Aviation Week

Including Space Technology

75 Cents

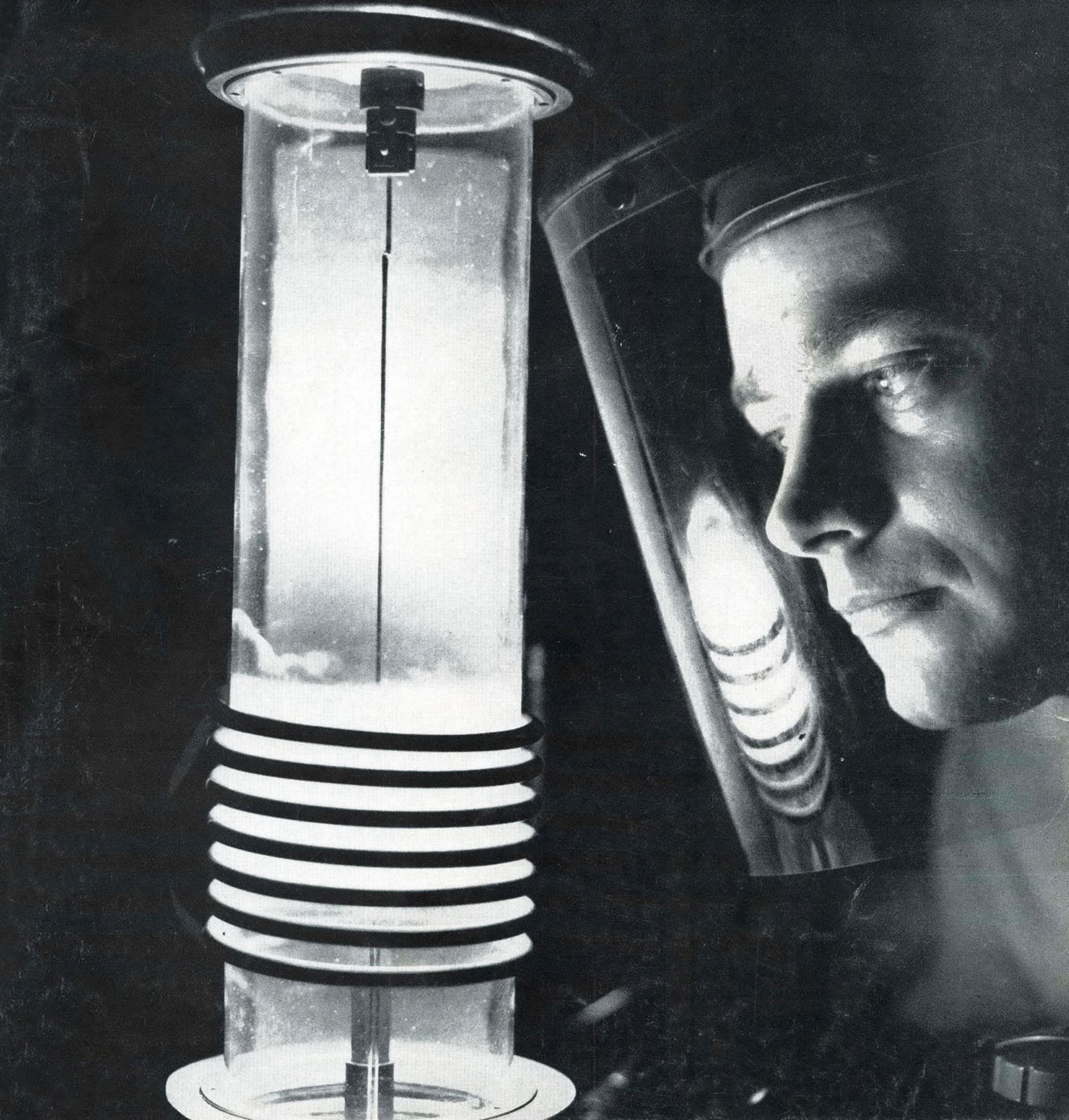
A McGraw-Hill Publication

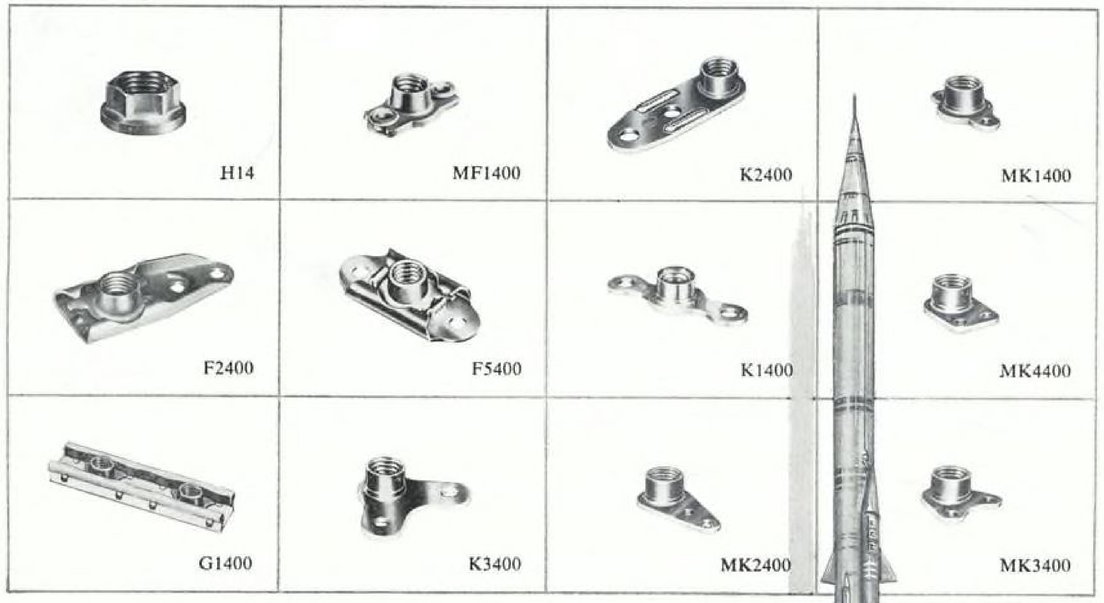
April 27, 1959

SPECIAL REPORTS:

- Swedish Air Alert
- Molectronics

Westinghouse Process For Semiconductors





Here's real

FASTENER POWER

KAYNAR: 160,000 PSI

It's here... a powerful, new Kaylock line... now a whopping 160,000 psi! Smallest, lightest, strongest all metal self-locking nuts ever made. Tailor-made by KAYNAR for 160,000 psi NAS high tensile short thread screws and bolts.

Latest addition to the KAYLOCK line is the H14 lightweight hex... best wrench clearance for narrow flanges... mightiest lightweight yet!

NEW H14 SAVES MOST IN SPACE • SIZE • WEIGHT

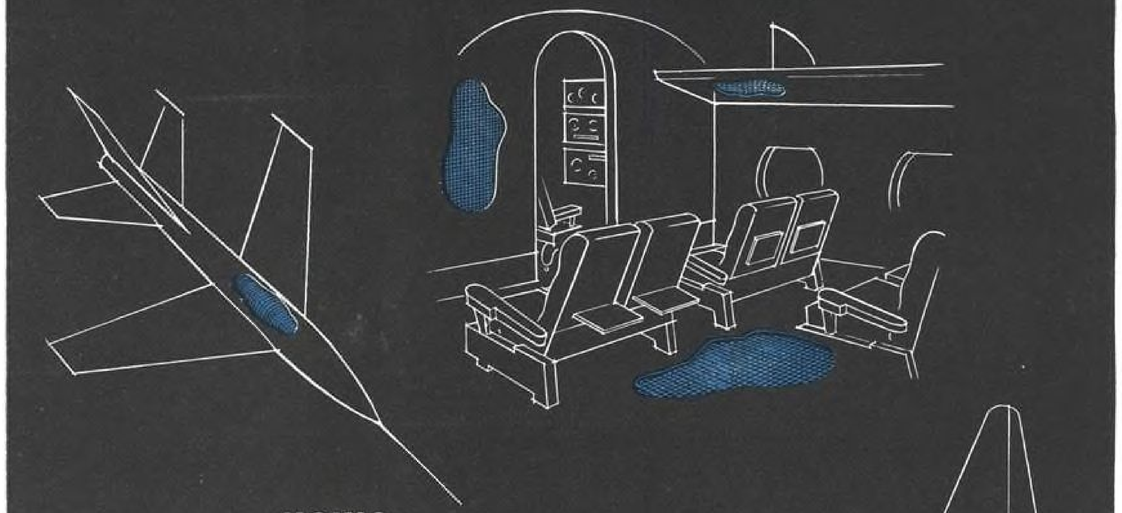
STRONGER— Strength to weight ratios increased up to 210%.
LOWER— Same low height as NAS 679.
LIGHTER— 20% to 67% below H10 or NAS679 series hex nuts.
SMALLER— By 2 to 5 socket sizes than standard AN and NAS nuts.
SPACE SAVER— Narrowest flanges. Moves bolt close to load centers for strongest design.
SELF-LOCKING— With patented resilient locking principle.
MATERIALS— Available in carbon steel for 550°F. applications. These configurations also in AMS6304 and A286 corrosion resistant steel.

FOR COMPETITIVE REASONS re-appraise your projects with an eye to "trimming off the fat." Send today for Kaynar's new full-line brochure of 160,000 psi self-locking nuts.

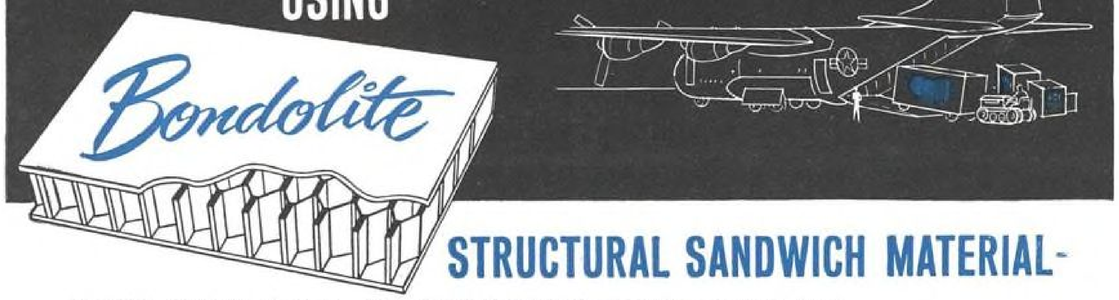
KAYNAR MFG. CO., INC.—KAYLOCK DIVISION
World's largest and oldest manufacturer of lightweight, all metal self-locking nuts. Home office and plant: Write Box 2001, Terminal Annex, Los Angeles 54. Branch offices, warehouses & representatives in Wichita, Kansas; New York, N.Y.; Atlanta, Georgia. Canadian Distributor: Abercorn Aero, Ltd., Montreal, Quebec.

KAYLOCK
All-metal self-locking nuts ®

NOW IT'S
"FABRICATE-THEM-YOURSELF"



USING



STRUCTURAL SANDWICH MATERIAL-
NOW AVAILABLE IN STANDARD FLAT PANELS

Now electronic boxes, mounting panels, mobile equipment shelters and primary aircraft structures —including bulkheads, decks, doors and racks— can be fashioned from lightweight structural sandwich panels in your shop with ordinary shop equipment!

For Goodyear Aircraft Corporation now makes available for immediate delivery its BONDOLITE— in standard flat panels of popular sizes (3′ x 10′ and 4′ x 10′) in a variety of cores and gauges, all meeting rigid military specifications. WRITE FOR the complete list, specifications, and easy Fabricate-It-Yourself instructions prepared by Goodyear Aircraft—a pioneer builder of rigid, lightweight structures. Goodyear Aircraft Corporation, Dept. 916AD, Akron 15, Ohio.

AVAILABLE TOO *IN Semi-Standard Panels* which offer a wider selection of face materials and over-all thickness; *IN New "Type-Z" Panels* for weight-savings of 50% over solid materials—can be riveted or bolted just like solid sheet aluminum!

STRUCTURAL PANELS BY
GOODYEAR AIRCRAFT
Plants in Akron, Ohio, and Litchfield Park, Arizona

Bondolite—T. M. Goodyear Aircraft Corporation, Akron 15, Ohio

STRIKE OF THE HAWK!

RAYTHEON-DESIGNED HAWK missile annihilates radio-controlled F-80 jet fighter at 500 ft. altitude.

ARMY'S HAWK MISSILE is fired from mobile launcher. Missiles, launcher and support equipment can be air-lifted or quickly transported by Army or Marine ground forces.

NEW ARMY MISSILE DESTROYS LOW-FLYING AIRCRAFT

This *proven* anti-aircraft missile operates even at tree-top heights, in the blind zone of other radar-controlled missiles.

Raytheon is prime contractor for the U.S. Army Hawk weapon system—now in production and slated for use with fast-moving Army and Marine Corps ground forces as well as for the defense of U. S. cities.

RAYTHEON

Excellence in Electronics

RAYTHEON MANUFACTURING COMPANY, Waltham, Mass.

AVIATION CALENDAR

May 3-7—Symposium on Electrode Processes, Phila., Pa. Sponsors: AFOSR/Chemistry Division and Electromechanical Society. (Contact Electrochemical Society, Inc., 1860 Broadway, N.Y.C.)

May 4-6—National Aeronautical Electronic Conference, Institute of Radio Engineers, Biltmore Hotel, Dayton, Ohio.

May 4-7—Fifth Annual Flight Test Instrumentation Symposium, sponsored by the Instrument Society of America, Seattle Section, Olympic Hotel, Seattle, Wash.

May 4-7—American Meteorological Society's 176th National Meeting, held jointly with the American Geophysical Union, National Academy of Sciences, Washington, D. C.

May 5-7—Joint Meeting, International Scientific Radio Union and Institute of Radio Engineers, Willard Hotel, Washington, D. C.

May 5-7—Annual Meeting, California Assn. of Airport Executives, Casa Munros Hotel, Monterey, Calif.

May 6-8—1959 Electronic Components Conference, Benjamin Franklin Hotel, Philadelphia, Pa.

May 6-9—15th Annual National Forum, American Helicopter Society, Sheraton Park Hotel, Washington, D. C.

May 7-10—Annual Meeting, National Intercollegiate Flying Assn., University of Illinois' Airport, Champaign, Ill.

May 9—Federal Aviation Agency's "fly-in" for pilots and aircraft owners, National Aviation Facilities Experimental Center, Atlantic City, N. J.

May 15-16—Spring Meeting, Society of Aircraft Materials and Process Engineers—Eastern Division, Hotel Statler, New York, N. Y.

May 18—Symposium on Space Medicine Electronics, Franklin Institute, Philadelphia, Pa.

(Continued on page 6)

AVIATION WEEK Including Space Technology

April 27, 1959
Vol. 70, No. 17

Published weekly with an additional issue in December by McGraw-Hill Publishing Company. James H. McGraw (1860-1948), Founder. See panel below for directions regarding subscription or change of address. **Executive, Editorial, Circulation and Advertising 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; L. Keith Goodrich, Vice President and Treasurer; John J. Cooke, Secretary. Officers of the Publications Division: Nelson L. Bond, President; Harry L. Waddell, Senior Vice President; Ralph B. 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, including missiles and space technology. Position and company connection must be indicated on subscription order.

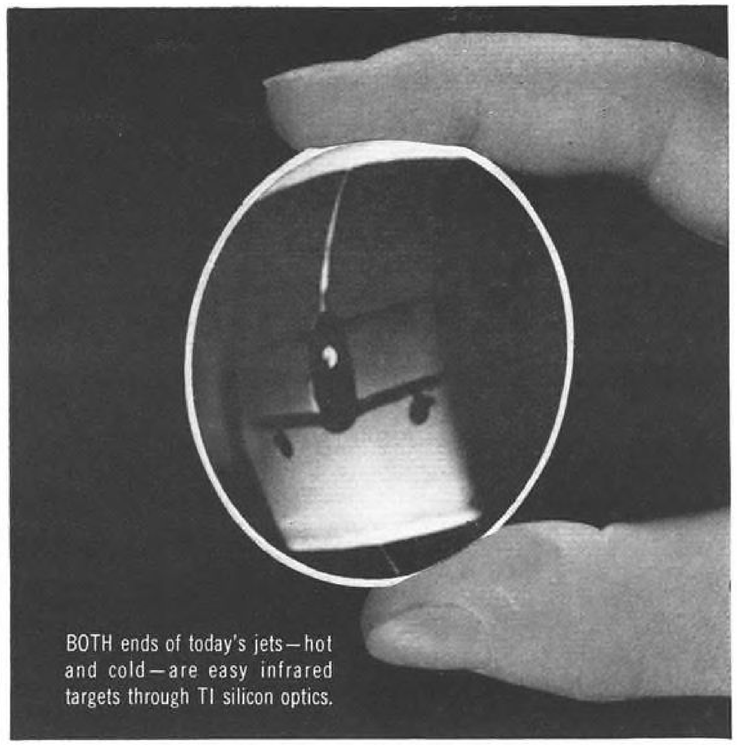
Single copies 75¢. Subscription rates—United States and possessions, $7 one year. Canada $8 one year. All other countries, $20 one year.

Second class postage paid at Albany 1, N. Y. Printed in U. S. A. Title registered in U. S. Patent Office.

©Copyright 1959 by McGraw-Hill Publishing Co., Inc. All rights reserved. Cable Address: "McGraw-Hill New York." Publications combined with AVIATION WEEK including SPACE TECHNOLOGY are AVIATION, AVIATION NEWS, AIR TRANSPORT, AERONAUTICAL ENGINEERING and AIRCRAFT JOURNAL. All rights to these names are reserved by McGraw-Hill Publishing Co.

Subscribers: Send correspondence and change of address to Fulfillment Manager, Aviation Week, 330 West 42nd Street, New York 36, N. Y. Subscribers should notify Fulfillment Manager promptly of any change of address, giving old as well as new address, including postal zone number. Enclose recent address label if possible. Allow one month for change to become effective.

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



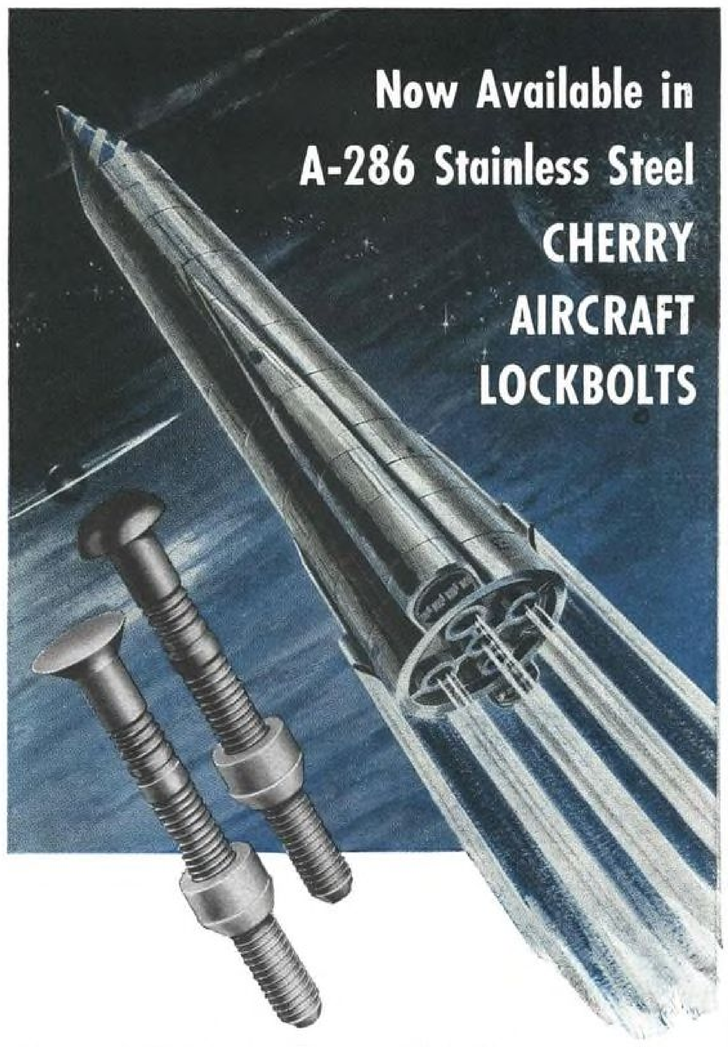
BOTH ends of today's jets—hot and cold—are easy infrared targets through TI silicon optics.

BIRD'S IR VIEW...
of a Hot Stove Pipe

THE WEDDING OF OPTICS to electronics may well be the marriage of the century . . . a TI-fostered union producing infrared guidance systems capable of finding, evaluating, rejecting false targets, and directing its "bird" to point-of-impact. Texas Instruments — leading producer of silicon optics for infrared applications — has achieved an intimate understanding of this and other unusual materials for specific portions of the spectrum.

In one of the nation's best equipped facilities, TI optics specialists design, grind, polish, and coat silicon lenses, prisms, windows, and other elements with the precision accuracy necessary for even the feeblest IR signals. Backed by a full-time engineering service with fast computers for design execution, the Texas Instruments optics team has the "know-how" to carry through your project from sketch pad ideas to custom-made systems. For detailed information on any phase of precision optics technology, contact SERVICE ENGINEERING DEPARTMENT:

TEXAS INSTRUMENTS
OPTICS DEPARTMENT
INCORPORATED
6000 LEMMON AVENUE
DALLAS 9, TEXAS



Designed especially for High Strength—High Temperature and liquid oxygen and other corrosive applications, Cherry Aircraft Lockbolts* are now available in austenitic A-286 Stainless Steel.

Available for the aircraft industry in a wide range of diameters, grip lengths and head styles in A-286 . . . Cherry Lockbolts are also produced in Alloy Steel and Aluminum.

Cherry Lockbolts are structural fasteners providing simplicity and speed of installation with uniform high tensile preloads.

Shop men like them.

For information on Cherry Aircraft Lockbolts, write Townsend Company, Cherry Rivet Division, P.O. Box 2157-N, Santa Ana, California.

*Licensed under Huck patents RE22,792; 2,114,493; 2,527,307; 2,531,048; 2,531,049 and 2,754,703

CHERRY RIVET DIVISION
SANTA ANA, CALIFORNIA
Townsend Company
ESTABLISHED 1816 • NEW BRIGHTON, PA.

AVIATION CALENDAR

(Continued from page 5)

May 18-21—18th Annual National Conference, Society of Aeronautical Weight Engineers, Hotel Henry Grady, Atlanta, Ga.

May 20-22—National Spring Meeting & Exhibition, Society for Experimental Stress Analysis, Sheraton Park Hotel, Washington, D. C.

May 20-22—Second Jet Age Airport Conference, American Society of Civil Engineers, Shamrock-Hilton Hotel, Houston, Tex.

May 21-22—1959 Ohio Valley Instrument and Automation Exhibit and Symposium, Cincinnati Section, Instrument Society of America, Music Hall, Cincinnati, Ohio.

May 24-June 5—Federation Aeronautique Internationale Annual Meeting, Moscow, USSR.

May 25-27—1959 National Telemetering Conference on Investigation of Space, Brown Palace and Cosmopolitan Hotel, Denver, Colo. Sponsors: American Rocket Society, Institute of the Aeronautical Sciences, American Institute of Electrical Engineers and Instrument Society of America.

May 25-27—All Industry Production and Quality Control Exposition and Convention, American Society for Quality Control, Cleveland Public Hall and Hotel Sheraton, Cleveland, Ohio.

May 25-28—Design Engineering Show and Conference, American Society of Mechanical Engineers, Convention Hall, Philadelphia, Pa.

May 26-28—Supersonic Transport Meeting, San Diego Section, Institute of the Aeronautical Sciences, San Diego, Calif.

June 1-3—National Symposium, Institute of Radio Engineers' Professional Group on Microwave Theory & Techniques, Harvard University, Cambridge, Mass.

June 4-5—Third National Conference, Institute of Radio Engineers' Professional Group on Production Techniques, Villa Hotel, San Mateo, Calif.

June 5-6—Annual Meeting of the Army Aviation Assn. of America, Shoreham Hotel, Washington, D. C.

June 5-6—10th Annual Maintenance & Operations Meeting, Reading Aviation Service, Inc., Municipal Airport, Reading, Pa.

June 8-11—Semi-annual Meeting and Astronautical Exhibition, American Rocket Society, El Cortez Hotel, San Diego, Calif.

June 12-21—23rd French International Air Show, Le Bourget, Paris, France.

June 16-19—National Summer Meeting, Institute of the Aeronautical Sciences, Ambassador Hotel, Los Angeles, Calif.

June 21-26—Summer-Pacific General Meeting and Air Transportation Conference, American Institute of Electrical Engineers, Olympia Hotel, Seattle, Wash.

June 23-25—33rd Meeting, Aviation Distributors and Manufacturers Assn., St. Francis Hotel, San Francisco, Calif.

Aug. 31-Sept. 5—10th Annual Congress, International Astronautical Federation, Church House, Westminster, London.

Sept. 7-13—1959 Farnborough Flying Display and Exhibition, Society of British Aircraft Constructors, Farnborough, Eng.

Oct. 12-16—15th General Convention of the International Air Transport Assn., Tokyo, Japan.

Avco/Nashville experience
And . . . . . .
Convair 600

The new Convair 600 marks a "first" in aviation—it is the first jet transport to employ the "area rule" concept for increased cruise speed at critical Mach numbers.

For design and production of many of its components—the horizontal and vertical stabilizers, and important parts of the wing leading and trailing edges . . . Convair once again has selected Avco's Nashville Division, which already is producing important components for the Convair 880 jet liner. Both Convair jets are planned to give years of dependable airline service.

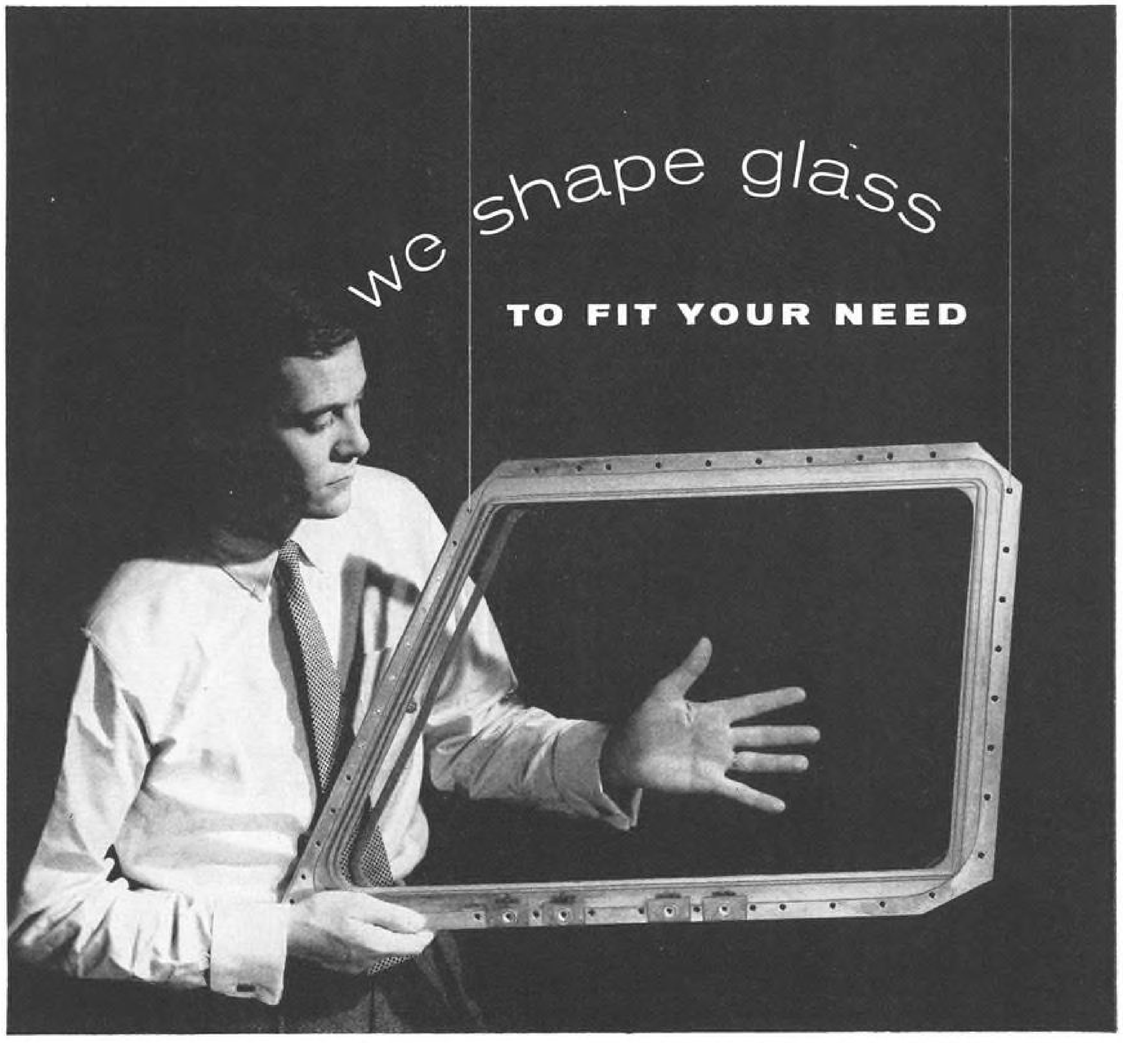
Avco/Nashville has such advanced manufacturing techniques as:

- *Production of Avcomb—high temperature, stainless steel honeycomb structures for hypersonic aircraft and missiles.*
- *Aluminum honeycomb structures for aircraft such as the Convair 880, and for other applications such as missile and communications shelters.*
- *Metal bonding and chemical milling of lightweight aluminum structures.*
- *Design Engineering services to assist contractors.*
- *Experienced Management to insure on-schedule completion of each job at the most economical cost.*

UNUSUAL CAREER OPPORTUNITIES FOR QUALIFIED SCIENTISTS AND ENGINEERS . . . WRITE AVCO/NASHVILLE TODAY.

