at Burnside, Louisiana—an ideal deep-water port—construction was begun on a large new Alumina plant. And on the Ohio River, at Clarington, Ohio, work was begun on the first reduction plant ever to have its own integrated coal supply and power-generating facilities. These new plants, fruits of a $300 million investment, form the assured source of supply for Olin Aluminum.

Better Tolerances, Finishes and Alloys

Two-thirds of the output of this fully integrated primary Aluminum production system will go directly to the new Olin Aluminum Rolling Mill at nearby Omal, Ohio, and to other Olin Aluminum facilities in the Midwest, on the West Coast and on the Gulf Coast. From these modern plants will flow custom-made Aluminum better adapted to your individual needs than any you have ever before been able to obtain. That is the goal of Olin Aluminum: a new concept of quality and service in the Aluminum Industry.

Turn the page for more news about Ω →

"Weaponization"

"Weaponization" is the latest of the coined words generated by missile scientists. It refers to the process by which a tested missile prototype is integrated into a complete weapon system with all its necessary handling, servicing, transporting and maintaining gear. Chronologically, weaponization occurs during the latter phases of the development test program, although planning and designing for weaponization begins—or should begin—almost at the start of the program.

ratory is another of the different types of oragnizations that keep showing up in ABMA. Systems analysis is self-explanatory. Reliability, generally assumed to be everybody's responsibility and therefore in practice nobody's, is one assigned task of this lab. At every stage of missile development, specialists from this unit are there with recommendations or analyses, aimed at improving the reliability of components and systems.

Firings of test missiles is done at the Air Force Missile Test Center at Cocoa, Fla., by the Missile Firing Laboratory.

Missile Procurement

The Industrial Operations Division, headed by Col. John M. Stark, has a dual responsibility in furtherance of the life cycle of ballistic missiles as they progress through the Research and Development phase into full scale production for field use.

During the Research and Development phase, which is the primary responsibility of the Development Operations Division, the Industrial Operations Division furnishes necessary support by arranging for the timely procurement of services, materials and components necessary for the fabrication and test of missile prototypes.

As the design of a missile progresses to the point of standardization or "weaponization" as the term is applied, the engineering and procurement personnel of the Industrial Operations Division assume responsibility for full production and procurement and continued engineering support. This of course, includes the establishment of a Quality Assurance program designed to maintain this reliability and provide for continued improvement of the missile system.

The Procurement Operations Branch, a major organizational segment of the Industrial Operations Division, receives from the Development Operations Division requirements for components and subassemblies of prototype Research and Development missiles to be fabricated at this agency. For those missiles which are operational, the Support and Training Divisions likewise furnish total requirements for missiles for evaluation firings, training and stock pile for field use. The analysis of all these requirements culminates in a planning operation which includes a phasing in of all components and a study of such aspects as lead time and a determination of the necessary deadline for component procurement.

Once the procurement schedule is established, it is placed under continuing coordination with all necessary segments of the agency to assure mission accomplishments. All changes are carefully analyzed to assure that no unknown slippage will result. Changes in lead times are carefully noted and applied in forward planning. Preparation of budget data and future procurement requirements thus have the benefit of current experience.

Once a procurement plan is firm, action is taken through the Ordnance District Office complex to buy the items and services required. Good procurement practice is a must with quality and certainty of delivery on schedule as paramount considerations in selecting sources.

When contract is consummated, continuous follow-up is maintained to assure compliance with desired delivery requirements.

During the Research and Development phase of missile system programs under ABMA cognizance, the Engineer-

ing Branch of Industrial Operations Division is responsible for laying groundwork which will later facilitate conduct of a production engineering program. To this end, Engineering Branch personnel keep abreast of Research and Development progress and interject production engineering requirements to the extent that these do not compromise Research and Development efforts. Thus, quality assurance program is initiated, arrangements are made for preparation of documentation in accordance with approved format, and engineering service is rendered in liaison between the Research and Development group and the Procurement Operations Branch which processes all technical procurements.

Design Improvements

Beyond the aforementioned responsibility during the Research and Development phase, the Engineering Branch of Industrial Operations Division is fully responsible for all engineering work relating to ABMA missile systems when they are ready for production as a tactical weapon. The design evolved under the Research and Development program is normally functionally suitable, but this design can often be improved. Such improvements are made to eliminate components that may be difficult to produce or may use inordinate amounts of critical materials; to eliminate nonstandard items which may be replaced by standard ones without affecting functioning; or to improve reliability, operability, maintainability, or correct weaknesses which are located during operational suitability evaluations and service use.

Unlike the Development Operations Division of ABMA, the Engineering Branch of Industrial Operations Division is staffed to perform principally a technical management function. Detailed redesign and re-engineering during production phase is normally procured as engineering service from industrial organizations or other Government agencies.

Managerial Role

In its managerial role, the operations of Engineering Branch include the maintenance of controls to assure that all changes to initial design of system equipment to improve the product are compatible within the system, consistent with user requirements, desirable from all other technical aspects, and are scheduled so that there will be timely availability of all components which are required for delivery of complete, congruous, tactical systems on established schedules.

A staff representing a cross-section of the Department of the Army is assigned to the Agency with a single intent: To bring the influence of the user to bear on the development program at the earliest date.

The Army hopes to save as much as two years in the development cycle of its missiles by using this approach. The Dept. of the Army staff can monitor the program so that the five aims of the using service—ruggedness, simplicity, reliability, accuracy and flexibility—can be built into the missile system at an early stage.

Senior officer of the Army staff is Col. C. G. Patterson, whose background includes service on the Research and Development Board and a tour at the War College where his thesis was a study of the influence of technology on strategy. Other officers on the staff are drawn from Continental Army Command, Office of the Deputy Chief of Staff for Logistics, Field Forces—but the majority are combat arm officers.

Patterson emphasized that the Army officers are a working part of the Agency and not simply liaison types. Only five of the officers perform administrative staff functions; the remaining 32 are out working in the laboratories.

Feedback from these officers to the requirements branch of the Army General Staff is constant, formal and informal, said Patterson. In addition to providing this much-needed feedback link between the development agency

AIRCRAFT POWER– in whatever form it takes

The imagination and engineering skills which created so many outstanding Pratt & Whitney Aircraft engines—from the dependable and efficient Wasp to the widely-used J-57 turbojet—are today pushing ahead in projects which can influence the whole future of aviation.

Operating in the nose of this modified Douglas C-124 test bed aircraft, for example, is the Pratt & Whitney Aircraft T-57 propeller turbine. A major advance in its field, the T-57 combines a power potential never before realized in a propeller turbine with many operating advantages for efficient, long-range flight. Power plants with these capabilities are required for giant aircraft still under development.

Such achievements show Pratt & Whitney Aircraft's ability to develop the right kind of engine at the right time . . . whether piston engines, turbojets or turboprops—or entirely new engines of the future.

Today, nearly every branch of theoretical and applied science is contributing to progress in aircraft propulsion at Pratt & Whitney Aircraft. Specialists in nuclear physics, advanced metallurgy and electronics, chemical engineering and many other fields—all have vital roles. Whatever form the future takes . . . in new principles of propulsion, new materials or new fuels . . . Pratt & Whitney Aircraft is prepared to offer continued advancement in power plant design and production.

Pratt & Whitney Aircraft

MAIN OFFICE AND PLANT: EAST HARTFORD, CONNECTICUT • BRANCH PLANTS: NORTH HAVEN, SOUTHINGTON, MERIDEN

In Canada: Canadian Pratt & Whitney Aircraft Co., Ltd.

Portion of Eclipse-Pioneer's synchro calibration and test facility.

and the requirements branch, the Army detachment serves to build up a pool of specially trained officers to help in the integration of missiles into field service.

ABMA Personnel

One of the unusual aspects of the Agency is that every man in it from Medaris down was hand-picked because of his abilities. The officers are drawn primarily from the Army's career management program. In some cases, a specific man wasn't available when needed because he had just been assigned somewhere. His file is tagged; when his next assignment is due, he'll be heading for Huntsville.

Because of this kind of staffing, morale is high. There is a close professional relationship between the military and civilian scientists working at ABMA because of mutual respect for each other's skills. Medaris' own background includes large amounts of engineering and field combat; he knows both sides of the missile coin.

A large portion of the credit for the operation of the Agency must be placed directly on the force of his personality and the strength of his technical knowledge.

Ballistic History

Army experience with ballistic missiles started with feasibility studies in the summer of 1943. Guided missile program reached the firing stage in December, 1944, when "hardware" was fired by Jet Propulsion Laboratory. About that time Ordnance Corps contracted with the General Electric Co. to form Project Hermes. Early in 1945 GE personnel started moving through German scientific areas with Ordnance intelligence teams, examining and assessing the technical booty that was being abandoned or hidden by the retreating Germans.

They routed out DPs and vagrants living in V-2 bodies stored near depot sites and shipped almost 100 complete rockets back to the U.S. They went down in mine shafts and abandoned wells to unearth documents and technical files.

They rounded up the scientists and technicians who worked at Peenemuende originally, and who had moved that great installation piece by piece to the Bavarian redoubt. They were shot at and spat at and cursed, but they shipped back the heart of the German ballistic missile program, complete with its people.

After some months spent establishing the status of the Germans—who were wards of the Army first, and then special employes of the War Dept.—and straightening out whether State Dept. or War Dept. had cognizance, they were offered employment with Ordnance Corps at Ft. Bliss, Texas, doing missile development.

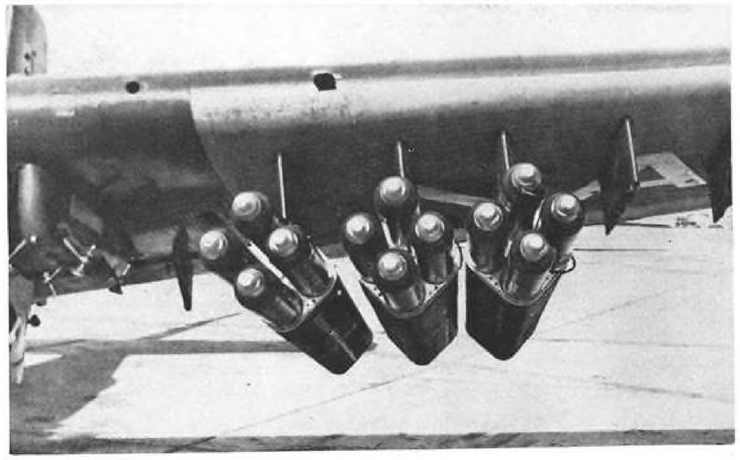
The particular missile they developed there was known first as the Hermes II, a two-stage missile based on the geometry of the V-2 but with the warhead replaced by a second-stage ramjet-powered missile. GE was assigned the supporting task—drafting and fabrication services, as well as firing responsibility.

Redstone Enters

By June of 1950 the guided missile work at Ft. Bliss had outgrown its sand-blasted site. The whole works was transferred to what had been a Chemical Corps plant in Huntsville, Ala., and renamed the Ordnance Guided Missile Center. Later this was changed to the Guided Missile Development Division, Ordnance Missile Laboratories, and responsibility for the Hermes II was taken from GE and assigned to the Redstone Arsenal.

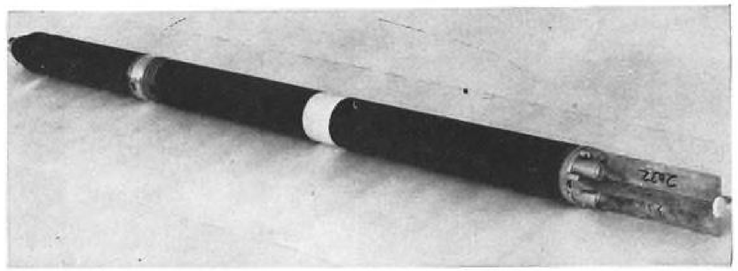
The ramjet-rocket idea was dropped and the Redstone development division was directed in 1951 by the Chief of Ordnance to begin development of an improved missile, the Major, later called Redstone.

Between 1931 and late 1955, the Redstone program carried out its basic tasks of research and development. The first test round was fired in August, 1953 at



Economical Zuni Package

Five-inch Navy Zuni rockets are carried, launched from same packing cases in which they are delivered from factory and stored. Pods are jettisoned after firing. Rockets, which cost $150 apiece, are replacement for World War II High Velocity Altitude Rocket (HVAR). Zuni is folding fin, solid-propellant missile designed for air-to-ground and air-to-air use. Closeup (below) shows folding fins. Rocket was developed by Naval Ordnance Test Station, China Lake, Calif.



the Air Force Missile Test Center, Cocoa, Fla. Spurred by the missiles performance during these tests, the Army made the decision to go into an IRBM program built around the nucleus of Redstone's missile development division.

Gen. Medaris was assigned the job of organizing a new agency to handle the manifold problems of ballistic missiles for the Army, and ABMA was the result. Work on the Redstone weaponization and development of Jupiter progressed on schedule. The only threat of a break came when the first news of the Wilson directive broke in the Huntsville area.

The stories had hardly appeared in local papers before Medaris issued a statement clarifying the problem. It was posted on bulletin boards and passed with routing slips from office to office. It is credited with averting some of the minor panic that always results when policy decisions change the direction of a weapons program.

Early the following week Medaris reemphasized some of the points in the Wilson directive for the benefit of his staff. Developmental work on the Jupiter will continue, he told them.

"After all, this is not a new position for Army Ordnance," he said. "We've often made weapons for other services to shoot. We have no predilections about our customer."

Now only one hurdle remains between Jupiter as a project and Jupiter as a program: The technical evaluation scheduled for this year. At ABMA, they're confident that they will take that hurdle in their stride.

Almost $14 million in new construction is being added for the Agency, which will eventually live on 3,000 acres of Redstone Arsenal's 40,000.

Now under construction for ABMA:

- **Missile inspection** and assembly hangar valued at $2.1 million.
- **Guided missile** test shop valued at $1.2 million.
- **Structures fabrication** laboratory addition valued at $1.1 million.
- **Computations laboratory** valued at $1.463 million.

Contracts have been let for the structures and mechanics laboratory, a three-story, four-in-one complex consisting of a structures and mechanics unit, an office building, an engineering, metallurgy and methods development unit and a shop. Total value of the complex is $4.28 million.

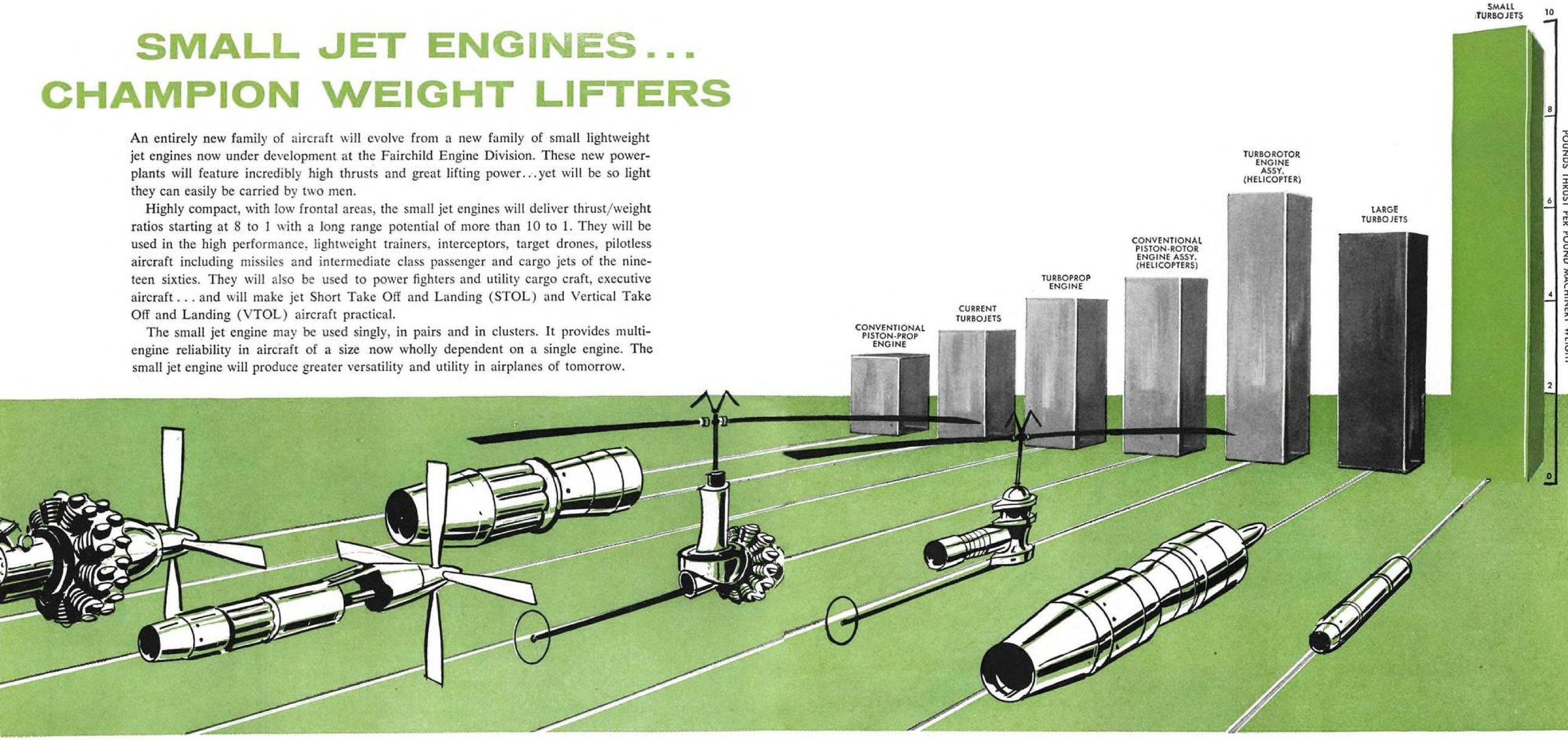
Approval is expected soon for the construction of other projects, including a powerplant test stand, a technical photo and video instrumentation lab and a surface-treatment facility.

SMALL JET ENGINES... CHAMPION WEIGHT LIFTERS

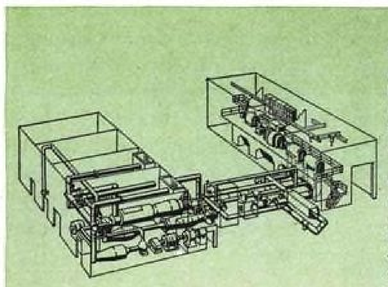
An entirely new family of aircraft will evolve from a new family of small lightweight jet engines now under development at the Fairchild Engine Division. These new powerplants will feature incredibly high thrusts and great lifting power...yet will be so light they can easily be carried by two men.

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

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



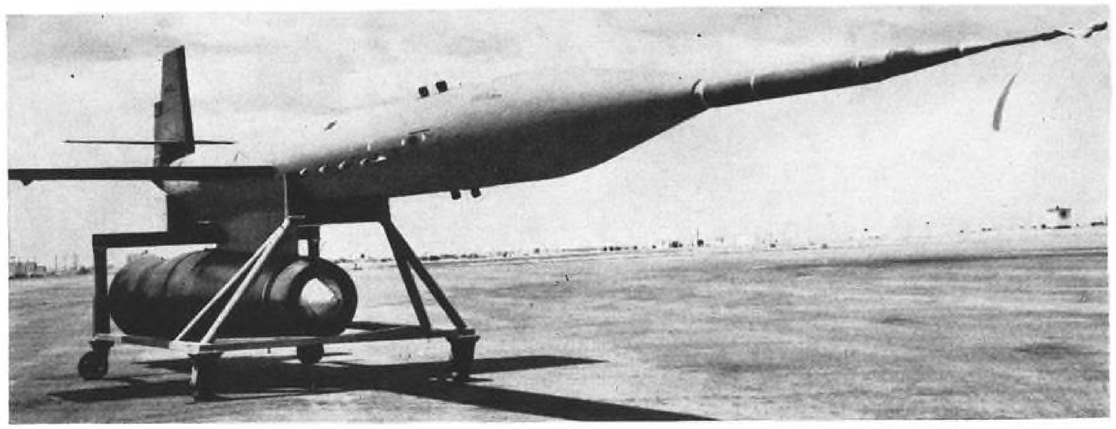
COMPARISON OF LIFTING CAPACITY OF POWER SYSTEMS
How the new family of Fairchild Small Jet Engines compare with other mechanical lifting systems.

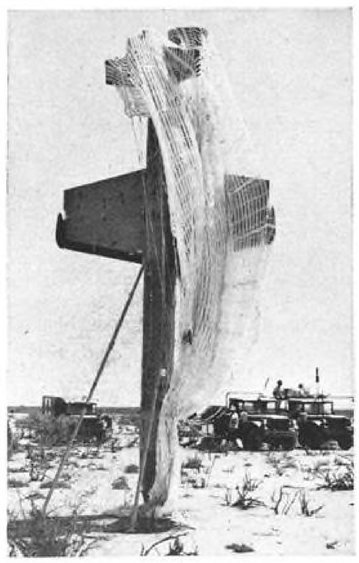


The extensive research facilities at Fairchild Engine Division have been designed solely to test performance of the small jet engine. They range from full scale, high altitude test chambers to supersonic research for component design. Fairchild Engine Division has spent a decade in the design, development and production of small, powerful jet engines.

FAIRCHILD
ENGINE DIVISION
DEER PARK, LONG ISLAND, N. Y.
A DIVISION OF FAIRCHILD ENGINE AND AIRPLANE CORPORATION

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





X-7 Lands On Nose Spike

Recovery and ground handling details for Lockheed X-7 ramjet test vehicle are shown in this sequence at Holloman AFB, N. M. Before mounting under wing of B-29, the X-7 is mounted on caster-wheel dolly (top). Nose spike of vehicle is used for parachute assisted landing (left). Technicians check components (right) before the vehicle is loaded into a truck (below). Vehicle is driven to supersonic speed by rocket booster (see cover), and ramjet cuts in when maximum acceleration is reached. X-7 is used to test the Marquardt 36 in. ramjet engines for Boeing Bomarc (AW Aug. 6, p. 455). Lockheed built a drone version of the X-7, designated the QT5, which used a different and larger Thiokol solid booster. This version was destroyed in crash at White Sands.

BOAC Interested in Victor Civil Version

London—British Overseas Airways Corp. is interested in a civil version of the Victor jet bomber.