Avco/Nashville

For further information, write to: General Marketing Manager—Structures, Nashville Division, Avco Corporation, Nashville, Tennessee.



This is a side window panel for the Douglas DC-8 commercial jet.

Need glass that's stronger than some metals? Lighter than aluminum? Sensitive (or insensitive) to light, heat or electricity? Corrosion resistant, nonabsorbent, or low in contraction or expansion? These are among the many glass characteristics L·O·F has provided for aircraft design and safety requirements.

And as one of the world's major producers of glass, we can supply you with "grid photo-tested", top-quality glass at reasonable prices.

Aircraft Division, Dept. 7349, Libbey·Owens·Ford Glass Company, 608 Madison Avenue, Toledo 3, Ohio.

LOF GLASS

LIBBEY·OWENS·FORD... *a Great Name in Glass*

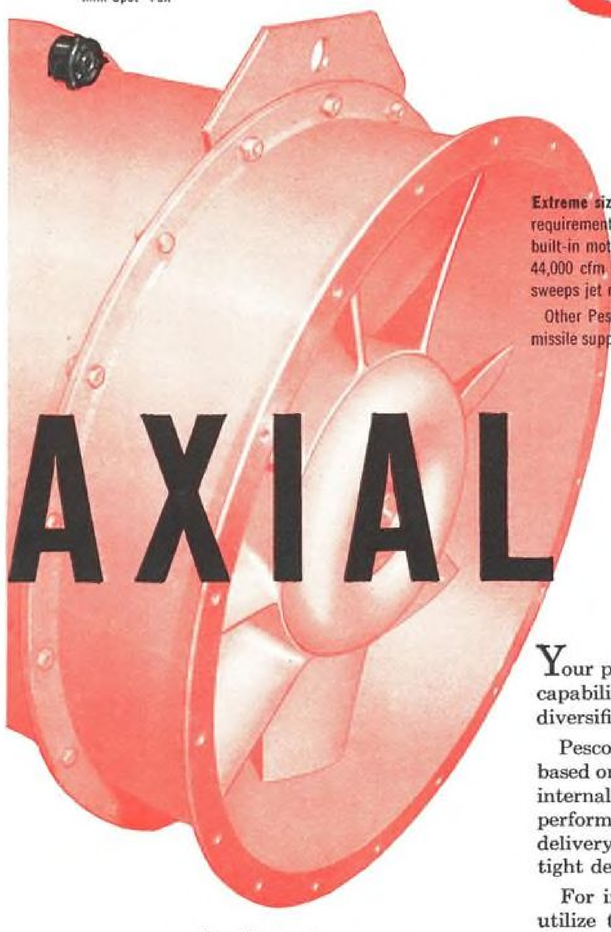
608 MADISON AVENUE, TOLEDO 3, OHIO

Creative engineering ...for the space age

Pesco engineering production

B-W

"Mini-Spot" Fan



Runway Sweeper Fan

Extreme size range of Pesco Axial Flow Fans covers most space age requirements. Tiny unit shown here is 4-oz. Pesco "Mini-Spot" Fan with built-in motor which delivers 33 cfm for spot cooling. It is dwarfed by 44,000 cfm all-welded steel fan for giant vacuum cleaner which sweeps jet runways.

Other Pesco fans have been custom-designed for cooling electronic units, missile support systems, aircraft compartments and helicopter engine oil.

AXIAL FANS

Your project can receive a major assist from Pesco capabilities in the development of axial flow fans for diversified applications.

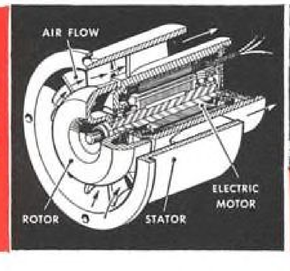
Pesco creative engineering produces optimum designs based on the most advanced aerodynamic principles. Close internal design-production coordination means maximum performance and reliability. Integrated facilities permit delivery of prototype and production units to meet tight deadlines.

For ingenious, economical solutions to fan problems, utilize the creative engineering available at Pesco.

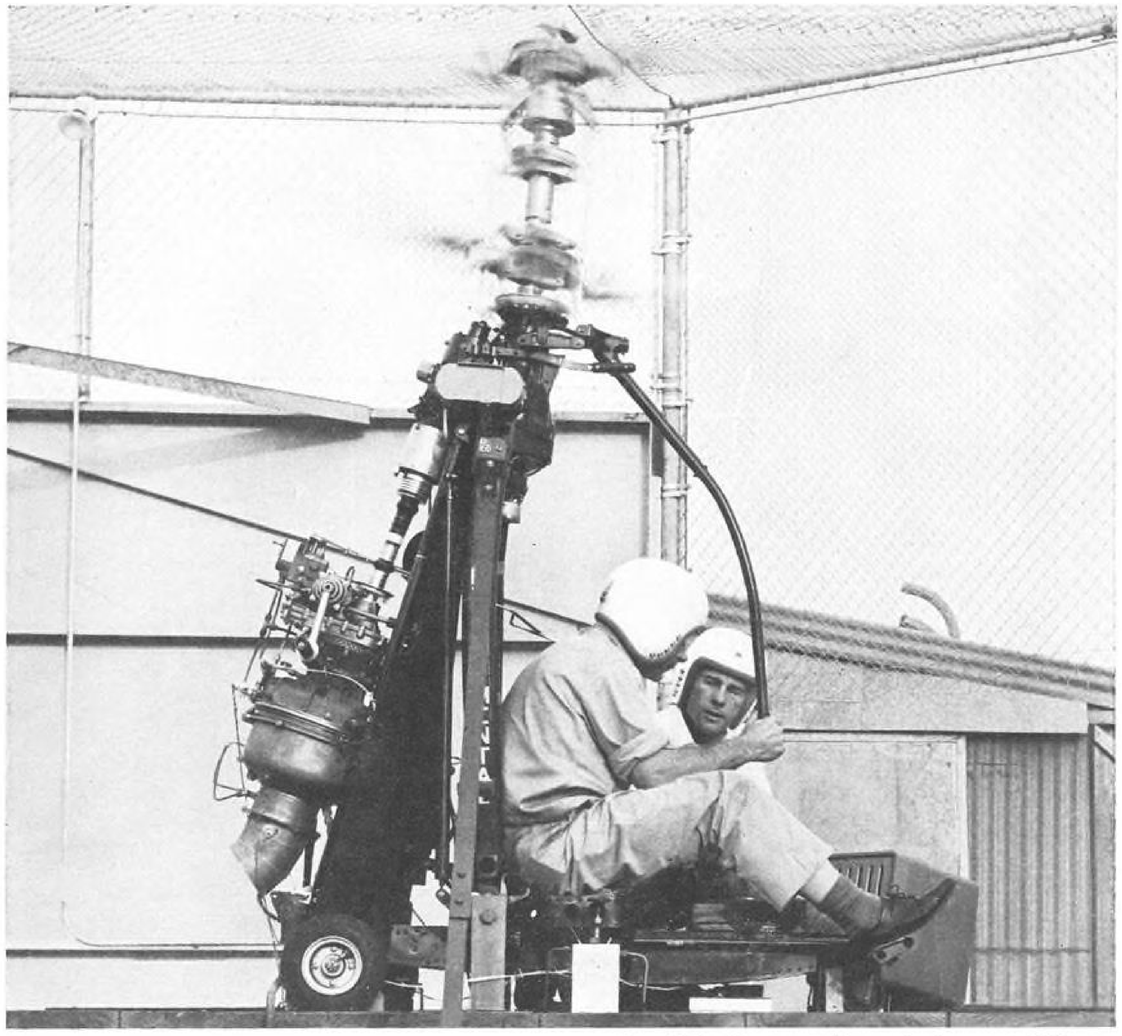
PESCO PRODUCTS DIVISION
BORG-WARNER CORPORATION
24700 North Miles Road • Bedford, Ohio

Export sales: Borg-Warner International Corporation • 36 South Wabash Ave. • Chicago 3, Ill.

Miniaturized "package" design utilizes integral Pesco motor for minimum weight and size. Axial flow principle assures maximum air flow and pressure.



Highly skilled fan engineers are backed up by extensive Pesco research, testing and production facilities *plus* Borg-Warner Central Research.



Test of Solar Titan *gas turbine engine in one-man helicopter.*

Newest Solar gas turbine ideal for wide range of applications

LIGHTWEIGHT, DEPENDABLE power is the keynote of this latest addition to Solar's growing family of gas turbine engines. Only 21 inches long and less than 13 inches in diameter, the 52 lb, 70 hp turbine is one of the simplest fuel-burning engines ever made. Originally developed for one-man helicopters, the compact power plant is nearing the end of a comprehensive test program. Instant starting, a high power to weight ratio and reliability make it an ideal power source for airborne auxiliary power units, portable generators, missile ground support and other important applications.

Today, proven-in-service Solar gas turbines—ranging from 50 to 1100 hp—are creating new standards of performance and reliability. They are easy to maintain, start instantly after long periods of inactivity, are only a fraction of the size and weight of conventional engines of similar hp, and can burn a wide variety of fuels—including gasoline, kerosene, diesel fuel, jet fuels and natural or manufactured gas. Investigate the Solar family of gas turbines for *your* power needs. Write to Dept. F-145, Solar Aircraft Company, San Diego 12, California.

SOLAR
AIRCRAFT COMPANY
SAN DIEGO
DES MOINES

ENGINEERS WANTED: Challenging projects, unlimited opportunities with Solar. Write today!

Engineering developments that make Rollway Cylindrical Roller Bearings suitable for a wide range of aircraft applications

Hydraulic control-system bearings

Helicopter rotor assembly thrust bearings

Helicopter planetary gear support bearings

Turbine bearings

Eight years after the Wright brothers' flights at Kittyhawk, Rollway began the production of cylindrical roller bearings. Careful inspection, metallographic checks, design evaluations and lubrication studies have steadily improved the range speed, stress, ambient and operating temperatures.

We produce the practical, while we develop the science of the possible. Our key personnel are always ready to work on experimental or production models where high-stress, high-temperature, and high-precision bearings are essential.

Illustrated are a few of the Rollway Bearings produced for general aeronautics use. Not illustrated, for obvious reasons, are Rollway experimental bearings developed for test in various projects. A wire, letter or print will initiate a cooperative relationship that could be mutually rewarding. *Rollway Bearing Co., Inc., Syracuse, N. Y.*

ROLLWAY
BEARINGS
COMPLETE LINE OF RADIAL AND THRUST CYLINDRICAL ROLLER BEARINGS

ENGINEERING OFFICES: SYRACUSE • BOSTON • CHICAGO • DETROIT • TORONTO • PITTSBURGH • CLEVELAND • SEATTLE • HOUSTON • PHILADELPHIA • LOS ANGELES • SAN FRANCISCO

What is knowmanship— and what can it do for you?

As a prime contractor, your task becomes easier—the success of your project more certain—with an associate contractor who can fit into your "team" picture quickly and expertly. And this applies during initial planning stages—when you're first invited to bid on a major systems contract—as well as during production on the contract.

Such an associate contractor must be heavy on specialized talents—the kind that can't be acquired overnight. His background can come only from years of experience in subsystem research, development and production. It can come only from practical experience under the Weapons System concept.

Both these indispensable areas are thoroughly covered by Eclipse Pioneer's KNOWMANSHIP—our word for the critical combination of technical knowledge, experienced management and specialized craftsmanship that an associate contractor must have to offer maximum value to a prime contractor.

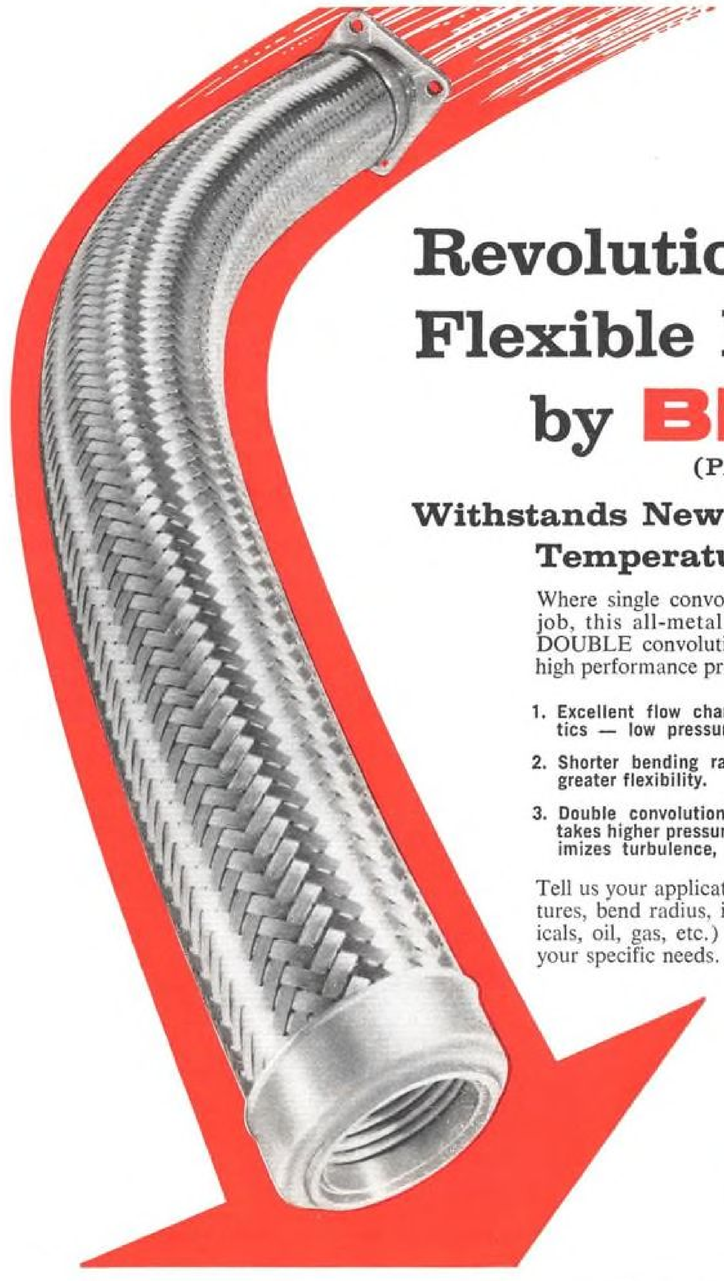
Eclipse-Pioneer KNOWMANSHIP under the Weapons System concept dates from the very first contract of this type—in our association with Convair on the Air Force B-58 Hustler. Here, we developed and now supply from production Primary and Automatic Flight Control Systems, Stability Augmentation and Central Air Data Systems. Another of our major sub-system responsibilities is to the Martin Company for Inertial Guidance, Stable Platform and associated equipment on the Army's Pershing missile.

Add in our physical resources—9,000 engineers and other highly skilled workers, 1,104,000 square feet of plant space, plus the most modern tools and equipment—and you have the significant *total* reason why Eclipse-Pioneer KNOWMANSHIP makes such a knowledgeable partner for prime contractors on advanced aircraft and missile development and production.

A letter, wire or phone call will bring our representatives to your office with complete facts about E-P associate-contracting capabilities.

ECLIPSE-PIONEER
TETERBORO, N. J.
DIVISION of
Bendix
AVIATION CORPORATION

AUTOMATIC FLIGHT CONTROL • CENTRAL AIR DATA SYSTEMS • SPECIALIZED INSTRUMENTATION • NAVIGATION COMPUTERS AND DIRECTORS • STABLE PLATFORMS • INERTIAL GUIDANCE • RADAR ANTENNA STABILIZATION AND TRACKING SYSTEMS



Revolutionary New Flexible Metal Hose by BREEZE

(PATENTED)

Withstands New Highs in Pressures, Temperatures and Vibration

Where single convolution and synthetic tubing can't do the job, this all-metal hose, formed by BREEZE exclusive DOUBLE convoluting process will solve the most exacting high performance problems. Here are the advanced features:

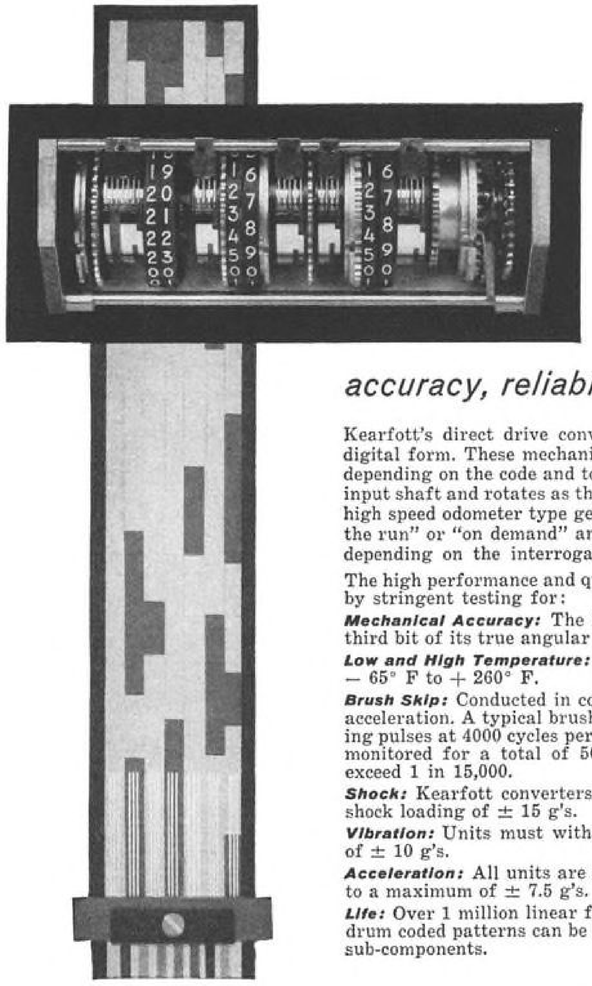
1. Excellent flow characteristics — low pressure drop.
2. Shorter bending radius — greater flexibility.
3. Double convolution design takes higher pressures, minimizes turbulence, absorbs vibration. No "set" due to misshaping of convolutions under high pressures, severe surges and pulsing.
4. All metal, high alloy 100% non-corrosive material. Withstands high temperatures where synthetics fail.

Tell us your applications, requirements in pressures, temperatures, bend radius, inside diameters and usage (fuels, chemicals, oil, gas, etc.) We will fit this premium grade hose to your specific needs.

BREEZE MARK

BREEZE
CORPORATIONS, INC.
700 LIBERTY AVE., UNION, N.J.

BREEZE PRODUCTS: ACTUATORS • HOISTS • TRANSMISSIONS • GENERATORS • STARTERS STARTER GENERATORS • BELLOWS • SLIP RINGS • HOSE CLAMPS • HITEMP FLEXIBLE TUBING RADIO IGNITION SHIELDING • GROUND SUPPORT EQUIPMENT



. . . Kearfott analog-to-digital converters

accuracy, reliability, varied capacities and codings

Kearfott's direct drive converters translate shaft rotation into electrical and visual digital form. These mechanically positioned units consist of coded drums, the number depending on the code and total count. The first, or units drum, connects directly to the input shaft and rotates as the shaft turns. On models where more than one drum is used, high speed odometer type gearing provides interconnection. All models can be read "on the run" or "on demand" and all tracks may produce simultaneous or serial readings, depending on the interrogating pulse.

The high performance and quality of Kearfott's analog-to-digital converters are assured by stringent testing for:

Mechanical Accuracy: The location of any code transition point must fall within one-third bit of its true angular position.

Low and High Temperature: All units operate efficiently at temperatures ranging from − 65° F to + 260° F.

Brush Skip: Conducted in conjunction with tests for temperature, vibration, shock and acceleration. A typical brush skip test employs 200 μsec., 23V DC amplitude interrogating pulses at 4000 cycles per second. With the shaft rotating, each output drum track is monitored for a total of 500,000 pulses, in which "lost" counts or "skips" will not exceed 1 in 15,000.

Shock: Kearfott converters are subjected to 18 shocks in three different planes with shock loading of ± 15 g's.

Vibration: Units must withstand vibrations between 5 and 500 cps with applied load of ± 10 g's.

Acceleration: All units are subjected to radial accelerations of varying magnitudes up to a maximum of ± 7.5 g's.

Life: Over 1 million linear feet (1000 hours at 82 RPM) of continuous brush travel on drum coded patterns can be achieved without excessive wear to drums, brushes or other sub-components.

Write for new ADAC brochure.

ANALOG-TO-DIGITAL CONVERTER CHARACTERISTICS

Kearfott Unit No.	423830-1	423607-1	Y1241-11A	P1240-11A	Y1240-11A	U1240-11	P1241-11A
Code (1)	B.D.	B.D.	B.D.	B.D.	B.D.	B.D.	C.B. (Gray)
No. of Drums	1	1	2	3	3	4	5
Range	0 to 84 in 348.5° of arc. 11.5° dead spot coded O	−19 to 0 to + 19	0 to 359	(+) 0 to (+) 999 (−) 999 to (−) 0	0 to 359.9	0 to 359.9	0-32,768 (2^{15})
Bits per Revolution	85	39	40	20	40	40	16
Revolutions for Total Range	1	1	9	100	90	90	2,048
Volts D.C.	23	12	23	23	23	23	10.5
Current (ma.)	20	20	20	20	20	20	20
Inertia (gm. cm.²) (2)	158	48	104	28	158	100	20
Unit Diameter (in.)	2⅛	1¾	1 5/16	1 1/16	1 5/16	1.875	1 1/16
Unit Length (in.)	31/32	1 1/16	1-43/64	1 5/16	2 3/16	2.8125	3
Life (3)	10^6 revolutions or 10^3 hours						
Static Torque (in.-oz.) (4)	0.5	0.1	1.0	.5	1.0	1.0	2 (break) 1 (running)
Weight (oz.)	5	3.5	5.75	4	7.75	6.5	5
Maximum Speed (RPM)	1100	250	300	400	300	700	600
Dielectric (Volts DC)	500	500	500	500	500	500	500

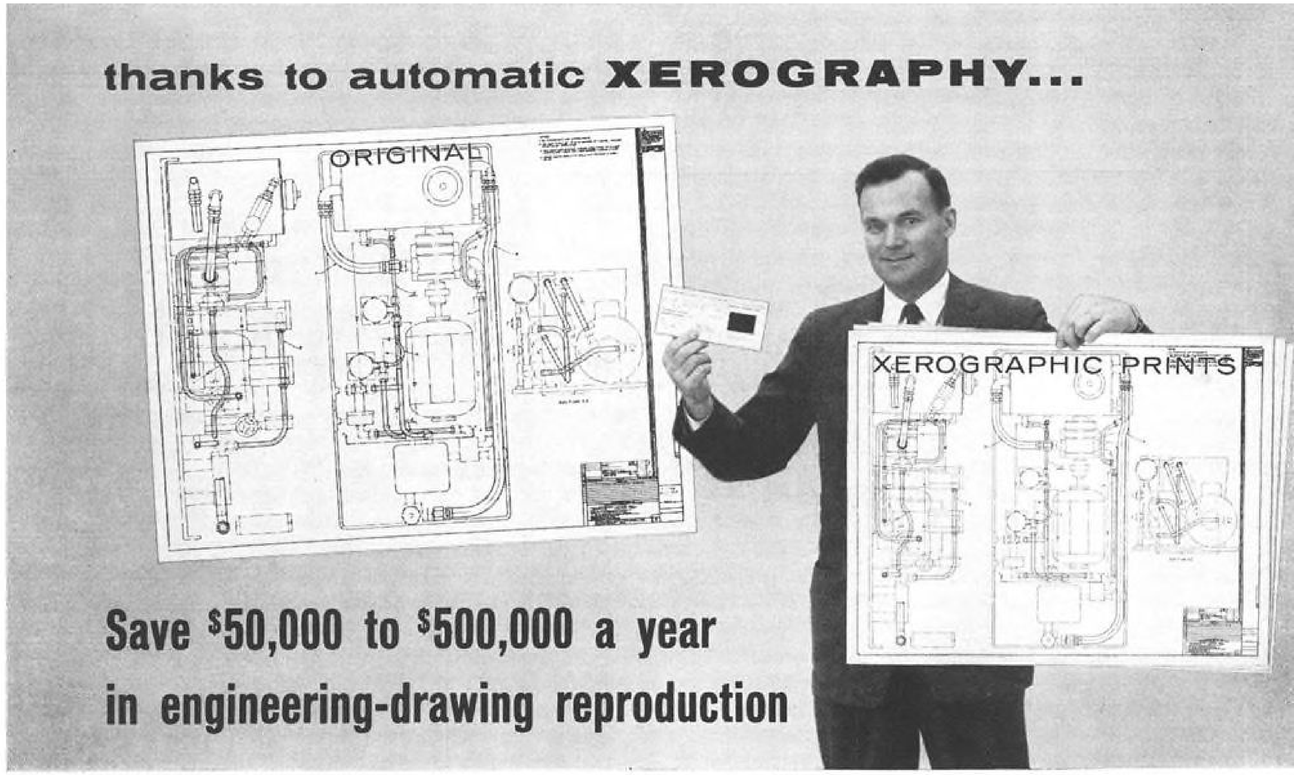
(1) B.D. (Binary Decimal), C.B. (Cyclic Binary). (3) Under recommended conditions.
(2) Inertia measured at maximum trip. (4) At room temperature.

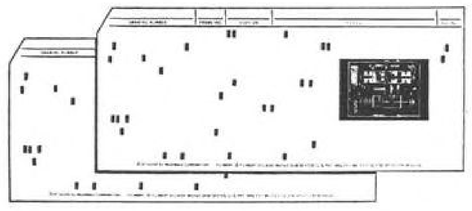
Engineers: *Kearfott offers challenging opportunities in advanced component and system development.*

Kearfott — A GENERAL PRECISION COMPANY

KEARFOTT COMPANY, INC., LITTLE FALLS, N. J.

A subsidiary of General Precision Equipment Corporation
Sales and Engineering Offices: 1500 Main Ave., Clifton, N. J.
Midwest Office: 23 W. Calendar Ave., La Grange, Ill.
South Central Office: 6211 Denton Drive, Dallas, Texas
West Coast Office: 253 N. Vinedo Avenue, Pasadena, Calif.





Data-processing aperture cards, **above**, are fed into XeroX Copyflo 24 continuous printer, **below**, and within seconds dry, positive prints emerge.

Push the button and copies flow!

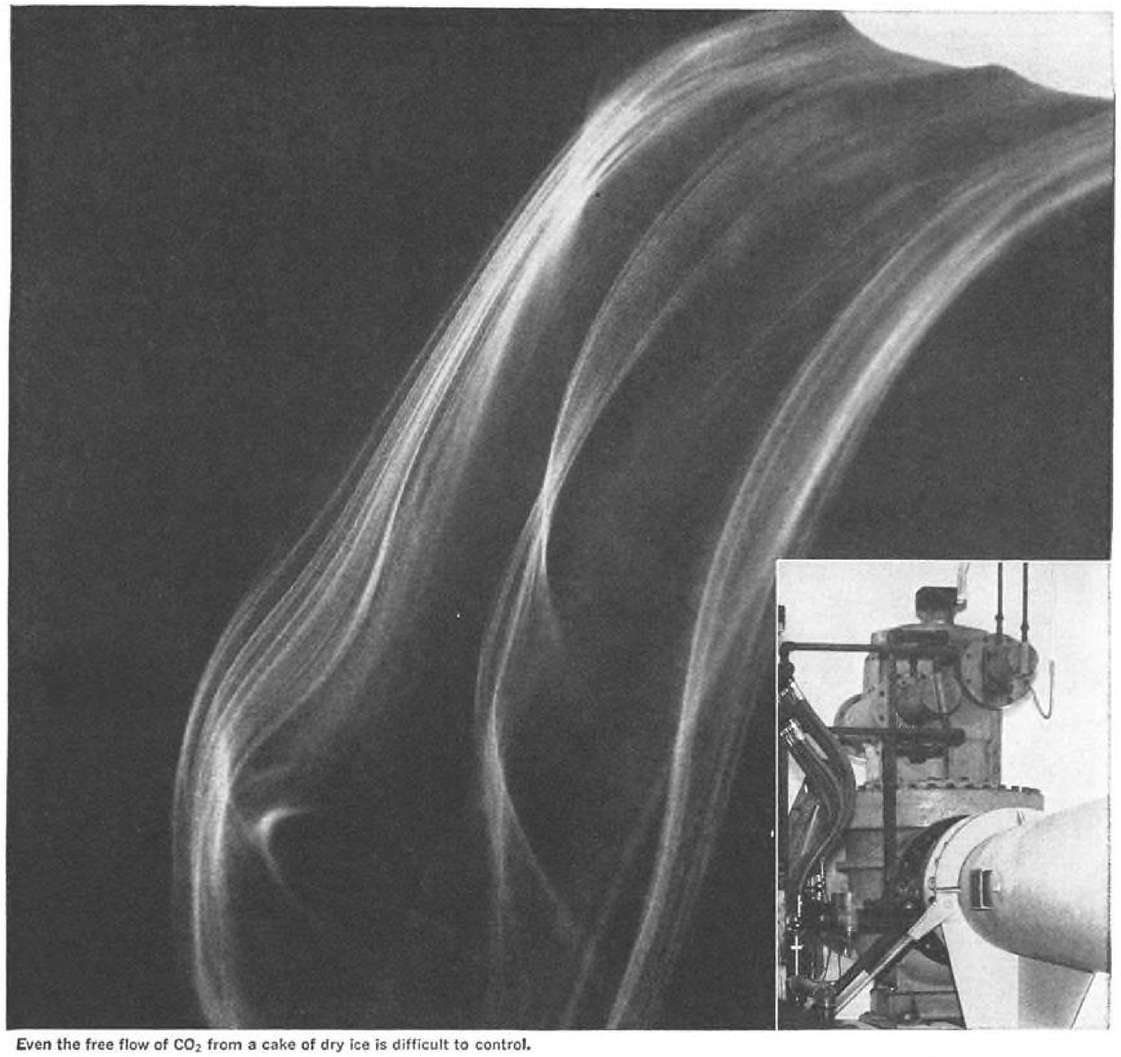
A unitized microfilm system is a revolutionary concept in the storage and rapid reproduction of engineering drawings. Besides superb quality it provides major savings in time, space, materials, and money—up to $500,000 yearly. It consists of three basic steps:

The copying onto microfilm of original drawings or tracings; the mounting of individual microfilm frames into apertures of data-processing cards; and, from the cards, the rapid and automatic reproduction of the drawings by xerography in a XeroX® Copyflo® 24 continuous printer.

Since xerography is a clean, fast, electrostatic copying process requiring neither water nor liquid chemicals, it produces dry, positive prints ready for immediate use. Quality is superior to that of any other method of engineering-drawing reproduction . . . If your need is to copy hundreds—or thousands—of engineering drawings daily, a unitized microfilm system is for *you*. Write HALOID XEROX INC., 59-100X Haloid St., Rochester 3, N. Y.

Branch offices in principal U. S. and Canadian cities. Overseas: Rank-Xerox Ltd., London.

HALOID XEROX®



Even the free flow of CO_2 from a cake of dry ice is difficult to control.

HOW TO RELATE FLOW, VOLUME AND PRESSURE

Shown above is a 24-inch, high-speed Rotovalve installed as a pressure control valve between the blowdown vessels and settling chamber of a Mach 5 wind tunnel operated by the Convair Division of General Dynamics Corporation at San Diego. The valve operates at 600 psig, 400°F., on a one-second, open-to-close cycle. Its rangeability is 150 to 1.

Perhaps you have a similar problem, involving flow, volume, pressure and time. Every special valve application requires the consideration of many questions, in order to relate all the factors that can influence a fluid control problem. This demands specialized engineering . . . the kind you get from Allis-Chalmers.

A-C Rotovalves may be your answer. Their full-line opening offers no obstruction to flow. They may be designed to give you extremely close control of closing time. Positive closure gives completely tight shutoff against either pressure or vacuum.

If you have a fluid control problem, A-C offers you a broad background of specialized valve engineering and application skills. To find out more about how we might assist you, contact your nearest A-C valve representative, or write Allis-Chalmers, Hydraulic Division, York, Pa.

Hydraulic Division — RESEARCH · DESIGN · HYDRODYNAMICS · ENGINEERING · FABRICATION

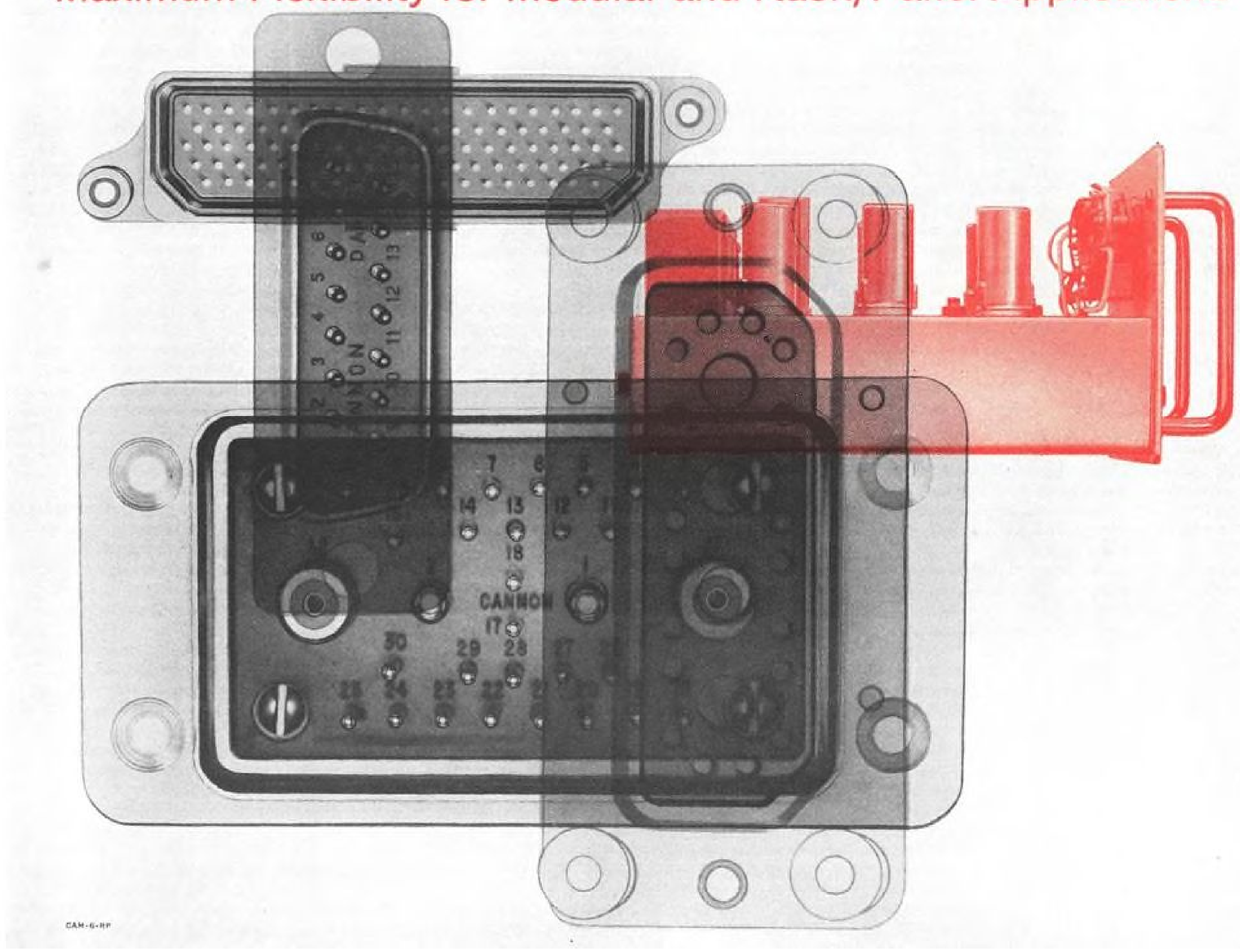
Hydraulic Turbines & Accessories • Pump-Turbines • Pumps • Liquid Heaters
Rotovalves • Ball Valves • Butterfly Valves • Free-Discharge Valves

ALLIS-CHALMERS

CANNON PLUGS

The assembling of highly-flexible electronic systems and subsystems into a modular package . . . for fast inspection, testing, service, and replacement of components . . . calls for standardized-type plugs throughout the system. Reliability and optimum flexibility in shell designs and types of layouts are the design criteria for the more than 18 different basic Cannon Modular and Rack/Panel Plug Series. This Series is available in standard, miniature, or subminiature sizes . . . for standard or printed circuitry. Up to 180 contacts and a varied combination of contacts for control, audio, thermocouple, co-ax, twin-ax, and pneumatic connections. Single or double-gang. With or without shells. The Rack/Panel Series ranges from the tiny "D" subminiature to the heavy-duty DPD Rack/Panel Plug. For further information on Cannon Modular and Rack/Panel Plugs write for Cannon DP Catalog, Cannon Electric Co., 3208 Humboldt St., Los Angeles 31. Please refer to Dept. 00. Factories in Los Angeles, Santa Ana, Salem, Toronto, London, Paris, Melbourne, Tokyo. Distributors and Representatives in the principal cities of the world.

Maximum Flexibility for Modular and Rack/Panel Applications



April 27, 1959

Aviation Week
Including Space Technology

Vol. 70, , No. 17
Member ABP and ABC

EDITORIAL OFFICES: New York 36—330 W. 42nd St., Phone: LOngacre 4-3000 (Nights 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: HUntley 2-5450 Dallas 1—1712 Commerce St. Phone: RIverside 7-5117 European Office—1 rue du Temple, Geneva, Switzerland, Phone: 32-35-63

PUBLISHER .....Robert W. Martin, Jr.
EDITOR.....Robert B. Hotz

MANAGING EDITOR.....William Gregory
EUROPEAN EDITOR.....David A. Anderton
WASHINGTON.....Cecil Brownlow
NEW YORK..Robert I. Stanfield, Harry Raven, Herbert J. Coleman
LOS ANGELES.Irving Stone, Richard Sweeney, Russell Hawkes, William S. Reed
DALLAS.....Craig Lewis
ENGINEERING.J. S. Butz, Jr., Michael Yaffee
AVIONICS...Philip J. Klass, James A. Fusca
CONGRESS..Katherine Johnsen, Ford Eastman
SPACE TECHNOLOGY.....Evert Clark
TRANSPORT.....Glenn Garrison, L. L. Doty, Robert H. Cook
EQUIPMENT.....Barry Tully
BUSINESS FLYING.....Erwin J. Bulban
ART EDITOR.....Lawrence J. Herb
SPECIAL PROJECTS .....John A. Nammack
EDITORIAL PRODUCTION....Arnold Sherman
ASSISTANT EDITORS....Elizabeth M. Hein, Edith Walford
EDITORIAL ASSISTANTS.....Marjorie Nail, Jerome Bailey, Marjorie Todd
LIBRARIAN .....Eleanor Milano

FOREIGN NEWS SERVICE
EDITOR.....John Wilhelm
LONDON.....John Tunstall
PARIS.....Robert E. Farrell
BONN.....Morrie Helitzer
MEXICO CITY.....Peter Weaver
TOKYO.....Sol Sanders

DOMESTIC NEWS BUREAUS
ATLANTA 3.....1301 Rhodes-Haverty Bldg.
CHICAGO 11.....520 No. Michigan Ave.
CLEVELAND 15.....1510 Hanna Bldg.
DETROIT 26.....856 Penobscot Bldg.
HOUSTON 25.....1303 Prudential Bldg.
SAN FRANCISCO 4.....68 Post St.

SALES
ADVERTISING SALES MANAGER E. P. Blanchard, Jr.
ATLANTA.....R. H. Powell
BOSTON.....A. C. Boughton
CHICAGO and ST. LOUIS.....J. S. Costello, D. C. Jackman
CLEVELAND.....H. P. Johnson
DALLAS.....R. T. Wood
DENVER.....John G. Patten
DETROIT.....R. R. Butera
LOS ANGELES.....C. F. McReynolds, D. T. Brennan, C. A. Ransdell
NEW YORK.....M. J. Storz, J. M. Grinton, J. D. Warth
PHILADELPHIA..J. D. Willis, W. L. Blanchard
SAN FRANCISCO.....William Woolston
PROMOTION & RESEARCH MGR..C. C. Gersna
RESEARCH AND MARKETING Mary Whitney Fenton, Jacqueline Gonnet

BUSINESS
BUSINESS MANAGER.....J. G. Johnson
CIRCULATION MANAGER.....T. J. Lucey
ASST. BUSINESS MANAGER ..W. V. Cockren
PRODUCTION MANAGER.....F. A. Dube

USAF Considering Moon Base by 1968 26
▶ Industry members brief Ballistic Missile Division on operational requirements of earth-moon-earth trip.

Northwest Wins Round in BOAC Battle 38
▶ CAB examiner proposes denial of British carrier's bid for Tokyo stop on its around-the-world route.

USAF Launches Molectronics Program 54
▶ Westinghouse objectives include sharp reduction in avionics size, weight, plus gains in reliability.

SPACE TECHNOLOGY
USAF Considering Moon Base 26
Radioplane's Mercury Parachute 114
ARPA Satellite Design Bids 28
Mercury Rolls 31
British Satellite Proposals 34
Project Scout Contracts 34
NASA Space Contract Awards 34
NASA Satellite Launchings 93

MISSILE ENGINEERING
McDonnell Quail Missile 30
Aeronutronic Missile Contract 37

AERONAUTICAL ENGINEERING
Swedish Planes on Underground Alert 70
French Plan Aviation Future 27
Saunders-Roe Ducted Fan Vehicle ... 32
XV-3 Completes Gear Shift 83
Flying Crane's Load Carrying Uses ... 85
Ground Effects Vehicles 89

AVIONICS
USAF Molectronics Program 54
Compatible Omnirange Details 62
Filter Center 64

EQUIPMENT
New Aviation Products 119

AIR TRANSPORT
Northwest-BOAC Battle 38
General Aircraft Becomes Division ... 38
Flying Tiger Predicts Revenue Boost .. 39
Pilots Fight Foreign Competition 40
American Transport Disposal Pace .. 42
Mockup Displays S-61 Layout 50
Shortlines 47
Airline Observer 47
Airline Income & Expenses 52

MANAGEMENT
Lockheed Expansion Plans 31
GAO Charges Excessive Costs 33
Boeing-Wichita Design Team 34
Fairchild Tightens Central Control ... 37
Who's Where 23
Industry Observer 23
Washington Roundup 25
News Digest 37
AMC Contracts 112
Petroleum Contracts 112

BUSINESS FLYING
Mooney Mark 20-A Pilot Report 97
First Grumman AG-Cat Sold 108
Private Lines 111

Calendar 5
Letters 134

EDITORIAL
Weapon Systems Management 21

COVER: Radically new Westinghouse technique produces long, thin highly polished ribbons of semiconductor crystal at a very fast rate, eliminating many costly operations now required to make transistors. The process is the cornerstone of a new USAF molecular electronics program, described on p. 45.

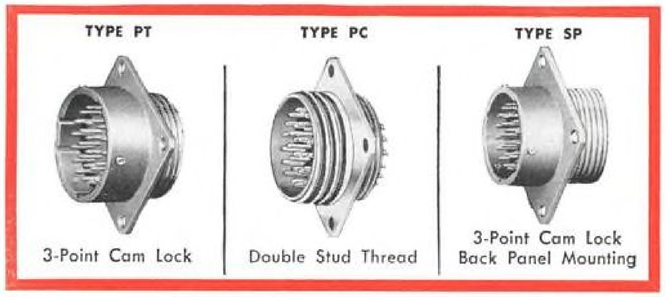
PICTURE CREDITS
Cover—Westinghouse; 27—Dassault; 28—ARPA; 30—McDonnell; 32—Saunders-Roe; 39—Flying Tiger Line; 42—General Electric; 43—Pan American World Airways; 50, 51—Sikorsky; 54, 55—Westinghouse; 70, 71, 75—Royal Swedish Air Force; 70 (top), 71 (bottom), 75 (top), 77—D. A. Anderton; 85, 115—Aviation Week; 93, 114—NASA; 97, 99, 100, 103, 104—Mooney Aircraft.

76,386 copies of this issue printed

BENDIX*
PYGMY*
MINIATURE
ELECTRICAL
CONNECTORS

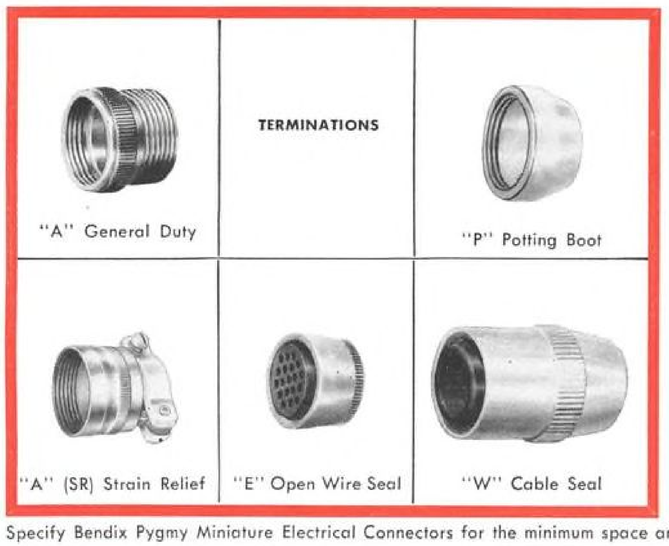
Presenting our big and growing family

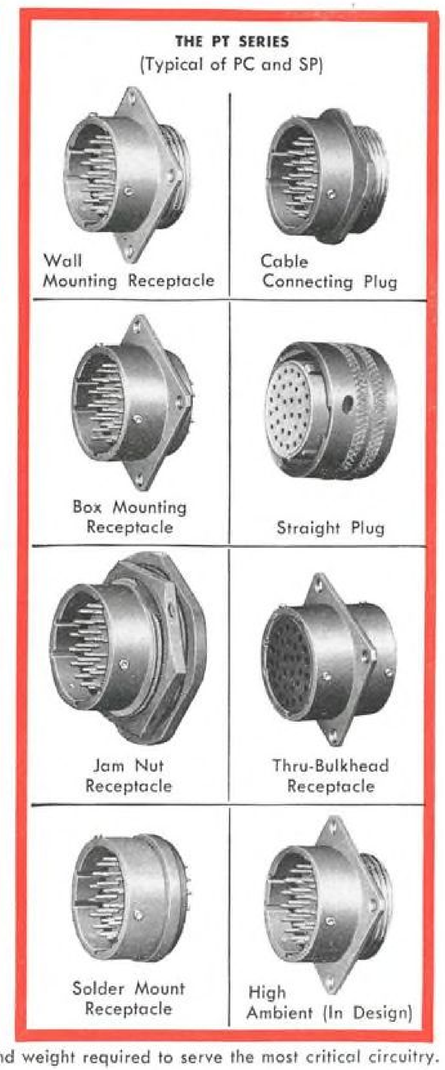
*TRADEMARK



FAMILY FEATURES

Lightweight, Compact
Resilient Inserts
Closed Entry Sockets
MS Mtg. Dimensions on PC & PT Series
5 Key Polarization on PT & SP Series
Heavily Gold Plated Contacts
Moisture and Vibration Resistant
Quick Disconnect—All Series





Specify Bendix Pygmy Miniature Electrical Connectors for the minimum space and weight required to serve the most critical circuitry.

Scintilla Division
SIDNEY, NEW YORK

Bendix AVIATION CORPORATION

Export Sales & Service: Bendix International Division, 205 E. 42nd Street, New York 17, N. Y. Canadian Affiliate: Aviation Electric Ltd., 200 Laurentien Blvd., Montreal 9, Quebec.

EDITORIAL

Weapon Systems Management

The weapon system concept has been the dominant theme of military research and development for the past seven years ever since it was developed about 1952 by the then newly hatched Air Research and Development Command of USAF. Since then, it has been adopted in its broad form by the Navy and, finally, by the Army, which has drastically modified its arsenal concept in the direction of weapon system development with increasing reliance on industry.

It is pretty generally accepted now that the weapon system concept is the only feasible technical approach to the creation of the increasingly complex weapons of the future required by all three services. However, while this technical necessity is conceded, there is still considerable controversy surrounding the role played by management, both military and industrial, in this process. The current Capitol Hill hearings being conducted by the House Armed Services Subcommittee headed by Rep. Edward Hebert (D.-La.) are symptomatic of this controversy.

Since there have been so many popular misconceptions arising from the management aspects of the weapon system concept, we think it is an excellent idea for both the military and industry to have an opportunity to explain their operations in this area. We suspect that when the record of testimony before the subcommittee is complete, many of these misconceptions will evaporate.

For example, it is already apparent in the Convair B-58, the first genuine weapon system development program, and in the North American B-70 and F-108 projects, representing perhaps the most advanced weapon systems now in active development, that many of the fears of subcontractors and small business proved groundless. The concentration of procurement funds in a few large organizations that was so widely feared by many smaller concerns has certainly not materialized.

The B-58 and B-70 programs have concentrated the systems management function in large firms with the type of broad, over-all technical capability that only the largest firms can afford. But, while concentrating systems management responsibility, the procurement funds have continued to pour through the ever-broadening base of subsystem developers, subcontractors, vendors and suppliers.

Testifying before the Hebert subcommittee, Lee Atwood, president of North American, pointed out that approximately 70% of all research, development and production funds expended on the B-70 and F-108 programs will go to companies other than his firm which is the weapon system manager. He estimated that eventually a total of 20,000 firms scattered throughout the country will be contributing to these programs in North American's subcontracting and suppliers structure, while another 60,000 firms will be involved with the major subsystem developers who are working with North American on these programs (AW April 20, p. 32).

This is a message that should be given wider circulation by both the military services and the corporate leaders of the weapon system management type of firms. It is equally true of the Convair B-58 and Boeing B-52 aircraft programs, the global communications system being developed under the systems management of IT&T and RCA and the missile programs such as the Convair Atlas, Martin Titan and the Minuteman. It will apply equally well to the space exploration and operational systems now appearing in the technical spectrum.

While there is no compromise with the technical requirement that modern weapons must be developed from their inception as a complete combat-ready system with all major subsystems compatible technically and properly time-phased in production, there is considerable flexibility in how the management function can be exercised over each of these new weapon systems.

In fact, the technical nature of the system under development usually requires a somewhat different management approach to meet its peculiar requirements.

Originally, the weapon system manager's function was delegated by the Air Force almost entirely to its prime contractor. This was the aegis under which the B-58 program was hatched with Convair as the prime weapon system manager responsible for delivering to USAF a complete combat-ready bombing, reconnaissance and ECM system. USAF retained only a veto power in this arrangement, although engine development was still kept out of the over-all systems management responsibility.

It was this approach that led to the facetious comment by industry people that "if USAF will tell us their targets, we will deliver the bombs on a cost plus fixed fee contract."

This initial system manager approach has since been modified in a variety of ways to fit the peculiar problems of each new weapon system.

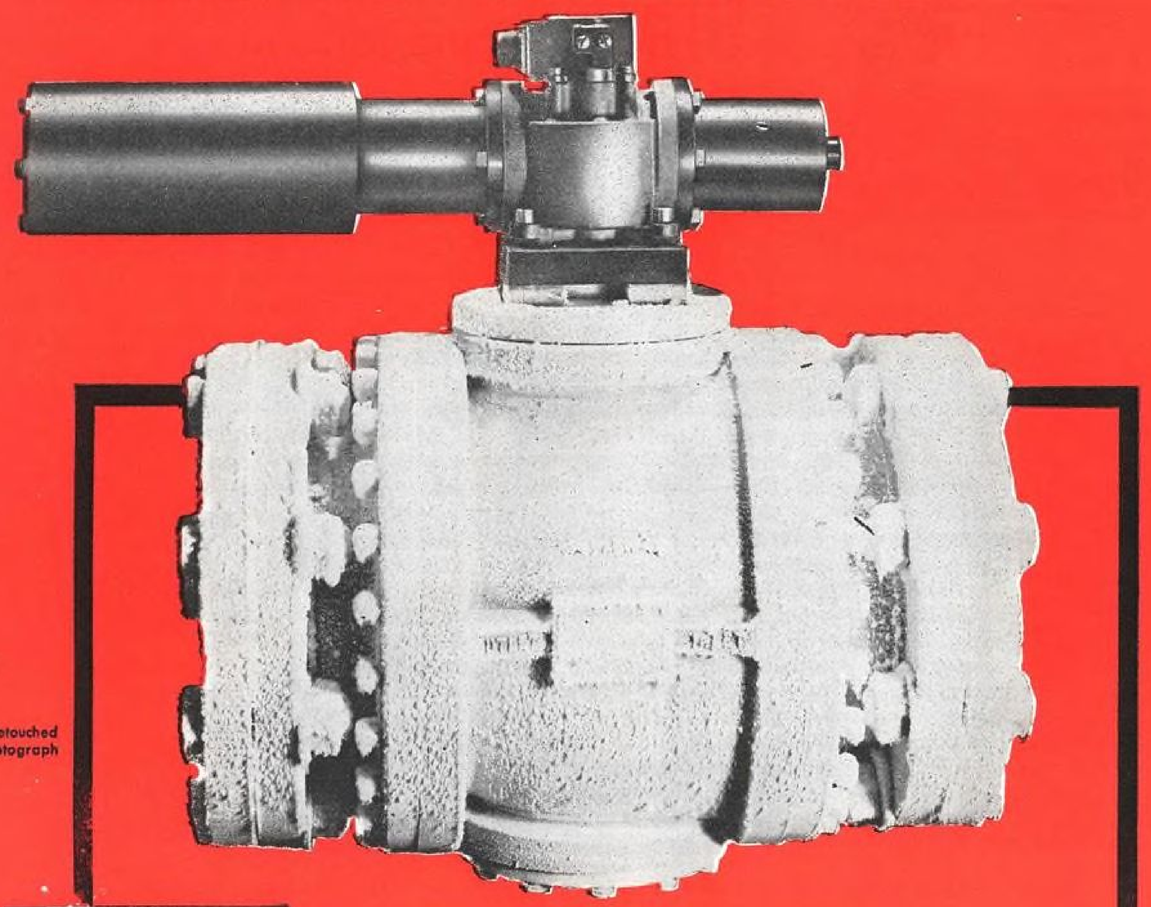
For example, in the air defense area it was deemed expedient to create a new type of organization—the MITRE Corp.—to meet the requirements of an over-all system manager. Similarly, in the new global communications system under development, IT&T and RCA have been given systems management functions at the expense of limiting their hardware participation in the programs. The role of Space Technology Laboratories in the ballistic missile and space programs is another example of a different approach to the basic weapon system manager function. It is likely that these variations on the central theme of weapon systems management responsibility will continue to develop as the basic concept takes deeper root in all three military services. It also appears likely that the National Aeronautics and Space Administration will require a somewhat similar approach even for its research and exploration systems.