In his annual report to Handley Page stockholders, the company chairman, Sir Frederick Handley Page, said BOAC is talking about such a jet for use in the early 1960s. He said it is a more advanced civil development of the Victor than the HP-97 jet transport offered to BOAC in 1952.

He did not give further details of the new project but commented that it was "unfortunate that such interest was not shown earlier, for the country might well have saved the many millions of dollars BOAC is spending on American aircraft."

The HP-97 could have been in service well before American jets if it had been ordered in 1952. He described it as a 100-passenger aircraft capable of non-stop operation between London and New York.

Company is playing a "prominent" role in the combined study of supersonic transports which has been undertaken by the British aircraft industry. The chairman said Handley Page is studying supersonic flutter characteristics and making an analysis of the lift and drag of supersonic wings.

The annual review also emphasized the firm's work on boundary layer control. Proposals have been submitted to BOAC for long-range laminar-flow transports. The report asserted that all-up weight of the Boeing B-52 could be reduced from 400,000 lb. to 225,000 lb. without sacrificing performance if laminar flow were used.

De Havilland Warns Against Fund Cuts

London—Chairman of the de Havilland Aircraft Co. warned that large British defense cuts will place Britain's aircraft industry in a difficult position to compete with foreign manufacturers.

W. E. Nixon, chairman of de Havilland Holdings, Ltd., said that the U.S. industry has strong government backing, with military orders making up nearly 90% of American industry's total sales.

Every possible support must be given to British research and development efforts and to new projects so that the industry can continue to share in civil markets of the world, he said.

In the group's annual report, the chairman disclosed that production of Venoms and Vampires for the RAF and Royal Navy has been cut back. Production of Ghost and Goblin jet engines is also declining. Advanced rocket engines in two forms, for takeoff and for flight, are entering the production stage to be installed in what he termed "a new generation of military aircraft."

Flight trials with the Spectre rocket engine already have begun, Nixon said. Flight testing is to begin shortly of the Gyron Junior turbojet.

Government Explains Troubles With Hunter

London—Hunter Mk. VI and modified Mk. IV aircraft comply with all requirements for operational use at altitude, Supply Minister Aubrey Jones told Commons.

Engines on the Mk. I and IV Hunters were liable to stoppage when the guns were fired. Fitting of modified engines in Mk. IV aircraft began in February, two years after the trouble was first encountered.

Jones said it was not considered worthwhile to modify the Mk. I aircraft.

The minister was asked when it was first found that the elevator controls of the Hunter were not effective at a certain speed, when the modification of a moving tailplane was first decided upon, when this modification was

effected, and whether he is satisfied that the modified controls are as effective as those fitted on the North American F-86 "seven or eight years ago."

He replied that the elevator control was first reported as having "certain shortcomings" in January, 1953. It was decided in June of that year to proceed with the design of a flying tail. First fully modified aircraft from new production will be delivered in June of this year.

"The aircraft as modified will be a more advanced and more powerful aircraft than the F-86," he asserted. "The Mk. VI now coming forward is operationally serviceable.

"Insofar as we are behind in the field of fighter aircraft, it is because we were more reluctant than the Americans to hazard men and lives in experimenting in supersonic flight."

HDM 105 Transport Makes First Flight

London—First flight of the HDM 105 experimental light transport with high-lift wing was made last week.

The twin-engined aircraft is a result of collaboration between British designers F. G. Miles, Ltd., and the Societe des Avions Hurel Dubois. The long, narrow wings supported by special lifting struts are expected to give good performance at low cost.

A joint company has been formed to produce improved versions of the prototype. Plans include HDM 106, a 16-passenger transport designed for small field operation. The firm estimates it would enable fares on short routes to be reduced by one-third.

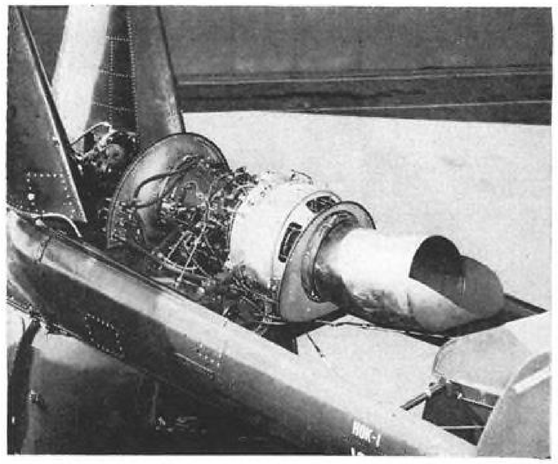
Also in the future is the HDM 107 turboprop-powered military assault transport.

The company also disclosed plans for entering the air transport business. It has applied to Air Transport Advisory Council for licenses to operate seasonal scheduled passenger, freight and mail services from the British South Coast to the Channel Islands and the French Coast.

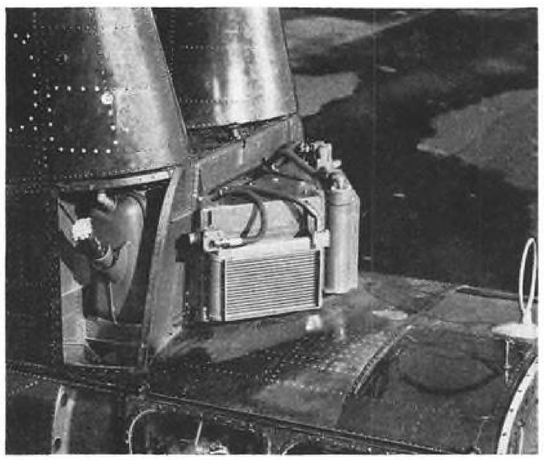
Handley Page Marathon and de Havilland Heron four-engined airliners are planned initially for the service.

Breguet Twin Jet Fighter Is Flown for First Time

Breguet twin jet lightweight support fighter 1100 made first flight at Istres Test Center. Powered by two Turbomeca Gabizo turbojets each developing 2,400 lb. thrust, aircraft is constructed entirely of bonded material, NATO version of the aircraft is being equipped with Bristol Orpheus engine. Second prototype of twin jet version is destined for use in Naval carrier operation.



ACCESSIBILITY to T53 and drive system is aided by external mounting. Engine cowl (removed) can be pivoted aside about quick-release pins or entirely dismounted. Stainless steel engine supports transfer loads to twin tail booms. "Lip" on exhaust deflects gases.



OIL COOLER and tank (left) serve gas turbine; larger cooler and its tank, on other side, serve transmission. Fairings are removed. Belt-driven axial-flow fan beneath pylons forces air into plenum chamber beneath coolers. Cooling air is exhausted via gill openings.

TURBINE inlet screen and firewall (background), drive shaft, rotor disk brake, turbine/transmission speed reduction unit and generator blast tube.

EXTERNAL cargo hook can handle loads too awkward to stow in K-600-3 cabin via clamshell doors. The K-600-3 is a modified version of Kaman's HOK-1, built for Navy.

Two Turbine Versions of HOK-1 Offered to Military

Kaman K-600-4 Performance

(Powerplants.....2 Blackburn Turmo)

	2-Place	5-Place	3,000-lb. Cargo Carrier
Useful load (lb.)	1,800	2,340	3,770
Crew	200	200	200
Passengers	200	740	.....
Cargo	.....	.....	3,000
Fuel	1,300	1,300	470
Miscellaneous	100	100	100
Empty weight (lb.)	3,955	3,955	3,955
Gross weight (lb.)	5,755	6,295	7,725
Standard Day Performance			
Vertical climb @ sea level (fpm.)[1]	960	460	.....
Vertical climb @ sea level (fpm.)[2]	1,810	1,360	140
Absolute hovering ceiling (ft.)[1]	15,200	12,000	.....
Absolute hovering ceiling (ft.)[2]	18,000	15,200	4,000
Maximum climb @ sea level (fpm.)[1]	1,350	1,130	600
Maximum climb @ sea level (fpm.)[2]	1,986	1,670	960
Service ceiling (ft.)	23,200	20,600	12,700
Speed @ sea level (kt.)	101	99.3	95
Speed @ altitude (kt./ft.)	106/8,000	103/6,000	95/S.L.
Range @ sea level (naut. mi.)[3]	177	172	66
Range @ sea level (naut. mi.)[4]	200	193	54
Cruise speed (kt.)[3]	92	91	86
Cruise speed (kt.)[4]	80	77	60
Endurance @ sea level (hr.)[3]	2.47	2.34	.764
Endurance @ sea level (hr.)[4]	3.52	3.25	1
Cruise speed (kt.)[3]	43	44	51
Cruise speed (kt.)[4]	43	44	51

[1] Normal power: 600 hp. [2] Military power: 720 hp. [3] Two-engine operation. [4] One-engine operation.

New York—Strong effort to obtain military contracts from U. S. and Canadian military services for two new turbine-powered versions of the HOK-1 helicopter is being made by Kaman Aircraft Corp., Bloomfield, Conn.

If commercial interest develops in these models, Kaman will undertake Civil Aeronautics Administration certification of them, but military orders are first priority, a company spokesman told AVIATION WEEK.

Both types are modified versions of the piston-powered HOK-1, which has been in production since 1952. Some 50-60 HOK-1s are in service and contracts call for output continuing until 1959. New models being developed are:

- **K-600-3 powered** by a single Lycoming T53 free turbine, which Kaman has been testing since last September. To date the K-600-3 has completed more than 80 hr. of operating time including 50 hr. of tiedown test and 30 hr. of flight time during which it has attained speeds up to 115 kt. and been to 5,000-ft. altitudes.
- **K-600-4, another** version of the HOK-1, is still in the engineering stage; project calls for installation of two British-built Blackburn & General Aircraft Turmo 600 turbines. Kaman has purchased two of these powerplants and is busy on the drawing boards developing the conversion. Paper studies of the Turmo 600-powered HOK-1 have been submitted to U. S. and Canadian military authorities.

Of the two projects the twin Turmo K-600-4 will probably be of greatest interest to commercial operators because of its single-engine operating characteristics (see box, p. 74). Engine passed its 150-hr. Air Registration Board certification tests in England and is production, Kaman told AVIATION WEEK.

Data relating to power developed by the twin Turmo has been brought in line with the T53 to provide ready comparison. Twin Turmo maximum power is 900 hp.; continuous rating is 800 hp. Actual derated powers for installation in the HOK were not available at this writing; they probably will be higher than derated ratings of the T53, according to Kaman.

Preliminary analysis indicates that the K-600-4 cargo carrier will have direct operating costs of $1.37/ton-mile. With a pilot and seven passengers, seat-mile costs are estimated at 18 cents.

Immediate gain from the switch from P&W R1340 piston engine to turbine installation is a jump in seating capacity from five to eight persons or 3,000 lb. of cargo, made possible by approximate doubling of usable cabin area to 170 cu. ft Turbine installation is external, above the cabin The piston engine is installed at the rear of the cabin internally, with access to the latter by means of vertically split clam-shell doors. Doors are retained in the turbine projects to provide ease of loading.

Pilot operating procedures are eased considerably with the turbine engines. A turbine power control system (governor) automatically provides proper power demanded by the pilot when he actuates pitch stick and it also maintains rotor rpm. at the constant speed pre-selected by the pilot.

Maintenance also is eased because of the engine's external mounting. In addition, the T53 being a free turbine, no weighty clutch system is required.

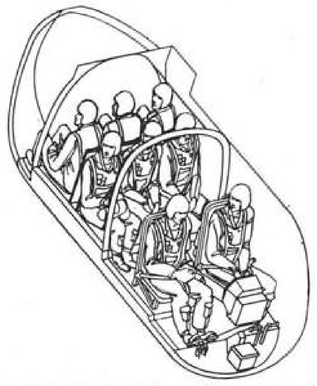
Kaman K-600-3 Performance

(Powerplant.....1 Lycoming T53)*

	2-Place	5-Place	3,000-lb. Cargo Carrier
Useful load (lb.)	1,800	2,340	3,770
Crew	400	400	200
Passengers	.....	540	.....
Cargo	.....	.....	3,000
Fuel	1,300	1,300	470
Miscellaneous	100	100	100
Empty weight (lb.)	3,780	3,780	3,780
Gross weight (lb.)	5,580	6,120	7,550
Standard Day Performance			
Vertical climb @ sea level (fpm.)[1]	1,130	620	.....
Vertical climb @ sea level (fpm.)[2]	1,960	1,500	300
Maximum climb @ sea level (fpm.)[1]	1,420	1,200	680
Maximum climb @ sea level (fpm.)[2]	2,080	1,770	1,080
Maximum speed (kt.)	107	104	96
Absolute hovering ceiling (ft.)[1]	18,000	14,500	.....
Absolute hovering ceiling (ft.)[2]	19,000	15,700	7,000
Service ceiling (ft.)	25,500	22,000	15,200
Range (naut. mi.)	260	250	80
Endurance (hr.)	3.8	3.6	1.6
Military Hot Day Performance			
Hovering out of ground effect (ft.)[1]	9,200	5,000	.....
Hovering out of ground effect (ft.)[2]	10,200	6,000	.....

*Lycoming T53 is rated at 825 hp. (military) and 770 hp. (continuous). For K-600-3 installation ratings are 600 hp. (maximum continuous) and 720 hp. (military).
[1] Maximum continuous power. [2] Military power.

Comparative analysis of K-600 (HOK-1) specifications with its turbine-powered sisterships: empty weight of the K-600 is 4,040 lb.; of the K-600-3, 3,780 and of the K-600-4, 3,955. Maximum gross weight of the K-600 is 6,800 lb.; the turbine-powered model maxi-



EIGHT MEN, including pilot, squeeze into enlarged cabin area of Turbocopter. Removal of piston engine gives needed room.

mum gross is given as 7,725 lb. Vertical rate of climb for the K-600 at 5,800 lb. is 800 fpm.; at 6,800 lb. it is 100-fpm. For the K-600-3, vertical rate of climb at 7,550 lb. is 300 fpm. at military power. Maximum rate of climb of the piston K-600 is 700 fpm.; for the T53 powered K-600-3, maximum climb rate is 1,080 fpm. at top gross weight.

Maximum speed at sea level for the K-600 is 90 kt.; turbine versions have a maximum speed of approximately 96 kt. at about 7,700 lb. Maximum useful load of the piston K-600 is 2,760 lb.; for the turbine-powered versions it is 3,770 lb.

HOK-1 with T53 currently installed is operated by Kaman on a bailment contract from Navy, to provide flight development on the powerplant, which is a U. S. Army project under direction of the U. S. Air Force Power Plant Laboratory. Turbine HOK-1 is scheduled to be delivered to Lycoming-Conn. in about a month for a 100-hr. test.

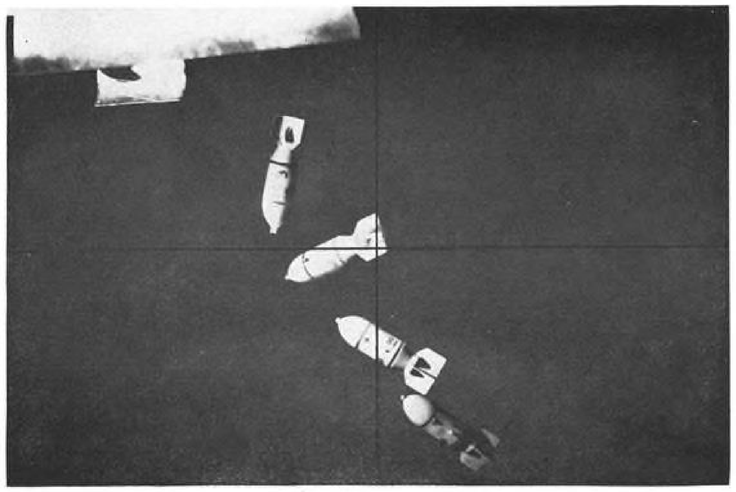
Kaman has provided additional company funds to develop the T53 testbed installation into a prototype of a turbine-powered "in being" helicopter.

Surface Protection Needed in Jet Molybdenum

Suitable surface protection and better joining methods are the primary needs for utilizing molybdenum in jet engines, R. T. Begley, Aviation Gas Turbine Div., Westinghouse Corp., told the Society of Automotive Engineers Aeronautical Meeting.

"Encouraging" results were obtained from a number of sheet metal turbine nozzle vanes fabricated from Inconel-clad .3% Cb-molybdenum alloy, Begley said. The sheet was clad on both sides and fabricated by stretch-forming.

No particular difficulty was encountered with the forming operation when the metal was heated to 600-800F. The trailing edge of the vane was



Cornell Tests Bomb Drops

Stroboscopic photo shows trajectory of a 1,000 general purpose bomb after release from the bomb bay (upper left) of a model aircraft mounted in Cornell Aeronautical Laboratory's Mach 1.3 wind tunnel. Bomb drops in Cornell Aeronautical Laboratory's Mach 1.3 wind tunnel are helping solve bomb bay aerodynamic configuration problems before they delay operational usefulness of new USAF fighters and bombers, according to C.A.L. engineer Wilbert Schwartzapfel. While it is simple to predict a bomb's trajectory once it has passed through the turbulent region near the bomb bay, the turbulent region may cause the bomb to tumble and spin (they have even flipped back into the bomb bay). So far C.A.L.'s model bomb drops have been limited to sonic tunnel flows, but future runs will simulate high performance aircraft making supersonic drops.

Advanced Systems Engineering for Commercial Flight by Honeywell Aero

For three new American Jet Transports– Transistorized Fuel Gage by Honeywell

SOON America's first three jet transports, now in rush production, will be shortening flying time to points all over the globe.

And Honeywell Aero is proud that these planes will carry a Honeywell Transistorized Fuel Gage—the most accurate, the most reliable fuel gage available today.

This new fuel gage retains the pinpoint accuracy of the famous Honeywell electron-tube gage. It can measure any fuel load to within two percent, and has these added advantages: less weight and bulk, a smaller power requirement, greater ruggedness, longer life.

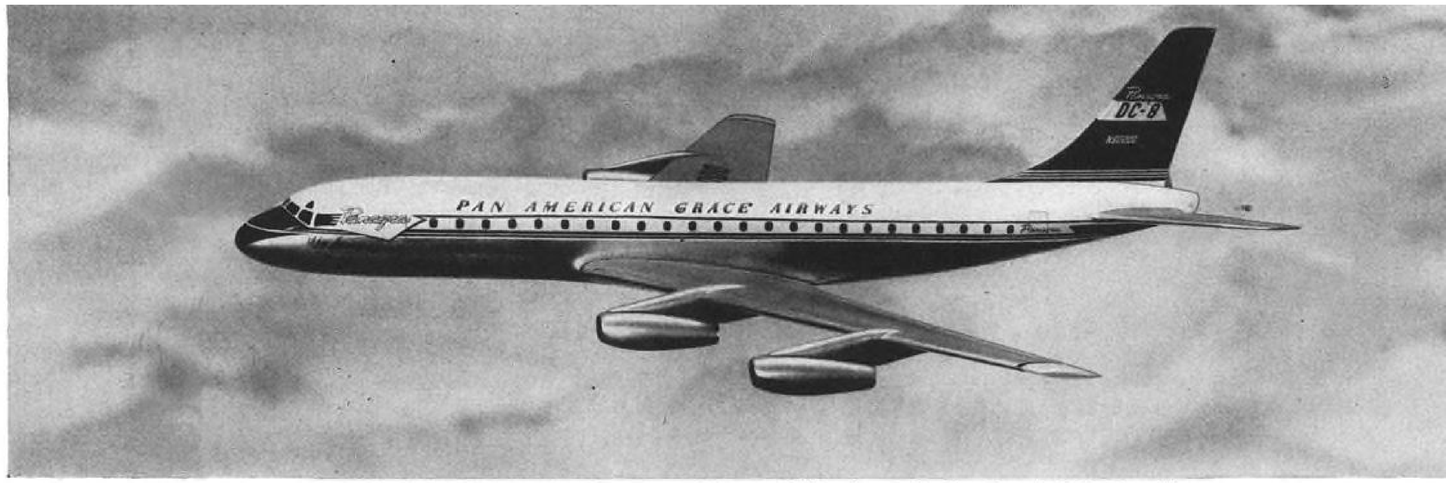
For these reasons, the Honeywell Transistorized Fuel Gage was a logical choice for the Boeing 707, the Douglas DC-8, the Lockheed Electra.

The transistorized fuel gage is another Honeywell "first"—made possible by Honeywell's development of the power transistor.

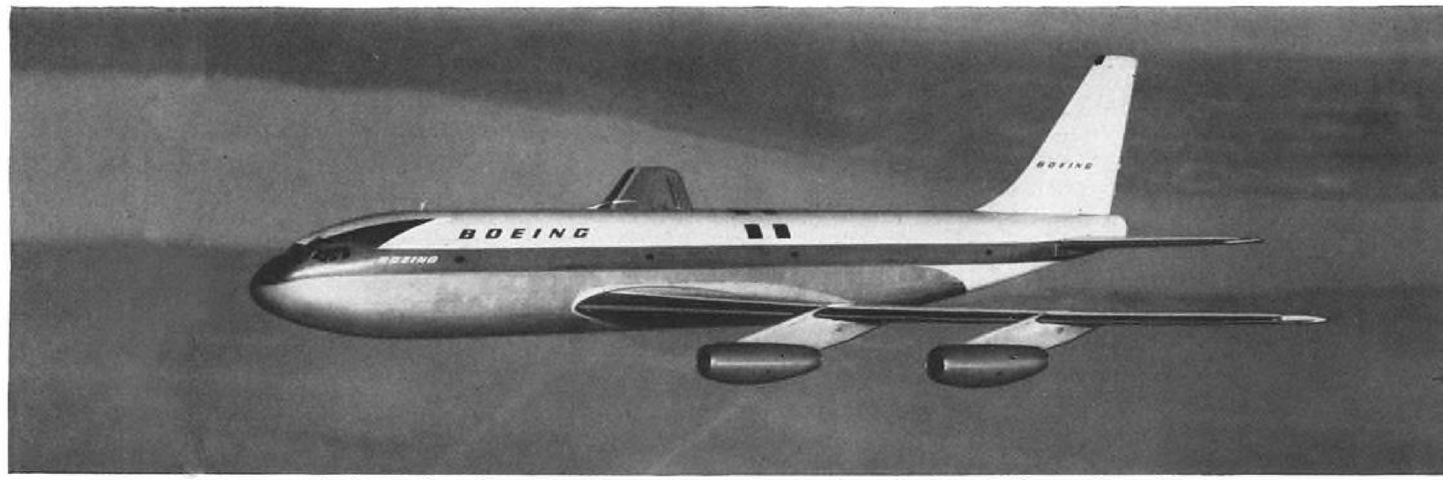
For more detailed information on the new Honeywell Transistorized Gage and its applications in both commercial and military aircraft, write to Dept. AW4-155, Mail Station 661, 2600 Ridgway Road, Minneapolis 13, Minnesota.