Thus, we can see developing for the future the basic requirement for efficient, technically capable weapon system managers of various corporate shapes and degrees of responsibility, plus the pattern of research, development and production money spreading down through an ever-broadening base of technical and production specialist organizations whose position in this structure is cemented by the reputation of their past performance.

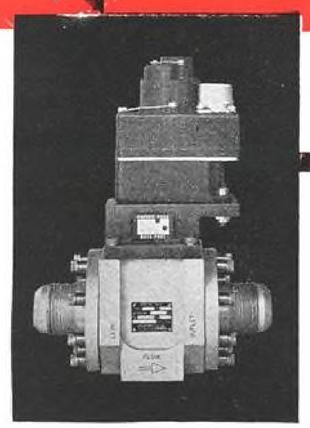
We recommend that the military and industry take advantage of the opportunity offered by the Hebert subcommittee to tell these aspects of their story and follow strongly with further efforts to establish these points with the American public whose tax dollars support the entire structure.

—Robert Hotz

Maximum performance



Unretouched Photograph



... at -320°F.

Hydromatics *FLO-BALL* valves

Hydromatics makes them all---from fast-acting motor-operated airborne valves that control 3250 psi helium at −360°F., to compact 6" LOX fueling valves that can fill a missile from mobile transfer equipment in just 2 minutes.

All incorporate Hydromatics unique 100% flow efficiency characteristic.

For off-the-shelf hardware to meet your temperature requirements down to −425°F., write for complete information on Hydromatics outstanding line of ***FLO•BALL*** valves for high pressure, cryogenic and corrosive applications.

Hydromatics, Inc.

LIVINGSTON, NEW JERSEY • WYMAN 2-4900

FLO-BALL

WHO'S WHERE

In the Front Office

Dr. Walter R. Dornberger, director of engineering, Niagara Frontier Division, Bell Aircraft Corp., Buffalo, N. Y. Also: **Julius J. Domonkos,** vice president-manufacturing in Bell's corporate office.

Ralph J. Osborn, president and director, Lockheed Aircraft Service, Inc., Ontario, Calif.

William S. Wheeler, a corporation vice president and general manager of Motorola Military Electronics Division, Phoenix, Ariz.

Allan Shivers, former governor of Texas, a director of Braniff Airways, Inc.

Richard S. Reynolds, Jr., president of Reynolds Metals Co., elected board chairman of Robertshaw-Fulton Controls Co., Richmond, Va.

R. L. Weir and **Sir Giles Guthrie,** directors, British European Airways.

Thomas H. Hintze, a partner, William C. Wold Associates, New York, N. Y.

Boyd T. Marshall, vice president-general manager, Technical Products Division, Waste King Corp., Los Angeles, Calif. Also: **Frank J. Gallagher,** chief manufacturing engineer; **Robert Potter,** manager-manufacturing services; **Arthur R. Schneider,** chief engineer.

J. H. Overholser, vice president-sales and engineering, Turbo Products, Inc., Pacoima, Calif.

James C. Elms, vice president-electronics systems engineering, Crosley Division, Avco Corp., Cincinnati, Ohio .

Owen C. Davis, vice president and treasurer, Vickers, Inc., Detroit, Mich.

Graydon Hall, vice president-sales, Southern Airways, Inc.

The following appointments have been made in the Bureau of Flight Standards, Federal Aviation Agency, Washington, D. C. Flight Inspection and Procedures Division: **Arthur E. Jenks,** chief; **Raymond A. Shepanek,** deputy chief; **J. Chester Shimp,** chief-operations branch; **Jack G. Webb,** chief-intermediate section; **Alfred P. Swanson,** chief-standards section. Operations Division: **James W. Shipp,** chief, and **John R. Shaffer,** deputy chief, international operations branch. Program Management Division: **Charles G. Abrams, Jr.,** chief-management analysis branch.

Honors and Elections

Thomas Richard Quermann, chief gyro engineer of the Norden Division's Ketay Department, has received United Aircraft Corp.'s second George Mead Medal for Engineering Achievement in the development of gyros for missiles and spacecraft.

Willis G. Lipscomb, vice president-traffic and sales of Pan American World Airways, has been named Air Cargo Man of the Year by the Air Freight Forwarders Assn. for contributions to air cargo development.

The University of Southern California's Aviation Safety Division has been named 1959 winner of the annual Flight Safety Foundation-Aviation Week magazine Distinguished Service Award for promoting and achieving safer utilization of aircraft.

(*Continued on page 124*)

INDUSTRY OBSERVER

► Soviet Union has test fired several radical new long-range ballistic missiles employing control techniques that enable the missile to change its direction in flight and extend its range by flattening its ballistic trajectory. The control techniques involve simple petal flap extensions similar to those displayed on Soviet research rockets and described in NACA research reports in 1957 (AW Nov. 11, 1957, p. 26). Soviet tests were made from firing points in northwestern Russia, impacting in eastern Siberia.

► **First Discoverer satellite to use an Atlas ICBM as a booster will be launched from USAF Missile Test Center, Cape Canaveral, Fla., rather than from Vandenberg AFB, Calif., from where Discoverer vehicles using Douglas Thor IRBM boosters have been launched.**

► Cryogenic gyroscope, a new-type of device which may offer extremely high accuracy and long life, has been developed by General Electric's Electronics Laboratory in Syracuse, N. Y. Gyro, which operates at near-absolute zero temperature, has attractive possibilities for use in space vehicles.

► **Present schedule for two U. S. Venus probes (AW Feb. 23, p. 26) calls for Thor-Able IV to be fired on June 4 or 5 and Atlas Able IV, launched by Atlas booster 9-C, to be fired on June 6, 7 or 8. If Thor vehicle is not fired in the first two days alloted it, it will be rescheduled for June 10 or 11.**

► Air Force and Navy are working jointly on an expendable powered target drone for use with high speed aircraft. Navy has cognizance over project.

► **Reconnaissance version of its 600-kt. target drone is under development by Beech Aircraft Corp. in hopes of arousing Army-Navy-Marine interest. Target version is entered in current Army supersonic drone competition, on which the decision is expected by July 1.**

► Final version of USAF-Convair Atlas D and Atlas E intercontinental ballistic missiles will have an increased thrust achieved by higher fuel flow rate in the North American Rocketdyne engines than on earlier models. D series also incorporates a glass fiber skirt around the two booster chambers. Use of glass fiber also includes some structural supports.

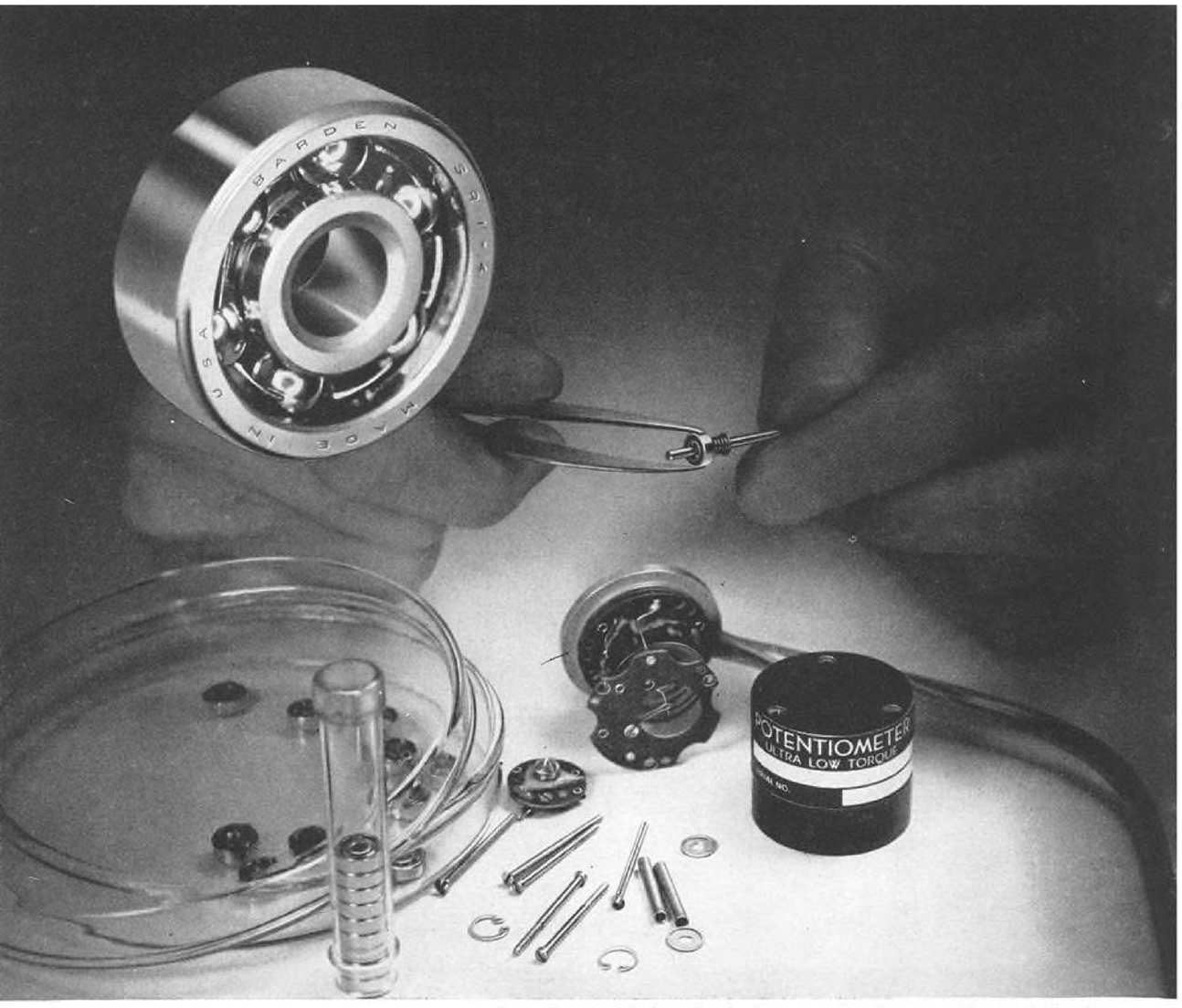
► **Scientists now working theoretically on nuclear rockets using gaseous material for fuel say small scale experimental work will not provide significant data and that full scale engines with combustion chambers 15 ft. in diameter and several feet long will have to be built early in any development program. Specific impulses theoretically possible with such engines are many times those now planned for the solid fuel heat exchanger rockets of Project Rover.**

► McDonnell Aircraft Corp. mockup of the Project Mercury manned space capsule has been completed and inspected by a National Aeronautics and Space Administration team. Capsule contract for $10.5 million was awarded last February.

► **High priority task of United Aircraft Corp.'s new United Research Corp., Menlo Park, Calif., is to strengthen the parent firm's position in the solid propellant rocket field. General mission of Menlo group is to work in areas where United has not had previous experience. Chemistry is one field in this area that will be pushed hard.**

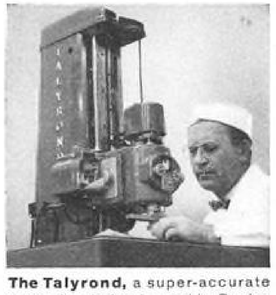
► New single-place helicopter incorporating ramjet engines on the rotor blade tips reportedly is being ground-tested by Russia's Kharkov Aviation College. Flight tests are scheduled shortly.

► **Strong interest by Rolls-Royce, Ltd., in business and utility aircraft market as a means of diversifying British company's efforts is noted by general aviation observers who report that the firm has been making an extensive worldwide survey in this field. Industry sources who have seen the Rolls-Royce market survey call it the most detailed that they have seen, report that the company has discussed possibility of manufacturing licenses in Britain with U. S. business plane manufacturers.**



Barden Precision SR1-4 miniature bearings as used in a linear or non-linear potentiometer.

BARDEN *miniature-size bearings are built with instrument precision*



The Talyrond, a super-accurate measuring device, is used by Barden as a development tool; as a standard for correlation of other quality control instrumentation; as a gage for ultra-precise bearing parts. It measures roundness and waviness to five millionths of an inch.

Precision-built potentiometers require concentric, smooth-running wiper contacts and ultra low torque characteristics to provide accurate and rapid response to small motivating forces.

Barden Precision miniature-size bearings have the inherent concentricity, smoothness and low torque values to assure this sensitive response and electrical accuracy.

Barden Precision miniature bearings are built to the same high standards of consistent quality as Barden's larger instrument sizes. *Barden Precision* means not only dimensional accuracy but performance to match the demands of the application.

Your product needs *Barden Precision* if it has critical requirements for accuracy, torque, vibration, temperature or high speed. For less difficult applications, Barden *predictable* performance can cut your rejection rates and teardown costs.

Write today for your copy of Catalog Supplement M1 which gives dimensions, performance and engineering data on *Barden Precision* ball bearings 5/8" O.D. and smaller.

THE **BARDEN** CORPORATION

41 E. Franklin St., Danbury, Connecticut • Western office: 3850 Wilshire Blvd., Los Angeles 5, California

SPECIFY BARDEN PRECISION BALL BEARINGS FOR• INSTRUMENTS • AIRCRAFT ACCESSORIES • COMPUTERS AND RECORDERS • MACHINE TOOL AND TEXTILE SPINDLES • OTHER PRECISION APPLICATIONS

Washington Roundup

Science Department Debate

Proposals to create a U.S. Department of Science on a cabinet level met with mixed reaction during hearings of the Senate Government Operations Subcommittee on Reorganization and International Organizations. Hearings were called by subcommittee chairman Sen. Hubert H. Humphrey (D.-Minn.) to obtain the views of scientists, engineers and government officials regarding the proposed legislation.

Witnesses supporting creation of such a department included Dr. Wallace R. Brode, board chairman of the American Assn. for the Advancement of Science; Alden H. Emery, executive secretary of the American Chemical Society; Enoch R. Needles, president of the Engineers Joint Council, and Dr. Howard A. Meyerhoff, executive director of the Scientific Manpower Commission.

Those opposing the measure were Commerce Secretary Lewis L. Strauss and Dr. A. Hunter Dupree, of the University of California's Department of History. Both agreed that there is an urgent need for more effective coordination of scientific activities but said it could be accomplished without creation of a Science Department.

Detection Debate

Meanwhile, the position of Dr. Herbert York, Assistant Defense Secretary for Research and Engineering, in the ballistic missile early warning debate has become the matter of mild debate in its own right.

York told a recent meeting of the American Ordnance Assn. that use of satellites equipped with infrared sensors to detect ballistic missiles at the instant of launch now appears to be one good solution to the problem of missile early warning. Advanced Research Projects Agency's program for such satellites is designated Project Midas.

York said, however, that the Midas program should not be considered as part of U.S. space program as such and should have to compete for funds only with other ICBM detection techniques. Some observers interpreted York's comment as an indication that he prefers the Midas approach to the current USAF concept, now under industry study, of employing airborne early warning aircraft outfitted with infrared and radar detection equipment. But others interpreted the comment to mean that York now doubts the wisdom of assigning major military space weapons to ARPA and believes they should be developed alongside more conventional weapons by the military service which will use them for its specific mission.

Argus Discussion

Argus high-altitude nuclear explosion experiments are scheduled to be discussed at two scientific sessions of the National Academy of Sciences here on Wednesday. Symposium on Scientific Effects of Artificially Introduced Radiation at High Altitudes is scheduled for 9 a.m. as the last of four symposiums at the Academy's 96th annual meeting. Participants are Richard W. Porter, of General Electric, chairman; Nicholas Christofilos, University of California; James A. Van Allen, Carl E. McElwain and George H. Ludwig, of the State University of Iowa; Maj. Lew Allen, Jr., and Capt. Joseph A. Welch, Jr., USAF's Air Research and Development Command's Special Weapons Center; Philip Newman, of ARDC's Cambridge Research Center and Allen M. Peterson of Stanford University and Stanford Research Institute.

Second meeting involving Argus will be the opening session of a day-and-a-half Symposium on Problems of Space Exploration, sponsored by the Academy, the American Physical Society and the National Aeronautics and Space Administration. It is scheduled for 1:30 p.m. Wednesday at the Academy. Chairman is Bruno Rossi of Massachusetts Institute of Technology. Papers will be given by Fred L. Whipple, of the Smithsonian Astrophysical Observatory; Thomas Gold, of Harvard College Observatory; Eugene N. Parker of the Enrico Fermi Institute of Nuclear Studies, University of Chicago and by Van Allen and Christofilos.

A round table discussion, chaired by John A. Simpson of the Fermi Institute, will follow. It also will include A. R. Hibbs and Dr. Robert Jastrow, head of NASA's Theoretical Division.

Appointment Confirmed

Richard E. Horner last week officially resigned as Assistant Secretary of the Air Force for Research and Development, effective June 1, to become Associate Administrator of National Aeronautics and Space Administration, a move predicted by AVIATON WEEK (April 20, p. 25). Horner will be responsible for general management of NASA operations under Deputy Administrator Hugh L. Dryden at a salary of $21,000. His successor, probably USAF chief scientist Dr. Joseph V. Charyk, for the Air Force job, had not been formally named as of late last week.

Flight Pay Savings

Defense Department estimates that a new order tightening "proficiency" flying by desk officers (AW April 16, p. 25) will eventually save $40 million a year. Brig. Gen. R. J. Friedman, USAF Budget Director, estimates that the annual fuel bill for proficiency flying in the Air Force is now $10 million.

Capital Elections

Two major stockholders of Capital Airlines have been elected to top-level positions by the company board of directors. George R. Hann, who has been closely associated with the company for over 30 years and who owned 45,832 shares of common stock as of last Dec. 31, was named chairman of the board, a position that has been vacant since J. H. Carmichael, now president of Fairchild, resigned last year. Charles H. Murchison, a partner in the legal firm representing the airline as general counsel and owner of 78,132 shares of common stock as of Dec. 31, was named chairman of the board's executive committee. In the past year, Murchison has increased his holdings from the 10,632 shares of common stock as reported to the Civil Aeronautics Board for the year ending Dec. 31, 1957.

Renegotiation

Boeing President William M. Allen will be the first industry spokesman this week on proposed extension of the renegotiation law at hearings of the House Ways and Means Committee. Committee expects to complete public sessions in three days.

—Washington staff

USAF Considering Moon Base by 1968

Industry members brief Ballistic Missile Division on operational requirements of earth-moon-earth trip.

Washington—United States Air Force is weighing operational factors involved in establishing a base on the moon by 1968. Air Research and Development Command's Ballistic Missile Division, Inglewood, Calif., was briefed recently by industry members on broad requirements for earth takeoff, moon soft landing, operations on lunar landscape and return to earth.

Presentation stretched over four days and was made under ARDC's Systems Requirement 183, which anticipates establishment of a lunar observatory. Basic facets of this requirement, which is based on military intelligence interests, are similar in many respects to a more advanced formulation labeled SR 192, related to military bombardment retaliatory capability from a moon base. Some industry observers feel that concentration should be put directly on SR 192. They reason that if the gigantic effort and expenditure required to establish a moon base is going to be supported, the result should embody the added potential of bombardment capability.

An interim report on SR 192 will be made this summer at ARDC headquarters by at least three industry members who hold study contracts, and possibly by other companies which are funding their own studies under SR 192. At completion of the study, representatives of Avdanced Research Projects Agency and National Aeronautics and Space Administration also are scheduled to sit in on the final presentation.

Peaceful Use

Indications are that the general subject of lunar bases is being played down because of the U. S. State Department's attitude to promote peaceful use of outer space. Industry observers feel, however, that in view of the difficulty of negotiating with the Soviets on everyday international problems, it is presumptuous to assume that any specific, harmonious agreement could be reached with regard to the ramifications of space exploration. These observers feel that technology leading to moon base acquisition should be pushed, because this same effort is being advanced by Russia.

Briefing on SR 183 given by industry members was in the nature of a progress report, since final proposals are scheduled somewhat down the time scale.

Government agencies which had representatives at the briefing included:

- **USAF's Office of Advanced** Technology, headed by Brig. Gen. Homer Boushey as director of advanced technology-deputy chief of staff for development. Gen. Boushey has been a vigorous spokesman for the feasibility of military bases on the moon.
- **Ballistic Missile Division,** ARDC.
- **Ballistic Missile Center,** Air Materiel Command.
- **Wright Air Development Center,** ARDC.
- **Strategic Air Command.**
- **National Aeronautics** and Space Administration.
- **Jet Propulsion Laboratory,** NASA.

Industry members participating in the briefing included:

- **Boeing Airplane Co.**
- **Republic Aviation Corp.**
- **Douglas Aircraft Co.**
- **North American Aviation Co., Inc.**
- **North American Aviation's** Rocketdyne Division.
- **United Aircraft Corp.'s** Missiles and Space Division.
- **General Electric Co.**
- **Minneapolis-Honeywell.**

Two of these companies are reported to have Air Force contracts for SR 183 study, while other studies by other industry members are supported by company funds.

Presentation under SR 183 was a mixture of specifics, theory, optimism and pessimism. Most optimistic attitude was toward mechanical developments, while most pessimistic views were voiced with respect to biomedical aspects, particularly as related to sustaining space travels in the hostile lunar environment.

Air Force medical men are aware of a capability-shortage to keep up with their new responsibilities in the space regime. One medical participant in the SR 183 briefing declared that until recently there had been enough medical specialists in the Air Force to handle the bioscience problems of out-of atmosphere excursions, but that these problems had grown at a fast pace, outstripping the increase in the number of medical personnel required to keep abreast of the state of the art.

There was frank admission by industry members that cost of the enterprise would be colossal—perhaps on the order of $20 billion for the complete initial system to establish a lunar base. They admitted it would have to be justified by distinct need for the end use of the base—military retaliation or surveillance.

Value of the base as a surveillance station was considered questionable with respect to percentage of time the earth would present reasonable viewing per day and per year. Studies under SR 183, which are in effect, feasibility evaluations, are slanted to consider all methods of surveillance—optics, infrared, radar and other procedures. Optics aren't viewed too favorably because of cloud cover obliteration.

Also, weight of the optical system for viewing the earth would scale a very high figure, with lenses of the system probably transported individually and assembled into a composite system. Infrared viewing is considered better than optics but even this method would leave much to be desired in the way of specific detection results through cloud cover. Some participants feel that relatively low altitude earth satellites would be a better investment.

Moon Vehicle

Proposals discussed at the briefing included these highlights:

- **Vehicle for the lunar** mission was envisioned to accommodate up to 10 persons.
- **For the trip out,** probably four stages of propulsion will be required, and probably two stages for return from the moon, making a total of six stages.
- **One booster scheme** contemplated a cluster of liquid propellant engines developing 16,000,000 lb. thrust. Even logistic support required to fuel these rockets for takeoff was portrayed as a stupendous task. Another plan envisioned use of a large cluster of solid propellant rockets for booster service. Nuclear propulsion in the form of a single stage for the outward journey also was proposed, but for a later operational date than 1968.
- **Estimates of takeoff weights** of the lunar vehicle varied from about 5,000,000 lb. up.
- **Individual propulsion scheme** to propel spacemen over the lunar landscape also was considered as a condition which might be necessary to cope with lunar surface phenomena in the event the dust layer was too soft and deep to permit normal traversing.
- **Cycle for replacing voyagers** to the moon varied, with 20 days stay offered as a representative figure.

While detailed system design and hardware projections were specified, some military observers at the briefing were skeptical of what they considered pat answers to various problems. For example, one item which was considered to be treated too lightly was a space suit projected to be used on the moon. This type of garment, some observers felt, would require considerable research and development before safety was definitely ensured.

One point of considerable controversy was related to protection of people in the moon return vehicle in the event it should land over hostile territory on earth.

This was viewed by some at the briefing as a prime example of unjustifiable detail for a situation about which very little could be done.

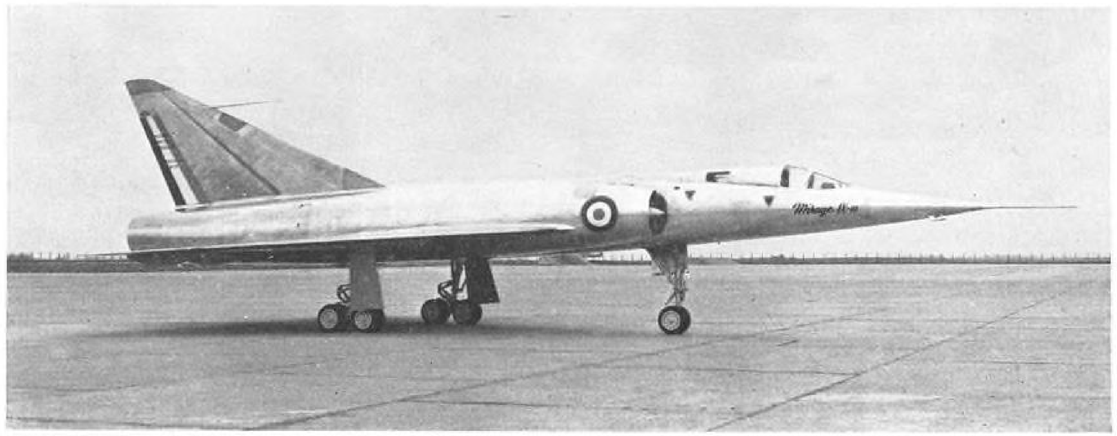
One industry representative felt that while some preliminary design definitely was justified in the moon base studies, too much emphasis was being placed on specifics and not enough on the approach looking to the accumulation of environmental data to serve as a stepping stone to lunar landing.

Factors considered necessary in the category of basic information include moon radiation level, frequency of meteorites, surface dust consistency and depth, and whether gases emitted from moon surface would be harmful or useful. Another factor seen affecting cost and effort for base establishment is whether shelters could be erected above ground or underground.

Impacting explosive rockets, followed by other rockets sailing past the moon to pick up and sample the debris thrown up by the explosion, then telemetering results, is one projection seen as offering a possibility of determining lunar surface composition. Radar reflection tests also are seen as a means of revealing lunar landscape secrets.

Despite all the problems which would have to be solved and the tremendous cost involved in establishing a lunar base, opinion was firm among participants that if the project were going to be supported, it would be necessary to channel sufficient effort into the project soon, if a realistic date of attainment was to be achieved.

Previously, a presentation on feasibility of establishing a lunar base was given last September before Advanced Research Projects Agency in Washington. The presentation consisted of a fairly detailed analysis of velocities required for exit from earth and moon environments, propulsion requirements, vehicle weights, cost for logistic transport vehicles, and moon-to-earth bombardment capability. The program anticipated that a base probably could be established by 1965 if sufficient support were available.



DASSAULT Mirage 4 Mach 2 bomber is powered by two Snecma Atar 9 turbojet engines. The aircraft will have a 937-mi. range. The French Air Ministry has said it is a development vehicle for a 100,000-lb. Mach 3 bomber with 1,250-1,875-mi. range. Engines probably will be Pratt & Whitney J75 turbojets built by Snecma under license (AW Feb. 9, p. 23).

French Plan Aviation Future

Paris—French Air Ministry's long-range program covering transition from piloted jets to missiles envisions use of the Sud Aviation Smasher tactical missile and a 2,000 mi. French-designed intermediate range ballistic missile, with Dassault Mirage 4 becoming the last piloted bomber built in France (AW Mar. 9, p. 275).

Gen. Louis Bonte, Ministry technical and industrial director, listed these projects up for action by French Assembly:

- **Sud Smasher,** ground-to-ground weapon being tested in Algeria.
- **Dassault Etendard 4-M** jet fighters and Breguet 1150 twin-turboprop anti-submarine for the French naval air arm.
- **Dassault Mirage 3,** Fouga Magister twin-jet trainer, Nord Noratlas transport, and Morane-Saulnier Epervier 1500 for French air force. These will be supplemented by four new aircraft: production version of Mirage 4 and a twin-turboprop colonial support aircraft and either the Sud Voltigeur 117 or Dassault Communaute 415.

Sud now is redesigning wing of the Voltigeur, following in-flight failure of a sandwich section which resulted in a crash last January, and the time lag may act in Dassault's favor. Long-range plan also includes a French VTOL tactical aircraft and the Nord Noratlas heavy transport with a 1,250 mi. range.

The Noratlas will be a French-German designed development of the Nord transport, with Nord manufacturing the aircraft for both countries.

Gen. Bonte said the long-range civil aircraft program includes design and construction of a Super Caravelle turbojet transport, possibly powered by Pratt & Whitney J75 jet engines built under license by Snecma.

Ministry disclosed no time schedule or costs involved in the program. Sources indicated the Ministry is pushing to get the program accepted by the French Assembly this summer.

No further details on the VTOL aircraft were given, but future of the Snecma Flying Atar is not clear. All three French services will be supplied with Sud Aviation Model 3200 triple turbine heavy helicopters under the Ministry plan.

Production of military aircraft for export also figures in the program. Involved are the Breguet Alize 1050 turboprop-powered anti-submarine monoplane; the Etendard 4-M and the three air force aircraft now in production.

Non-military production would center on the Sud Caravelle, the Max Holste Super Broussard twin-engine transport and the Breguet 941 transport, powered by four General Electric T58 jet engines and featuring boundary layer control.

Bids Readied for ARPA Satellite Designs

By Philip J. Klass

Washington—Several dozen companies are expected to bid this week for design of the first of three basic types of active communication satellites to be developed by Defense Department's Advanced Research Projects Agency. Awards for two other types of communication satellites are expected within several months.

The three types of communication satellites, which promise radical improvement in long-distance military communications, include:

• **Delayed relay, known** as Project Courier, a 500 lb. satellite which can carry 20 100-word-per-minute teletype messages between two or more earth stations. This delayed relay satellite, a more sophisticated version of the Project Score "talking satellite" launched last December, receives a message by radio from one earth station, records it on tape, then rebroadcasts it when the satellite passes near and is interrogated by an authorized station in some other part of the globe. First model, for which bids are due this week, is slated for launching in 12 to 18 months.

• **Hovering real-time repeater,** a 600 lb. satellite designed to be placed in a 22,400-mi. equatorial orbit, so that it remains in fixed position relative to earth, will be able to instantaneously and continuously rebroadcast radio/teletype messages received from one earth station to another. Satellite is to have the capacity for 144 voice channels or several thousand teletype channels. Three such satellites, equally spaced in equatorial orbit, can provide world-wide communications between any two points on the earth except for the area above 80 deg. latitude. ARPA's timetable calls for orbital tests on major satellite components and techniques in about 18 months, with a completely operational hovering satellite in orbit in three to four years.

• **Polar real-time repeater,** a 450 lb. satellite which functions similarly to the equatorial hovering type, will be placed in a lower-altitude polar orbit to fill in the high latitude gap in coverage of the hovering satellites. The polar repeater is expected to be a great boon to USAF's Strategic Air Command, whose bombers must now rely upon high frequency (HF) radio which is frequently disrupted in the Arctic by atmospheric disturbances, by providing direct ground-to-satellite-to-aircraft communications in the ultra high-frequency (UHF) band which is not affected by such disturbances. ARPA hopes to launch a prototype of its first polar real-time repeater satellite in 18 to 24 months and have an operational system in orbit in approximately three years.

Responsible Agencies

Responsibility for developing new active communication satellites and associated launching vehicles and ground stations has been assigned as follows:

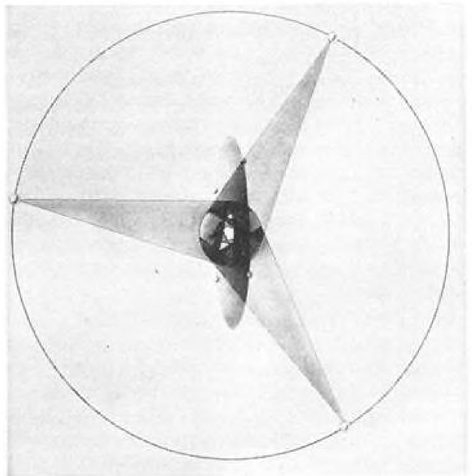
• **Delayed relay satellite:** Army Signal Laboratories, Ft. Monmouth, N. J., will develop satellite, ground stations and associated tracking antennas, with USAF's Ballistic Missile Division responsible for booster, upper stages and guidance. More than 40 companies attended last month's prebidding briefing session held by the Signal Corps and more than half of them indicated an intention to submit proposals which are due this week.

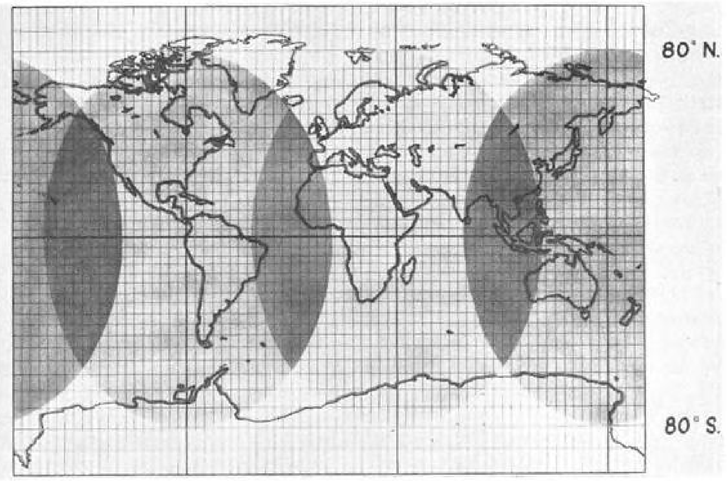
• **Hovering equatorial repeater** satellite: Army Signal Laboratories and Air Force Ballistic Missile Division also share similar responsibilities for this project. Because of the greatly increased complexity of satellite avionic equipment, launch, guidance and stabilization problems, initial contracts will cover research and development of basic techniques and components rather than calling for design of the complete system. Subsequent contracts probably will not be awarded for another year or longer.

• **Polar repeater satellite:** Although a firm decision has not yet been made, USAF's Ballistic Missile Division appears likely to head this program. Wright Air Development Center's Communication & Navigation Laboratory will handle the satellite-borne avionics and a special aircraft antenna required for ground-to-satellite-to-aircraft communications. Prebidding briefing for prospective contractors may be held within 60 days.

Operational versions of the courier (delayed relay) satellite will be placed in a circular equatorial orbit at an altitude of approximately 1,200 mi. according to present plans. However, this requires a difficult dog-leg maneuver of the launching vehicle when fired from Atlantic or Pacific missile test ranges. Because of this, ARPA probably will settle for an inclined orbit of 500 to 800 mi. for the first prototype model.

Satellite radio transmitter/receiver will operate in the microwave region, probably 1,000 to 2,000 mc. Output from the transmitter will be a few watts. Electric power will come from silicon solar cells and rechargeable batteries, enabling the satellite to transmit in sunlight or darkness. Antennas will be positioned around the outer surface of the satellite to avoid the necessity of stabilizing satellite attitude with respect to earth stations.





COMBINATION of three hovering satellite repeater stations in equatorial orbit and four or more rotating satellite repeaters in polar orbit, to be developed by ARPA, will provide continuous communications from any point on earth to any other, as well as to aircraft, submarines and ships. Coverage area obtained from three hovering satellites alone, with high latitude gap, is shown at right.

Redundancy in the form of dual or triple elements will be used throughout the avionic equipment to assure maximum reliability in this, and other, communication satellites.

In the event of failure, the earth station will be able to switch in a standby element by radio control, according to present plans.

To prevent intentional or unintentional interrogation of the courier satellite transmitter by unauthorized stations, depleting the batteries and causing the satellite to lose its voice over authorized stations, moderately sophisticated security techniques will be employed in avionic equipment design. Where privacy is required, messages sent to the satellite for rebroadcast can be coded.

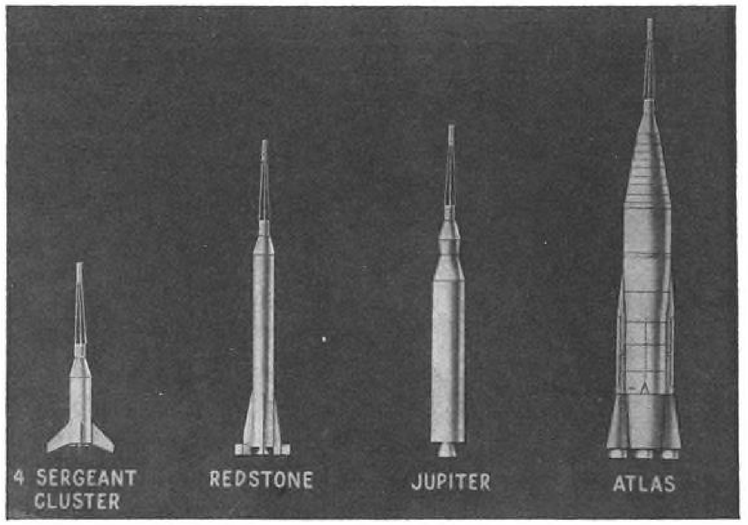
The inherent delay in message transmission by a courier-type satellite suggests that this type will be used for routine military messages and logistics traffic. More urgent messages will go by real-time repeater-type satellite.

Hovering Repeater

A hovering real-time repeater satellite poses far more difficult design problems than the courier-type, but it offers important advantages once these problems are solved. For instance, injection of a hovering satellite into orbit will require extremely precise guidance and control. Once in orbit, small changes in satellite velocity, introduced by gas jets or other means, may be needed to keep its position fixed relative to the earth. But once this is accomplished, the need for using steerable antennas on the earth to track a moving satellite will be eliminated. This will permit use of larger, higher-gain antennas which allows reduction in power of the satellite transmitter.

The hovering type satellite can provide instantaneous, continuous communications between any two points on the earth (below 80 deg. latitude) over distances of approximately 8,000 mi. But continuous operation with present payload limits raises the problem of providing adequate electric power aboard the satellite.

To minimize the power level of the satellite transmitter, ARPA plans to use high-gain directional antennas on the satellite, but this requires that the satellite attitude be stabilized so that the antenna always points toward earth. Also, solar cells in a hovering satellite must be able to automatically position themselves toward the sun. Since a hovering satellite is visible from so large a portion of the earth's surface, it is vulnerable to jamming by anyone in that large area. (The courier-type can be jammed only in the vicinity of a friendly station when its receiver-transmitter is turned on.)



Project Mercury Test Vehicles

Test vehicles for Mercury manned orbits are, from left, Little Joe, Redstone, Jupiter, Atlas. Pilots will ride Redstone on suborbital flights, Atlas for orbits (AW April 20, p. 28).

ARPA is planning on duplex operation for its hovering satellite, i.e. simultaneous transmission and reception on different frequencies. Operating frequency also will be in the microwave region.

Study of anti-jamming techniques for satellite use will be one of the major areas to be investigated by the Signal Corps and its contractors under awards to be made within the near future. Other problem areas to be investigated by Army, and by the Air Force, include: possible satellite configurations, station-keeping and attitude stabilization, frequency stability and reliability. ARPA has set a goal of one year's operating life for satellite reliability.

The polar orbit repeater satellite is, in many respects, a simplified version of the hovering repeater. One difference is that it will transmit and receive in the ultra high frequency (UHF) band. This will permit aircraft-satellite communications using existing UHF communications equipment now installed on military aircraft. A special steerable antenna for tracking the satellite will have to be added to the airplane, however.

The polar repeater also will employ directional antennas which must be kept suitably oriented relative to the earth. Problem of station-keeping will be somewhat less severe than for the hovering satellite. Relative positions of repeater satellites in their polar orbit must be established, and maintained, such that at least one is always visible to military bases and to aircraft, submarines or ships operating in the Arctic or Antarctic.

If the position of each polar repeater can be established accurately as desired, a total of four should provide full global coverage. If not, additional satellites will be required to assure that one is always in view.

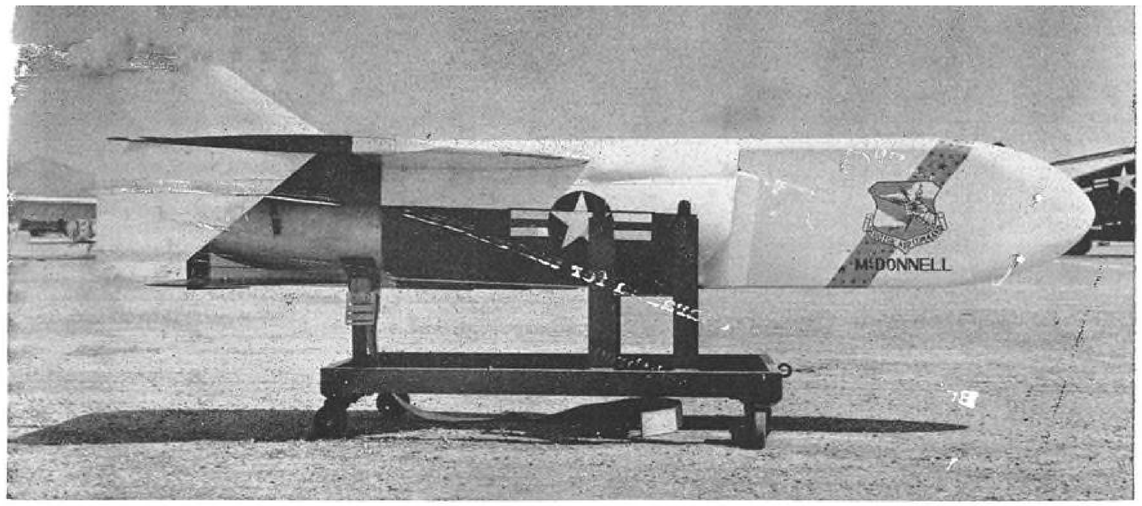
Jamming also will present a problem for the polar repeater satellite. Although voice communication is preferable for aircraft use, coded data link may be used because it is less susceptible to enemy countermeasures.

Initial prototype of the polar repeater is scheduled to be launched in about 18 to 24 months, with a fully operational system in orbit within four to five years.

The Future

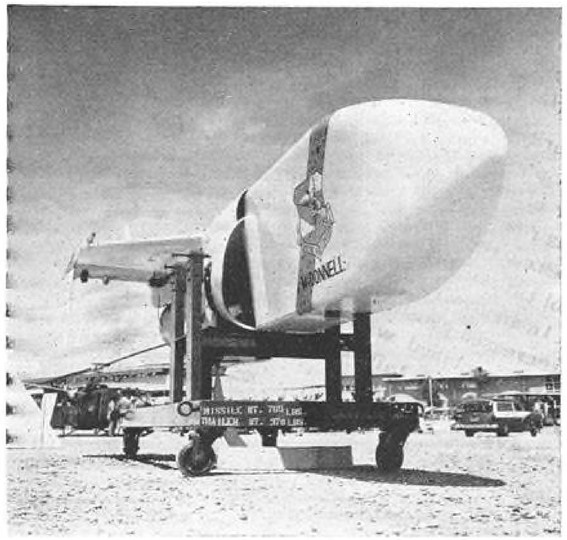
Eyeing the larger booster engines now under development, ARPA has long-range plans for a communication satellite weighing 10,000 lb. The added payload would permit use of higher power transmitters, greater bandwidths for transmitting battle reconnaissance information and greater conservatism in avionic design for improved reliability. More sophisticated anti-jam features also can be included.

Both ARPA and the National Aeronautics and Space Administration are working in the field of communication satellites. ARPA currently is placing emphasis upon active types which carry avionic equipment aboard; NASA is



Quail Decoy Wing, Fins Fold for Storage in B-52

Design details of McDonnell's GAM-72 Quail decoy missile, including how the truncated delta wing and fins fold for storage in the mother ship (below, right), were shown in this display at the World Congress of Flight at Las Vegas, Nev. The top surface fin folds outward toward the tip and lower surface fin fits inward. Intakes for the General Electric J85 turbojet engine with ramp and airscoop above are shown (top, and below, left).



working with a passive type consisting of a large inflatable aluminum-coated plastic sphere which reflects radio signals back to earth.

Paul A. Price, who heads ARPA's communication satellite and tracking efforts, says that there has been no rivalry between the two agencies in his field. ARPA is seeking to apply the existing state of the art to find systems usable for military use, while NASA is doing advanced, basic propagation tests which may suggest new avenues of approach.

The present active/passive line of demarcation is not a rigid one. NASA Administrator Keith Glennan said in recent congressional testimony that his agency planned to investigate active communication satellites for possible commercial (civil) applications. Similarly, ARPA is thinking about the possibility of passive satellites equipped with wideband flat-plate reflectors once it has solved the satellite attitude stabilization problem. ARPA also may investigate the possibility of placing thousands of tiny metal pellets into orbit to serve as a passive reflector of radio waves.

Present communication satellite program management philosophy at ARPA is that it is not necessary to give complete project responsibility to a single agency to assure adequate coordination, except where the satellite and launching vehicle guidance or stabilization are intimately related. This explains why responsibility for launching the vehicle has been delegated to one service, the satellite to another, in two of the major programs to date.

Price recognizes that close liaison is required for all satellite programs and points out that the Air Force Ballistic Missile Division has men stationed at Army Signal Laboratories and vice versa to assure the required coordination and integration.

Army Signal Laboratories subcontracted bits and pieces of its Project Score talking satellite avionics, then assembled the elements itself. For the forthcoming courier satellite procurement, however, a single contract is expected to be awarded for the complete satellite package.

Gross Details Lockheed Expansion Plans

By Katherine Johnsen

Washington—Robert E. Gross, board chairman and chief executive officer of Lockheed Aircraft Corp., outlined Lockheed's plans last week for expanding into non-aircraft fields and for building the technical competence needed to sustain its position as a military weapon system manager.

Gross followed J. L. Atwood, president of North American Aviation, Inc. (AW April 20, p. 31), as a witness at hearings of the House Armed Services Investigating Subcommittee, now making an evaluation survey of weapon system procurement. The group, headed by Rep. Edward Hebert (D.-La.), is scheduled to hear testimony this week from William M. Allen, president of Boeing Airplane Co. J. V. Naish, president of Convair, will testify the week of May 4.

Growth Rate Target

Gross told the subcommittee that Lockheed's "reasonable target" is a growth rate of 9% a year, the average rate of sales growth of the 38 largest industrial companies over the past 30 years.

In order to maintain its present position in the economy, Gross pointed out, Lockheed must at least parallel that of the gross national product, which is increasing at a rate of about 3.25% a year.

The Lockheed executive ruled out the possibility of accomplishing this with additional military business. He said Lockheed studies indicate that defense expenditures will increase a maximum 2.75% a year. "And, of course, with any decrease in international tension, it is always possible that these expenditures may decline." He added:

"In any event, we cannot reasonably expect to gain for ourselves a greater share of this defense market. Our present share is about 7%, and we believe in view of our past experience, regional and community pressures and the highly competitive nature of the business, that we cannot significantly increase this figure.

"The alternative is to broaden into non-defense work."

In this direction, Gross pointed out that Lockheed has recently taken these steps toward expansion:

• **Established a Mexican subsidiary,** Lockheed S. A., to participate in "a number of activities and plans in that country." One of these plans that has materialized is an agreement with a group of Mexican industrialists to form an affiliated company, Lockheed Azcarate, to manufacture and sell light utility aircraft—GL 402-2s and GL 402-4s.

• **Worked out an agreement** to purchase a controlling interest in Puget Sound Bridge and Dredging Co. of Seattle, a West Coast shipbuilding and construction firm (AW April 6, p. 37).

Another major step recently taken by Lockheed—establishment of an Electronics and Avionics Division—is aimed at expanding the firm's weapon system competence, as well as developing new markets, military and industrial, Gross said.

He also told the subcommittee that the new division now has less than 12 employes.

Its first assignment is "to exploit two or three small products that we have developed that might have broad application."

As weapon complexity increases, Gross pointed out, the system manager "must develop managerial skills to meet the complex problems of relating all the parts to the whole and of supervising an ever-increasing volume and variety of work."

In the airborne early warning system Lockheed is proposing, Gross said that, "although the unit weapon would cost about $6 million, we plan to build only about $2 million worth ourselves. Nevertheless, we will have to provide managerial control over the whole." He added that, "We have got to have more competence than we now have to manage a world-wide anti-missile detection system." Lockheed has already spent $500,000 on studies and designs on its airborne early warning development system, Gross reported, adding that there are at least half a dozen other industrial teams in the race.

Gross said that, although only big business can compete for weapon system contracts, there is still sharp competition within the industry, and "many companies fall by the wayside."

He added:

"One of the difficulties we in the traditional aircraft-missile industry are now facing is the competition of companies from other fields that are establishing or seeking to establish themselves in aircraft and missiles.

Why Diversify?

"If these companies believe they can beat us out of our own field, they're entitled to the chance. We ask the same opportunity to expand and diversify ourselves.

"This is the reason why we are attempting to broaden and deepen our strength. We are trying to qualify ourselves to meet this new competition and to handle ever larger, ever more complicated systems."

Although feasibility studies and design proposals are financed with government funds, Gross pointed out that the Electra turboprop airliner and the Jetstar executive jet transport, both of which are expected to have military applications, were developed and built entirely with Lockheed's own funds. "The Navy found that with some modifications the Electra becomes a fine anti-submarine patrol aircraft. And we are offering both planes to perform other important military missions. In these cases there is no reimbursement of our development costs except as they are included in an off-the-shelf delivery price and borne by both military and commercial customers."

Polaris Development

To illustrate "the way competition develops and the extent to which it operates" in weapon system management, Gross detailed development of the Polaris solid-propellant fleet ballistic missile program:

• **Navy announced** in December, 1955, that it was interested in a fleet ballistic missile with a 1,500-mi. range. At that time, it was to have been a surface-to-surface missile, ship launched and liquid propelled, to be developed in conjunction with the Army Jupiter system, using Jupiter components and systems.

• **Early in 1956,** Navy rejected liquid fuel as unstable for shipboard use. "Beyond this, the outlines of a totally new concept were beginning to appear—the breathtaking possibilities of a missile

Mercury Roles

Washington—Negotiations concerning the division of assignments in National Aeronautics and Space Administration's Project Mercury man-in-space program were still under way late last week, involving NASA, Air Force's Ballistic Missile Division and Space Technology Laboratories, Inc.

Space Technology Laboratories will not have responsibility for systems engineering and technical direction of the Mercury project as reported by Aviation Week (April 13, p. 23), although it may have this assignment for some parts of the booster and test launch trajectory phases.

NASA plans to use at least 10 Atlas boosters in the Mercury program. It is ordering these through the Ballistic Missile Division. Two contracts to BMD, which amount to transfers of NASA funds, have been announced thus far—one for $1.4 million and the other for $5.6 million.

launched underwater from hidden submarines."

• **Navy brought together** an industrial team to make feasibility studies: Aerojet-General for a solid propellant engine; General Electric Co. to adapt its Jupiter guidance device to a moving launching platform and Lockheed for over-all evaluation of a solid fuel weapon. To get the job, Gross declared, "we had to battle a number of companies—including two of America's industrial giants" (Chrysler Corp. and General Electric). He said that Lockheed's competence in solid propellant missiles began in 1953 when a management planning study identified the solid propellant missile field as the most promising.

• **Formation of the Polaris** study team did not rule out competition. Lockheed, for example, submitted a guidance proposal that was rejected in favor of GE.

• **In January, 1957,** the original Polaris radio guidance was supplemented by an inertial system that Massachusetts Institute of Technology had developed, and M.I.T. came in as prime contractor for guidance.

• **In December, 1956,** Navy formed a steering task group—with representatives of Navy, Lockheed, Aerojet, GE, and M.I.T.—which recommended construction of Polaris for submarine launch, and, a few months later, Navy accepted the recommendation. The determining factor was that by this time a smaller nuclear warhead was available. "Some of the earlier proposals—for example, a seven-rocket cluster the Navy once contemplated—would have been so large there was considerable doubt you could even get them in a submarine, let alone launch them," Gross said.

• **As of last December,** there were 2,898 suppliers under the Lockheed phase of the Polaris program. Of these, 519 were large companies and 2,379 were small firms. In addition, there are hundreds of suppliers to Aerojet-General and General Electric.

Gross told the subcommittee that the best way for a small firm to develop competence and pass into the large firm category of over 500 employes, is to work on increasingly complicated subcontracts under the weapon system management concept.

Saunders-Roe Studies Ducted Fan Vehicle

London—First details of the Saunders-Roe SR-N1 "Hovercraft" prototype disclose an elliptical planform and use of a ducted fan driven by a single Alvis Leonides 450-hp. piston engine.

Over-all length is 30 ft., width 14 ft. and height 12 ft.

Weight of the craft is 4,000 lb. and it is expected to cruise at 30 kt. at a height of one-two feet.

The ducted fan feeds a plenum chamber which supplies air to the lift and propulsion systems. No aerodynamic details of the lift system have been disclosed due to patent negotiations not having been concluded.

Propulsion and Control

Propulsion and control is achieved by differential thrust from twin ducts fed from the plenum chamber. Lift is generated by low-pressure air fed from the plenum chamber and ejected from a duct governed by a central under surface, the ground surface and a vertical pneumatic curtain created by a large number of peripheral jets normal to the ground.

The inventor of the Hovercraft, C. S. Cockerell, began work in 1953 on the project, using tethered and free flight models of a few pounds weight.

More recent theoretical and experimental work was carried out under a Ministry of Supply development contract. The tests established close agreement between the theoretical and experimental lift and provided fundamental information on the behavior of the vehicle on and above large wave formations, static stability of the craft, over-all efficiencies and drag values.

During these tests inventor Cockerell also developed a recirculation system which recovers about one-third the power required to develop the lift.

Based on the success of these tests, Saunders-Roe Ltd. is now proceeding with a detailed design study of two passenger and cargo ferries. Estimated development cost is $15 million over a six-year period.

The largest, a passenger and car ferry, with a gross weight of 400 tons, is designed to carry 1,200 passengers and 80 cars. Seven Rolls-Royce Tyne 11 gas turbines driving ducted fans and totaling 33,000 shp. will provide the low-pressure lift air.

Design speed of the Hovercraft is 70 kt. cruising at a height of three feet over a sea developing 13-ft. waves, the maximum permissible height. Under smoother conditions the speed approaches 90 kt.

Characteristic planform of all the Hovercraft developments will be elliptical, and the 400-ton version will have an over-all length of 250 ft., a width of 114 ft. and a height of 65 ft. It will be manned by a crew of 30.

This craft will represent the last of a projected four-phase development program, will take three years to build and could be flying by 1966.

A smaller 30-ton craft precedes the passenger and car ferry in the development program and will be based closely on the SR-N1 prototype. This version, thought to be the smallest economical size, will have accommodation for 100 passengers. Powered by a single Rolls-Royce Dart gas turbine of 2,120 shp., it will cruise at 70 kt. at a height of two feet. Its maximum hovering height is 2.6 ft. Over-all length of its elliptic planform is 83 ft., its width is 41 ft., and height 27 ft.

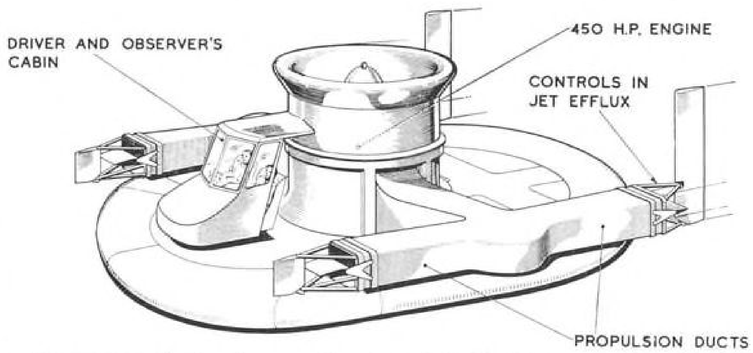
Payload Weight

Outstanding feature of Hovercraft is the high payload-structure weight ratio for an airborne craft. Payload of the 400-ton model is just over 200 tons, the structure and powerplant weight amounting to only 160 tons.

The 200-ton payload allows for a total fuel load of five tons which is sufficient for a range of 2,000 naut. mi. under moderate sea conditions.

The payload ratio with decreasing size and with the 30-ton craft payload is down to eight tons. High payload factor together with a cruising speed about five times that of a modern cross-channel ferry (giving high utilization) leads to lower seat mile and ton mile operating costs than those of ship ferries, according to Saunders-Roe cost studies.

Estimated cost of the 400-ton craft on the basis of six produced is $7 million which is approximately twice that of a typical British ship ferry. The ferry also has about twice the payload capacity. Consequently, due to relatively high first cost and much higher maintenance costs, the cost per operating hour of the Hovercraft works out at about twice that of the ship.