Honeywell

Aeronautical Division



Douglas DC-8. *Pan American, Panagra and Eastern Airlines have ordered 53 Douglas DC-8 jets with Honeywell's Transistorized Fuel Gage. Deliveries are to begin in 1959.*



Boeing 707 Stratoliner. *144 of these turbojet transports have been ordered by 16 different airlines, with deliveries scheduled for 1957 and 1958. The 707 will be equipped with Honeywell's Transistorized Fuel Gage.*

Lockheed Electra. *8 different airlines have placed orders for a total of 131 of Lockheed's turboprop transports, with deliveries to start late in 1958. The Electras will be equipped with Honeywell's Transistorized Fuel Gage.*

joined by brazing with Ni-Cr-B alloy and the molybdenum at the exposed top and bottom edges of the vane was protected by applying a thin layer of the same brazing alloy to each end.

Thermal shock, endurance and sand errosion tests were run on these vanes installed in a conventional first stage turbine nozzle. During the tests peak temperatures of 2,000F were encountered, with the average gas temperature at vane locations 1,800F.

Though cracks did appear at the brazed trailing edge joints, Begley said that the resulting oxidation of the molybdenum base was not excessive.

Landing Aids Advocated For Good Weather Too

Use of automatic landing aids in good weather as well as bad was advocated by Brig. Gen. Joseph D. Caldara, director of USAF flight safety research, at the Society of Automotive Engineers' Aeronautical meeting. Landing accidents account for 45% of all major Air Force flying mishaps, he said, and the majority of these occur during normal landings in good weather.

Increased landing speeds, and the difficulty of handling high performance planes at low speed are not the only factors causing trouble in jet landing.

The pilot's depth preception is adversely affected after a long flight at high altitude where he is removed from normal distance references. This is believed to contribute to the number of over- and under-shoots the Century Series fighter pilots make on landing.

The Air Force is studying Bell's new automatic system and other proposed and existing automatic landing systems in an effort to ease this problem.

Aerojet Runs Test On Thrust Reverser

Los Angeles—Aerojet General Corp., has successful tested its Aerobrake thrust-reverser on an Allison J71 jet engine. The thrust-reverser was developed by Aerojet General under license from the French firm SNECMA.

Test on the J71 involved 170 hours of runs. Maximum reverse thrust, the tests showed, could be obtained in about 3½ seconds.

With modifications, the thrust reverser could be adapted to other jets.

Vertical Lift Research Craft Makes First Flight

Short SC.1 vertical lift research aircraft made its first flight last week at Boscombe Down, lasting a quarter of an hour. Series of flight tests will precede any attempt to convert from forward to hovering flight or to take off vertically.

COMPLETE DESIGN FLEXIBILITY WITH EVERY TYPE OF SHOCK ABSORPTION FROM CLEVELAND PNEUMATIC

Any aircraft landing gear requirement you have can be solved by Cleveland Pneumatic. The gear can be designed around a conventional AEROL, a new-type high-pressure AEROL, or a Cleveland Pneumatic liquid spring. We engineer and produce all three types of shock absorbers.

If space aboard is extra-tight, the small-cubage Cleveland Pneumatic liquid spring gives you the greatest shock absorption in the smallest package. Static pressures as high as 20,000 psi can be used.

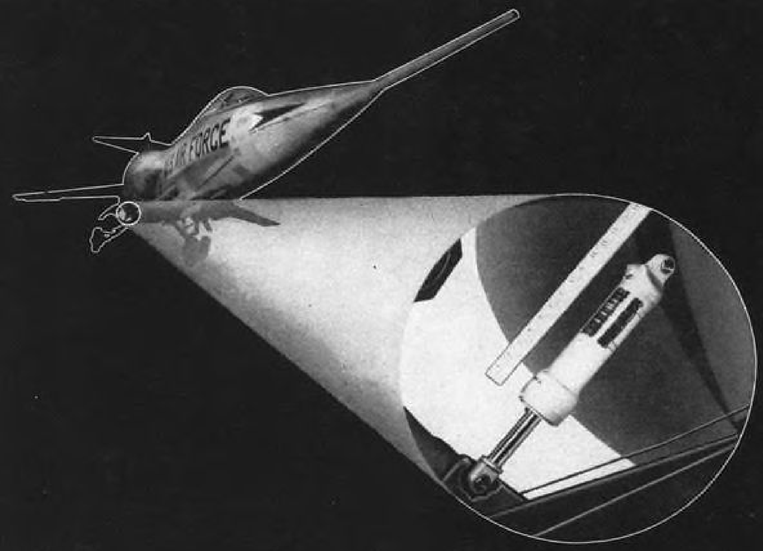
Another weight- and space-saver is the high-pressure AEROL. It was developed by Cleveland Pneumatic to operate at 5,000 psi static pressure with special CPT pressure seals. (Tests were successful up to 8,000 psi static.)

Tell us your landing gear requirements at the start. Cleveland Pneumatic designs and builds all types of landing gear, recommends the type best for your service needs.

Write for the 8-page technical booklet which describes the principle of the liquid spring. Ask for "Booklet LS-10".

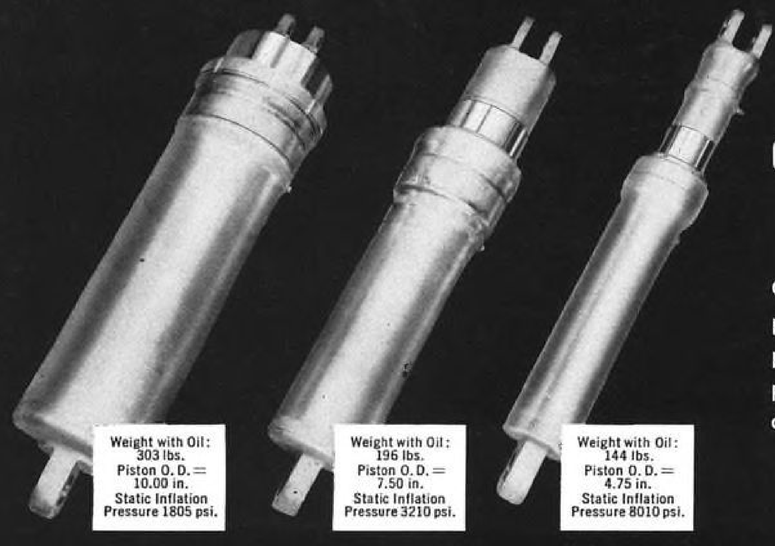
CLEVELAND PNEUMATIC

TOOL COMPANY • CLEVELAND 5, OHIO



LIQUID SPRING ON LOCKHEED F-104 PROVIDES MAXIMUM IMPACT ABSORPTION IN LEAST SPACE

High-pressure seals developed by Cleveland Pneumatic provide leak-proof operation at static pressures up to 20,000 psi.



THREE PRESSURE-RANGES OF AEROLS SHOW BENEFITS OF HIGH PRESSURE

Comparison of (left) standard low-pressure AEROL, (middle) medium-pressure AEROL and (right) high-pressure AEROL. Note reduction in diameter of shock-absorber package.

GE to Put Accessory Department Under Weapons System Concept

By Robert Cushman

Lynn, Mass.—General Electric's Aircraft Accessory Turbine Dept. is altering its engineering and sales techniques to fit the weapons system concept of USAF and Navy.

USAF's weapons systems philosophy has been well illustrated on the airframe level by Convair's B-58 weapons system.

It is making its full impact felt upon the subsystem level, as evidenced by GE management policy change.

Sold Separately

In effect, GE is gathering up the bits and pieces it has been selling separately and wrapping them up on one package designed to be attractive to the large weapons system prime contractors.

General Electric soon expects to be in a strong position to bid on complete airborne accessory power systems. The Turbine Department has formed the nucleus of a new group of systems engineers who will provide the technical know-how. The department has backed up this group by integrating the hydraulic drive section, Schenectady, N. Y., formerly part of the Aircraft Products Dept., with the AAT Department's pneumatic drives. The AAT Department probably will be renamed to cover its broadened scope.

Because this new 25 man systems group now will be working for both GE's pneumatic and hydraulic drive interests, airframe and missile manufacturers will for the first time be offered a comparison of these two competitive drives, according to Walter C. O'Connell, general manager, ATT Dept.

Current Production

The Turbine Department currently is making pneumatic alternator drives for the Boeing B-52 auxiliary power system. The constant speed hydraulic section has been supplying hydraulic drives for the generators on the Douglas A4D Skyhawk.

Chief Engineer Irving Kalikow and Sales Engineer Richard McManus, of the Aircraft Accessory Turbine Department, explained some of the system considerations:

Pilot from his cramped quarters needs control energy capable of being applied at the many remote locations about the aircraft. This is usually in the form of piped hydraulic or wired electrical energy.

In the case of a missile, the electronic guidance not only needs energy for the corresponding remotely located functions, but needs power to run itself. In addition, most modern aircraft use electrical power in the form of precisely controlled alternating current. Alternating current permits transformers and, if accurately controlled, can be used as a time standard for navigation and other devices.

Most piloted aircraft use the main propulsive plant as the initial source of accessory system energy. Unfortunately, the loads and speeds needed for propulsion do not coincide with the loads and constant speed needed for accessory systems.

This is particularly true in landing, where the engine is idled back but a good portion of the control power is still needed.

In missiles, accessory power is still needed after rocket burnout, at which time the missile is very likely to be beyond the earth's atmosphere so that ram air cannot be used. In this case independent power sources are obviously mandatory.

Kalikow would not be surprised to see independent power sources used in larger aircraft. For example, he said that in planes of the B-52 catagory and larger the power demands are becoming such that a T58 turboshaft engine (also made by GE in Lynn) just for powering the accessory power would not be out of order. Since it would be running at constant speed, part of the power delivery problem, that of delivering constant frequency power from a varying speed source—would be eliminated.

Drive Comparison

At the present time, however, most of the competition remains between pneumatic drives which use main engine compressor bleed air and hydraulic systems driven off the main rotor.

According to studies made by AAT, pneumatic systems are best for pod-mounted engines in planes with short missions, for turboprops where the propeller reduction gearing doesn't leave much space for direct drives, or for ramjets where there is no source of mechanical power.

Hydraulic direct drives are best for long range aircraft because of their inherently higher efficiency, for engines which are sensitive to compressor bleeding, for buried engine configurations

Martin Models P6M Line

Scale model of P6M SeaMaster was used by Glenn L. Martin Co., to give plant personnel quick familiarization with the overall manufacturing process for the Navy seaplane. Model was used as guide to establish the actual production line.

where they don't add to the frontal area, and for weapon systems which have high electrical loads.

One of the goals of the new group at Lynn is to program the general power take off problem in a general purpose IBM 704 computer so that, when the sales department brings in an airframe manufacturer's requirements, the group can grind the special case into the computer and in a short order come up with the power system that looks best.

For the time being this new group will restrict itself to supplying accessory power as far as the distribution bus. However, the AAT Dept. has other products which could be phased into more elaborate system studies in the future. They have been working on a line of cartridge-turbine actuators, which out of a very compact package can supply bursts of very high horsepower. From a 5¼ oz. package they can produce 20 hp.; from a 2½ lb. package they can produce 250 hp.

AAT also has pneumatic actuators and turbopumps for duel and hydraulic power.

GE in its Direct Current Motor and Generator Dept., Erie, Pa., makes a.c. alternators, though the alternators used on the B-52 are being made by Westinghouse.

Although, with these three product lines and certain electrical control units, which are made in GE's Waynesboro, Va., plant, GE would appear to have the complete in-house capability to supply all of any system it subcontracts, O'Connell says that there is no intention that GE will try to make all of the components. For example, he said, GE will continue to encourage firms like Pesco Products, a division of Borg-Warner which specializes in pumps, to supply pumps.

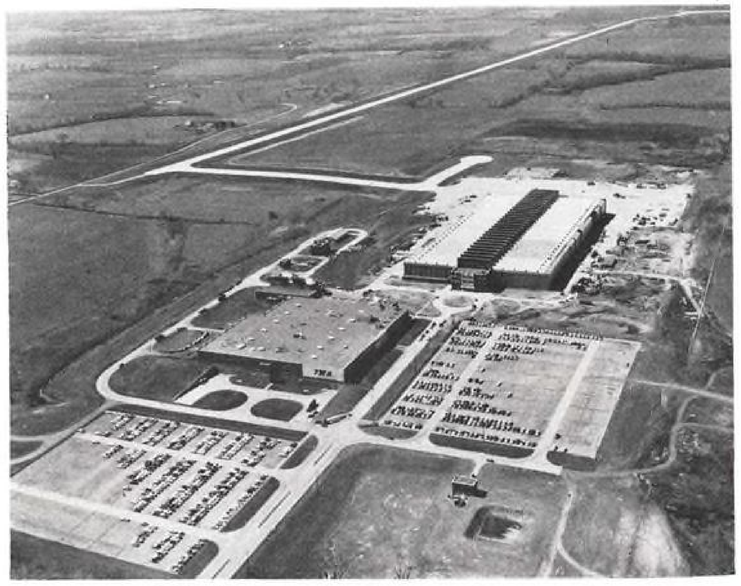
O'Connell strongly feels that tendency of a large supplier under the weapon systems concept to try to make everything under his own roof will only prove poor business in the long run. In this respect his advice to the smaller firms is to pay closer attention to the performance gaps complained about by the larger firms and aim at providing special items for these gaps.

O'Connell thinks that the days of the parts supplier who relies on price competition with shelf items are limited.

New York Airport Passengers Increase

New York—Three of the four metropolitan area airports operated by the Port of New York Authority handled 12,109,583 passengers in 1956, an increase of 11.6% over the 1955 total. LaGuardia airport handled 5,403,239 of the passengers, New York International 4,490,050, Newark 2,183,256. Teterboro, not served by scheduled carriers, had 222,187 plane movements.

Air cargo moved at the airports totaled more than 323 million lb., up



TWA Overhaul Base Progress

Trans World Airline' new $25 million overhaul base near Kansas City is scheduled for summer 1957 completion. Engine overhaul building, lower major structure in picture, is already in use by the airline. Hangar is still under construction. Base is located on Platte County's Mid Continent International Airport, 15 mi. northwest of Kansas City.

6.9%; mail was up 7.4% to 92.8 million lb.

PNYA spent $33.2 million in airport improvements during 1956, expects to lay out $90.9 million in capital expenditures this year. Gross operating revenues from the four airports and new mid-Manhattan heliport totaled $17.9 million during 1956.

Most of the agency's 1956 investment went into Idlewild, where a $120 million "terminal city" is under construction. Installation by Civil Aeronautics Administration of bi-directional instrument landing systems at Newark and Idlewild was begun during the year.

Of the total passengers, 10,579,988 were domestic and 1,529,595 overseas.

TWA's Burgess Moves Top Level Personnel

New York–Carter L. Burgess, Trans World Airlines president, is reassigning the carrier's top level personnel in line with a reorganization plan previously announced (AW Feb. 4, p. 41).

The changes, effective immediately, include:

- **Frank E. Busch,** vice president-operations, is shifted from Kansas City to New York.
- **George H. Clay,** former vice president and secretary, becomes vice president-administrative services in Kansas City.
- **Ronald Duckworth,** former assistant treasurer, has been named secretary of the company.
- **W. E. Rooker,** general auditor, becomes assistant treasurer.
- **James Feeney,** director of industrial relations, becomes assistant vice president in charge of industrial relations.

In the operations department, western, central, Atlantic and overseas regions are absorbed into two basic divisions–international and domestic.

Floyd Hall becomes general manager of United States operations in Kansas City. W. L. Trimble will be general manager of international operations in Paris.

TWA which grossed $240,394,000 in operating revenues in 1956, reported a net loss of $2,237,000. Loss was 70 cents a share on 3,337,036 shares outstanding, compared to a $5,407,000 profit in 1955, or $1.62 a share. Gross revenues in 1955 totaled $217,431,000.

TWA carried 4,428,000 passengers during 1956, a 10.5% increase over 1955.

Under its new president, economies and reorganization measures have been instituted. First full use of a new overhaul base at Kansas City will be possible, new aircraft are being introduced, and round-the-world service in conjunction with Northwest Airlines is expected to begin this year.

Teflon Hose Use in Jets, Missiles Grows

By George L. Christian

Roseland, N. J.—High pressure—3,000 psi.—Teflon aircraft hose is gaining wide acceptance in most of the country's latest supersonic weapon systems, both in manned aircraft and their powerplants, and in missiles.

Called R700, the hose is produced by Resistoflex Corporation in its new plant here. Company says that R700 is being widely sought for use in most new weapon systems because it is the first flexible hose to couple high pressure capability with the desirable features inherent in Teflon products: resistance to high and low temperatures and immunity to corrosive action by virtually any product known, including fuming red and white nitric acids.

Needed for Heat

R700, which has undergone three years of continuous testing in Resistoflex' laboratories, also has seen two years of actual field service on such jet engines as the J79, J71, J67, J46, and J40.

On all these engines, the hose was used to transmit hydraulic power to the very hot afterburner eyelid actuating mechanism. In these applications the hose operates at 3,000 psi. and lives in continuous temperatures of 350F, rising to 400F during shut-down soak periods.

In addition, in GE's J79, the hose is used in the hydraulic mechanism which varies the angle of the inlet compressor stators. Pressure is 3,000 psi. and operating temperatures are about 250F to 350F.

As new planes became faster, heat, which had been confined to the powerplants, crept out of the engines and began to invade the whole airframe. One of the first areas attacked was the hydraulic system.

For this reason, R700 is used in various hydraulic system hot spots on virtually all new supersonic aircraft, plus a number of missiles.

Supersonic Stable

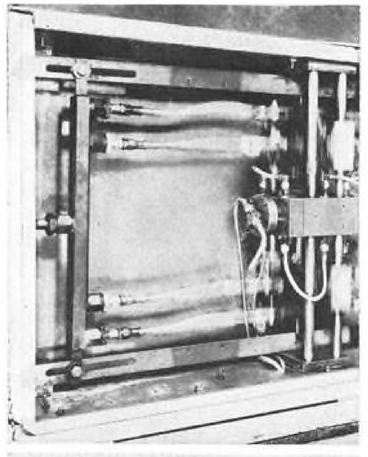
Resistoflex cites these aircraft in the supersonic stable which use or are testing its R700 hose: the entire Century Series Air Force fighters—F-100, -102, -104, -105, -106, -107, and the B-58, which, Resistoflex says, uses R700 extensively. Company adds that the Navy's new F4H fighter's hydraulic system was designed around the use of high pressure Teflon hose. And the Canadians are using it in their supersonic CF-105.

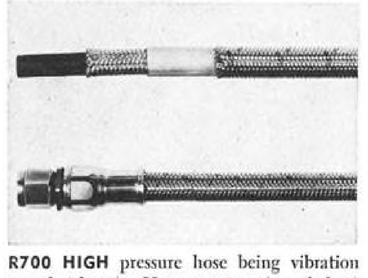
Among missiles using R700 are the Atlas, Regulus II and Thor.

Still another use, according to company officials, will probably be on the de Havilland Comet IVs being bought by Capital Airlines. The carrier, which insists that Teflon hose be used on its Comets, wants Resistoflex to run tests to qualify R700 hose to British standards.

Use of Teflon hose is not restricted to hydraulic systems. It also is proving to be superior to rubber hose in cartridge actuated devices such as ejection seats. Reason is that the Teflon inner tube, unlike rubber inner tubes, does not tend to expand when hit by the sudden rush of expanding gases when the CAD charge is fired. Result is that a much sharper, more efficient charge is transmitted by the Teflon hose from the initiator to the actuator.

A year ago, Wright Air Development Center granted IDE (industry developed equipment) approval for Resistoflex hose assemblies to be used with all automatic opening lap belts in lieu of the hose assemblies then in use. However, the Center specified that, until a Government detail specification was issued and a qualified products list established, prime airframe contractors are still required to obtain approval from the Aircraft Laboratory, WADC, for the specific use of Teflon hose assemblies with automatic opening lap belts.





R700 HIGH pressure hose being vibration tested (above). Hose construction (below) shows: Teflon inner tube, first wire braid, Teflon cover, second wire braid.

Making R700

Resistoflex is making double-branded R700 in three sizes: −4, −6, and −8 ($\frac{1}{4}$, $\frac{3}{8}$ and $\frac{1}{2}$ in. inside diameter respectively). The company is also making hose experimentally in the −12 ($\frac{3}{4}$ in.) size with triple-braid construction.

R700 is made up of a Teflon inner tube called Floroflex—T covered with a cadmium-plated carbon steel first braid as primary reinforcement. This is covered with a thin Teflon tape to protect the inner braid from atmospheric moisture and to provide chafe resistance. An outer braid of stainless steel then is woven on to the hose which contributes to its pressure resistance and protects it from abrasion.

The $\frac{3}{4}$ in. size has an added carbon steel braid to give the additional strength needed for this relatively large diameter hose.

Resistoflex engineers say that, at first, they had a slight problem with leakage at the end fittings. They developed a secondary seal for the fitting which has cured the problem, they claim.

R700 is the first and only hose to have passed all tests to MIL-H-5512 with the temperature raised from the standard 120F–160F to 400F, according to Resistoflex spokesmen. The tests were conducted only last month by WADC's Aircraft Laboratory at 400F and 3,000 psi. Company points out that passing these tests does not constitute Air Force approval of the hose because no specification yet exists for such tests at the temperatures indicated.

Resistoflex says that its R700 hose is good for continuous use at 450F with lots of cushion. Company believes it will be able to raise this temperature limit to 550F. Plans are now under way to qualify the hose for Class 4 hydraulic systems which have temperature limits of 0 to 550F.

As company engineers point out, if R700 will operate satisfactorily for 50 hr. at 550F, this may represent about 500 hr. of aircraft operation, since only

a fraction of its total operating life will be spent at such extremes of speed and therefore heat. And 500 hr. may be the expected life span of the airframe.

In at least one engine application, R700 hose operated satisfactorily for three hours at an ambient temperature of 750F with 425F fluid running through it, Resistoflex officials claim.

Company also plans to test R700 to 4,000 psi.

Purpose is to determine whether the hose will withstand 4,000 psi. and, if so, for how long.