SAUNDERS-ROE drawing shows configuration of SR-N1 Hovercraft, designed to be powered by an Alvis Leonides 450-hp. piston engine mounted vertically on a platform 30 ft. long by 14 ft. wide. The engine drives a ducted fan which provides the air cushion supporting the fan. Propulsion is achieved by twin ducts fed from air-bleeds from the fan.

Wave Study

A statistical wave study of the world's inland waterways and short sea routes, particularly those connecting Britain to Europe, indicate that Hovercraft could operate on scheduled services for about 90% of the year.

The analysis of wave heights showed that waves of over 13 ft.—the maximum permissible—are relatively rare outside the Atlantic. They don't occur at all on Swiss lakes and the interference from waves exceeding this height on the Great Lakes of North America, and the seas surrounding Britain, would not exceed 4% of any scheduled service.

The prototype SR-N1 has a light alloy structure weighing 1,900 lb., its gross weight being 4,000 lb. It will have a two-man crew. As with all the developments, its planform is elliptical.

The air cushion has an area of 245 sq. ft. so that the loading of the cushion amounts to 16 lb. per sq. ft. The plenum chamber about which the craft is constructed is fed from a single ducted fan. Lower surface of the plenum chamber is detachable so that a large number of jet orifices and ventral surface configurations can be investigated.

Hovercraft Control

Control of the craft is effected by a combination of rudder surfaces together with differential thrust from the twin propulsion ducts, which are fitted with variable efflux nozzles. The height of the vehicle within its operating range remains virtually constant with changing forward speed.

Control of the 30-ton ferry craft, which will be more sophisticated in order to facilitate maneuvering in confined spaces, will use peripheral jet nozzles.

This version will also be confined to inland waters, and subject to restricted operations at certain times of the year.

Comparing the craft with a Supramar PT-20 hydrofoil launch, operating costs show a 30% advantage in favor of the Hovercraft.

Accommodation on the 400-ton craft is divided between two decks surrounding the air intake and plenum ducting.

Each of the seven gas turbines drives a 14-ft.-diameter ducted fan which feeds a common plenum chamber supplying air for the propulsion and lift systems.

Wave motion is claimed to be considerable damped out and the ride relatively smooth.

Buoyance chambers around the periphery of the craft enable it to float and it is capable of restricted land motion, for berthing operations.

GAO Charges 'Excessive' Cost In Navy-Westinghouse Contract

Washington—U. S. Comptroller General has charged that delays in price redetermination on a $16.4 million Navy contract for airborne fire control systems with Westinghouse Electric's Air Arm Division and the use of estimated costs instead of actual available cost figures resulted in excessive cost of $933,463 to the government.

Some points in the charge, made in a recent General Accounting Office report to Congress, are challenged by a top Westinghouse official.

The Comptroller General recommends in the report that Navy require its contracting officers to make every effort to obtain from its contractors, on a voluntary basis, latest available cost data and to use such costs in contract price redeterminations, pending incorporation of these provisions in a forthcoming revision of Armed Services Procurement Regulation.

Contract in Question

The contract in question, NOas 52-389, called for price redetermination when the company has produced 40% of the systems under contract. This point was reached on Dec. 31, 1954.

Final contract price redetermination did not take place until February, 1956, four months after all contract production was completed.

The figures used to establish final contract price were the cost estimates prepared at the 40% point, despite the fact that actual production costs for the entire contract, which were $933,463 lower, were then available according to GAO.

The report also notes that its review disclosed a number of other Navy contracts with Westinghouse where the same situation existed.

Westinghouse has agreed that if it is delinquent in the future in submitting price redetermination proposals, it will supply actual cost data up to a reasonable period prior to date of submitting proposal.

However, Westinghouse chairman of the board Gwilym A. Price has taken issue with the implications of some GAO charges. He points out that the company submitted its original price redetermination proposal on the contract in question on May 17, 1955, only four and one-half months after the 40% production point had been reached. He noted that it is generally recognized that on complex contracts of this type it normally requires 90 days for a company to develop cost figures and prepare estimates.

The Westinghouse official says it was nine months later before Navy started negotiations on the final price. He concedes, however, that the Navy should not be charged with all of this delay.

Lacked Experience

At that time, Air Arm was a new division, and its personnel had had no previous experience in preparing price redetermination proposals, Price said.

The Westinghouse official also questioned whether the GAO philosophy doesn't give the government an incentive to delay its price redetermination until the contract has been completed. Price redetermination contracts normally provide for downward revision only of contract price at the 40% point. If the government delays until the contract is completed and actual costs prove lower than the original estimate, the contract price would be decreased. But, if actual costs proved higher, the contract price can not be redetermined upward.

"This is far from the true concept of (redetermination) pricing in which there should be a risk to both parties," Price said.

Royalty Costs

The Comptroller General also charged that Westinghouse's Air Arm Division had proposed, and originally was allowed, royalty costs of 1% of total selling price, for payment to a third party, but that it actually paid 1% of the net selling price after deducting for non-royalty-bearing items. When this matter was brought to the attention of the Navy auditor and Westinghouse, the GAO report says, the excess royalty on this contract was reduced by $16,456.

Westinghouse has agreed in future price redetermination proposals to deduct non-royalty-bearing items in its estimated royalty charges, according to the report.

Boeing-Wichita Aims at Advanced Design to Develop Own Business

Wichita—Nearly a score of projects, covering not only its traditional customer—the U. S. Air Force—but also the Army and Navy, are on the drawing boards of a new advanced design section here as Boeing Airplane Co.'s Wichita Division orients itself towards self-sufficiency.

A Boeing management program, geared to the transition that the aircraft industry is facing whereby a smaller portion of its total effort will be devoted to production of aircraft units, allocates defined objectives to each of the manufacturer's divisions. Boeing President William M. Allen has told the Wichita Division that it holds its future in its own hands and is responsible for developing its own new business.

The Wichita Division's charter spells out these new roles and missions:

- **Management** of B-52 and B-47 programs.
- **Carrier-based** naval aircraft.
- **Military utility aircraft** and commercial derivatives other than for the airlines (latter being in the province of the Transport Division at Renton, Wash). One study undertaken by the Army systems team has been design of a Douglas DC-3-capacity high wing rear-loading twin-engine STOL transport for battlefield area support.

To provide technical manpower needed to handle these missions, Boeing-Wichita split the advanced design subsection from its technical staff section and moved it into completely remodeled quarters in company-owned Plant No. 1, where the program is managed by Milford F. Vanik. Since its formation last year with a nucleus of 35 employes, the section has approximately doubled its personnel.

Each of the three services has its own system manager, and they draw on a staff for design analysis, operations analysis and administration functions. Programs for each of the services are set up under a program manager who pulls together a group of two to 10 persons for the life of a particular project.

Prime program, taking the bulk of personnel, is extension of the B-52's production life. USAF system manager currently has some five programs covering advanced versions of the B-52. In working out new B-52 developments, advanced design section is permitted to tap skills in the other Boeing divisions in order to work out a complete weapons system proposal, or any portions of such a proposal.

In the case of a new project to develop the airplane as a missile platform to cover an Air Force requirement or for the purposes of submitting a proposal, Wichita's design section would work out the basic requirements for the system. In the case of the missile itself, the project would go to Pilotless Aircraft Division, which would have right of first refusal to handle this portion of the project. Carrier-based aircraft systems team would coordinate their work with the Boeing team handling anti-submarine warfare systems for a particular design covering such a mission.

Regular progress reports are made to Boeing headquarters. There also are monthly sales, engineering and management meetings at which Wellwood E. Beall, senior vice president, is represented. Considerable monitoring of various division projects is required to ensure that they do not inadvertently conflict when proposals are submitted.

Scout Contract

Washington—Chance Vought Aircraft, Inc., has won a $945,000 contract to build the airframes, assemble and build a launcher for the Project Scout rocket test vehicles for National Aeronautics and Space Administration. Thirteen companies bid in the competition. Initial test firings are expected in mid-1960.

NASA Announces Space Contract Awards

Washington—National Aeronautics and Space Administration obligated over $10 million last month on a broad variety of contracts, including $540,000 for infrared radiation and heat balance instrumentation for Project Tiros designed to launch a meteorological satellite to measure the earth's heat energy and take television pictures of the cloud cover (AW April 20, p. 28). Tiros contract was awarded to Army Signal Corps.

Other programs involved are:

- **General Electric Co.,** $4.12 million for the Project Vega second stage rocket engine which will be mounted on a Convair Atlas missile to send two tons into orbit.
- **NASA Jet Propulsion Laboratory,** $3 million for technical supervision, integration and payloads for Project Vega.
- **Bell Aircraft Corp.,** $1.07 million for hardware and studies to determine feasibility of rocket engine using fluorine and liquid hydrogen propellants.
- **North American Aviation, Inc.,** $930,000 for destruct system and design of ground support transport vehicles and launcher for Project Mercury man-in-space program.
- **Naval Research Laboratory,** $260,000 for telemetry test equipment.
- **U. S. Weather Bureau,** $150,000 for meteorological analysis.
- **Electro Mechanical Research, Inc.,** $120,000 for supplying two telemetry systems to build Mercury prototype.
- **Army Ordnance Missile Command,** $100,000 to reimburse that agency for special technical studies and activities.
- **U. S. Naval Ordnance Test Station,** $100,000 for research and development on advanced space television cameras.
- **Thiokol Chemical Co.,** $60,000 for Recruit rocket motors in high-energy work at Lewis Research Center.
- **Radioplane Division** of Northrop Corp., $60,000 for a landing and recovery system for the Mercury capsule.
- **Cook Electric Co.,** $80,000 for five 3-channel miniature airborne tape recorders for use in various projects.
- **Herrick L. Johnson, Inc.,** $50,000 for a 3,600-gal. liquid hydrogen trailer to be used in support of rocket development work at Lewis Research Center.
- **U. S. Army Ordnance** and Cooper Development Co., $20,000 for 10 two-stage Nike-ASP sounding rockets.

British Studying Satellite Proposals

London—British government is studying proposals for an earth satellite project. The decision on whether to go ahead with such a program will be announced "as soon as possible," according to Minister of Supply Aubrey Jones.

Any British space project probably would be based on the use of the Blue Streak and Black Knight missiles.

Britain's space research probably would be undertaken in cooperation with other Commonwealth countries.

Advice on the proposal for a British satellite program was sought from the Advisory Council on Scientific Policy, which made a report to the government. Contents have not been revealed.

The decision probably will be announced well before the meetings of the Commonwealth Spaceflight Symposium and the Tenth Congress of the International Astronomical Federation to be held in London in August and may come as early as this week.

There is considerable feeling in some government circles that, despite the cost, Britain must sooner or later enter the space field and that the sooner a start is made, the better.

That this feeling is not shared by all was made clear by Socialist Member Emmanuel Shinwell when he asked the House of Commons, "why bother about this problem?" He suggested Britain has sufficient problems on earth without looking elsewhere.

NORTH AMERICAN NAMES SUNDSTRAND SECONDARY POWER SUBSYSTEM MANAGER ON B-70 AND F-108

Sundstrand Aviation is proud to be named a member of the North American weapon system team which will develop and produce a new concept in American air power—planes which will roam the skies at three times the speed of sound and feature the capabilities of both missiles and manned aircraft.

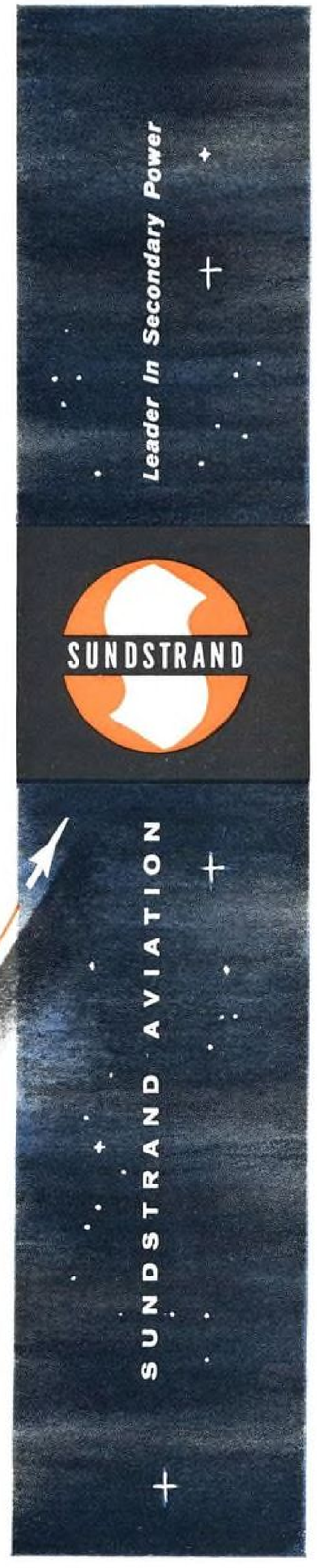
To meet its vast responsibility as a major system contractor for the B-70 Valkyrie intercontinental bomber and F-108 long-range interceptor, Sundstrand's system organization will include its own team of subcontractors—component suppliers and manufacturers whose reputation for technical skill, product development, quality, and reliability make them outstanding in their fields.

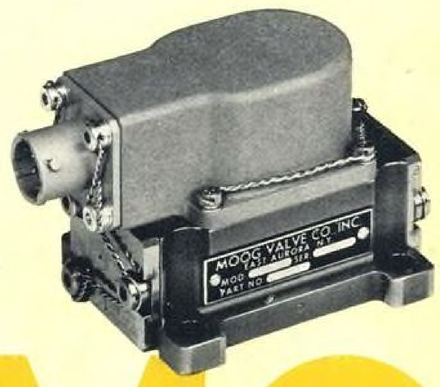
Utilizing the team concept with its subcontractors, Sundstrand provides the most efficient and effective means of accomplishing its assigned responsibility—development and production of reliable Secondary Power Systems for the B-70 and F-108.

SUNDSTRAND AVIATION

Division of Sundstrand Machine Tool Company, 2411 Eleventh Street, Rockford, Ill.

District Offices in Arlington, Texas; Hawthorne, California; Rexdale, Ontario; Rockford, Illinois; Seattle, Washington; Stamford, Connecticut; Washington, D. C.





series 31 and 32

flow control

servovalves

with mechanical feedback

from MOOG:

New performance levels can now be achieved at environmental extremes in advanced aircraft and missile applications. These light, compact, reliable servovalves are available in quantity to your specifications. Consult Moog for precision electrohydraulic servovalves, servoactuators and integrated servosystems.

WRITE FOR CATALOG 310

MOOG SERVOCONTROLS, INC. PRONER AIRPORT, EAST AURORA, N. Y.

LEADING INNOVATOR AND PRODUCER OF ADVANCED ELECTROHYDRAULIC SERVOVALVES

Fairchild Tightens Central Control

New York—Fairchild Engine & Airplane Co. is changing its management practices away from extreme decentralization and attempting to improve its engineering reputation to cope with a situation that led to a $17 million loss last year and $277,000 loss the first quarter of this year, stockholders were told here last week.

Besides pushing sales of the company's F-27 turboprop transport (AW April 13, p. 129), President J. H. Carmichael said, the company is bidding on several advanced drone projects and is exploring previously untapped fields for work to utilize its excess capacity. On a square-foot-per-emplove basis, Fairchild was operating at 75% capacity in 1958 and dropped to 50% this year, Carmichael said.

Fairchild has $125 million in orders, the president said, and the company probably will make a small profit for the year. However, if the company loses even a small portion of the business it now has, he said, a profit is unlikely. The first quarter loss was largely due to approximately $500,000 in expenses in shutting down the company's Deer Park, N. Y., engine plant following the J83 turbojet cancellation.

Measures taken by company include:

- **Reduction of executive salaries** on a total basis of 30.3%. Carmichael is being paid $70,000, compared with $116,000 annually paid to Richard S. Boutelle, former president. Willard L. Landers, vice president, has taken a voluntary reduction from $75,000 to $60,000, stockholders were told.

Some criticism was voiced by stockholders of pension payments continuing to Boutelle which amount to $93,127-$123,545, depending on how paid and an additional $20,000 a year to be paid through 1963. The company answered that these payments were from funds previously set aside for this and were not paid out of current funds.

- **Reduction of 1,085 employes** in the company's newly consolidated Missiles and Aircraft Division.
- **Reorganization** of the management structure to leave division managers independence, but greatly improving management supervision.
- **Improvement of cost control** so that current, perhaps daily, figures are available on every program to keep programs from getting out of hand.
- **Improvement of public relations** and community relations, stressing realism and not minimizing the company's problems.

In this connection, Fairchild said the company also had improved its relationships with its banks, a group led by Bankers Trust Co. of New York. It is understood these had deteriorated because of conflicts over information dealing with the company's affairs.

Retrenchment by Fairchild includes sale of the Deer Park engine plant, which Carmichael said, was currently in the negotiation stage. Not so much progress has been made, he said, in sale of the company's former headquarters building at Hagerstown, Md.

Initial F-27 results have been good, Carmichael said, although there have been a few bugs in the airplane. Some of these are vendor items with which Fairchild is not satisfied and some are design engineering, as the air conditioning and nose wheel steering. Fixes for these are ready, Carmichael said, and the company is almost current with them on a production basis.

F-27 Sales

Fairchild Engine & Airplane Co. is negotiating sales of 23 F-27 turboprop transports—15 to Aerolineas Argentinas, three to Cubana and five to Turkey's national airline.

Stockholders were told that the company also is in the talking stage with USAF and with several reorder customers. There are 67 firm orders for the airplane, that is orders with a firm contract and deposit and not including options. Forty-one had been delivered as of last week.

Aeronutronic Awarded Army Missile Contract

Los Angeles—Army's $23 million Shillelagh surface-to-surface missile development program has been awarded to Ford Motor Co.'s West Coast subsidiary, Aeronutronic Systems, Inc., following a design competition which began early in 1958.

Shillelagh is ready for full-scale development and is expected to be operational by the middle of next year. The Shillelagh is lightweight guided missile system for close support of ground troops.

Vehicle mounting is one application of the system which will make use of many advanced missile techniques and include high performance propellants and an electronic computer for guidance and control.

Aeronutronic has selected Raytheon Manufacturing Co. as its subcontractor for development of the missile's fire control subsystem. Raytheon's subsystem development will be undertaken at its Santa Barbara, Calif., laboratory.

Army reports that it will spend approximately $3 million on the project during the current fiscal year, and that the development contract eventually is expected to run to about $23 million.

The Shillelagh program will be initiated in a 550,000 sq. ft. plant in Maywood, Calif., directed by Roy P. Jackson, general manager of Aeronutronic's Weapon System Division.

Ordnance Tank Automotive Command, Detroit, Mich., is responsible for development of the Shillelagh system. The Army Rocket and Guided Missile Agency at Redstone Arsenal, Ala., is contract supervisor, working under the Ordnance Tank Automotive Command.

News Digest

Argentine Air Force is negotiating with State Department and Air Force to obtain financing for purchase of 28 North American F-86 jet fighters. Defense Department has $100 million set aside for credit extensions to foreign governments for military equipment purchases.

Gyrodyne Co. of America has received a $50,000 Navy contract for construction and testing of a man-carrying, 15-ft.-diameter ground effect vehicle (AW Jan. 12, p. 74).

Bids for the Phase III static test facility of a silo launch test complex at Edwards AFB, Calif., are being submitted to U. S. Army Engineer District, Los Angeles, for opening on May 7. While not specifically identified, the complex is associated with the development program for the Minuteman solid propellant ICBM.

Ryan Aeronautical Co. directors voted last week to split the company's stock 2½ to 1 and to pay an annual dividend rate of 20 cents a share on the new stock, in effect a 25% dividend payout increase (AW Mar. 23, p. 67). The split will increase the total number of Ryan shares from 540,568 to 1,351,420.

North American Aviation, Inc.'s Columbus, Ohio, division has received a $19.3 million Navy follow-on production contract for T2J-1 basic jet trainers. Six of the trainers already have been delivered to the Navy and are undergoing test evaluation at the Naval Air Test Center, Patuxent River, Md.

Vertol Aircraft Corp. reports an 11% increase in earnings during the first quarter of 1959 over the same period of 1958 despite a 14% decline in sales. Net earnings for the quarter totaled $179,890 on sales of $8,918,465 as compared with $162,635 on sales of $10,387,289 for 1958.

Northwest Wins Round in BOAC Battle

CAB examiner proposes denial of British carrier's bid for Tokyo stop on its around-the-world route.

By L. L. Doty

Washington—Northwest Airlines last week won the first round in its bid to prevent British Overseas Airways Corp. from serving Tokyo on a round-the-world route when a Civil Aeronautics Board examiner recommended Board support of the U.S. carrier's position.

In a surprise move, CAB Examiner Ferdinand D. Moran concluded that BOAC's request for a Tokyo stop should be denied but that a foreign air carrier permit should be granted to the British company authorizing an around-the-world route via Hong Kong, Wake, Honolulu, San Francisco and New York. Briefs and exceptions are scheduled to be filed today. Since Northwest is expected to request oral arguments in the case, a final Board decision may be delayed by as long as another two weeks.

The British government, meanwhile, made a third attempt to bargain with Northwest, sole intervenor in the case, when it proposed opening of negotiations at government level on an extension of Northwest's route from Tokyo into Hong Kong. Northwest turned down the offer as it did earlier when the British offered to negotiate for the route at airline level (AW April 20, p. 42).

Moran's recommended decision hinged on his findings that public interest standards cannot be met by any bilateral action that would be damaging to U. S. interests. His decision paralleled Northwest's petitions which urged only the denial of the Tokyo stop but agreed to the around-the-world service via Hong Kong and Honolulu.

State Department Stand

Previously, State Department had indicated its support of the BOAC position through its interpretation of Section IV (b) of the Bermuda pact. The Board's bureau counsel also found that the potential adverse economic effect on U. S. carriers is outweighed by other public interest considerations found in the existing bilateral agreement.

Moran, however, held that "the prospect of a BOAC-U. S.-Tokyo route holds grave diversionary threats, not only to the Pacific carriers whose services have required heavy government subsidy but also to the domestic carriers who depend upon interline traffic arising from U. S.-Tokyo markets to lend substantial support to their domestic services."

He concluded that, since Northwest and Pan American had developed the Pacific market with approximately $90 million of federal subsidy support, the public interest does not permit the large diversion of traffic from U. S. carriers that the proposed BOAC services could cause.

Moran also held the large amount of Fifth Freedom traffic that BOAC would carry on the route as another reason for denying the Tokyo application. He noted that the market in question "is composed of traffic to which BOAC has no primary claim under the Bermuda Agreement since over 99% would be Fifth Freedom traffic to BOAC."

Fifth Freedom traffic is that traffic moved by the carrier of one country from a second to a third country and is considered secondary traffic under the terms of the bilateral agreements between the U. S. and Britain.

Moran did not touch heavily on the Northwest contention that BOAC is not entitled to a Tokyo stop under IV (b) of the Bermuda pact on grounds that such additions apply only to stops of a minor nature. Tokyo, the carrier argued, is not a minor stop but a significant traffic generating city on global routes.

In this connection, a spokesman for the British embassy told AVIATION WEEK that the present case represents the only time the United Kingdom has requested a stop not listed in the Bermuda Agreement.

He added, that between 1946 and 1955, the U. S. has made requests and has received approval for 12 stops not included in the pact.

Moran said in his initial decision that "Tokyo, equal in size to New York, occupies a unique position of vital importance in the United States-Orient traffic flow on the American flag carriers.

"As a primary traffic generating center, it accounts for over 80% of all transpacific traffic, including that of foreign flag carriers."

Advantages to BOAC

According to Northwest, BOAC could omit any intermediate points it wished once it had a permit authorizing a Tokyo stop.

The carrier said it could operate nonstop between Tokyo and San Francisco or between Tokyo and New York.

Moran concluded:

"As technology improves so as to make such operations feasible, BOAC can thus operate routes which have a complete competitive coverage of United States routes."

Moran emphasized the effects of the diversionary impact on U.S. carriers that could be caused by authorizing a BOAC stop at Tokyo. He spoke of BOAC as a "global airline with access to all the principal air markets of the world" and noted that BOAC's routes and services already total 112,541 mi. in every continent.

He added that the BOAC route system would be backed by the subsidiary routes of Cathay Pacific and Hong Kong Airways to enable the British carrier to cover every significant market in the Far East. He also noted that BOAC would be joined at Honolulu by the Qantas route from Australia thus "augmenting the benefits of a strong British partnership route system operating jointly over a 5,000-mi. U. S. route between Honolulu and New York."

Northwest's estimate of diversion by BOAC from transpacific carriers is based on 1957 traffic activity and is calculated as high as $9,550,000 per year. Considering a normal growth of 10% per year from 1957, diversion at the 1960 level is set at $12.7 million per year.

Here is what Moran had to say on the subject of turbojet operations:

"The threat of heavy diversion by BOAC is particularly important to Northwest Airlines in its present state of transition from piston-powered equipment used in Tokyo service to the DC-8 jet age which is now only months away. In 1958, Northwest averaged only 30 passengers per flight in its U.S.-Tokyo service. Early in 1960, the 120-seat jet aircraft will be placed in this service, and the company must rely heavily, not only on retention of its existing traffic, but upon the continued growth of its Tokyo traffic to sustain an even partially economic transition to jet capacity."

Northwest has expressed confidence that it could make the transition to jet operations successfully if no further traffic diversionary factors were introduced. As a result, Moran concluded that it would be unwarranted to "see the very traffic required by the U. S. carrier to meet the jet age challenge drained off to BOAC, a foreign air carrier operating in a third country role . . ."

Moran also warned that present competitors—Japan Air Lines and Canadian Pacific—will introduce turbojet transports on the route and added:

"The U.S. carriers must meet this growing competition with the frequency and quality of service which will maintain the position of the U.S. in the Pacific area."

New Division

New York—General Aircraft and Leasing Co., an organization set up last year to deal in used aircraft (AW Nov. 10, p. 43), has become a division of General Dynamics Corp.

General Dynamics confirmed to Aviation Week the establishment on April 1 of General Aircraft as a division. General Aircraft was formerly a wholly-owned subsidiary of General Dynamics. It has bought 25 American Airlines used Douglas DC-7C aircraft (see p. 42).

Milton W. Arnold, who resigned last year as vice president-operations-engineering of Air Transport Assn., heads the used aircraft organization.

PART of a typical 21-ton freight load is about to be loaded into a Flying Tiger Lockheed Super-H Constellation air freighter.

Flying Tiger Predicts Boost in Revenues

Washington—Flying Tiger Line, bolstered by a 40% gain in revenues during the first quarter of the year, now expects to report gross revenues in excess of $40 million for its 1959 fiscal year which ends June 30.

Last year, the company's revenues topped $33 million for a modest profit of $1.28 per share of common stock. However, 60% of the profits represented capital gains from the sale of DC-6A and C-46 aircraft.

This year, per share earnings are expected to reach $2.25, with 80% of the profits coming directly from operations.

This progress, reflected by a high of $20 on the company's stock listed on the American Stock Exchange compared to a 1958 range of $6-$12, is attributed by company President Robert W. Prescott to the withdrawal of Slick Airways from service (AW June 30, p. 29) and improved efficiencies brought about by the introduction of Lockheed Constellation 1049s.

Expansion Plans

Next week, the carrier plans to expand its coast-to-coast all-cargo schedules in a move to combat the growing threat of increased competition from scheduled airlines now converting passenger aircraft into all-freight planes. Flying Tiger is confident it will successfully meet this growing competition through its freight sales techniques and its skill in cargo handling.

At the same time, the carrier is prepared to spend some $50 million for a fleet of 10 turbine-powered aircraft once an acceptable turbojet cargo plane becomes available.

Chief interest is now centered on a proposed cargo version of the Douglas DC-8 which can be operated at a direct operating cost of 3½ cents per ton mile as compared with the 7½ cents for the Constellation.

At present, Flying Tiger is realizing a 12-hr. utilization on its fleet of 14 Lockheed 1049Hs and, in December, reported a load factor of 84%. Loading and unloading times at terminal points have been reduced to an average two hours, an efficiency standard the carrier will expect of a turbojet fleet despite

savings in flight time over piston-powered operations.

An estimated 68% of the company's revenues is drawn from the Military Air Transport Service (MATS) charters, but revenues from freight are increasing substantially—up about 39% for the first half of the current fiscal year. At present, the airline is handling about 12% of all domestic air freight.

Large factor in the development of air freight by Flying Tiger has been the successful application of an air-truck system. Direct air connections with trucking facilities serving 33 points from major terminals covered by Flying Tiger under a combined air-truck shipping rate is expected to increase monthly revenues by $10,000 to $20,000.

Sales techniques now include joint airline-shipper analyses of distribution costs as a means of pointing up advantages of air freight. Recent example of the success of the technique is a program developed for American Optical Co. which last year saved an estimated $250,000 through the use of air freight.

American Optical's distribution and transportation experts furnished figures on costs of maintaining distribution costs and combined their findings with studies of basic point-to-point methods of cargo handling prepared by Flying Tiger salesmen.

The shipping program which was developed resulted in a savings of about 40% in inventory costs in the California area alone and a reduction in manpower of 25%.

However, Prescott feels that public education in the use of air freight "is far from complete." Chief goal now is to concentrate on long-haul routes feeding freight in and out of major terminals, to cut direct operating costs and to reduce tariffs so that air freight will lose its position as "the highest priced transportation."

During the first five months of the current fiscal year, direct flight expenses were sliced by 10% and indirect costs per ton mile are expected to decline as volume of traffic increases. Flying Tiger feels such efficiency is the way to lower freight rates and lessen resistance on the part of shippers to wide-spread use of air freight for long-haul distribution purposes.

Pan American Pilots Finance Plan To Bolster U.S. Bilateral Stand

Washington—Group of Pan American pilots, in an unprecedented action, have voluntarily launched a self-financed campaign to combat the growing competition of foreign flag carriers in international air transportation.

The program, begun a year ago by a committee composed solely of Pan American pilots, is directed primarily toward Congress and the Civil Aeronautics Board but is being billed as "a report to the citizens of the U. S." It was established and is being pushed independently of any measures or policies adopted in this field by Pan American management.

Main purpose of the campaign is to call official and public attention to the continuing decline in job opportunities for U. S. airline personnel as the result of annual inroads being made by foreign flag carriers on international traffic traveling to and from U. S. ports of entry. The comprehensive survey prepared by the pilots to back their campaign also presents an impressive survey of the current status of U. S. flag carriers in the international field.

Activities of the committee headed by Capt. A. L. Propps has the backing of the Pan American pilot group as a whole. In his introduction to the detailed survey and report, Propps emphasizes that the findings "represent the position of only our pilot group and are intended to convey conclusions that have been reached as a result of our years of experience and observations of events in international aviation."

The pilots admit that their studies reflect events that apply specifically to Pan American. They have prepared their reports on the basis that Pan American routes are typical in international aviation, and therefore, that their conclusions are generally applicable to the U. S. position in international aviation.

The group stresses that the yearly decline of the percentage of traffic carried by U. S. airlines has created "job advancement and expanded job opportunity for the foreign citizens at the expense of restricted job opportunity and loss of employment by U. S. citizens in corresponding positions. . . ."

Here are the specific examples of restricted employment growth cited by the pilots:

- **No World War II** nor Korean War veteran who joined Pan American as a copilot following cessation of hostilities has reached the status of captain.
- **Present pilot roster of** Pan American contains copilots with six years experience and with more than two million miles flight experience. Senior copilots of American, Eastern, United and TWA have approximately six years experience before advancing to the position of captain, according to the report.
- **Pilot complement in Alaskan** operations has shrunk 30% since 1951 so that only nine crews are now used in this area.
- **Pan American's roster** had more captains on the pilot seniority list in 1945 than in the spring of 1958 although airline pilots in the U. S. have increased three times in number since 1945.
- **Personnel stationed at the** Miami headquarters of the Latin American Division were reduced by 5% as a result of heavy competition in the South American market (AW Mar. 23, p. 48).

The report charges that "our own people in public office" appear to be "impeding and restricting Pan American most" in preventing the development of the company's route pattern. However, the report noted that "we now have a Civil Aeronautics Board that is shaping and showing signs of leadership, forward vision and direction."

Traffic Increases

Washington—Net percentage increase of traffic carried by individual carriers between the U. S. and Europe in 1957 over 1956 as reported by Pan American pilots:

• Air France	29%
• BOAC	34%
• KLM	28%
• Lufthansa	29%
• Sabena	64%
• SAS	46%
• Swissair	42%
• Pan American	16%

Qantas Bid

A spokesman for the pilot group cited to Aviation Week the recent CAB decision on the Qantas bid to carry traffic between U. S. points (AW April 13, p. 38) and the examiner's initial decision in the British Overseas Airways Corp. case (see p. 38) as examples of what he considered the Board's change in pace in the handling of international route awards.

The pilots do not confine their attack to foreign flag carriers but emphasize the effect growing competition of U. S. carriers in the Latin American market has had on Pan American during the past 13 years. In terms of passenger revenue miles, the pilots say Pan American's gain in Latin America during 1957 over 1956 was 13% as compared with 32% by Braniff, 29% by Eastern and 26% by Delta.

The pilots hit hard at the Board's refusal to award the airline domestic routes and pointed to the fact that eight U. S. trunkline carriers "can now tie their domestic system to their international operations."

In the North Atlantic area, the pilots said that 74% of the traffic on this route was handled by U. S. airlines in 1948. They conclude that "each and every year since 1948, the principal U. S. carriers on this route have silently observed the dilution of their total ratios to a point wherein 1957 traffic carried by TWA and Pan American was less than 43% of the total."

They also warned that Pan American and TWA may fall into the 30% increment of traffic ratios in the North Atlantic area if the present trend continues, despite the probability that 70% of all the traffic will be U. S. citizens.

In the final summary of the report, the pilots note that the number of carriers operating over international routes "appear to make international aviation the most fiercely competitive, and oft-times the least regulated of any existing "regulated businesses" and add that "still further foreign carriers are clamoring for entry into the U. S. market."

The group reports that 22 foreign countries have traffic rights to more than one point in the U. S. or rights beyond the U. S. and concludes:

"As a U. S. airline, we fail to understand why we do not enjoy privileges at least commensurate with those enjoyed by foreign carriers within and across our own country."

Here are some of the recommendations made by the Pan American committee:

- **Study of past and present procedures** followed in bilateral negotiations and administration of these agreements to assure compliance by the other party.
- **Restrict recommendations of** the executive branch of the government to diplomatic and defense considerations only when acting upon international route awards to U. S. carriers.
- **Study of the international route** structure for determination of equitable competitive structure for all certificated U. S. carriers.
- **Grant CAB authority** to control minimum fares charged on routes to and from the U. S. by non-IATA member airlines.
- **Study advisability of** limiting the entry of non-scheduled U. S. carriers into international operations.

JAL Urges Intercity Helicopter Service

Tokyo—Japan Air Lines has asked the Ministry of Transportation for support and assistance in the airline's experimental use of large helicopters in preparation for regular commercial helicopter service within Japan.

Reasons given for the request were:

- **Bottleneck** of Japan's civil aviation within the country is the time spent in transport between city centers and air terminals.
- **This bottleneck** becomes a drawback to fast air service over comparatively short distances in Japan today, while other means of transportation are increasing in speed—the introduction of high-speed railways between Tokyo and Osaka, for example.
- **Development** of such helicopters as the British Fairey Rotodyne, American Vertol 107 and Sikorsky S-61 has reached the point where they can be practically employed in commercial operation in Japan.
- **With maximum speed** of approximately 160 to 300 mph., these aircraft are almost comparable to jet transports for short-haul operation of 200 to 300 mi., considering the time saved by operation between the hearts of cities.

A Japan Air Lines spokesman said it is up to the Transportation Ministry to give approval to put helicopters into service on domestic runs.

BEA Viscount Makes Trial Moscow Flight

Moscow—A British European Airways Viscount landed at Vnukovo Airport last week at the end of the first proving flight from London to Moscow for twice-weekly round-trip service scheduled to begin May 14.

The plane carried Lord Balfour of Inchrye, company director, as well as technical personnel and three pilots.

British European Airways hopes to establish an office here. If successful, BEA will have the only British business office in Moscow.

Aeroflot is scheduled to start similar Moscow-London service with Tu-104 the same week that BEA flights will begin.

Jet Noise Complaints Force Flight Changes

New York—Pan American World Airways has been forced by London Airport authorities to reschedule New York-London jet service it planned to add on April 27. Because of complaints from the community of Longford near the airport, the plane will not leave London at 1:30 a. m. as planned, but instead will depart at 1:30 p. m. London time. The problem concerned jet noise.

Rescheduling of the additional London flight has necessitated another schedule change for PanAm in its jet service. A flight to be added June 1 between New York and Paris has been scheduled at 4:45 p. m. out of Idlewild instead of 9 a. m. It will still depart Paris at 9 a. m.

The new London flight will depart New York at 9:30 p. m. instead of 10 a. m.

PanAm 707 Damaged In Landing Accident

New York—A Pan American World Airways Boeing 707-120 jet transport was scheduled to go back into service last week after repairs following a landing accident at Grumman Field on Long Island.

The 707-120 landed short on a training flight and snapped its right landing gear strut.

Scott Flower, PanAm's assistant chief pilot-technical was at the controls when the jet landed just short of Runway 23 on a strip of macadam. Six crewmen were aboard the plane, which bounced, slid about three-fourths of the length of the runway, and came to rest just off the runway and slightly slewed to the right.

A fuel-spill fire broke out and was quickly extinguished by Grumman fire fighters.

The airplane was brought back to New York International Airport last week on three engines. The pod of No. 3 engine bore the weight of the jet's right side as it skidded along the runway after the gear strut broke and the gear separated from the airplane.

No one was injured in the incident. The flight was a routine training operation for the purpose of practicing landings.

No emergency had been declared and the landing, for all intents and purposes, seemed normal until the impact occurred.

TWA Jet Expansion Includes Baltimore

New York—Further expansion of Trans World Airlines' jet services was scheduled to begin last week with inauguration of daily Boeing 707-120 flights between New York and Los Angeles.

Another round trip schedule between the two cities is planned beginning May 1.

Within the next few weeks, TWA plans to add Baltimore's Friendship Airport to its jet stops and to provide jet service between Los Angeles and San Francisco.

The airline also expects to add a second New York-San Francisco schedule on June 3.

No specific date has been set for the Baltimore-San Francisco flights, which will stop at Los Angeles. The carrier began jet service Mar. 20 between New York and San Francisco and added Chicago-Los Angeles flights on April 9. The jet expansion program will continue through the summer, TWA said, as delivery of additional aircraft are made.

American Sets Transport Disposal Pace

By Glenn Garrison

New York—Plans for disposition of American Airlines' piston fleet indicate the critical roles of selectivity and timing are likely to play in the used aircraft market as more airlines release airplanes in line with their jet equipment programs.

American, well out in front with its piston disposal plans, is phasing these planes out gradually over a period scheduled to end in 1961. It has already either sold or arranged for the sale of 114 piston aircraft, and another 10 Douglas DC-7s are accounted for by plans to convert them to cargo aircraft (AW Feb. 9, p. 47). Another 36 of American's piston planes are under option for sale.

Biggest contractor for American's used equipment is Frederick B. Ayer and Associates, aircraft brokerage firm which has agreed to buy 75 of the airline's piston planes and has taken first refusal on 36 more (AW April 6, p. 43). Other transactions have been sale of 25 DC-7s to General Aircraft and Leasing Division of General Dynamics Corp. Ten of these planes have been delivered and the rest are scheduled to be delivered in the next few months. Sale of 16 Convair 240s was contracted to Dundel, Inc., but Ayer subsequently bought that firm and took over the disposal of six of the Convairs. The other 10 had been sold by Dundel to a Latin American buyer.

The remaining four American aircraft already disposed of were DC-6 series handled by the airline in direct sales to several individual brokers.

Ayer has contracted to buy 30 of American's Convair 240s; 45 of its DC-6 series airplanes; and has obtained first refusal rights on American's remaining 36 DC-6 series planes. The New York broker also has placed orders since last September for two DC-6Bs and three Convair 440s from Continental Air Lines.

Timing Factors

Ayer's operation and scheduling is closely oriented to the factors of selection and timing. First, Ayer considers the Convair and Douglas DC-6 airplanes top resale items in today's market compared with other aircraft becoming available, such as the Boeing Stratocruiser. Second, Ayer is carefully timing its receipt of aircraft for fast movement through lease or sale, and a consequent minimum inventory of idle aircraft.

Only 12 airplanes, all Convairs, have actually been phased out of airline operation and delivered to Ayer so far. Five of these aircraft have been resold, three to corporations and two to Southeast Airlines, which also has optioned two additional 240s. Two of the 12 Convairs are out on long term lease, and three are going to a major airline on lease in the near future. One plane is used by Ayer as a demonstrator. The 12th airplane has just been received from American at Forth Worth and is up for sale.

The other 68 planes Ayer has contracted to buy or has optioned will by no means arrive in one big lot, but will be turned over gradually and, to some extent, at Ayer's convenience.

Approximate delivery schedule from American calls for another Convair this month and the rest at about two a month with final deliveries by the end of 1959. The DC-6s will start going to Ayer at the rate of two a month probably not later than September, but the airline's planning doesn't yet extend past the end of this year, according to Ayer. Only about eight DC-6s are accounted for as yet in a fairly definite schedule.

The broker expects to get its DC-6Bs from Continental in July and September, and two Continental Convair 440s within the next month. The third Continental 440 has been delivered to Minneapolis-Honeywell Regulator Co.

Ayer can keep its actual outlay of its own funds down to a fraction of the cash value of its purchases if it can keep ahead of deliveries in its sale and lease transactions. This makes timing extremely important.

The company expects some help along these lines from American, if needed. For example, if Ayer had an excellent prospect for a DC-6, the airline might arrange to phase out the airplane ahead of schedule. On the other hand, it might delay release of an airplane to give Ayer a little more time to hunt up a customer, the broker said.

Penalty Clauses

Ayer's contract with American covering purchase of the aircraft, however, is a firm agreement with penalty clauses, Frederick B. Ayer, president and owner of the brokerage firm, told AVIATION WEEK.

Regarding his over-all operation, Ayer said he plans to offer a variety of packages to prospective buyers or users of his second hand aircraft. These include sales, long and short term leases, management counseling, assistance in financing, trade-ins, technical aid programs inflight training and maintenance. Ayer will offer these deals in varying combinations depending on airline needs.

The short term lease proposal would seem to require particularly precise timing and market evaluation. For example, Ayer might have arranged, by the time it was delivered, for a DC-6 to go out on lease to one airline for its peak winter season and then to another airline whose peak was in the summer.

Ayer would never physically take delivery of the airplane; it would arrive at Airline A's maintenance base for painting and the like a month or so before going into service. After it had served that airline's peak demands, it would go to Airline B's shops and then onto that carrier's schedules. Terms of the lease would be arranged, if necessary, to cover a month or so at each airline while the plane was more or less in storage rather than on the line.

Short Term Lease

For Ayer to recover its investment in this airplane, the short term lease rate would probably have to allow for any likely fall in the market value of the plane over the period of several years it was out working for the leasing carriers.

Where question of credit help is involved, Ayer said he plans to offer the services of an Ayer specialist staff member to analyze an airline's routes and financial structure and determine just what a reasonable equipment program would be for that carrier. Such a study might affect the number of planes bought, if any, or whether lease arrangements might be more appropriate.

As an example of the technical aid Ayer will offer, the purchaser of two Convair 240s, Southeast Airlines, sent personnel to American's Tulsa maintenance base for instruction, and its pilots received flight instruction with Ayer paying American a fee for the service.

Where trade-ins are involved, selectivity and timing again will be the big factors. An airline with DC-4s to turn in as part of a DC-6 purchase deal, for example, might do fairly well now with its old equipment because DC-4s are still considered a reasonably good item. But if, in a broker's evaluation, the DC-4 was due for a big plunge in price, the customer might do better to consider opening a chain of DC-4 diners with his old equipment.

But trade-ins of aircraft with continuing usefulness (including the DC-4, in Ayer's estimate) may be an element in Ayer's idea for a world-wide aircraft pool. Under this plan, the broker would provide airlines with a constant tool to upgrade their equipment, taking the next grade of equipment in trade where indicated and thus making that equipment available to an airline lower on the equipment scale to upgrade its fleet. This pool idea would also include planes for lease, and Ayer itself would seldom physically take possession of any plane.

Ayer's whole approach would seem to call for considerable skill in juggling various elements of time, market values, traffic needs and the like, but if all the balls were kept successfully in the air it would involve small actual inventories.

In terms of specific aircraft markets, Ayer said the Convair prospects split about one-third U.S. corporate, one-third U.S. airline, and one-third foreign, including airline and head-of-state executive aircraft users. Market for the Douglas planes split 25% U.S. airline and 75% foreign airline, in Ayer's view. There are also potential corporate customers for a few of the DC-6s.

Latin America, Ayer said, is by far the best foreign potential used aircraft market.

Ayer has set asking sales prices for the DC-6 series from $575,000 for a 54-passenger DC-6 to $875,000 for a DC-6A cargo plane. In between are the 80-passenger DC-6 at $625,000; the 62-passenger 1951 DC-6B at $700,000; and the 62-passenger 1953 DC-6B at $775,000. His Convair prices range from $250,000 for a 40-passenger airline-configuration 240 aircraft to $650,000 for a plush executive 440.

Ayer's aircraft are listed on the Aircraft Exchange (AW Dec. 8, p. 29), at a 3% markup over his own asking prices. Ayer's primary reason for joining the Exchange, he told AVIATION WEEK, was because of its excellent initial public relations job in circulating the offerings.

General Aircraft's Plan

General Aircraft and Leasing has taken delivery of about 10 of the American DC-7s, which are stored at Cheyenne, Wyoming with Land-Air, Inc., a subsidiary of California Eastern Aviation. All 25 of the aircraft are to be delivered by July 31.

None of the DC-7s have been sold by General Aircraft, according to C. M. Britt, vice president-sales. The sale to General by American was tied in with the airline's order of 25 Convair 600s from the Convair Division of General Dynamics Corp. (AW Aug. 4, 1958, p. 38).

General's approach would therefore seem to differ in some respects from Ayer's. General's program has not been spelled out as yet in detail, and will emphasize "flexibility," Britt explained.

The DC-7, in Britt's view, will be valuable as an intermediate range, tourist class aircraft for the next five or six years, with jets operating on long range runs where they are most efficient. Other possibilities for the DC-7 are in international service for countries unable to afford jets, and as freighters. General will offer them to customers interested in their airfreight use either already converted or as is.

General also foresees a variety of leasing possibilities as the airlines enter "an entirely new phase of financing in air transport." Leases must be tailor-made for the requirements of each customer, and the whole used aircraft disposal problem calls for the greatest flexibility in lease as well as sales arrangements.

General has not entered into any purchase transactions other than the one with American as yet, according to Britt. But the American deal, he said, was unlikely to be General's last transaction.

Sound Suppressors, Reversers Installed on 880

Daisy-ejector type sound suppressors and thrust reversers have been installed on the Convair 880 jet transport's General Electric CJ805-3 turbojet engines. Engine thrust is deflected by use of clamshell doors, sending thrust forward through cascades located on both sides of the engine pod (AW Nov. 17, p. 91). Installation shown here is on the No. 3 Convair 880. Daisy petal design increases shear area to reduce friction with ambient air.

Pan American Constructs New York Terminal

Steel roof supports have been installed for Pan American World Airways' new $8 million passenger terminal at New York International Airport. Jet transports will nose under the roof's overhang when loading and discharging passengers. Roof support is made up of 32 steel girders, fanning outward and upwards from a central core.

NEWEST MEMBER IN A FAMILY OF GREATS

The Canadair-Convair '540', by the application of turbine power, becomes the ultimate development of the widely used and approved Convair 240-340-440 series. The '540' is now on order and in full scale production, and is currently being demonstrated to airlines and business aircraft owners throughout North America.

6 MAJOR REASONS

why the '540' is the new challenger on short-to-medium routes!

1 DEFINITELY LOWER OPERATING COSTS

The standard 48-seat Canadair-Convair '540' offers **a direct operating cost of 1.4¢ per seat mile which comes down to 1.1¢ in the 58-seat configuration.** Over distances as short as 80 miles, its economy of operation matches even that of piston-engined aircraft.

2 GROWTH CAPACITY TO MEET GROWING ROUTE DENSITIES

The Canadair-Convair '540' has the built-in capability of growing with the increased traffic densities that are forecast for the years ahead. It can do this because its **seating capacity can be increased by 20%** from 48 to 58 **without weight or operating penalty.** All fuel for terminal-to-terminal operation could still be carried.

3 MATCHED-TO-TASK JET-PROP ENGINES

The Napier 3500 e.h.p. engines that power the Canadair-Convair '540' are **the only jet-props specifically designed for the particularly strenuous up-and-down life of short stage operations.** The sectionalized design of these powerful new engines make them singularly easy to service and maintain.

4 REDUCED EN-ROUTE GROUND TIME LOSSES

The Canadair-Convair '540' **eliminates numerous possible time delays at en-route stops:** passenger handling is expedited . . . time consuming engine warm-ups are unnecessary . . . as many as 6 route stops can be made without refuelling.

5 FASTER FLYING, QUICKER CLIMBING

Today's passengers want to **make time.** The Canadair-Convair '540' is **the fastest aircraft in its class,** flying at speeds up to 340 m.p.h. It's off the ground in a flash and takes only 6.4 minutes to climb to an operating level of 10,000 feet.

6 EXTRA CARGO SPACE FOR EXTRA PROFITS

The Canadair-Convair '540' has 402 cubic feet of easily accessible cargo space: enough for **two tons of additional payload** that can be carried with no operating penalty.

MOST IMPORTANT TO YOU: the Canadair-Convair '540' is a product of the combined experience and facilities of two of the world's great aircraft producers—Canadair Limited of Canada and Convair—both members of the General Dynamics family of companies.

FLY THE '540' IN A DEMONSTRATION DURING ITS PRESENT TOUR:

Canadair invites airline operators or businessmen interested in large executive aircraft, to fly the '540' in a demonstration flight. To schedule your flight, write or call Canadair Limited, Montreal, Canada, or Canadair Services Limited, 445 Park Ave., New York City.

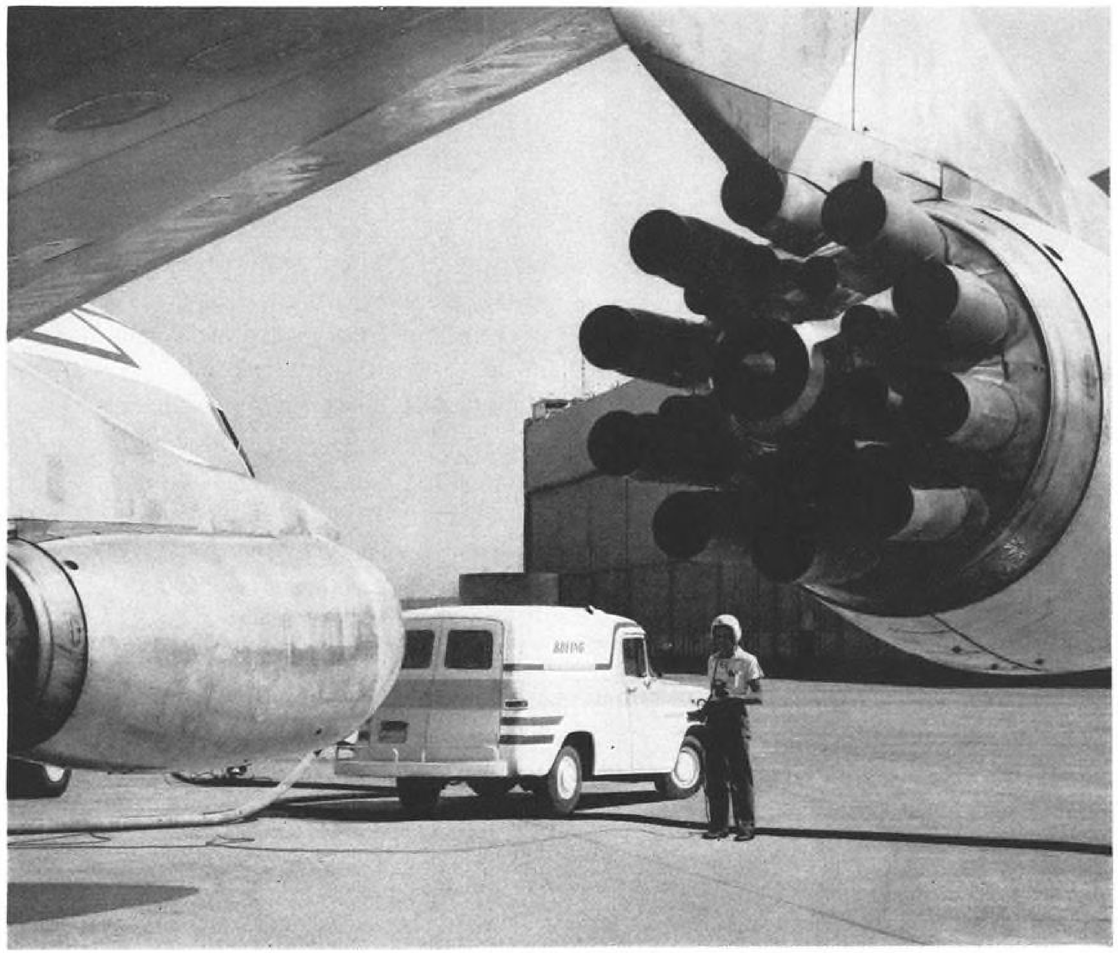
CANADAIR CONVAIR 540

JET-PROP AIRLINER

CANADAIR, MONTREAL, CANADA

THE CANADIAN SUBSIDIARY OF GENERAL DYNAMICS CORPORATION

CA59-540-22UST



Leading Airlines order

BOEING TURBO-STARTERS

Major airlines, including Delta, Pan American, TWA and United, have already ordered Boeing Turbo-Starters to provide fast, economical starts for large jet and turbo-prop engines.

This quiet and versatile Boeing unit, backed by thousands of hours of rugged field service, supplies air to start the largest jet and turbo-prop engines—quickly and economically.

The Boeing Turbo-Starter also provides air for ground operation of alternators, pneumatic systems, and for checking cabin air conditioning and pressurization. It can be used to remove snow and ice from aircraft and related equipment.

Power is provided by the Boeing 502-11B gas turbine, which incorporates all the advantages of Boeing's 15 years of experience in gas turbine research, development and production.

Installation is in half-ton panel trucks for maximum mobility. For complete details, write: Mr. J. C. Anderson, Sales Manager, Industrial Products Div., Boeing Airplane Company, Seattle 24, Washington.

SHORTLINES

► **British Overseas Airways Corp.** claims first place among foreign flag carriers in total number of passengers carried over transatlantic routes during the first quarter, 1959. BOAC, in issuing percentage figures for the quarter, said passenger loads have increased 54% over the same quarter of 1958. The British carrier says it plans to increase its seat capacity 32% over last summer on in-season schedules.

► **Continental Air Lines,** scheduled to begin Boeing 707-120 service between Chicago and Los Angeles with a single jet transport on June 8, plans to increase the service to three round trips daily on June 22. One new service to be offered on Continental's jet aircraft will be television in first-class passenger lounges. A Continental official says reception on sets is good at the 35,000 ft. altitudes the airliners will fly.

► **Eastern Air Lines** was scheduled to begin this week a new-type aircoach service over 12 points on its system offering complimentary hot meals and in-flight beverage service at a $1.00 charge on 19 recently delivered Douglas DC-7B aircraft. Fare increase on day coach flights will be $1.50 and subject to approval by the Civil Aeronautics Board.

► **Guest Aerovias Mexico** is increasing its transatlantic schedules from one to three weekly flights on May 1 using Douglas DC-6 aircraft. Guest and Scandinavian Airlines System recently concluded an agreement whereby SAS acts as technical advisor to Guest and promotes Mexican tourist and business attractions.

► **Iberia Air Lines** of Spain will accelerate its transatlantic schedules to four weekly nonstop flights from New York to Madrid on May 1.

► **Mohawk Airlines** expects to file a net profit of $279,000 for the year ending last Dec. 31 despite operating revenues of $8,402,000 and operating expenses of $8,925,000. The airline says the payment of more than $1 million in final past period mail pay should offset the higher expense figure.

► **Pacific Western Airlines** showed a net profit of $500,583 for the year ending last Dec. 31, the highest in the company's history.

► **Trans-Canada Air Lines** will offer a 35% increase in transcontinental tourist class accommodations on its summer schedules effective this week.