Point of Controversy

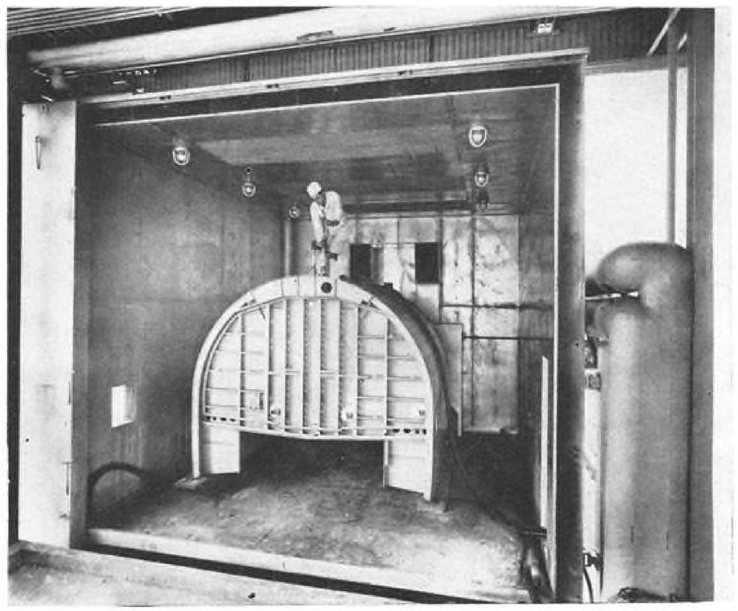
AVIATION WEEK's survey of high pressure Teflon hose uncovered a controversy concerning the construction of larger sizes (above —8 size) hoses.

Resistoflex believes that its standard, double braided construction will operate satisfactorily under the impulsing inherent in 3,000 psi. aircraft hydraulic systems. The company's double-braided hose is flying today in sizes —4, —6 and —8. The —12 size also is flying in Convair's B-58, but this hose is triple braided and its operating time is limited.

Aeroquip Corp., Jackson, Mich. disagrees. A company official told AVIATION WEEK that starting with the —8 size (possibly with the —6) and larger, double and even triple-braided construction will not be satisfactory. Reason is that braiding the steel wire crimps them and the impulsing of the hydraulic system fluid under 3,000 psi. causes

Designation Change

Resistoflex is dropping the Y prefix on its YR700 high pressure hose in the –4 and –6 sizes since the company feels that these two sizes have been fully proven. The Y will be dropped from other high pressure hose sizes only as each size completes a test program comparable that given to the two smaller sizes. However, the Y designation will continue on any size hose if a customer has frozen the letter into his specification.



Fuel Cell Development Lab

This hot and cold room is part of a new, $\frac{1}{2}$-million fuel cell development laboratory recently completed at B. F. Goodrich Company's Los Angeles, Calif. plant. Photo shows a technician fueling a Boeing B-52 fuel cell structure in preparation for hot and cold tests which are conducted at temperatures ranging from 165F to —85F. Hot and cold room is designed to test the rubber and rubber-like materials used in fuel cell construction. Other test facilities in the lab include two smaller cold chambers for development testing which can be brought to —100F to cool fuel. Equipment for the rooms includes a slosh table capable of handling a 30,000 lb. load for testing the ability of fuel cells to withstand fuel surge pressures; a vibration table capable of vibrating 2,000 cpm. at an amplitude of $\frac{1}{2}$ of an inch; a variety of ozone and flex testers; and laboratory ovens and other equipment to evaluate performance of new materials to 500F. Facility can test high energy fuels.

Vickers Servo Pump Systems

Provide rapid and accurate response to minute electrical or mechanical signals

The Vickers Servo Pump Unit shown at the right is a signal-controlled, variable delivery, positive displacement, reversible flow oil hydraulic pump. In combination with a rotary or linear hydraulic motor, it forms a signal-controlled hydraulic transmission for remote control operations and high-response servo systems.

The servo transmission may be considered as a power amplifier when viewed from the electrical signal input, of about five watts, to the mechanical power output of several thousand watts. Various sizes of transmissions have been built, having output capacity ratings from one to four hundred horsepower. The servo pump develops only that pressure required to move the load . . . which means reduced pressure over the greater part of the system life since peak loads occur only infrequently in the majority of systems. This greatly reduces power losses and minimizes heat rejection.

Any type of prime mover of sufficient capacity can be used to furnish the power input . . . electric motor, auxiliary drive pad on an airplane engine, air turbine, hydraulic motor, etc. Substantially constant speed is desirable.

Variable Pump Volume Controlled by Signal

Heart of the servo pump unit is the Vickers Variable Stroke Hydraulic Pump. This is usually a nine-cylinder pump housed in a pintle-mounted yoke. Varying the yoke angle varies piston stroke, hence, output volume from zero to maximum in either direction of flow. A stroking piston actuated by a pilot valve varies the yoke angle according to signal.

Low Control Power Requirement

Power for control purposes is low in a servo pump unit because metering valve action is confined to the volume-regulating system which is a low power level (100 to 300 psi) hydraulic system separate from the power transmission hydraulic circuit although a part of the pump unit. This volume-regulating system controls piston displacement and direction in the power pump which can operate at pressures up to 3000 or 4000 psi. Pressure drop across ports of a metering valve, with its inherent losses, is avoided in the power transmission system. Final power output from the pump is determined by the volume of flow which the volume-regulating system demands and by the actual resistance of the load . . . is not dependent upon pressure drop methods of control.

In a control system employing this servo pump, the variations in gain resulting from load change are negligible compared to those which may occur in a similar circuit controlled by a valve metering directly in the power line.

Constant Displacement Hydraulic Motor

Flow and pressure generated in the hydraulic pump are carried by tubing with no intermediate valving to the hydraulic motor or linear actuator. The fixed stroke hydraulic motor provides torque directly proportional to pressure and speed directly proportional to flow rate.

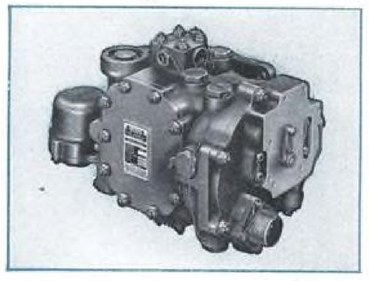
High Power-to-Weight Ratio

The servo pump unit and its associated hydraulic motor are designed for high power-to-weight ratio, high torque-to-inertia ratio, low inertia of rotating parts, and high resonant frequency.

Typical Example

High power-to-weight ratio—3.76 hp/lb (motor only)
High torque²-to-inertia ratio—3.5 x 10^7 lb-in./sec²
Low inertia of rotating parts— .052 lb-in.²
High resonant frequency— 20 cps (entire system)

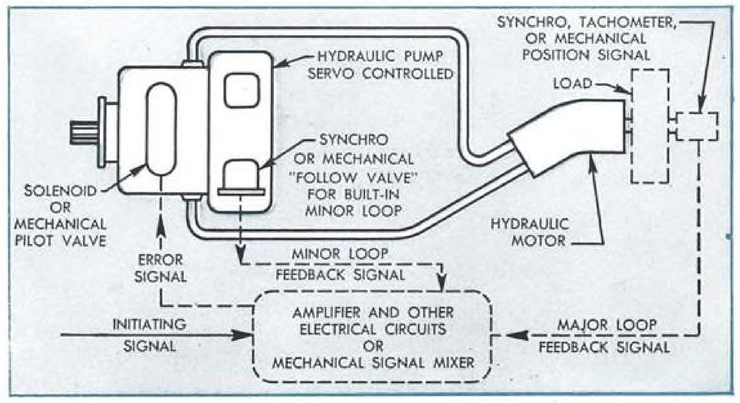
Other advantages are reliability and versatility of application. The smooth,



stepless speed changes and ability to hold position against any variation in load are additional reasons why this unit is a desirable resource which can solve many design problems.

Important among the applications of Vickers Servo Pump Units is extremely fast and accurate positioning of gun turrets on aircraft. Another is actuation of the exhaust nozzle for jet engines; here the servo pump's characteristic of providing at all times only sufficient power to meet the momentary demand minimizes the power loss and therefore the heat rejection. The greatly reduced average pressure level in this type of system prolongs the life and improves the reliability of all components.

For further information, ask for Bulletins SE-15 and SE-18 or get in touch with your nearest Vickers Aircraft Application Engineer. He can arrange for an engineering team to consider your problem and propose an optimum solution.



SIMPLIFIED DIAGRAM illustrates a servo control system employing Vickers Servo Pump Unit and Constant Displacement Hydraulic Motor. This system accepts initiating signals (either electronic or mechanical, depending on type of system), compares them with feedback signals from load and (through controlled changes in direction and volume of fluid pumped to motor) corrects the load as required. For added accuracy and stability, a minor loop providing signals proportional to rate of flow may be added. This may either be built into the pump in the form of a mechanical "follow valve" which results in modulating the flow as a function of the net signal to the pump, or may be a synchro which feeds a signal proportional to flow rate into the amplifier. The controlled output may be either a function of the position or velocity of the load.

Teflon Troubles

Resistoflex, which developed its own method of converting Teflon into extruded hose in a product called Fluoroflex-T, was faced with a problem in November, 1955, when its extruding machines started producing lace-like material instead of tubes. Production was shut down from November, 1955, to February, 1956, while the trouble was traced and remedied.

Du Pont researchers fixed the blame on one of the raw materials for the Tetrafluoroethylene resin. Paradoxically, the fault of the ingredient lay in its being made purer than before.

the wires to bang together, brinell and break. Also, three-braided hose is heavy, bulky and stiff.

Aeroquip is departing from the traditional braiding reinforcement and will use a spiral steel wire construction which avoids the overlapping wires and resultant potential breakage. The company has a −8 size, high pressure, high temperature hose using the spiral reinforcement under test in its laboratories. It believes that this construction is far superior to conventional braiding in its resistance to impulse fatigue. Tests with the hose are scheduled to be completed about the end of April.

Spiral Construction

Resistoflex is watching the spiral, or wound wire, construction. Company engineers are treating this type of construction with caution because, they say, it has inherent problems of wire separation which will allow the inner tube to extrude through the gap. Also, they believe that fitting attachment will pose problems.

Aeroquip says that it is in production on −4 and −6 double-braided high pressure, high temperature Teflon hose. Braiding is satisfactory in these small sizes. The −4 has been submitted to WADC for test, the −6 has not. Operational aircraft using the hose is Convair's F-102A, according to Aeroquip.

The hose is extruded and braided for the company by Electric Hose & Rubber Co., Wilmington, Del., and does a fine job, says Aeroquip. Aeroquip cuts the hose into desired lengths and attaches its removable Super Gem fittings to the hose assemblies.

Titeflex, Inc., Springfield, Mass., which like Resistoflex, extrudes and braids its own hose, is developing a 3,000 psi. hose. Company says that its development is not advanced enough to determine what type of construction will be used.

Resistoflex, which developed its own method of extruding braiding the high

Teflon Toxicity

Teflon has been accused in some quarters of giving off toxic fumes when heated to temperatures over 400F. Resistoflex offers these comments, from Wright Air Development Center, Aero Medical Laboratory.

"From information contained in WADC Technical Report 54-301, Teflon does not give off toxic fumes at temperatures below 300C (571F) but is toxic at temperatures above 375C (709F). . . ."

pressure Teflon hose, has licensed B. F. Goodrich to manufacture the product.

Flex-O-Tube, Inkster, Mich. has been licensed by Resistoflex to make fittings for the hose and is in production on the smaller sizes using Goodrich hose.

Stratoflex, Inc., Fort Worth, Texas, also will produce assemblies using Goodrich hose and its own fittings, according to Resistoflex.

At the current state of the art, elastomers appear to be doomed as hose material when temperatures exceed about 550F, Resistoflex officials concede. The only substitute on the horizon appears to be rigid metal tubing appropriately looped or spiraled to allow a certain amount of flexing between the two ends.

Resistoflex, which already preforms much metal tubing for its current hose assemblies, is intensifying its interest in this type of plumbing.

Removable fittings have these three advantages when used with relatively inexpensive rubber hose:

- **Fittings,** being the most expensive part of the assembly, can be saved and reused when the hose wears out or breaks.
- **Fittings** can be salvaged when rubber hose, because of its limited shelf life, has to be discarded.
- **Logistics** and inventory problems are greatly simplified because hose and fittings can be sent into the field in bulk. Hose can be cut to length and fittings assembled as needed instead of having to ship and stock large numbers of individual hose assemblies of various lengths.

All this has changed with the advent of Teflon hose, says Resistoflex. Here is why:

- **Hose** rather than the fittings, is now the most expensive part of the assembly.
- **Hose** made of Teflon has indefinite shelf life so never needs to be discarded.
- **Permanent** couplings are required in many cases by engine manufacturers who want to eliminate the possibility of in-the-field servicing by inexperienced personnel.

CAA Evaluates Lights To End "Black Pit"

Andrews AFB, Md.—Evaluation tests of high density runway lights described by Civil Aeronautics Administrator James T. Pyle as the "ground component of an all-weather navigation system" will be completed May 1.

In a recent series of simulated IFR approaches and landings conducted with Pyle at the controls, three types of runway lights designed to eliminate the "black pit" illusion were demonstrated.

Experimental flights using the three types, all of which are produced by Sylvania Electric Co., began here last January following the mockup installation of the systems. Decision as which of the three systems will be adopted will be made by CAA around May 1 after user comments have been evaluated.

Three Configurations

Two of the systems differ only in configuration:

- **First type consists of Elfaka** bars of light set flush along the first 3,000 ft. of runway at 100 ft. intervals. The inner lights are located 30 ft. from the runway centerline.
- **Second type** calls for an arrangement of the same number of bars 45 ft. from the centerline.

The Elfaka runway lights were originally developed by the Dutch and have been in regular use at Amsterdam's Schipol Airport since 1955 (AW Jan. 10, 1955, p. 21).

In this arrangement, each fixture is encased in a box that is overset with a protective grid and buried flush to the runway surface. The experimental lights in the Andrews Field installation are not yet flush but are set on top of the runway surface in boxes fitted with three baffles that simulate the flush attitude.

The third system at Andrews includes a 715 ft. continuous strip of very high output fluorescent tubes on either side of the runway, beginning 500-ft. from the threshold.

The lights flood the complete runway surface and pick up strip markings of luminous paint and aluminum silicate crystals.

This system has not yet been thoroughly tested under zero-zero conditions, and there is some question as to whether glare against fog may eliminate it as a possibility.

The fluorescent tubes have a 416 volt, three-phase power requirement. Each tube is a 400-watt tube; 20,000 candlepower is produced for each eight ft. of length of the system. Total consumption is 70 kilowatts.

CAA believes that this type of runway light will be effective only on a black asphalt paving since reflecting glare may be intensified by white concrete.

Chief advantage of the system is that only slight runway modification is required for installation.

Elfaka Installation

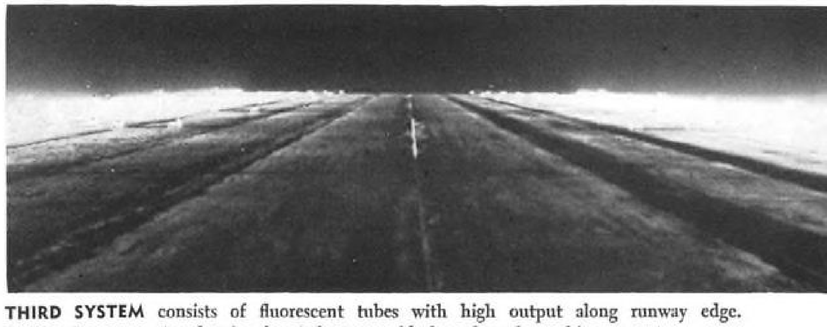
Introduction of the Elfaka lights probably will be confined to new runways since installation of the unit in present runways would call for much heavy construction work in laying the power lines and affixing the buried box units.

The Elfaka light is a 250 watt, PAR-56, 12¾ volt lamp. One lamp is located in each unit which, for experimental purposes, contains baffles to provide a conical beam and specific intensity curve.

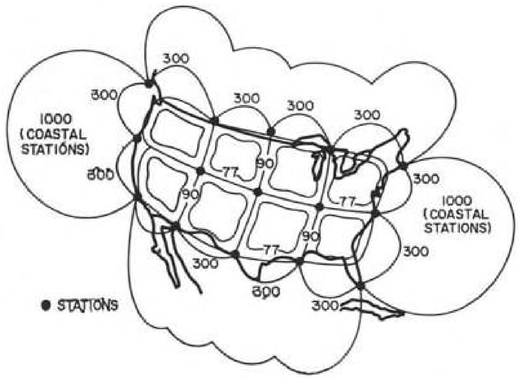
James Harding, project engineer of CAA's Technical Development Center is conducting the tests. Administrator Pyle says he is convinced that CAA has "the answer" to the "black pit" problem in any of the three lighting units. He added that an improved landing system that provides a more accurate glidepath or automatic ground control approach, will permit the CAA to eliminate the 200 ft., one-half-mile visibility restrictions at airports where the best of these systems is installed.

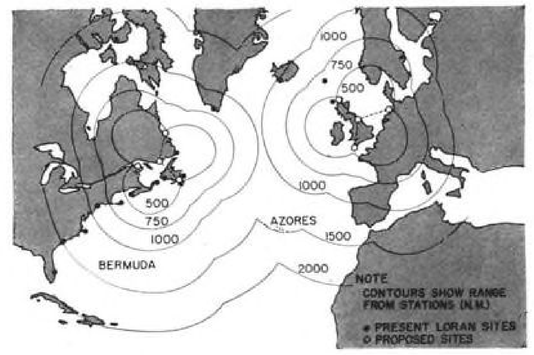
ONE SYSTEM of runway landing lights under test by CAA has bars spaced 30 ft. from runway centerline. In operational use, lights would be set flush in runway.

SECOND SYSTEM is similar except that the bars are spaced 45 ft. from runway centerline. Produced by Sylvania, the Elfaka runway lights originally were developed by Dutch.



THIRD SYSTEM consists of fluorescent tubes with high output along runway edge. Light reflects on painted strips, but is better on black surface than white concrete.





SPERRY CYTAC, a low-frequency, high-accuracy phase-comparison Loran, needs only 15 stations to blanket U. S. and adjoining areas. Figures (left) indicate probable errors in feet. North Atlantic coverage (right) would require only eight Cytac stations.

Cytac Makes Bid as Navigation Aid

By Philip J. Klass

New York—Cytac, an extremely accurate, low-frequency hyperbolic navigation system has shed its security wraps to bid for adoption as an international long-distance navigation aid. This puts it in competition with the British Delrac and Dectra systems, the French Radio-Web, and the Navarho system which the Air Coordinating Committee adopted as the official U. S. entry.

Sperry Gyroscope Co., which developed the system under USAF sponsorship, also views Cytac as a possible future Common System replacement for Vortac because of its high accuracy and low-altitude coverage.

Fifteen Cytac stations could blanket the U. S., portions of Canada and Mexico and 1,000 miles out to sea on either coast. Aircraft could determine their positions with an error of no more than a couple hundred feet anywhere in this area, a Sperry engineer told the recent Institute of Radio Engineers convention. (See sketch above.)

Two chains of four Cytac stations (eight total) could provide coverage of the North Atlantic with at least a 10-fold improvement over existing Loran accuracies, Winslow Palmer reported. (Palmer read a paper authored by Wilbert P. Frantz, one of three given by Sperry engineers on the Cytac system.)

Pulse, Phase Comparison

Cytac might be termed a low frequency Loran system with phase comparison added. A Loran type chain of stations transmits a series of pulses at standard Loran repetition rates (20 to 66 times per second). To obtain greater accuracy in determining the time between pulses arriving from individual stations in the chain, Cytac measures the relative phase of the radio frequency carrier in their pulse envelopes. This improves accuracy by a factor of 10-20 over standard Loran, according to Sperry engineers.

Cytac achieves considerably greater range than standard Loran because it operates at 100 kc. instead of Loran's 2,000 kc. frequency. Compared to Loran's daytime range of 700-800 miles over water, 200-500 miles over land using ground-wave signals, Cytac provides a usable ground wave signal out to more than 1,500 miles, Palmer reported. Loran range goes up to about 1,400 miles at night using sky-waves (that bounce off the ionosphere), but

LF For Common System?

Despite the heavy U. S. investment in present very high frequency (VHF) Vortac rho-theta navigation system, at least a few navigation-traffic control experts are taking a fresh look at low-frequency hyperbolic navigation systems as a possible future replacement for Vortac. This includes such systems as Cytac, British Decca and the French Radio-Web systems.

This must appear ironical to Europeans who urged the adoption of such systems 10 years ago when the U. S. was pushing VHF rho-theta navigation aids for international adoption.

Reasons for the re-examination of LF navigation systems include:

- Low altitude coverage for helicopter service is available from LF aids, not from VHF systems.
- Extended area coverage available from LF system would permit a few stations to blanket the U. S. whereas more than 1,000 VHF stations will be required for the same coverage.
- Higher accuracy generally is available at greater distances from the station, permitting closer spacing of aircraft, than with rho-theta line-of-sight system.

These were some of the points made at the recent IRE convention by Vernon Weihe of the Air Transport Association and Melpar.

However, there are two important disadvantages to most existing LF systems:

- Susceptibility to atmospheric disruption due to severe thunderstorm activity, whereas VHF is practically immune to such disturbance. Reliable navigation service is most needed during weather conditions.
- Weight and size penalty of airborne equipment, particularly for the private flyer when contrasted with weight and size of his present VOR receiver.

Admitting the vulnerability of LF systems to atmospheric disruption, Weihe suggested the use of a small, lightweight automatic dead reckoning computer to supplement the LF system. Such a device could provide moderately accurate navigation information for short periods when LF service was disrupted, could be periodically recorrected for drift errors when the LF signal was available.

sky-wave operation produces spurious pulses and requires that each reading be compensated for the longer sky-wave propagation path. Cytac, which operates solely from ground waves, does not encounter this problem.

Cytac originally was called Cyclan, a contraction of "Cycle-matching Loran." When its development was later redirected toward possible use by the Tactical Air Command, the name was changed to Cytac.

If the USAF has plans to make tactical use of Cytac, these have not been disclosed. Sperry holds a contract to set up a Cytac chain along the East Coast which will be used by the Coast Guard and the Navy for undisclosed purposes. Like Loran, Cytac can provide navigation service to surface ships.

Airborne Equipment

To date Sperry has built only experimental Cytac receivers which included classified functions not required for civil use. Palmer estimates that an airborne receiver for civil use, capable of automatically providing aircraft position fix data, can be built to weigh 40-50 lb.

Such a receiver would not directly indicate aircraft position. Pilot would have to read time-difference numbers, then refer to special Loran-type charts to determine position fix. However, for an additional 20 pounds, automatic plotting and display of aircraft position could be provided, Palmer estimates.

For domestic Common System application, aircraft operators probably would insist upon the fully automatic display provision. This would place Cytac at a moderate weight disadvantage compared to present airline Vortac equipment (including DME service), and at a sharp disadvantage for private flyers who now use only a 10 pound VOR receiver. Palmer says it may be possible to build a lighter-weight Cytac receiver for private flyers with somewhat reduced accuracy, but gives no weight estimate.

Loran, Cytac Fundamentals

Both Loran and Cytac operate on the basis of the following principles. If one ground station transmits a pulse of radio energy, followed a fixed and known time interval (T) later by another pulse, transmitted from a second ground station located some distance away from the first, then the two pulses will be received by a navigating vehicle with the same time spacing (T) if the vehicle is located at an equal distance from both stations.

If the vehicle is closer to the first station, called the "master," the time interval will be greater ($T + \Delta T$); if the vehicle is closer to the second station, called the "slave," the interval between pulses will be less ($T - \Delta T$). By measuring the spacing between the two pulses, and comparing it with the known spacing at the time the pulses were transmitted, the airborne receiver determines the vehicle's line-of-position—a hyperbolically shaped line whose focal points are the two stations.

If another pair of similar pulses are transmitted by a second pair of stations at least one of which is in a different geographic location from one of the first pair, the time interval between receipt of these two pulses establishes a second line-of-position.

Intersection of these two lines of position on a Loran-Cytac chart represents the vehicle's position. If a third pair of stations are available, they can provide a third line-of-position to double-check the vehicle's position fix.

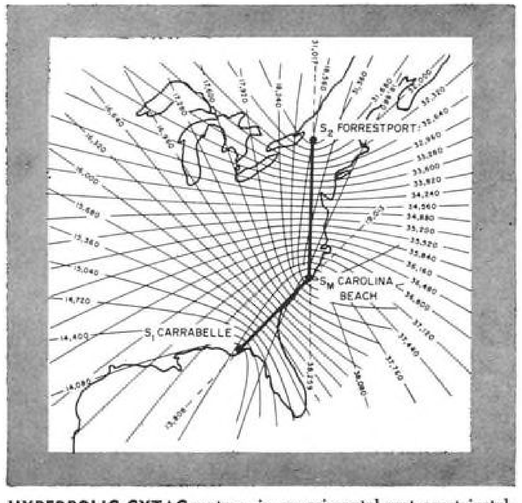
In practice, a single master station and two, or three, slave stations are frequently used instead of two or three distinct pairs of Loran or Cytac stations. In such case, the master station alternately teams up with each of the slaves to transmit a pair of pulses in a time-shared sequence on a single radio frequency.

Pulse Spacing Measurement

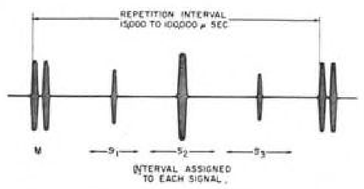
One of the major limits on the accuracy of standard Loran is the precision with which the time spacing between pulses can be measured. Because the pulses may be distorted when received, it is difficult to determine the time interval more accurately than to within one microsecond. It is impossible to give the equivalent position fix error in feet or miles since this will depend upon the configuration of the Loran chain and the vehicle's position relative to the stations. An ACC report says that typical Loran errors in daytime (using ground-waves) average about 1½ nautical miles over sea water.

The problem of measuring pulse spacing is more difficult at night when sky-waves, resulting from multi-hop ionospheric reflections, may produce a stream of up to 20 spurious pulses which can overlap the initial pulses from a subsequent ground-station transmission. This can cause considerably larger errors in measuring pulse spacing. ACC's report says these average about five nautical miles.

Cytac, like standard Loran, requires



HYPERBOLIC CYTAC system, in experimental east coast installation (left) produced errors well within estimated values (right). Small figures alongside curved lines show estimated error in feet. Actual errors experienced are shown at locations measured.



CYTAC PULSE sequence (top) resembles conventional Loran. Waveform as received at Clarkton, N. C., from experimental Cytac chain is shown below.

that transmission time of each master-slave station combination be synchronized to assure constant and known spacing between their pulses. Cytac, in addition, requires that the respective RF carriers of the two stations also be synchronized. Synchronization is accomplished by ground-wave signals between master and slave station.

The Cytac receiver measures pulse spacing in Loran-fashion to obtain a rough indication, then polishes it off precisely by measuring the relative phase of the RF carrier in the master and slave pulse envelopes. The rough pulse-spacing measurement is made with sufficient accuracy to prevent ambiguity in the phase comparison process, i.e. to prevent comparing phase of the first cycle of master pulse with the second cycle of slave pulse.

By combining pulse and phase comparison techniques, Cytac is able to measure pulse spacing to within 0.02-0.03 microseconds, according to Palmer. Cytac's instrumental error is only a fraction of the total system error, the bulk of which results from variations in the velocity of radio wave propagation due to changing weather conditions, Sperry's Walter N. Dean told the IRE. With suitable compensation for the latter, Cytac's overall timing errors are about 0.1 microsecond, compared to one microsecond for a standard Loran.

Sky-Wave Contamination

Sperry's tests indicate that the operating range of a single Cytac chain could be extended from 1,500 to perhaps as much as 2,800 miles if sky-waves were used. However, the system is designed to operate solely from ground-waves under normal conditions to avoid contamination from spurious pulses.

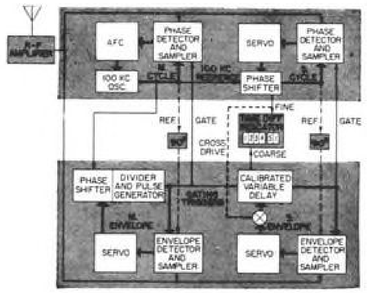
The first of any sky-wave pulses nor-

mally arrives at least 30 microseconds after the corresponding ground-wave pulse. To avoid sky-wave contamination, the Cytac system is designed to provide a fast-rising pulse whose amplitude is sufficient to permit phase-comparison of its carrier in something less than 30 microseconds.

In an experimental Cytac chain covering the Eastern half of the U.S., Sperry used pulses which rose from zero to full amplitude in about 50 microseconds, with the receiver designed to perform the phase-comparison approximately 27 microseconds after the start of the pulse.

At the low frequency at which Cytac operates, fast-rising pulses mean wide bandwidth. Cytac occupies the full 20 kc. presently allocated in the 90-110 kc. band for navigation purposes, and about one per cent energy spills outside band.

Some observers believe that the 20 kc. bandwidth requirement will make Cytac receivers extremely susceptible to atmospheric disturbance from thunderstorms. Navarho, which also operates in the vulnerable 100 kc. region, is designed to use extremely narrow-band techniques. (AW Apr. 26, 1954, p. 52.) However Sperry engineers say that more than a year of testing in the experimental Cytac installation resulted in no serious outages.



BASIC RECEIVER FUNCTIONS

BLOCK diagram of Cytac receiver.

A major source of error in the Cytac system arises from RF carrier phase shift due to different ground conductivity over different portions of the path between vehicle and ground station. Sperry found errors as large as 1½ microseconds. Temperature also had a marked effect on apparent propagation velocity, particularly in the winter, Dean told the IRE.

Phase shift due to different ground conductivity appears to remain reasonably constant, showing a variation of less than one part in 50,000 over a period of a year, Dean said. This suggests the possibility of mapping the Cytac service area to determine average ground conductivity variation errors, then distorting the Cytac charts to compensate for them, Dean said.

Sperry tests also indicate that phase shifts due to temperature changes are more or less linear along the propagation path. This opens the way to automatically adjusting the time interval between master and slave station pulses to partially compensate for temperature phase shift.

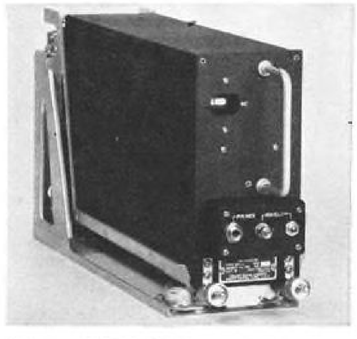
Dean concludes that "it is possible to reduce greatly the long-term variation in propagation, thus making feasible overall accuracies of time-difference determinations in the order of ± 0.1 microsecond."

Short-term variation, due to atmospheric noise and interference, are considerably smaller than these aforementioned long-term variations, Dean said.

Time-Sharing Receiver

The sequential nature of pulse signals from different stations in a Cytac chain permits extensive use of time-sharing within the receiver to reduce size, weight and complexity, Sperry's Robert L. Frank told the IRE.

For example, a common RF amplifier is used, supplied with a time-shared automatic gain control (AGC) voltage. This equalizes signal amplitudes, and phase measurements are made almost independent of RF tuning because all signals pass through the same circuits, Frank said. Timing circuits also are shared.



New VHF Receiver Weighs Only 10½ lb.

Cedar Rapids, Iowa—New lightweight VHF communications-navigation receiver for airline and business aircraft use, which weighs 10½ lb., occupies a short ⅜ ATR size case and provides 50 kc. channel spacing over the frequency band of 108 to 152 mc., has been announced by Collins Radio Co.

The new Model 51X-2 is less than half the size and weight of its predecessor, the 51X-1 which covered a more limited band (118 to 136 mc.). Substitution of semiconductor devices

for tubes and the use of a transistorized d.c. to a.c. converter instead of the familiar rotary inverter are partially responsible for the size and weight saving. The new receiver uses 9 tubes, 1 transistor and 7 crystal diodes compared to 19 tubes for its predecessor.

In addition to providing communications service in the 118 to 152 mc. band, the 51X-2, when used with a Collins 344B-1 navigation-instrumentation accessory (also contained in a short $\frac{3}{8}$ ATR and weighing about 12 pounds), provides:

- **ILS Localizer service,** at odd- tenth-megacycles from 108.1 through 111.9 mc. with simultaneous voice reception.
- **Omnirange (VOR) service** between 112 and 118 mc. with voice reception.
- **TVOR service** at even tenth-megacycles and odd 50 kc. steps from 108 to 112 mc. with voice reception.

The 51X-2 uses 42 crystals for the full 108 to 152 mc. coverage but can be supplied with fewer crystals if only 108 to 136 mc. service is required. The receiver is designed to Aeronautical Radio Inc. Characteristic 520A and employs modular construction throughout.

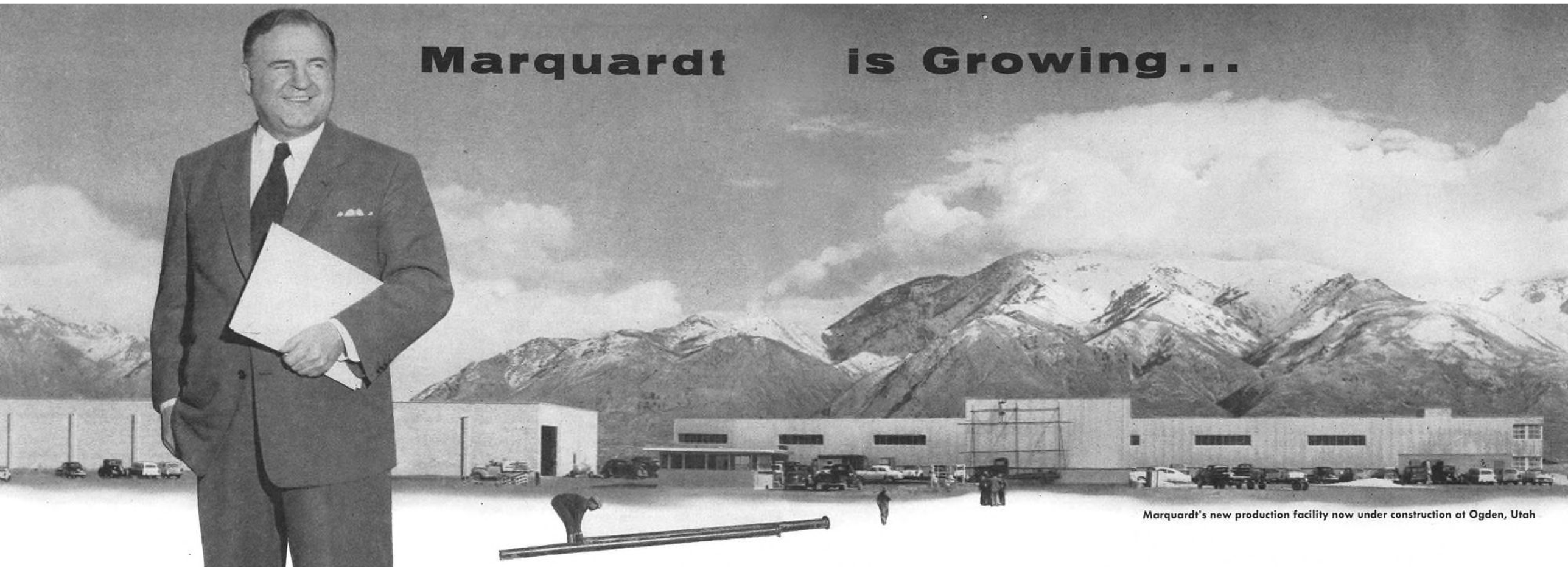
FILTER CENTER

► **Collins Sponsors PWI Research**—Four research investigations into various phases of the aircraft proximity warning/collision avoidance problem have been launched by Collins Radio Co. at several universities and research centers.

► **New Type Amplifier?**—Combination of two solid-state phenomena—electroluminescence and photoconductivity—may provide an interesting new technique for controlling flow of electric current, according to Dr. Malcolm H. Hebb of General Electric's Research Laboratory. Some semiconductor junctions emit light when current is passed through them, light which could be converted back into electricity when it strikes an adjoining photoconductor. Small emitter attached to one of the semi conductors could provide grid-type control. Hebb also speculates that semiconductor junction light source might be "the key to getting closer to the theoretical 200 lumens from every watt of electricity instead of the 20 lumens produced by a good incandescent bulb and 60 lumens from fluorescent lamps."

► **Changing Times And Names**—Radio-Electronics-Television Manufacturers Association (RETMA) may soon shorten its name, to Electronics Industry Association or Electronic Manufacturers Association. Originally called Radio Manufacturers Association, the

Marquardt is Growing...



Marquardt's new production facility now under construction at Ogden, Utah

ROBERT L. EARLE
Executive Vice President
is second in command of the Marquardt engineering-production team. With an engineering-business administration-educational background and more than 20 years' executive experience in the aircraft industry, Bob is one of the motivating factors in the rapid strides being made by the Marquardt team.

Engineering-Management — An engineering-management team, comprised of some of the country's recognized scientists and technical personnel in the field of supersonic propulsion, stimulates Marquardt's progress.

Research and Development — The West's largest ramjet test facility, situated at the Van Nuys plant, provides professional engineers with the tools to test advanced design and development ideas.

offering new opportunities to professional engineers

Freedom to pioneer — freedom to grow... these are the challenges and new engineering opportunities at Marquardt Aircraft.

Through these freedoms, Marquardt stands established as the leader in ramjets, "powerplant of the future."

Through these freedoms, Marquardt leads the way into advanced engineering projects.

These freedoms — pioneering and growth — are as individual as each professional engineer, as collective as the entire Marquardt team. Through them, Marquardt now offers new and unlimited opportunity for professional engineers in two of the West's most stimulating areas. At Ogden, Utah, in the heart of the Wasatch Mountain vacation area, Marquardt is now constructing a multi-million dollar production plant to produce supersonic powerplants for the Boeing Bomarc interceptor missile. And in Southern California's San Fernando Valley, Marquardt professional engineers are involved in a major expansion program for design, development, and test of new ramjet engines, turbojet and ramjet engine controls.

If you are a professional engineer interested in the freedom to pioneer — the freedom to grow — for yourself and your company, we invite you to investigate the opportunities at Marquardt Aircraft, today. Please contact Jim Dale, Professional Personnel, 16551 Saticoy Street, Van Nuys, California.

marquardt AIRCRAFT CO.
VAN NUYS, CALIFORNIA — OGDEN, UTAH

FIRST IN RAMJETS

Portable PA

Portable transistorized public address system, delivers 3½ watts audio power, weighs only five pounds and operates from eight flashlight batteries. Device has range of more than 400 yards under reasonably quiet conditions according to manufacturer, Kaar Engineering Corp., 2995 Middlefield Road, Palo Alto, Calif.

name was expanded when TV arrived on the scene. With the rising importance of the military and industrial electronic segment of the industry, it took its present name.

► **Braniff, Eastern Buy Flight Directors**—Collins Radio's newest Model FD-105 flight director system will be installed on Braniff Airways five new Boeing 707s and nine Lockheed Electras and on Eastern Air Lines' 23 Douglas DC-8s and 40 Electras. New model has four-inch diameter panel instruments.

Microwave System Uses Tropospheric Scatter

Tropospheric scatter communications system which operates at microwave frequencies (7,125 to 8,500 mc.) instead of in the usual UHF band, thereby making system less vulnerable to enemy interception and/or disruption, has been developed by Philco Corporation for the Air Force. System provides video bandwidths for transmission of television or radar signals over distances up to 200 miles.

System employs two 28-ft. parabolic antennas which provide a 54 db. gain and 0.3 degree beam width. This provides extremely high directivity which makes transmission less susceptible to interference from aircraft in or near the beam.

Also used are new four-cavity klystrom amplifiers rated at 2,000 watts continuous power and a device which combines the output from two diversity receivers without previous switching transient problems to provide a 3 db. gain in performance.

New York Police Helicopters Save Lives

By Erwin J. Bulban

New York—New York Police Department helicopter operation underscores the value of rotary wing aircraft as an effective life saving and law enforcement medium for local government.

Scores of lives have been saved thus far by Bell 47-Ds belonging to NYPD's Aviation Bureau. About a dozen drowning persons were rescued last year alone.

Highly publicized in the local press, NYPD's little Bells are almost as familiar to local New Yorkers as the department's ground-based patrol cars.

High Regard

Although the Bureau's modest $25,000 annual budget hasn't been increased over the past five years, some indication of the high regard held by municipal officials for Aviation Bureau operations can be seen by the easy treatment its budgets get during annual review, compared to other roughly treated city departments. When NYPD's Aviation Bureau decided to re-equip with modern aircraft, it received city approval necessary to purchase three new four-place Bell 47-J Rangers. Standard price for the 47-J is approximately $63,750. With all of the equipment specified by the Bureau, its aircraft will cost approximately $80,000 each, including litters, litter doors, air-rescue power hoist, approximately $2,000 worth of radio and spares.

Normally Bell recommends that purchasers of a single 47-J get $2,600 in spares; two ships should have $6,000 worth and three would require $26,000 worth. This is based on a single year, or 600 hr., operation. Bureau is fortunate that some 75% of its 47-D spares are suitable for 47-J operation, aside from engine and rotor blades.

First Delivery

First of the Bureau's three Rangers was delivered late in February; the other two were scheduled to be delivered to its Floyd Bennett Field base in Brooklyn this month. Of its two remaining 47-D1s, one will be used for training and the other eventually will be replaced with a new model.

Ranger's improved performance with increased payload was the major factor in ordering the new aircraft. Although the 47-D1 is rated by the manufacturer as a three-placer, Aviation Bureau considers it a two-place ship for its type of operation. Its new Rangers, with a current allowable gross of 2,565 lb., provide a payload of approximately 950 lb., permitting a good complement of rescue equipment and up-to-date radio to be carried. Payload increase to about 1,300 lb. may be available, with Bell working to increase the 47-J's allowable gross weight to approximately 2,850 lb.

FIRST OF THREE Bell 47-J Ranger helicopters purchased by New York police.

NEW MODELS will replace Bell 47-D1s. Department will keep two 47Ds.

Aviation Bureau's beat is along the vast stretches of water enclosing New York City, patrolling some 650 mi. of waterfront. It works with Civil Aeronautics Administration and Civil Aeronautics Board in checking complaints against low flying, enforces regulations of Department of Marine and Aviation regarding seaplane bases and other landing areas in its jurisdiction, and does a considerable amount of aerial survey for various City departments.

An average year's breakdown of the type and number of flights its helicopters make include: checking boats in

distress, 69; traffic surveys, 22; aerial photo surveys, 35; searches for missing persons and boats, 75; transport injured, 4; recover bodies, 15; storm warning coverage, 3; seeking boats reported interfering with bathers, 10; drownings, 5; convict searches, 4; apprehension of stolen boats with occupants, 3; locate stolen cars, about 15.

Once the police helicopters aided in apprehension of a band of kidnapers who tried to use carrier pigeons for delivery of ransom money; the helicopters trailed the pigeons to the kidnaper's hideout. Another time one of the helicopters helped narcotics agents nab a dope peddler who had evaded trailing for years. Detectives painted a mark on top of the suspect's car, followed him by air to a pickup, with the helicopter painted to blend with the sky.

Several times, prisoner escapes from Welfare Island have been foiled by the

Fire Copters?

New York—Fire fighting helicopters definitely will play a role in Fire Department operations in the future, N. Y. Fire Commissioner Edward F. Cavanaugh, Jr., told Aviation Week.

Commissioner Cavanaugh sees a need for a rotary wing "fire engine" large enough to carry about 10 firemen, 500-gal. chemical tanks, specially developed lightweight booms with fog-nozzles and two-way radio for air-to-ground contact. Such equipment especially would be useful in outlying suburban areas and to fight spread of brush fires difficult to reach over rough terrain.

Small liaison-type helicopters also are needed to transport Fire Department officials quickly to the scene of major blazes where they could effectively direct operations from the air via radio. Commissioner Cavanaugh and several men in his department have used borrowed Police Department Bell 47-D1s on such occasions. Commissioner Cavanaugh estimates that if his department had its own small helicopter it would be used for such duties at least four times a month.

However, such equipment doesn't appear to be in the procurement stage at present; the Commissioner says there is no room now in the department's budget for helicopters.

Several helicopter manufacturers, particularly Bell, Kaman and Vertol, have studied fire-fighting helicopter projects. Bell has been working with Ansul Chemical Co. in fitting a chemical dispensing boom on its Model 47 and demonstrating how close the copter can work to fires. Ansul currently is studying what is needed in the way of lightweight dispensing equipment.

	Low Flying Complaints	Forced Landings	Crashes
1950	51	12	7
1951	46	5	8
1952	101	7	6
1953	81	7	5
1954	62	5	6
1955	51	10	8
1956	57	22	9

helicopters maintaining surveillance over the island, forcing escapees to remain under cover until they were located.

Traffic duties include checking busy parkways from the air. If officers see anything that might stall traffic for more than five or ten minutes, they radio to send patrol cars to the scene. Accidents being a major source of traffic tieups, the helicopters are engaged in photographing parkway entrances and exits; pictures will be supplied to ground units, so that in event of a major accident, they will be able to spot the best places to hold the flow of traffic to allow easy passage of tow vehicles and ambulances. If needed, the helicopters would be called in to evacuate injured.

To assist in getting injured rapidly to nearest hospital, the Aviation Bureau developed an Emergency Manual containing aerial photos it took at approximately 20 of the city's major hospitals, each one pinpointing the actual landing area adjacent to the building that would be used by a copter.

Procedures also are developed so that the helicopters will cover any of the city's prisons in event of trouble.

Police may fly serum to upstate children's camps threatened by epidemics and have been used to fly blood plasma to emergency cases. Sometimes they have gone out to locate doctors on fishing boats, dropping a note in the water alongside the boat to tell the doctor he is urgently needed on a case. Occasionally the copters cover upstate parks hunting lost children, or game areas seeking missing hunters.

Aerial Survey

The helicopters are estimated to have saved untold sums in aerial photo survey work for other departments. Officers estimate that thousands of pictures have been made from the Bells. One major project was photographing the entire lower Manhattan to aid city engineers in developing a sewer project. Oblique views enabled them to estimate building heights and calculate amount of pipe that would be required. Other

U. S. Business & Utility Aircraft Shipments

(January–February 1957)

Make and Model	Aircraft		Builders Net Billing Price	
	Feb.	Jan.	Feb.	Jan.
Aero Design 560-A	1	1		
680	7	18	$635,000	$1,416,000
Beech 35 Bonanza	47	41		
50 Twin-Bonanza	5	15	2,122,378	3,048,221
18 Executive	8	11		
Callair A-4	2	2	12,270	12,000
Cessna 170	9	6		
172	66	58		
180	39	40	2,381,850	2,557,608
182	62	81		
310	14	15		
Champion 7EC Traveler[1]	10[1]	13	47,000	52,745
Colonial C-1 Skimmer	3	3	51,000	56,000
Helio H-391B Courier	2	2	46,000	46,000
Mooney Mk. 20	5	6	49,000	61,000
Piper PA-18 Super Cub	26	26		
PA-18A Super Cub	49	40	1,865,744	2,541,873
PA-22 Tri-Pacer	90	123		
PA-23 Apache	30	48		
Taylorcraft Mk. 20	1	1	10,000	10,865
Trecker Royal Gull P.136-L1	1	0	74,500	0
Totals	477	550	$7,294,742	$9,802,704

[1] Two-week plant shutdown in February for model change.
Source: Compiled by AVIATION WEEK from manufacturer's reports.

photo missions are flown for Board of Estimate to survey land sites subject to litigation and also to study sites for new schools and other public buildings.

To cover its territory, the Bureau works out of a hangar leased from the Navy at Floyd Bennett. Aerial patrols start at 8 a.m. and last through sundown. In summertime, when daylight saving time prevails, this means the ships are aloft until approximately 9 p.m.

Emergency Use

Normally missions are canceled if winds exceed 35 mph. or if visibility is less than three-quarters of a mile, but in an emergency police helicopters have gone out even when these minimums have been exceeded. Once, after a hurricane, they went aloft in winds of approximately 50 mph. to rescue two small boys who had ventured out into choppy water on flimsy rafts. The weather was so rough that all boats were tied up and the helicopter beat a police launch that attempted the rescue from a distant point.

In the course of its operations, Aviation Bureau personnel have been awarded 15-20 department commendations for their work.

Four heliports, strategically located around the city, make it possible to base helicopters about five minutes away from the farthest point from each station; the main base is about 25 minutes away from the farthest point in the Bureau's jurisdiction. All of the helicopters return to main base each night. Although the helicopters are equipped for night flying, this is avoided because of the difficulty of locating anything after sunset, except when a bright moon is out. Police helicopters put in approximately 50 hr. of night flying annually.

With five helicopters, the Bureau is able to have four ships available for duty at all times, the fifth being in overhaul. Each 47-D put in between 30-40 hr./month. On this basis, operating costs average out at approximately $14/hr.

Low Overhead

Key to the low costs, of course, is low overhead. Pilots and maintenance personnel are uniformed officers drawn from Police ranks, with previous flying experience. Flying roster is made up of 11 pilots and 13 maintenance personnel. Two men fly on each patrol.

Requirement for pilots who want to transfer to the Aviation Bureau is that they have at least a commercial pilot's rating; maintenance personnel have to have an A&E mechanics rating. Some 30-35 pilot applications and about half that number of mechanics are usually on file with the Bureau.

Aviation Bureau is one of three units belonging to NYPD's Emergency Service Division commanded by Deputy Chief Inspector Walter E. Klotzback. The Bureau is in charge of Lt. Kenneth C. Johnston, an ex-USAAF instructor with the Training Command who taught multi-engine transport pilots. Lt. Johnston came to the Police Department as a patrolman in 1946, spent three years on the street before transferring to the Aviation Bureau.

Pilot strength comprises Lt. Johnston, a sergeant, two acting sergeants and seven patrolmen. Maintenance personnel is made up of a sergeant and 12 patrolmen. Original group of pilots were trained at Bell Helicopter Corp., when it was based in Buffalo, N. Y., in 1948. Since then, new patrolmen pilots have been trained at Floyd Bennett by Sgt. Harold W. Behrens.

Basic course uses Bell's training manual and comprises 35 hr. flight time, with considerable attention to emergency autorotations. Spot autorotation landings are stressed in the curricula because the Bureau is operating single-engine helicopters over populated areas, although the majority of their flying actually is over water areas skirting the metropolis. According to Sgt. Behrens, Bureau pilots have never experienced a full power failure. Sgt. Behrens is in charge of

SPERRY ANNOUNCES

TWO NEW WEAPON SYSTEMS DIVISIONS

CARL G. HOLSCHUH, *President of Sperry Gyroscope Company.*

"In the years ahead, the nation's requirements for new and more efficient weapon systems, delivered at maximum speed and minimum cost, will impose greater demands on industry. For its part, Sperry is moving to meet these demands with the formation of our new Air and Surface Armament Divisions.

"Objective of this product-team realignment within the Sperry organization is to assure more advanced design, shorter lead times and lower costs in the development of weapon systems in these two categories. Each division, with its own engineering, manufacturing and contract organization, includes specialists in radar, fire control, gyroscopics, navigation, inertial guidance and all the allied sciences essential in the engineering of complex weapon systems."

C G Holschuh

SAMUEL AGABIAN has been appointed Manager of the Air Armament Division. Formerly works manager, Mr. Agabian is an Annapolis graduate and former Marine Corps officer. His work at Sperry has included responsibility for computing gunsights, bombsights, antiaircraft devices, radar and infrared developments.

AIR ARMAMENT

Air-to-air missiles and systems
Air-to-surface missiles
Airborne radars
Airborne beacons
Airborne electronic countermeasures
Bombing-navigation systems
Aircraft fire control radars
Airborne inertial systems

MYRON D. LOCKWOOD, manager of the Surface Armament Division, was formerly a systems engineering director. A World War II Lt. Col. of Artillery, and military-technical advisor at M.I.T., Mr. Lockwood has been associated with Sperry projects in underwater torpedo fire controls, guidance computers for missiles, antiaircraft control systems and inertial navigation equipment.

SURFACE ARMAMENT

Surface-to-surface missiles
Surface-to-air missiles
Ground and shipboard search radars
Ground and ship tracking radars
Battlefield surveillance equipment
Mortar and artillery locators
Land, ship and submarine fire control systems
Computers
Land and ship-based transmitters
Weapon direction systems
Ground and ship-based electronic countermeasures

SPERRY GYROSCOPE COMPANY
Great Neck, New York
DIVISION OF SPERRY RAND CORPORATION

training Bureau pilots. He came to the Department as a patrolman in 1946 after an extensive civilian and military instructor's career. Ratings include commercial pilot, single- and multi-engine, and he is a rated CAA-qualified examiner in helicopter and fixed wing aircraft.

Autorotation landings have always been made on water, because such training is a tricky procedure on land, calling for exact touchdown procedure to avoid damage. Rated pilots also are checked every there months to shoot autorotations for periods of about an hour and a half, making engine-off landings on dye marker in the water from 90 deg., 180 deg. and 360 deg. into the wind.

Spot landings for rescue work also are stressed, pilots being required to touchdown on flat areas on rock jetties measuring about half the length of the helicopter's float gear. In addition, rated pilots are checked out any time they have been inactive for a two-week period.

Personnel turnover apparently isn't a major problem with the Bureau, although industry has absorbed 30-35 patrolmen pilots since it started helicopter operations in 1948.

Switch to the new Model 47-J will entail approximately five-hour flight check for all Bureau pilots.

Do Own Overhauls

Another major factor in keeping overhead down is that the Bureau handles overhauls on its equipment, including engines up to majors, which are handled by the factory. At 600 hr. periods, the 47-D1s are completely torn down by Bureau mechanics, who overhaul transmissions, gearboxes, main and tail rotors (including necessary splicing, recovering). Parts requiring Magnaflux or Zyglo checks are sent out on bids. All the radio work also is done in shop at Bennett.

Considerable do-it-yourself is evident in the shop and operating equipment at Bennett; examples include a multi-position engine stand, which simplifies power-plant maintenance, built from Bell blueprints that the Bureau mechanics redesigned for more versatility. The Bureau also designed and built its own mobile helicopter landing platforms which speed getting the ships in and out of the hangar and airborne.

The Bureau appears satisfied with its equipment. Spark plug problems mostly have been licked through the use of 100 octane Shell TCP fuel, which the Bureau has been using since the petroleum company asked that it be tried on a test basis before it was introduced. Plugs are now seldom changed between 25 hr. checks; changes are made 100 hr.

Another top-rated piece of equipment

NOW! Get Extra Aviation Space Values at No Extra Cost

SCHEDULE THE AVIATION WEEK RESEARCH AND DEVELOPMENT EDITION JUNE 3rd

A Guide to Airpower Progress

Need for Specialized Research and Development Information

Manufacturers are busy broadening their research and development activities. They recognize that their competitive position depends on the ability to compete in the urgent quest for new basic scientific knowledge in such diverse fields as geophysics, aerothermodynamics, metallurgy, human factors and aerothermochemistry, etc. Because of the highly specialized sciences and technical fields concerned, manufacturers must often obtain research and development assistance from outside sources – government, university, scientific foundation, foreign and other manufacturers. In a sense, research and development has become a *unique commodity that is produced, bought and sold.*

Expansion of research and development procurement activities has brought the need for a Guide which will increase the understanding of procurement procedures and available facilities and capabilities. To satisfy this need, the Research and Development Edition, an outgrowth of editorial pioneering in this field as outlined later in this announcement, will provide the following specialized research and development information:

INDUSTRY

Industry's vital and rapidly increasing role in research and development will be surveyed.

Indexed guidebook section tells industry what facilities and capabilities are available, where they are and how to utilize them. Information on the marketing of research and development availabilities will be reported

Newly revised government research and development contracting policies and procedures explained in detail.

GOVERNMENT

Missions, organizations and operating procedures of National Advisory Committee for Aeronautics; Air Research and Development Command; and Office of Naval Research summarized. Their laboratories, research stations and test center facilities, capabilities and availabilities analyzed in detail.

UNIVERSITIES AND SCIENTIFIC FOUNDATIONS

Exhaustive report on the important research and development programs at work at various universities and independent establishments throughout the country. Particular attention is given to the procedures of sub-contracting these resources.

INTERNATIONAL

Exclusive coverage of oversea's sources of research and development available to industry as reported by our Geneva, Switzerland office.

Pioneer Research and Development Coverage

AVIATION WEEK pioneered research and development coverage in 1953 when it presented an exclusive full-scale report on the USAF Air Research and Development Command and the gigantic industry, military and scientific production team that it coordinates. Thousands of extra copies were purchased by government, industry, university and foreign establishments and used as the standard reference for training research and development and procurement personnel.

In 1956, AVIATION WEEK was called upon to publish a second Air Research and Development Command Edition to report the many changes, improvements and advances that had been made. It is now in use as a current standard reference and training aid on research and development.

AVIATION WEEK's 26 full-time graduate engineers and aviation specialists located in key aviation centers throughout the world will provide the editorial manpower and know-how for this newest research and development service edition. Their extensive experience in this field which was pioneered editorially by AVIATION WEEK assures an information packed Guide of outstanding usefulness and serviceability.

ADVERTISERS' BENEFITS

Long lasting reference use by industry and the military assure advertising repeated exposure. Aviation's largest engineering-management, scientific and military audience provide advertising widest possible circulation.

Regular June 3rd weekly issue allows extra advertising values at no extra cost.

Regular rates apply and insertions may be a part of your AVIATION WEEK contract.

Advertising will be positioned in appropriate sections; heavy stock four-color dividers will make up sections.

Special leather bound copies for military, civilian and government leaders. Contact your AVIATION WEEK district sales representative for complete information.

AVIATION WEEK

ABC ABP

A McGraw-Hill Publication
330 West 42nd Street, New York 36, N. Y.

are the SAFT nickel-cadmium batteries, 35-lb. units which replaced former four-cell Rebat equipment weighing about 80 lb. Since the SAFT's were installed in Bureau copters in 1953, it has never had to charge one (its battery shop is inactive now) and it has never had a ship stuck with battery trouble regardless of weather, Lt. Johnston told AVIATION WEEK. He mentioned an instance where one of the helicopters had overturned in the water and sunk. Battery was salvaged several hours later. All that was required was a hosing to wash off salt water. It was installed in another helicopter, where it turned the engine over without trouble.

Communications

Older type low-band seven channel Aircraft Radio Corp. communication gear installed in the 47-D1s also works out satisfactorily, according to the Bureau. It said it hasn't had to make a tube change or adjustment in this equipment for five years.

Rangers are having new ARC radio gear installed by Atlantic Aviation, Teterboro, N. J. Equipment will comprise an R-19 receiver, T-20 transmitter, A-12 antenna and C-56 control unit, providing two-way whistle-stop tuning VHF communications with these crystals installed: 118 m.c., 118.7, 119.1, 121.5, 121.7, 121.9, 122.1, 122.5, 122.7, 122.8, 126.18.

The Bureau stocks $30,000 worth of parts, practically enough to assemble another ship except for the cockpit and center frame. Johnston maintains a credit of $2,500 with Bell so that he can get what he needs quickly without having to go through time consuming city purchasing procedures. Whenever this drops down to approximately $500, he puts in for another blanket purchase order to keep himself at the $2,500 level. Purchase order is routed from the Bureau to the Emergency Service Division, through the PD-Quartermaster and then to New York City's Department of Purchase. The Department of Purchase puts Bureau requests for material out on a bid basis, often follows the Bureau's recommendations on sources.

American Begins Work On Idlewild Hangar

New York—American Airlines is beginning construction of a $20 million maintenance facility at New York International Airport. The expandable 750 ft. x 360 ft. hangar is scheduled for late 1958 completion. It will accommodate 10 jet transports at once.

The facility will occupy a third of a 76-acre site about half mile from Belt Parkway on the access road to Idlewild. A 500-car parking lot will be built.

Certificates of Necessity

Washington—Office of Defense Mobilization has awarded United Aircraft Corp., Pratt and Whitney Aircraft Division's new Palm Beach Co., Fla. Facility a certificate of necessity for accelerated tax amortization in the amount of $26,175,000 for research and development with 70% of the amount certified allowed.

General Dynamics Corp., Convair Division, San Diego, was awarded a certificate for research and development in the amount of $17,022,000 with 60% allowed. Other certificates awarded:

Aerojet General Corp., Sacramento, Calif., research and development, $417,740 with 60% allowed.

Leach Corp., Los Angeles, military aircraft components, $246,400 with 50% allowed.

Glenn L. Martin Co., Baltimore, Md., military aircraft, $504,670 with 65% allowed.

International Silver Co., Wallingford, Conn., military aircraft engine parts, $375,000 with 65% allowed.

Western Electric Co. Inc., Winston-Salem, N. C., military electronic components, $99,886 with 65% allowed.

Western Electronic Co. Inc., Winston-Salem, N. C., military electronic components, $27,596 with 65% allowed.

Western Electric Co. Inc., Greensboro, N. C., military electronic equipment, $39,390 with 65% allowed.

Western Electric Co. Inc., Burlington, N. C., military electronic equipment, $11,587 with 65% allowed.

United Aircraft Corp., East Hartford, Conn., military aircraft engines, $2.1 million, with 65% allowed.

Atlantic Mastercraft Co., Bronx, N. Y., military aircraft parts, $119,609, with 65% allowed.

Propulsion Research Corp., Santa Monica, Calif., research and development, $88,359 with 70% allowed.

Fenwal Inc., Ashland, Mass., scientific instruments for military use, $8,859 with 70% allowed.

Bendix Aviation Corp., Bendix Products Div., South Bend, Ind., military jet engine components, $63,300 with 60% allowed.

Glenn L. Martin Co., Baltimore, Md., military aircraft, $61,235 with 60% allowed.

Raytheon Manufacturing Co., Microwave and Power Tube Operations, Waltham, Mass., military electronic equipment, $349,080 with 55% allowed.

McDonnell Aircraft Corp., St. Louis, research and development, $5,718,107 with 80% allowed.

AMC Contracts

Wright-Patterson AFB, Ohio—Following is a list of unclassified contracts for $25,000 and over as released by the Air Materiel Command:

Wade Labor Construction Co., Inc., Denver Colo., $2,322,470 for construction of utilities at the Air Force Academy.

Radio Corp. of America, Camden, N. J., $1,586,176 for product improvement of air navigation equipment.

American Air Filter Co. Inc., Herman Nelson Division, Louisville, Ky., $5,900,180 for engine and shelter heater.

Curtiss-Wright Corp., Caldwell, N. J., $3,961,933 for propeller assembly.

Lockheed Aircraft Corp., Marietta, Ga., $1,325,639 for air load survey and final structural integrity demonstration tests.

General Electric Co., Syracuse, N. Y.,

$7,437,458 for research, development and test of radar set.

Beech Aircraft Corp., Wichita, Kan., $1,709,227 for modification of L-23 aircraft.

Westinghouse Air Brake Co., Union Switch and Signal Division, Swissvale, Pa., $1,013,959 for modification of flight simulators.

General Electric Co., Small Aircraft Engines Department, West Lynn, Mass., $1,008,664 for YT-58 turboshaft engines.

Avco Manufacturing Corp., Lawrence, Mass., $2,798,700 for facilities for guided missile program.

Marquardt Aircraft Co., Van Nuys, Calif., $11.5 million for facilities at Ogden, Utah, for research and development.

Dresser-Ideco Co., Columbus, Ohio, $1,327,820 for radar tower.

Industria Meccaniche Aeronautiche Meridionali, Aerfer, S.P.A. Naples, $3,112,882 for F-84 spare parts.

CAA Contracts

Washington—Following is a list of contracts as released by the Civil Aeronautics Administration:

General Cable Corp., Washington, $71,672 for 62,000 ft. of armored cable.

Bendix Aviation Corp., Eclipse-Pioneer Division, Teterboro, N. J., $64,400 for four automatic pilot systems and associated equipment for use in DC-3 aircraft.

Nems-Clarke Inc., Silver Spring, Md., $29,760 for 600 type V identification keyers and 600 keyer mounting plates.

Bendix Aviation Corp., Boonton, N. J., $9,841 for 14 inverters.

Aircraft Radio Corp., Boonton, N. J., $5,500 for three signal operators, instruction books and three course checkers.

W. L. Maxson Corp., Long Island City, N. Y., $2,575.06 for 647 audio matching transformers.

General Electric Supply Corp., Washington, D. C., $1,194.13 for 97 insulators.

Army Contracts

Following is a list of unclassified contracts of $25,000 and over as released by Army Contracting Offices:

CORPS of ENGINEERS, Jacksonville Dist., 575 Riverside Ave., Jacksonville, Fla.

B. B. McCormick & Sons, Inc., P. O. Box 248, Jacksonville Beach Fla., construction of site preparation for complexes 15, 16, 19 and 20 WS-107A project AF Missile Test Center, (Serial No. ENG-08-123-(NEG-57-2), job, $359,160.

J. A. Jones Construction Co., 209 Fourth St., Charlotte, N. C., construction of G/M contractor's facilities, laboratory, storage building, radar towers and addition to Northrop Guidance Laboratory AFMTC, Patrick AFB, Florida, (ENG-08-123-(Neg-56-13), job, $1,708,766.

CORPS OF ENGINEERS, Office of the District Engineer Albuquerque District, P. O. Box 1538, Albuquerque, N. Mex.

C. H Leavell & Company, 1900 Wyoming Street, El Paso, Texas, Construction of Missile Propellant Storage Facilities, White Sands Proving Ground, Las Cruces, New Mexico contract No. Da-29-005-Eng-1746 (IFB Eng-29-005-56-38) job, $226,657.

Robert E. McKee, General Contractor, Inc., 1918 Texas St., El Paso, Tex., construction of track control and maintenance facilities, (Schedules A, B, C, & D), Holloman Air Force Base, Alamogordo, New Mexico, (Contract No. DA-29-005-ENG-1798 (IFB Eng-29-055-57-33), job, $1,189,990.

LOS ANGELES ORDNANCE DISTRICT, 55 S. Grand Ave., Pasadena, Calif.

Southwest Welding & Manufacturing Co., 3201 W. Mission Rd., Alhambra, Calif., liquid oxygen tank, job, $96,627.

NEW YORK ORDNANCE DISTRICT, 180 Varick St., New York 14, N. Y.

Stavid Engineering, Inc., U. S. Highway,

Plainfield, N. J., Engineering study of Automatic Assembly Techniques for Guided Missile Electronic Equipment, DA-30-069-ORD-1853, $126,586.

Eclipse-Pioneer, Division of Bendix of Bendix Aviation, Teterboro, N. J. Transmitter, Tacometer Assy E. C. 8002-1-B ORD No. 7,723,274, Ord Stk, No. G-244-77-23274, Fed. Stik, No. 6680-772-3274-G244, Government Spec, MIL-S-11744A as modified by Contractors GSM 216, Change E, dated 12 April 1956, Beh Appl Snl G251, G244, G256, G258, G262, G268, $31 ea., $126,586.

RESEARCH CONTRACTING DIV., Trans. Research & Developing Command, Fort Eustis, Va.

The Board of Trustees of the Leland Stanford Junior University, Stanford, Calif., development of a system of transportation movements involving use of electronic data processing systems, (Contract DA 44-177-TC-384), job, $324,055.

Navy Contracts

Following is a list of unclassified contracts of $25,000 and over as released by Navy Contracting Offices:

AVIATION SUPPLY OFFICE, 700 Robbins Avenue, Philadelphia 11, Pa.

Autometics, North American Aviation, Inc., 9150 E. Imperial Hwy., P. O. Box "AN", Bell Flower, Calif., controls, (383/2130-1118/52), 247 ea., $133,177.

Brad Harrison Co., 4222 Warren Ave., Hillside, Ill., cable assys., (IFB-383-207-57), various, $111,868.

Fletcher Aviation Corp., Fletcher Airport, Rosemead, Calif., parts for tank assys., (383/2110-138X7/1/53), various, $137,186.

Douglas Aircraft Co., Inc., 3000 Ocean Park Blvd., Santa Monica, Calif., cabin supercharger transmission assys, (383/23055-1 A 4/1/57, 383/2110-1225/53), 100 ea., $122,500.

Lockheed Aircraft Corp., P. O. Box 551, Burbank, Calif., cylinders, pistons, axles, (383/2110-1683/52, 383/2110-840/53, 383/2110-1684/52), various, $270,549.

B. F. Goodrich Tire & Equipment Co., B. F. Goodrich Co., 500 S. Main St., Akron 18, Ohio, deicer boots, (383/2150-1549 X 7/3/52), various, $245,966.

The Yeland Electric Co., American Machine & Foundry Co., 1501 Webster St., Dayton 1, Ohio, motor generators, (IFB-383-2032-56), various, $182,456.

Eclipse-Pioneer Div. of Bendix Aviation Corp., Teterboro, N. J., indicators, (383/2120-90/55383/2120-159/54), various, $320,-648.

Hewlett-Packard Co., 275 Page Mill Rd., Palo Alto, Calif., signal generators (383/29069/56, 383/2110-8375/55, 383/2110-8360/55), various, $289,564.

Vickers, Inc., 1400 Oakman Blvd., Detroit 32, Mich., assemblies & maintenance parts (383/2150-1464/52), various, $269,592.

Jack & Heintz, Inc, 17600 Broadway, Cleveland 1, Ohio, Maintenance parts for starters (383-234/53) Various $436,897.

McDonnell Aircraft Corp, P. O. Box 616 St. Louis 3, Mo. Ground Handling equipment for F2H Aircraft (383-29065-29 S3/1/57) Various $107,090.

Gill Electric Mfg. Corp. 624 West Citrus Ave, P. O. Box 431 Redlands, Calif, Batteries (PREN11-805-57, PREN11-793-57) 232 ea, $255,655.

NAVY DEPARTMENT, Bureau of Ordnance, Washington, D. C.

Tele-Dynamics, Inc., Philadelphia, Pa., telemetric data receiving set, AN/UKR-10, (NOrd-17398, Prop. No. NOrd 30-57), $147,515.

DISTRICT PUBLIC WORKS OFFICE, Eighth Naval District, New Orleans, La.

Noser Construction Co. P. O. Box 871, McAllen, Tex Construct Air Force TM-190 Site, Naval Auxiliary Landing Field, Port Isabel, Tex (IFB NOy-91220) $879,600.

DISTRICT PUBLIC WORKS OFFICE, 11th Naval Dist., San Diego 32, Calif.

Edward R. Siple Co., 2545 San Fernando Rd., Los Angeles 65, Calif., additional aviation fuel storage facilities Naval Ordnance

Test Station, China Lake, Calif., Contract NBy-4197 (IFB 4197'56B), job, $112,681.

U. S. NAVAL TRAINING DEVICE CENTER, Port Washington, N. Y.

Clevite Research Center, Cleveland, Ohio, design, development and construction of ASW targets, contract N61339-75, lot, $265,-608.

NAVY DEPT., Bureau of Aeronautics, Washington 25, D. C.

Philco Corp., 22nd St. and Lehigh Ave., Philadelphia 22, Pa., field engineering services to provide technical assistance and instructions in the maintenance of aircraft electrical and electronic equipment, NOas 57-224-c (MA-30-3764-57), $894,431.

E. W. Bliss Co., 1375 Raff Rd., S. W. Canton 10, Ohio, technical professional services (SI-14) EN11-4766-57, NOas-57-225-S, $489,240.

Southwest Airmotive Company, Dallas 9, Texas, Modification of engines, NOas 57-401-f (PD-41-1072-57) $733,185.

United Aircraft Corp., Hamilton Standard Div, Windsor Locks, Conn, Propeller equipment, NOas 57-304-1 (PD-41-1127-57) $26,-141,040.

Lockheed Aircraft Service-International, Inc, New York, International Airport Jamaica 30, N. Y., Maintenance of WV-2 Aircraft, NOas 57-173-f (MA-44-4365-57), $199,418.

E. W. Bliss Company, 1375 Raff Road, S. W. Canton 10, Ohio, Steam catapult launching engine cylinders, NOas 57-226-f (SI-31 5850-56) $172,170.

USAF Contracts

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

EGLIN AFB, Fla.

Blanchard Construction Co., P.O. Box 1129, Pensacola, Fla., modification of range 22, firing-in butt and control tower, (PR ACMI 56-2; IFB 08-603-56-667), job, $97,-473.

HOLLOMAN AIR DEVELOPMENT CENTER, Air Research and Development Command, Holloman Air Force Base, New Mexico.

Radiation, Inc., Post Office Box 37, Melbourne, Fla., Pulse Code Telemeter System, $192,244.

SACRAMENTO AMA, McClellan AFB, Calif.

North American Aviation, Inc., Los Angeles International Airport, Los Angeles, Calif., installation of advanced electronic equipment and IRAN (inspect and repair as necessary) of F-86D type aircraft. (P/R SM-536813), 355 ea., $3,500,000.

OGDEN AIR MATERIEL AREA, Hill AFB, UTAH

ERCO Div., ACF Industries, Inc., P.O. Box 209, Hyattsville, Md., (definitized letter contract, $168,000, PR 00-498050, reported 24 February 1956), modifications of flight simulators, (PR-00-498050, 00-498050-1, 00-498050-2) $520,796.

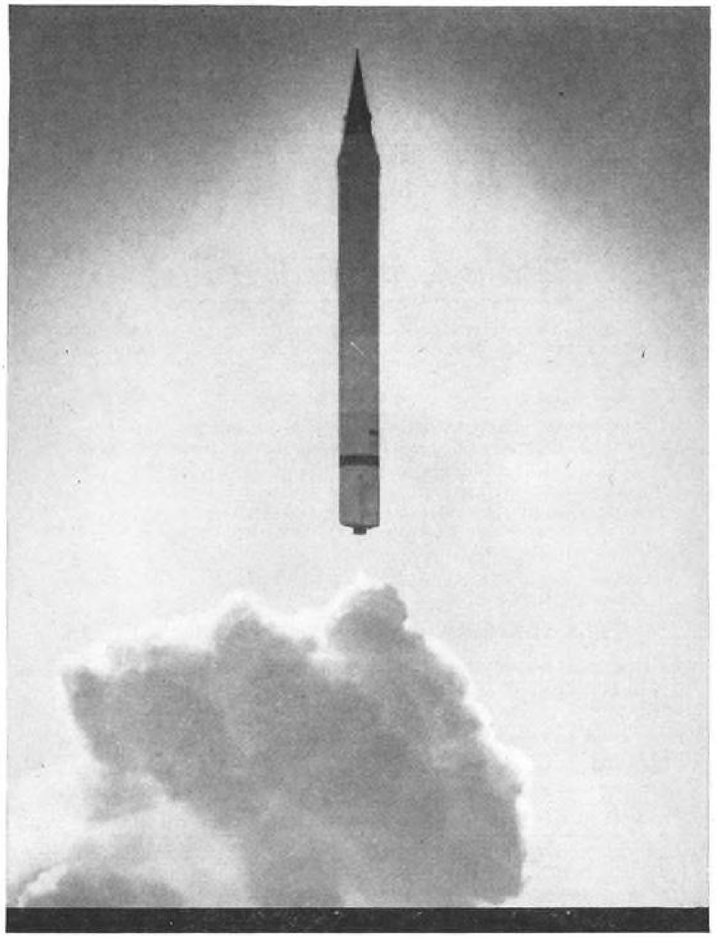
DAYTON AIR FORCE DEPOT, Gentile Air Force Station, Dayton 10, Ohio.

Elastic Stop Nut Corp. of America, 1027 Newark Ave., Elizabeth 3, N. J., test set-air field lighting systems type MM1 in a/w MIL-T-26898 dtd 23 March 1956, 250 ea., handbook data and engineering data, (RFP 33-604-56-3802), $572,812.

Borg-Warner Corp., Byron Jackson Div., Electronics, 492 E. Union St., Pasadena, Calif., signal generators, AN/USM-16, 302 ea., and maintenance data (revisions), (MIPR R56-7012-SC-PR GE566239 & Amend No. 1, SMD-24), $1,133,348.

Aermco, Inc., 10 State St., Mankato, Minn., relay, subminiature hermetically sealed, contractor's P/N R95-2519, 28V, DC, Collins Radio Co. P/N 974-0531-00, 24300 ea., (RFP 33-604-56-3867), $170,100.

G-V Controls, Inc., 45 Hollywood Plaza, E. Orange, N. J., relay, thermal time delay, contractor's type RM-60, 17500 ea., (RFP 33-604-56-3866), $131,250.



ceiling: ∞
subject: **PROPULSION**

From Mach 2 speeds to photon physics...from jet propulsion to nuclear-powered flight...Martin propulsion engineering problems offer the widest range of challenge and opportunity in the aircraft industry today.

If challenge is your dish and the sky is your limit, why not put this to the test?

Contact J. M. Hollyday, Dept. AW-8, The Glenn L. Martin Company, Baltimore 3, Maryland.

MARTIN
BALTIMORE

UNITED IS HIRING 228 FLIGHT OFFICERS

New aircraft scheduled for delivery in 1957-1958 requires immediate expansion of United's Flight Officer personnel. United is interviewing applicants now for training classes extending to February 1958.

You receive frequent, regular pay increases as a United Air Lines Flight Officer. You're paid while training at United's comprehensive Flight Training Center at Denver, Colorado. When you go on line duty you receive $485 a month—$515 at the end of your first six months. As you advance, so do your earnings. United also offers a generous insurance program, retirement income plan, many other benefits.

To qualify you need only a commercial pilot's license with 300 hours or more (no multi-engine time required); you must be a U. S. citizen, 21-28, between 5'7" and 6'4" in height, a high school graduate, and able to pass a flight physical without waivers.

Write today for booklet outlining your opportunity for a high-paying career with United Air Lines.

C. M. Urbach, Supt. of Placement
UNITED AIR LINES, INC.
Operating Base, Dept. Avia-4
Stapleton Airfield, Denver 5, Colo.

Please send me at once your booklet outlining my career opportunities as a United Air Lines Flight Officer.

Name.....

Street.....

City.....Zone....State.....

FOR RATES OR INFORMATION

About Classified Advertising,

Contact The McGraw-Hill Office Nearest You.

ATLANTA, 3
1301 Rhodes-Haverty Bldg.
JAckson 3-6951
R. POWELL

BOSTON, 16
350 Park Square
HUbbard 2-7160
H. J. SWEGER

CHICAGO, 11
520 No. Michigan Ave.
MOhawk 4-5800
W. HIGGENS
J. BRENNAN

CINCINNATI, 37
1825 Yorktown Road
Swifton Village, Apt. 2
G. MILLER

CLEVELAND, 15
1510 Hanna Bldg.
SUperior 1-7000
W. SULLIVAN

DALLAS, 2
Adolphus Tower Bldg.,
Main & Akard Sts.
RIverside 7-5117
G. JONES

DETROIT, 26
856 Penobscot Bldg.
WOodward 2-1793
W. STONE

LOS ANGELES, 17
1125 W. 6 St.
MAdison 6-9351
C. F. McREYNOLDS
D. BRENNAN
D. McMILLAN

NEW YORK, 36
330 West 42 St.
LOngacre 4-3000
S. HENRY
D. COSTER
R. LAWLESS

PHILADELPHIA, 3
17th & Sansom St.
RIttenhouse 6-0670
H. BOZARTH

ST LOUIS, 8
3615 Olive St.
JEfferson 5-4867
W. HIGGENS

SAN FRANCISCO, 4
68 Post St.
DOuglas 2-4600
W. WOOLSTON

Designers – for GENERAL ELECTRIC

Here's your chance to be a part of our nation's leader in the Jet Engine Industry. With GENERAL ELECTRIC you can face the challenge of new advancements in jet engines and propulsion mechanisms.

GENERAL ELECTRIC offers many extra liberal benefits including company financed educational opportunities.

SPECIFIC FIELDS TO CHOOSE FROM:

Tool Design

Tool designers are needed for manufacturing the components of these engines. A minimum of three years experience in the design of jigs, fixtures and gages for either manufacturing or inspection is required.

Product Design

Product openings are for designers to work on improvements on present Jet Engines as well as many new ones for the future. Previous engine drafting experience is desirable along with three years of product design.

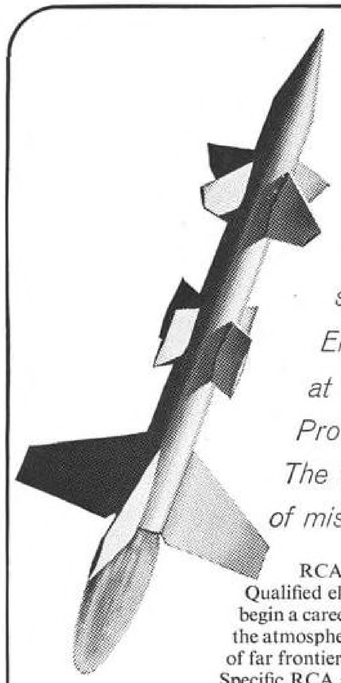
FOR YOUR FUTURE'S SAKE, FILL OUT AND MAIL COUPON TODAY!

Dear Mr. Van Arsdall:
I'm interested in full details about an opportunity at General Electric as a Designer. Please send me an application. I understand all replies are held in strictest confidence.

Mr. J. W. Van Arsdall
Personnel Section,
P.E.D.,
General Electric Co.,
Building A
Cincinnati 15, Ohio

NAME.....
STREET.....
CITY..... STATE .....
I'm interested in.....

GENERAL ELECTRIC
CINCINNATI 15, OHIO



ELECTRONIC ENGINEERS...

become one of the first staff members of RCA's new ENGINEERING OPERATION at WHITE SANDS Proving Ground. The very nerve center of missile electronics!

RCA is new to White Sands! Qualified electronic engineers can now begin a career in a responsible position where the atmosphere crackles with the stimulation of far frontiers in missile electronics. Specific RCA assignments are in missile electronics, ground support systems, missile guidance and complex launching systems. You must, of course, have your EE, ME or physics degree, several years' electronic design experience . . . and must be familiar with one of these fields:

System and sub-system analysis
Reliability data control
Evaluation of new components
Internal instrumentation
Equipment control
Data analysis

Projects will relate to sub-systems such as:

PRECISION RADARS
DIGITAL DEVICES
ANALOG DEVICES
DATA PROCESSING EQUIPMENT
FIRE CONTROL
DATA SIMULATION

Start at an excellent salary . . . A full program of liberal benefits gives your income added security. RCA's Tuition Refund Plan will provide for advanced studies. RCA pays relocation expenses.

ARRANGE CONFIDENTIAL INTERVIEW WITH ENGINEERING MANAGEMENT

Send complete resume to:
Mr. David D. Brown, Dept. V-10D
Mgr. Engineering Employment
Radio Corporation of America
Moorestown, N. J.

RADIO CORPORATION of AMERICA
DEFENSE ELECTRONIC PRODUCTS

INSTRUMENTATION PROJECT ENGINEERS

The Missile and Ordnance Systems Department of General Electric Company has several challenging openings on its staff for Instrumentation Project Engineers.

Position Requirements:

- BSEE with electronics major
- Minimum of four years' experience in the synthesis and/or operation of electrical instrumentation systems and electronic circuitry

Position Responsibilities:

- Determine and integrate data requirements for ICBM nose cone development and testing
- Establish and specify instrumentation systems and characteristics, such as, power supply requirements, component size, shape and weight, cabling and connection points, and external interconnections.
- Evaluate ground and airborne instrumentation test results

The environment is completely technical and professional. We are a research and development laboratory affiliated with one of the world's largest, most diversified and progressive industrial organizations. We hold prime contracts of a long-term nature with all the armed services. Salary and benefits are liberal. Philadelphia location. Excellent facilities and equipment.

Please send resume in confidence to:
Mr. John E. Watt
Technical Recruiting, Room 582-3

MISSILE & ORDNANCE SYSTEMS DEPARTMENT

GENERAL ELECTRIC

1617 Pennsylvania Ave., 17th Floor
Philadelphia 3, Pa.

Budd

Explorers of the Unknown in Metals—Wants High Level

ENGINEERS

To Blaze New Trails in the Development & Perfection of Metals Suited for Use in

- **AIRCRAFT STRUCTURES**
- **MISSILE STRUCTURES**
- **NUCLEAR PROPULSION & REACTOR ELEMENTS**
- **NUCLEAR PROPULSION STRUCTURES**

Another *FIRST* for Budd!

Here in our Aircraft Research and Nuclear Propulsion Laboratories — an outgrowth of the research activity which produced such great industrial engineering FIRSTS as the all steel automobile body, stainless steel railway cars and the all steel two-engine planes — BUDD has just reached another milestone in its exploratory achievements: a solution to the practical and efficient manufacture of structures for aircraft and missiles subject to aerodynamic heating has been found!

With a manufacturing background of nearly half a century and more than 20,000 people on its payroll, The BUDD Company is the established leader in its field. To competent Technical and Scientific Personnel seeking an association with a company offering established employment stability and salaries commensurate with ability, there *truly* is no finer place to work.

If you are interested in an association in a high level research environment, in one of our plants in the East, please fill in the Ready-Reference Card below and send to THE PLANT OF YOUR CHOICE, today, along with a complete resume of your educational and work background.

Mail Today!

READY-REFERENCE CARD
ENGINEERING EMPLOYMENT SERVICE
Address Your Inquiry To One Of The Following:
THE BUDD COMPANY

Personnel Manager
HUNTING PARK PLANT
Philadelphia 32, Pa.

Personnel Manager
RED LION PLANT
Bustleton, Pa.

Personnel Manager
CHARLEVOIX PLANT
Detroit 15, Michigan

Personnel Manager
CHASE PLANT
Gary, Indiana

NAME _____ (Last) _____ (First) _____ (Middle) Date _____

PRESENT ADDRESS _____

BIRTH DATE _____ ARE YOU A CITIZEN OF U.S.? YES___ NO___ DATE AVAILABLE _____

List in order of preference positions for which you feel best qualified:
1 _____ 2 _____ 3 _____

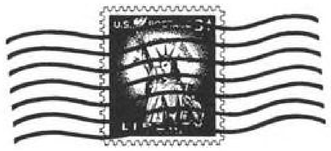
EDUCATION	NAMES & LOCATIONS	DATES ATTENDED	COURSE	DEGREE	DATE
High School					
College					
Other					

NAME OF PRESENT OR MOST RECENT EMPLOYER _____

ADDRESS _____ CITY AND STATE _____

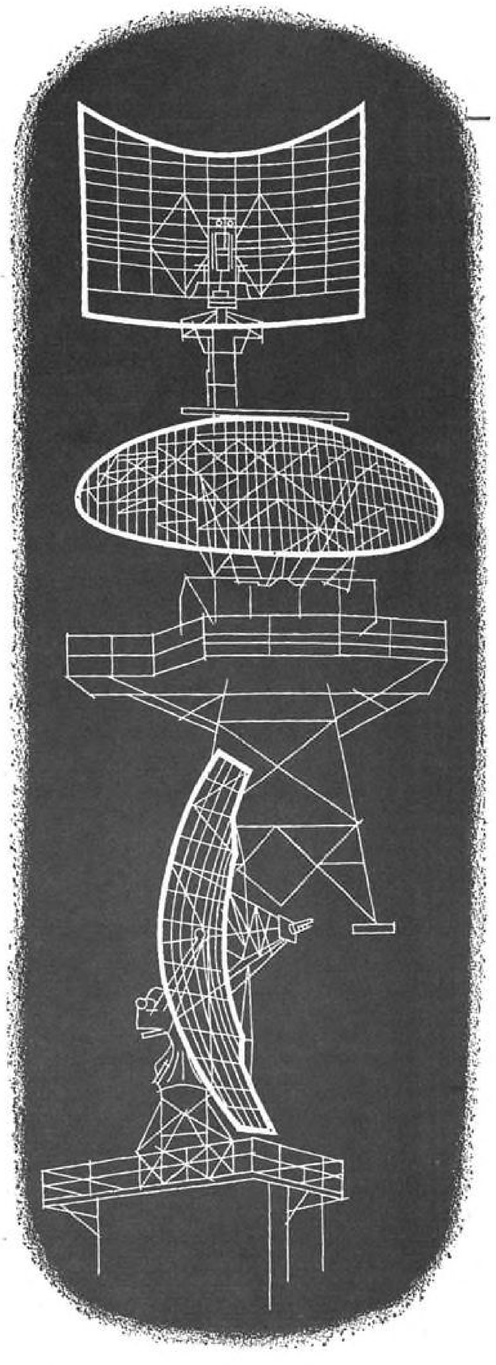
POSITION HELD _____ EARNINGS _____

(THIS INFORMATION WILL BE HELD IN STRICT AND COMPLETE CONFIDENCE)
Is Your Resume Attached?



Towers of strength for America's defense

—Another challenge, another opportunity for Goodyear engineers



Wherever the American flag flies, you'll find radar structures like these—on 24-hour alert—ready to warn of an enemy's approach by air or sea.

Built by Goodyear Aircraft for the industry's leaders, radar structures require the utmost in engineering skill and training. They require a specialized knowledge as rare as it is vital. And they're typical of the opportunities that fire the imagination of our engineers at Goodyear Aircraft.

Here you'll find exciting challenges in airship design, electronics, missile components, metals engineering, radomes—the list is broad, the possibilities for achievement almost limitless.

At your disposal are the most modern engineering and research laboratories, including a large computer laboratory. And, needless to add, an environment in which individual expression can flourish, and ideas take wing.

Our continued growth and diversification have required expansion of our engineering staffs in all specialties at both Akron, Ohio, and Litchfield Park, Arizona. If you have faith in your ideas and in your ability to make them work, a rewarding career can be yours at Goodyear Aircraft.

Salaries and benefits are, of course, liberal. And if you wish to continue your academic studies, company-paid tuition courses leading to advanced degrees are available at nearby colleges.

For further information on your career opportunities at Goodyear Aircraft, write: Mr. C. G. Jones, Personnel Dept., Goodyear Aircraft Corporation, Akron 15, Ohio.

They're doing big things at

GOODYEAR AIRCRAFT

ENGINEERS EXPAND YOUR FUTURE AT RYAN

Join a **fast-growing company** pioneering in research aircraft—jet-propulsion—electronics. Work on

Jet VTO
Automatic Navigation
Missile guidance
Rocket combustion
High-temperature metallurgy
Advanced aerodynamics

Join a 34-year old company—not too big—not too small—where you will get broad experience, advance rapidly. Live in clear-sky San Diego, only minutes from work, beaches, mountains, parks.

Write in confidence to James Kerns.

RYAN
AERONAUTICAL COMPANY
2720 Harbor Drive
San Diego 12, California

REPLIES (Box No.): Address to office nearest you c/o This publication Classified Adv. Div.
NEW YORK: P. O. Box 12 (36)
CHICAGO: 520 N. Michigan Ave. (11)
SAN FRANCISCO: 68 Post St. (4)
LOS ANGELES: 1125 W. 6th St. (17)

POSITIONS VACANT

Executive Pilot. Twin Engine aircraft. Require A.T.R. rating and minimum of 5,000 hrs. Good salary and full expenses. P-4612, Aviation Week, 1125 W. 6th St., Los Angeles 17, Calif.

Opening for Co-Pilot-Mechanic. Chicago-Based DC-3 D18S A&e Comm. Instrum. ratings preferred. P-4756, Aviation Week.

Flight engineers experienced on Constellation 1049 Aircraft. Consideration also given to engineers experienced on earlier model Constellations. Address replies to Chief Flight Engineer, California Eastern Aviation, Inc. Oakland International Airport, Oakland, California.

POSITIONS WANTED

ATR Pilot: SEL-MEL-DC3 Tube rating, Instructor, A&E mechanic, 7,000 hrs. 3,000 hrs. MEL. 420 hrs. actual instrument. Airline Captain & executive experience. All ratings current. Age 33, married, two children. Available immediately. Foreign or domestic. H. Johnson, R 1 Box 328, Benton Harbor, Michigan.

Twenty—DC-6B Captains. Group Averages; tot. time 10,000 hrs., Comm. Airline 8,000 hrs, Command 7,000 hrs., International & Domestic. Current type ratings: DC-7, DC-6, DC-4, DC-3. A.T.R. Avg. Age 35½. Available May 1, will consider any & all offers. PW-4875, Aviation Week.

Attorney, military contracts, missiles, electronics, aircraft, indstrl assoctns, 8 yrs. indrl & govt. exp., CPFF, FP, R&D, T&M, Subs. PW-4868, Aviation Week.

Desire position as corporation pilot. Age 32, single, ATR, former airline captain. Best references, perfect record. PW-4808, Aviation Week.

STAFF POSITION OPPORTUNITIES FOR AERONAUTICAL ENGINEERS INTERESTED IN STATE OF THE ART STUDIES

Battelle has staff positions available for several experienced engineers to participate in a number of long-range research programs concerned with the determination and prediction of trends in technologies related to propulsion systems and airframe design. Duties would consist of literature surveys, visits to research and development establishments, preparation of trend and state of the art reports, and consultation with representatives of government and industry. Staff members would also have the option of participating in technical research programs, and special studies directed toward the development of techniques for predicting state of the art. For descriptive brochure and technical application blank, write to:

TECHNICAL PERSONNEL MANAGER
DEPARTMENT B, BATTELLE INSTITUTE
COLUMBUS 1, OHIO

ENGINEERS AC needs SPECIFICATION WRITERS (Technical)

Knowledge of Military Specifications and formats required. Should be familiar with functional and environmental testing of specialized electro-mechanical, electronics equipment. Must be capable of interpreting engineering drawings. Some engineering experience or formal engineering education is desirable.

Work with top men on Challenging Opportunities in the most versatile laboratories and with the finest test, research and development facilities. As part of Major, Permanent, Expansion Program new plant being added in suburban Milwaukee.

AC provides financial assistance towards your Master's Degree. Graduate programs available evenings, University of Wisconsin, Milwaukee.

GM's aggressive position in the field of manufacture and GM's policy of decentralization creates individual opportunity and recognition for each Engineer hired.

GM INERTIAL GUIDANCE SYSTEM PROGRAM
Electronics Div.

Recent EE,ME Graduate Inquiries Also Invited

MILWAUKEE
offers ideal family living in a progressive neighborly community in Southern Wisconsin where big league baseball and every shopping and cultural advantage is yours for the taking.

For personal Confidential interview in your locale send full facts about self to
Mr. Cecil E. Sundeen,
Supervisor of Technical Employment
Electronics Div.
GENERAL MOTORS CORP. Milwaukee 2, Wis.

Electronics Div.
General Motors Corp.
FLINT 2, MICHIGAN
MILWAUKEE 2, WISCONSIN

USE NATIONAL CLASSIFIED ADVERTISING

for bringing business needs or opportunities to the attention of men associated in administrative, executive, management, sales and responsible technical, engineering and operating capacities and served by Aviation Week. For advertising rates or other information write:

Classified Advertising Division—Aviation Week, P. O. Box 12, New York 36, N. Y.

LIAISON ENGINEERS

Will be responsible for engineering liaison activities associated with Design, Development, and manufacturing of Airplanes, Missiles, and Helicopters. Requires graduate engineers with some experience in Engineering Design, as well as a heavy background in Engineering Liaison. Practical experience and knowledge of manufacturing techniques may be substituted for Liaison experience. These openings offer great promise in a growing function of our engineering organization.

If interested, send experience resume to:

R. F. Kaletta
Technical Placement Supervisor
P. O. Box 516
St. Louis 3, Missouri

McDONNELL *Aircraft Corporation*

ENGINEERS

Is the future of the personal-type helicopter intriguing to you?

Would you like to become a member of an engineering group that is working on the development of light, simple, low-cost helicopters in the one- and two-place categories and larger?

Needed immediately:

Airframe and Controls Designers, Stress Analysts, and Instrumentation Engineers *—helicopter experience desirable but not essential.*

Mechanical Designers—*helicopter transmission or engine transmission experience desirable.*

Aerodynamicists and Flight Test Engineers—*helicopter experience essential.*

The opportunities are excellent for capable men to advance rapidly in this growing organization.

Attractive country living conditions on Long Island's north shore.

Write or phone for interview or application.

GYRODYNE COMPANY OF AMERICA, INC.
ST. JAMES, LONG ISLAND, NEW YORK TELEPHONE: ST. JAMES 2-6366

SEARCHLIGHT SECTION

UP TO
25,000 Sq. Ft.
Ml Floor Space for Lease
Just vacated by Aerophysics Development Corp.

5th & Colorado, Santa Monica

Douglas .....4 miles
North American .....12 miles
Northrop .....15 miles
Lockheed .....20 miles

400 Amp, 220 V, 3 ph. Power circuits—½ under Automatic Sprinkler — Gas Heating
SMOG FREE AREA

WALDO D. WATERMAN, Owner
100 Esparta Way, Santa Monica, EXbrook 3-1595 | 354 San Gorgonio, San Diego 6, Cal., ACademy 2-9724

Deal Directly with Owner
Executive style 6 passenger cabin
Immediately available
Fly as much as you like
No long term contract required

1951 Executive Dove
FOR LEASE
$1000 monthly

At this very low rate it will pay you to lease instead of own. We pay hull insurance, lessee pays maintenance, operating cost, engines. Option to purchase may also be arranged with lease payments applicable.

TRADE-AYER COMPANY
Linden Airport, Linden, N. J.
A. J. Ming Hunter 6-7690

SEARCHLIGHT SECTION

Remmert-Werner
Inc. of St. Louis, Lambert Field | Inc. of Florida, Pompano Beach | Inc. of Toledo, Express Airport
Lodestar DC3 Beech
Specialists in Conversion, Maintenance, Overhaul

400 KILOVOLT X-RAY
for industrial x-ray
Inspection of heavy metals.
$5,000.00
Original cost $17,000.00
KELEKET X-RAY OF FLORIDA
511 N. E. 15th Street, Miami, Florida

NAVCO Inc. Lambert Field, St. Louis, Mo. PErshing 1-1710
has in stock
A.R.C. Bendix Collins
Sperry Wilcox
Executive Aircraft Radio

FOR SALE
LOCKHEED LODESTAR
A&W 1830—94
SPARE ENGINE & ACCESSORIES
EXCELLENT RADIO, GYROSYN COMPASS & ZERO READER
FS-1844, Aviation Week, 68 Post St., San Francisco 4, Cal.

AN HARDWARE & FITTINGS
Stainless, Aluminum, Brass, Steel. All sizes—immediate delivery from world's largest shelf stock. Buy direct from manufacturer. Lower prices—quicker service. Send for free wall charts showing complete line of AN Fittings.
COLLINS ENGINEERING CORPORATION
9050 Washington Blvd. Culver City, California

C-47B-DOUGLAS
Passenger or Cargo configuration. Near zero time airframe and engines 1830-92 P & W. Sale or lease no brokers. Immediately available—not in service.
FARRAR AVIATION, 325 W. MAIN ST.
P.O. BOX 113, ONTARIO, CALIF.

LEASE OR SALE
DC-4E
R-200-7M2 engines
Convertable interior 76 seats
Overseas Radio
Financing Available
Write, call or wire
NATIONAL AERO LEASING CORP'N
P.O. Box 184, Miami 48, Fla.
Telephone Newton 5-0734

C-46 F
Available for immediate sale
"O" TSOH
AAXICO AIRLINES
P. O. Box 875 Miami 48, Fla.
TU 7-1541

WORLD'S FOREMOST
LODESTAR
SERVICE CENTER

Inspection | Radar
Maintenance | Interiors
Instrumentation | Engine Change
Modification | Exteriors
Overhaul | Radio

PacAero Engineering Corp.
(Formerly Lear Aircraft Engineering Division)
Santa Monica Airport, Santa Monica, California
Builders of the Incomparable Learstars

EXECUTIVEAIR
By
LEEWARD
AERONAUTICAL

DC-3 SPECIALISTS
INSPECTIONS
MODIFICATIONS
OVERHAULS
PAINTING
REPAIRS
ENGINES
RADIO

schedule your work
by writing P. O. BOX 233
Miami 48 FLA.
by phoning Tuxedo 7-5527

AVAILABLE
DC4 Skymasters
for June 1st, 1957 delivery
Four DC4A's—One DC4B
Complete Airline Radio Installation
Attractive 60-passenger interior
P&W R2000 11M2 Engines
Now being operated and maintained by Colonial Division of Eastern Air Lines
For additional information contact
Mr. R. A. LATTA
Eastern Air Lines
International Airport
Miami 48, Florida
Phone: NEwton 4-3571

SALE or LEASE
DC-4's
Cargo or Passenger
Heavy Floor and Cargo Door
R-2000-9M2—Engines
2876 Gallon Gasoline
Complete Radio Equipment
70 Passenger
WE ARE OWNERS
Ready to Go
Contact Thomas Millstein
NATIONAL SURPLUS SALES CO.
1800-14 Charlotte, Kansas City, Mo.

EXECUTIVE DC-3 AVAILABLE
9-place conversion . . . Total time less than 5000 hours . . . Since 100-hour inspection, 14:30 . . . P&W 1830-92's, SMOH 14:30 . . . Toothpick blade props, SMOH 814:30 . . . 2-bottle Jato . . . Cockpit completely modernized January, 1957 . . . 200,000 BTU Janitrol heater . . . Complete panel and radio, including DME and dual omnis . . . Ample spare parts and accessories, including 2 engines now in prepaid overhaul . . . Realistically priced . . . Excellent condition . . . Write for technical brochure . . . Crew available.
LINE MATERIAL INDUSTRIES
R. C. Hitchcock
700 W. Michigan Street
Milwaukee 1, Wisconsin

DC-3
AND
CARGO C-47
FOR LEASE
TRANS-INTERNATIONAL AIRLINES, INC.
P. O. Box 233—Miami 48, Florida

Deal Directly with Owner
HANGARS
U.S. Navy type.
120' clear span
by 200' depth
Doors 120'x28'
All Steel Constructed. Excellent monetary saving and good delivery if you are considering the construction of a hangar of this size.
TRADE-AYER COMPANY
Linden Airport Linden, N. J.
Hunter 6-7690

DC-3
FOR SALE
We are owners.
LEEWARD AERONAUTICAL SALES, INC
P.O. BOX 233, MIAMI 48, FLA.

CANNON PLUGS
Nation's largest factory stock
AN "E" Connectors | K Series
KO Minlatures | AN Connectors
DPD Series | Diamond "UG's"
Authorized distributor
For immediate delivery, wire, write, phone
LIBERTY AIRCRAFT, INC., Dep't. A-W
1023 W. Arbor Vitae St. Inglewood, Calif.
ORegon 8-5217

SALE or LEASE
SIKORSKY HELICOPTER
S51 type H5A with Spare Parts
Factory Inspected & CAA Licensed
Immediate Delivery—For Demonstration Contact
KEYSTONE HELICOPTER CORPORATION
841 Land Title Bldg., Philadelphia, Pa.
Rittenhouse 6-9572

Immediate Delivery
We stock, overhaul, and install
PRATT & WHITNEY: **R1830** —75, —92, —94
WRIGHT: **R1820** —202, —56, —72
R985 R1340 R2000
and our most popular DC3 engine
R1830 - SUPER - 92
ENGINE WORKS
Lambert Field Inc. St. Louis, Mo.

- COLLINS
- BENDIX
- SPERRY
- LEAR
- ARC

Page AIRWAYS INC.
ROCHESTER AIRPORT
PHONE GENESEE 8-7301
ROCHESTER 11, N.Y.

RADAR
AUTOMATIC PILOTS
NAVIGATION AND
COMMUNICATION SYSTEMS

ADVERTISERS IN THIS ISSUE

AVIATION WEEK, APRIL 15, 1957

CLASSIFIED ADVERTISING

F. J. Eberle, Business Mgr.

ADVERTISERS INDEX

LETTERS

Suspension

If the transcript of radio communications by TWA Capt. Leonard Specht (AW, March 18, p. 30) includes all of the important transmissions, Capt. Specht's license certainly should be suspended. The transcript clearly indicates that he arbitrarily endangered the lives of his own passengers and crew, those of the Capital plane at 16,000, and those of the people below the two planes. Other than severe freezing rain or extremely heavy turbulence, it is difficult to imagine an emergency which would require a climb from 14,000. It is even more difficult to imagine an emergency which would allow the pilot to plan his climb to commence three minutes after his first declaration of emergency, yet would not allow him to give even a general indication to ATC of the nature of the emergency.

I agree with the ALPA that it is unjust to suspend a license unless there is strong evidence that the pilot has performed the violation without justification. Certainly the abbreviated transcript gives this evidence.

I work with a great many airline captains and consider many of them close friends. I, along with nearly all other pilots, have the greatest respect for their ability. Even more than their ability, I respect their integrity—integrity which makes it impossible for them to accept unsafe practices, to push approaches, or to let any other factor relax what they consider safe procedure. The ALPA as a body is completely ignoring integrity when they attempt to protect a member from the normal and reasonable consequences of a performance such as that of Capt. Specht. If they have evidence contradicting the transcript, let them present it. In the meantime, as a frequent passenger, I am thoroughly grateful that the CAA has made it impossible for Capt. Specht to carry me through Capital's altitude because, ". . . we were out of La-Guardia first ahead of that traffic and that was our requested altitude and we should have it."

MILITARY PILOT
New Orleans, La.

Danger Inherent

I have just finished reading the article concerning the actions of Flight Capt. Leonard Specht of TWA on Jan. 29 (AW, March 18, p. 30). The danger inherent to this incident prompts me to submit several comments.

Unless a serious emergency did, in effect, exist, Specht should have the book thrown at him.

Some airline pilots are under the impression that they are God's gift to the traveling public. The actions of the ALPA in many instances do not help to alleviate this situation.

My business requires a substantial amount of air travel, including occasional trips on TWA. If Specht is typical of TWA pilots, then rest assured that TWA will be off my flying list. Unfortunately, it doesn't take very many Spechts to endanger all aircraft.

Undoubtedly, this letter will ruffle the feathers of a few "demagogic" flight captains. Just to assure them that I have some idea what it's all about, I'd like to point out that I'm an ex-military and civilian pilot with time in some twenty types of aircraft, from four-engine bombers to 40-horse Cubs.

It would be interesting to read about the outcome of this affair in some future edition of AVIATION WEEK.

J. R. STANTON
Bloomfield, N. J.

Aviation Week welcomes the opinion of its readers on the issues raised in the magazine's editorial columns. Address letters to the Editor, Aviation Week, 330 W. 42 St., New York 36, N. Y. Try to keep letters under 500 words and give a genuine identification. We will not print anonymous letters, but names of writers will be withheld on request.

Pilot Complement

Your "Letters" page has displayed, over the period of the past few months, a number of discussions concerned with differences of opinion in the matter of pilots versus flight engineers. For the most part, the interchange has been quite instructive. However, of late, acrimony has crept into the writings, with a consequent loss of the benefits which might be expected from objective debate of an important issue. If it were simply an airing of open differences between the two segments of the flight crew, the matter might pass unremarked. However, the pages of an influential technical journal are read by many persons in policy-making areas, and if no attempt is made to uncover the underlying reason for the apparent differences between pilots and flight engineers and no measures suggested to establish understanding, the possibility of unfortunate rule-making or legislation will be enhanced.

It may be that the difference springs from a fundamental aspect of flying which is rarely, if ever, discussed publicly. Flying is most certainly not the natural environment of man and exposes its practitioners to constant strain, regardless of their experience level. Air carrier operation is a most requiring branch of flying—the high speeds, increased mechanical complexity and desired all-weather regularity of themselves impose a substantial burden on the existing flight crew members. When one adds to this the ever-present delays in traffic control, the frustrations of cluttered communications channels and the growing concern with collision hazards, the adequacy of a two-pilot flight crew complement on a long flight is questionable. Present standards of time on duty, lengths of flight and conditions of flight quite possibly represent excessive strain on all but the exceptional flight crew member. It is my feeling that from these factors we get the basic reaction of the ALPA—that of advocating an increase in the pilot complement for the larger and faster machines.

Because of the constant economic tug of war that goes on in the air carrier industry, there is undoubtedly a subconscious pilot reluctance to offer any direct suggestion as to increases in pilot complement, since such a suggestion could be regarded by air carrier management as featherbedding and, in turn, used to hold the pilots up to public ridicule and contempt in order to buttress the management argument that pilots are the principal stumbling block in the efficient and economic operation of the airlines.

Thus, it is quite understandable when the pilots seize upon an opportunity to convert the already established third member berth to a pilot category—an effort to relieve the burden which they themselves do not fully understand or, if they do understand, are unwilling to present for candid examination. The advent of turboprop or turbojet aircraft has apparently been grasped as offering the opportunity. The impact of Captain Robson's testimony should not be overestimated, since his comments tend to indicate he may be a Convair captain, undoubtedly expert on the subject of communications, navigation, and traffic control problems between Washington and New York, but not necessarily expert in the field of crew complement requirements.

The introduction of jets may possibly offer a reduction in cockpit complexity, but the other parameters of turbine operation are more requiring, not less. The improvements in the practice of meteorology and traffic control which will give turbine operation the same margins of safety currently available in the piston engine area are not presently available, and their advent may follow rather than lead the introduction of jets. These problems, together with that of the proper crew complement, plus numerous others, will require the combined efforts and good will of all concerned if the appropriate solutions are to be available in time.

We should not assume that the publicly held position of the ALPA necessarily parallels that of individual four-engine captains with extensive flight engineer association. Speaking from personal experience, it would appear that long-range high altitude, high speed operations may well require three pilot crew members, plus at least one flight engineer, and the sooner the need is recognized, the better are our chances of an orderly transition to this method of operation. When flying for an airline, I appreciated the presence of a competent flight engineer in the crew and gave no thought to his usurping my authority. It would be worthwhile, in this dispute, to determine if any major segment of the airline pilots group with heavy four-engine experience feels differently.

T. O. MCCLURE
Paoli, Pa.

More Impressive

With regard to the lower photo on p. 64 (AW, March 25)—this photograph depicts a feat somewhat more impressive than merely towing a "2½ ton amphibious truck" off the beach. The "DUKW" is in reality a Marine Corps LVT, or "amtrac," models of which weigh up to 35 tons. Trust this will be of some interest. Thank you.

JAMES J. MULQUIN
Washington 18, D. C.

Intercontinental Peacemaker

Long arm of SAC's deterrent force, Boeing Airplane Company's intercontinental B-52 has as its nerve center the AN/ASB-4 Bombing/Navigation System, developed and produced by International Business Machines for the United States Air Force.

Aside from pinpoint navigational and bombing accuracy, this complex system is notable for a high level of reliability achieved by painstaking care in detail design, rigorous proofing of each part, and a system configuration comprising unit-tested modules.

Servomechanisms, Inc., in addition to quantity production of the Pressure Transducers and Quadrature Rejector units which are important input and control elements of this system, has also contributed to the development of several other important elements of this system.

SERVOMECHANISMS INC.

PLANTS: WESTCHESTER, CALIFORNIA • HAWTHORNE, CALIFORNIA
WESTBURY, L.I., NEW YORK • GARDEN CITY, L.I., NEW YORK
GENERAL OFFICES: 12500 AVIATION BLVD., HAWTHORNE, CALIFORNIA