AIRLINE OBSERVER

► New York financial sources feel American Airlines' latest financing (AW April 20, p. 40) was not a matter of necessity but of opportunity. American already had covered its basic jet requirements, they believe, adding that the new financing might give the company a ready source of funds in the event a supersonic transport appears abruptly or cash to handle a merger if the opportunity for acquisition should arise. In other words, Wall Street feeling is that American, with cash in hand, will be in a strong position to take quick advantage of any expansion opportunities which may appear.

► **Civil Aeronautics Board Examiner Ferdinand D. Moran's recommended decision in the British Overseas Airways Corp. application for a Tokyo stop came as a complete surprise. With only Northwest Airlines intervening and with strong State Department pressure favoring the British position, most observers felt that an initial decision supporting the British application was virtually a foregone conclusion. Feeling now is that the Board will back Moran but that the White House may well reverse the decision. No matter what the final outcome is, the case will definitely carry long-range significance in all future U. S. bilateral air transport pacts.**

► Airline traffic continued to remain heavy during the first two weeks of April following the steady upward trend set during the first quarter of the year (AW April 20, p. 39).

► **Russia is preparing to place its twin-rotor Yak 24 helicopter in commercial passenger service. A 30-seat cabin arrangement has been approved. First exhibited at the 1955 Tushino air show, the Yak 24 has been thoroughly tested by Russia's military services.**

► Pratt & Whitney records show that the average utilization of the company's J57 jet engines in airline service to date has been approximately eight hours per day in comparison with a utilization of around seven hours per day for the P&W R2800 engine during a similar time span when the latter engine being introduced into service on the Douglas DC-6.

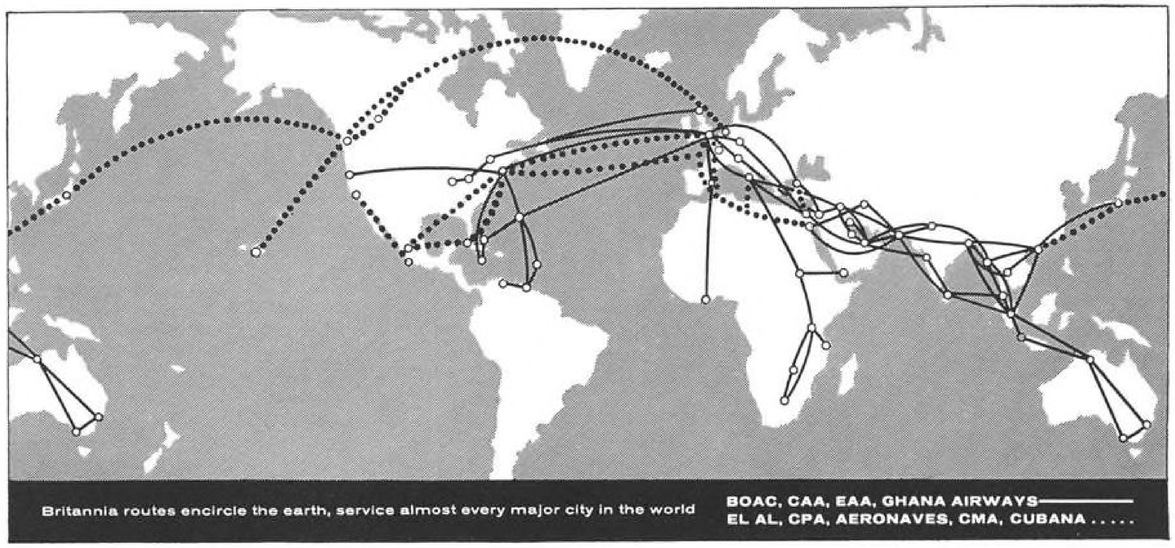
► **Vickers-Armstrongs will recommend a cruise speed of 425 mph. for its turboprop Vanguard when powered by Rolls-Royce Tyne 11 engines. Vanguard may make its first appearance overseas at Hamburg on May 6 and is scheduled to be shown at the Paris air show on June 12-21.**

► Swissair technicians at Geneva's Cointrin airport are installing weather radar and Tacan in the Douglas DC-3 assigned to Federal Aviation Agency's flight inspection group operating out of Beirut. Mission is keyed primarily to the calibration of VOR facilities in the Middle East and Africa. FAA specialists have recently finished a tour of the area, checking VOR systems at Cairo, Nairobi, Khartoum, Aden and Salisbury, all in East Africa.

► **Trans World Airlines told the Civil Aeronautics Board last week that jet schedules already committed by TWA and United in the New York-San Francisco market will produce 525,000 seats by 1960 as compared with the some 363,000 potential nonstop passengers that are expected to use the service that year. American, which is making a bid for nonstop rights between the two points, charged that development of the route had lagged behind that of Los Angeles-New York due to inadequacies in service.**

► Seaboard & Western Airlines last week increased its daily transatlantic airmail and airfreight service to two flights daily. Civil Aeronautics Board earlier this month certificated the airline to carry mail on its all-cargo Atlantic routes on a service rate basis.

► **Recently concluded Third Congress of the Communist Polish United Workers Party approved directives calling for expansion and improvement of LOT's, the Polish airline, operations under the nation's new seven-year plan. During the 1959-1965 period, Poland hopes to "extend domestic and foreign air routes, add jet and turboprop planes to the civil aviation fleet, rebuild airports in accordance with the latest requirements and provide these fields with complete facilities and equipment."**



BRITANNIA

demonstrated by new reliability, profitability BOAC enterprise

Britannia 312's play leading part in first-ever round-the-world jet airliner service

Latest evidence of Britannia dependability and operating economy is provided by BOAC's enterprise in setting up the first-ever round-the-world jet airliner service.* This achievement by a British airline using British aircraft makes it possible to fly round the world in 3 days, 14 hours, 50 minutes—less than 87 hours, a figure expected to be reduced soon to under 80 hours.

Britannia versatility brings profit to operators

Already Britannia routes encircle the earth, service almost every major city in the world. Britannias fly over 2½ million miles a month; show unique range flexibility by covering stage lengths ranging from 300 miles inter-city to nearly 5,000 miles transpolar. They make no special demands on length and strength of existing runways.

At the same time Britannias are attracting new traffic with their quiet comfort and cruising speeds of over 400 mph—at least as high as any turboprop or piston-engined airliner in service anywhere in the world today. They prove their versatility by carrying a tremendous variety of freight loads, and bring profit to operators.

New traffic

Since introducing Britannias, El Al Israel Airlines have trebled their share of transatlantic traffic, while Canadian Pacific Airlines on their transpolar Vancouver-Amsterdam route in 1958 gained a 32% increase in westbound traffic over the same period of the preceding year.

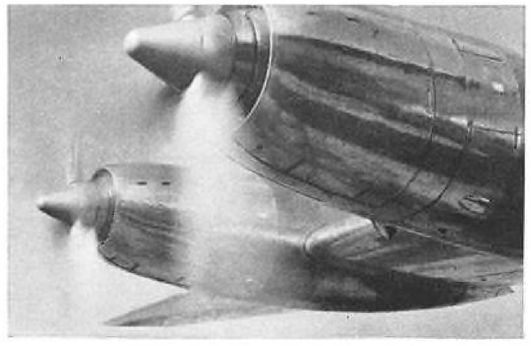
Big Charter assignments

Air Charter Ltd. Britannia flights between Christmas Island and Great Britain have been carrying no less than 128 persons—largest-ever passenger loads regularly carried across the Atlantic by a civil operator. Only 15 days after receiving their first Britannia, Air Charter had completed a full route-proving programme across the Atlantic and Pacific; the aircraft was thus earning money almost at once. Furthermore, in its first three months, it achieved an average utilisation of 7.28 hours a day.

Hunting-Clan Air Transport experience, too, has proved the Britannia unequalled at carrying large payloads at high speed over long distances. Recently a Hunting-Clan Britannia flew round the world in 65 hours flying time—a distance of 24,000 miles at an average speed of 374 mph. On the Christmas Island-London leg of the flight the aircraft was carrying 127 persons.

Engine reliability

Britannia operating economy is rooted particularly in the proven reliability of its Proteus engines. Overhaul life on the Proteus 705 series reached 2,000 hours in under 2 years. No engine of comparable power in service today has an overhaul life that even approaches this length. Annual engine overhaul costs for BOAC's Britannia 102's have been cut by 75% since the aircraft went into service. Continued development will give Proteus even longer overhaul life, entailing even lower operating costs.



Meanwhile, current versions of the engine give greater power, lower fuel consumption, and materially improve the Britannia's cruising speed, range, and take-off performance.

Finally — Britannia overall profitability is evidenced by airline experience. *El Al's Britannias are operating at a ton/mile cost approximately 20% less than any previously experienced.*

Other recent Britannia airline achievements

BOAC extend Britannia services—to Venezuela via Bermuda, Nassau; across USA to San Francisco; and via Montreal to Detroit and Chicago.

Ghana Airways—a BOAC associate—introduce Britannias on weekly London-Barcelona-Accra service on April 14.

Aeronaves de Mexico Britannia services have been slicing more than an hour off previous Mexico City-New York schedules. Now an Aeronaves de Mexico Britannia has flown Mexico City-New York in 4 hrs 57 mins (437 mph), beating own record (of 5 hrs 2 mins) made only the previous week. Load factors have been extremely high.

Cubana de Aviacion fly return journey after inaugural flight Havana-Mexico City in record-breaking 2 hrs 53 mins—shortly to set up Britannia services Havana-New York, and transatlantic via Azores to Madrid.

*Subject to governmental approval

BRISTOL
Britannia

BRISTOL AEROPLANE CO (USA) INC
400 PARK AVENUE, NEW YORK 22, NY

MOCKUP of Sikorsky's S-61 triple turbine civil helicopter is rolled out prior to shipping to the Paris air show.

Detailed Mockup Displays S-61 Layout

Stratford, Conn—First details of Sikorsky Aircraft's S-61 twin- or triple-turbine commercial helicopter call for a 5,000 lb. payload in the 25-passenger version and a target overhaul period of 1,000 hr. by 1962 for all major components.

A mockup of the ship, with color scheme and interior by Raymond Loewy Associates, has been completed and was being prepared for shipment last week for display at the French International Air Show at Paris in June.

Two basic all-passenger arrangements are specified: a longer range version including galley and lavatory accommodating 22 passengers and a shorter range version carrying 25.

Various passenger-cargo configurations also are offered. The first three seat rows can be folded to the side to provide 411 cu. ft. of cargo space and 15 passengers. A light, easily installable partition separates passenger and cargo compartments. This partition can be placed at any of the first three seats to provide variations between 15 and 24 passengers. With the full 25 passengers, the cargo capacity is 100 cu. ft.

Performance figures given for a typical gross weight of 18,435 lb., including 5,000 lb. payload, 1,637 lb. of fuel and 53 lb. of oil call for a range of 100 naut. mi. and an average cruising speed of 129 kt., Sikorsky officials said.

TRANSPORT interior has two-and-one seating, ceiling racks for small baggage.

At this weight, hovering ceiling out of ground effect on a standard day is 10,800 ft.; on a 100 deg. day the hovering ceiling in ground effect is 1,900 ft. Vertical climb is 750 fpm. and best rate of climb is 1,770 fpm. with engines at maximum continuous power of 900 hp.

The triple turbine layout means that with one engine out the S-61 can maintain flight and hover. With two engines out, level flight may be maintained for up to 60 min. at 17,800 lb. gross weight or for 2½ min. up to 20,000 lb. gross weight.

With all three engines out, an autorotational landing can be made without more than a 50 ft. ground roll.

Good emergency climb-out capability, long range and hot day performance are the principal benefits of the three turbines. A twin engine version is offered, however, for operators with less severe terrain, obstacle and range requirements.

Target overhaul periods for the major dynamic components call for 500 hr. at the beginning of 1960, 700 hr. by 1961 and 1,200 hr. by 1963. The engine overhaul targets are approximately the same, with a goal of 1,500 hr. established for 1965. As part of the test program, Sikorsky will complete by mid-1961 1,450 hr. running of a complete tie-down helicopter.

Two of the engines are mounted at the front of the transmission housing on the top of the fuselage, and are mounted directly on the main transmission for simpler lighter installation. The third engine is mounted aft of the rotor on the left side of the pylon.

The flying boat hull is capable of takeoff and landing up to the mid-sea-state 2. A retractable landing gear is mounted in the sponsons and the sponson struts are designed so that replaceable telescopic sections collapse to absorb loads in hard landings. Contact velocities as high as 17 fps. can be made without rupturing the sponson fuel cells.

As an option, either a fixed landing gear saving 40 lb., or a fixed faired gear replacing the sponsons and saving 363 lb. compared with the water alighting version are available.

All-weather capabilities with the use of Sikorsky's Automatic Stabilization Equipment will be an optional item. Weather radar also is envisioned.

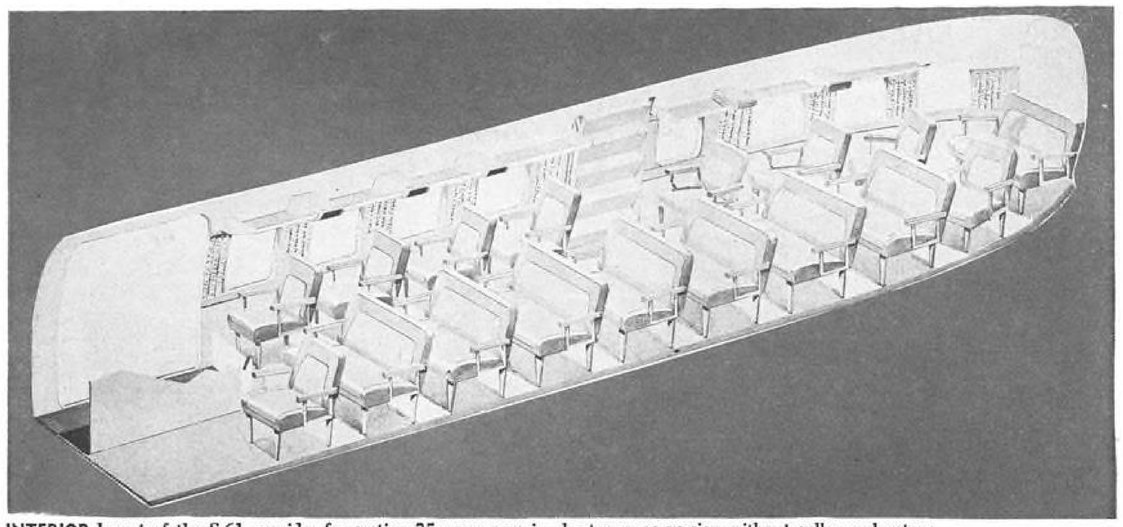
Turbine engines are General Electric T58-6 engines, the same as in the Navy's HSS-2 anti-submarine helicopter (AW Mar. 30, p. 30). The S-61 is basically the same helicopter but with a 50 in. longer fuselage and the third engine. T58-8 versions rated at 1,050 eshp. maximum continuous power will be available.

The Loewy-designed mockup color scheme uses a light blue and medium blue stripe at the window level on a white fuselage. The hull is gray and lettering is gold.

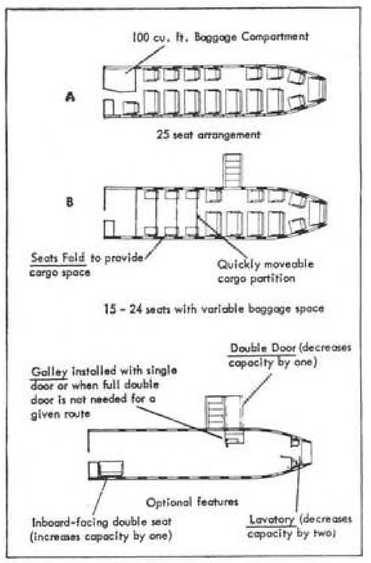
The matching interior has a sky blue ceiling, off-white side panels, a gold carpet and a combination of these colors on the striped seats. The rear door drops down with built-in stairs, and a double door is available by sacrificing one passenger seat. The front cargo door is split into upper and lower sections and measures 66 x 50 in.

The five-bladed main rotor is 62 ft. in diameter. Over-all length with all blades turning is 72 ft. 6 in. Fuselage length, except for blades is 57 ft., 8 in., width 15 ft. 8 in. and height, except for blades is 15 ft. 4 in.

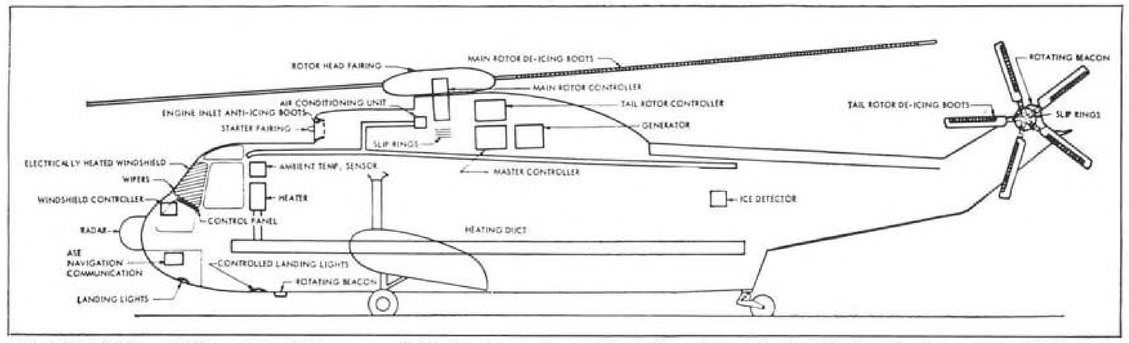
The height with blades turning is 16 ft. 8 in.



INTERIOR layout of the S-61 provides for seating 25 passengers in shorter range version without galley or lavatory.



VARIOUS cargo-passenger configurations are possible in the basic S-61 cabin.



ALL-WEATHER capabilities of the S-61 are provided with the equipment, including Automatic Stabilization Equipment, specified.

Airline Income and Expenses—January, 1959

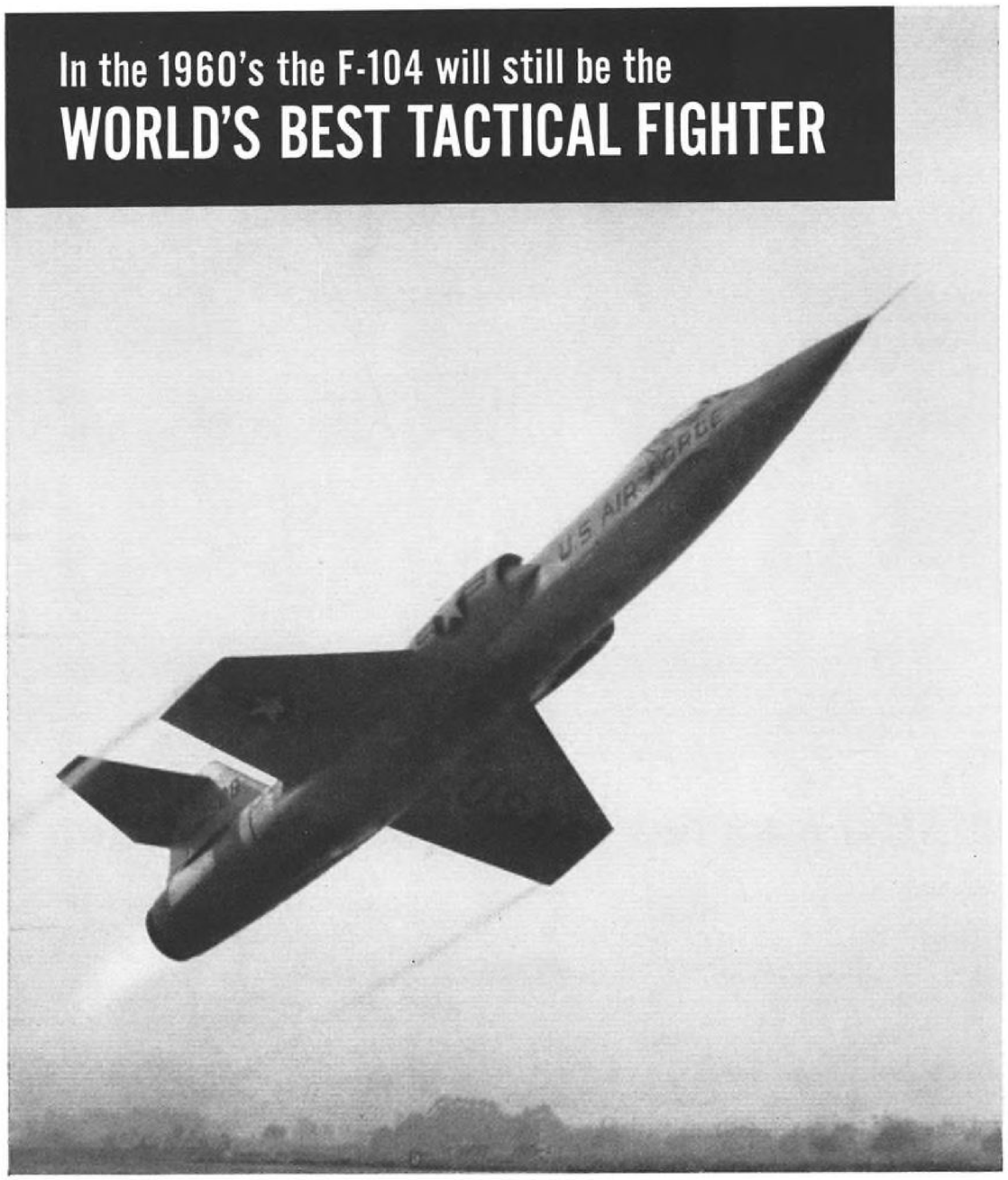
(IN DOLLARS)

	Passenger Revenue	U. S. Mail	Express	Freight	Charter	Total Operating Revenues	Total Operating Expenses	Net Income Before Taxes
DOMESTIC TRUNK								
American	13,783,403	382,102	1,313,282[2]	.....	.....	15,577,177	19,206,480	−3,184,233
Braniff	5,821,366	168,290	87,684	200,282	37,574	6,399,684	5,016,329	1,331,249
Capital	8,886,747	173,258	113,614	98,761	41,634	9,314,206	9,057,190	257,016[5]
Continental	2,945,257	41,169	14,331	47,416	4,118	3,174,416	2,692,273	482,143[5]
Delta	8,111,000	160,000	114,000	313,000	17,000[6]	8,870,000	8,187,000	627,000
Eastern	15,849,488	324,257	708,453[2]	.....	38,623	17,087,282	17,275,164	−448,574
National	6,689,678	112,849	40,294	174,888	24,524	7,261,934	6,248,131	945,297
Northeast	2,586,850	37,264	16,484	34,080	.....	2,747,190	2,855,787	−108,597[5]
Northwest	5,997,398	179,362	500,535[2]	.....	4,204	6,680,902	6,842,968	−162,065[5]
Trans World	20,287,095	512,863	1,136,788[2]	.....	42,960	22,098,551	19,091,702	2,931,639
United	23,935,484	927,607	2,168,299[2]	.....	262,966	27,573,224	24,213,702	3,180,961
Western	4,110,742	85,372	28,000	109,144	33,439	4,414,439	3,481,634	857,643
INTERNATIONAL								
American	325,662	2,541	38,139[2]	.....	.....	386,921	394,649	−9,165
Braniff	489,580	9,803	.....	27,606	.....	570,996	593,376	−39,879
Caribbean-Atlantic	228,979	2,407	10,089[2]	.....	2,594	248,739	183,267	65,668
Delta	414,000	4,000	.....	13,000	.....	453,000	467,000	−16,000
Eastern	1,804,663	24,147	64,295[2]	.....	.....	1,894,406	1,522,721	342,783
Mackey[1]	.....	.....	.....	.....	.....	.....	.....	.....
National	305,059	2,634	1,881	7,420	20,594	346,301	350,382	−2,525
Northwest	1,589,040	641,076	292,430[2]	.....	7,287	2,624,824	2,298,386	326,438
Pan American								
Alaska	183,000	13,000	26,000[2]	.....	.....	238,000	412,000	−174,000
Atlantic	7,001,000	671,000	899,000[2]	.....	245,000	9,348,000	10,264,000	−950,000
Latin America	6,532,000	188,000	1,080,000[2]	.....	36,000	8,214,000	8,379,000	−158,000
Pacific	4,054,000	625,000	701,000[2]	.....	600,000	6,263,000	6,513,000	−256,000
Panagra	1,091,000	45,000	.....	154,000	.....	1,417,000	1,531,000	1,199,000
Resort	605,070	.....	.....	.....	.....	605,083	530,773	74,310[5]
Trans World	2,203,599	500,748	288,442[2]	.....	1,159,496	4,312,619	6,172,592	−1,967,382
UMCA	5,933	19	640[2]	.....	.....	6,592	11,684	−5,092
United	990,938	42,136	19,900[2]	.....	6,030	1,070,439	988,032	72,964
Western	409,990	6,083	.....	1,906	.....	424,247	370,030	23,000
LOCAL SERVICE								
Allegheny	396,452	16,478	4,859	12,794	1,539[4]	634,876	834,015	−199,139[5]
Bonanza	260,387	3,894	2,659	4,319	2,841	422,981	403,224	18,797
Central	183,551	8,364	2,792	6,978	3,073	443,745	419,400	24,346[5]
Frontier	347,488	210,103[3]	3,500	21,180	8,421	602,083	699,080	−96,997[5]
Lake Central	183,863	5,083	6,976[2]	.....	1,795	312,437	319,142	−6,705[5]
Mohawk	626,802	7,859	5,607	7,494	8,543	827,759	801,072	26,687
North Central	678,449	20,934	13,500	.....	31,616[4]	1,016,899	1,155,360	−146,940
Ozark	391,786	233,710[3]	7,688	12,410	19,277	669,761	718,707	−54,215
Pacific[1]	.....	.....	.....	.....	.....	.....	.....	.....
Piedmont	825,178	8,607	5,248	6,898	19,243[4]	825,178	931,359	−137,498
Southern	253,499	8,643	3,958	6,308	1,608	478,227	471,957	5,392
Trans-Texas	337,200	14,443	4,131	12,346	6,660	625,403	571,336	53,496
West Coast	282,242	4,299	1,435	4,918	5,052	442,754	624,881	−182,187[5]
HAWAIIAN								
Hawaiian	407,411	3,391	.....	51,426	1,851	509,284	532,630	−39,168
Aloha Airlines	153,784	565	.....	4,639	466[4]	163,127	202,997	−39,870[5]
CARGO LINES								
AAXICO[1]	.....	.....	.....	.....	.....	.....	.....	.....
Aerovias Sud Americana	.....	.....	.....	112,106[7]	16,007	130,224	141,704	−3,271
Flying Tiger	.....	14,015	1,171,857[2]	.....	1,408,217	2,542,548	2,326,520	149,693
Riddle	.....	3,614	473,473[2]	.....	310,375	785,590	990,508	−204,918[5]
Seaboard & Western[1]	.....	.....	.....	.....	.....	.....	.....	.....
Slick[1]	.....	.....	.....	.....	.....	.....	.....	.....
HELICOPTER LINES								
Chicago Helicopter	53,840	104,901[3]	.....	.....	.....	158,775	182,872	−27,997
Los Angeles Airways	11,705	9,595	7,409[2]	.....	.....	109,563	96,543	13,028
New York Airways	54,307	2,615	2,988	3,522	.....	265,096	250,239	10,416
ALASKA LINES								
Alaska Airlines[1]	.....	.....	.....	.....	.....	.....	.....	.....
Alaska Coastal	35,768	6,908	.....	5,371	1,270	73,471	134,360	−58,888[5]
Cordova	7,137	7,680	.....	3,113	24,370	88,329	89,342	−1,875
Ellis	28,215	4,078	.....	3,231	368	82,798	78,550	4,248[5]
Northern Consolidated[1]	.....	.....	.....	.....	.....	.....	.....	.....
Pacific Northern	406,832	60,573	56,166[2]	.....	976	767,192	786,226	−32,897
Reeve Aleutian[1]	.....	.....	.....	.....	.....	.....	.....	.....
Wien Alaska	37,843	41,321	.....	16,194	141,065	377,623	403,841	−26,218[5]

[1] Not available [2] Property figure [3] Federal subsidy included [4] Non-scheduled services [5] Net operating profit or loss
[6] Other transportation [7] Common carriage

In the 1960's the F-104 will still be the

WORLD'S BEST TACTICAL FIGHTER



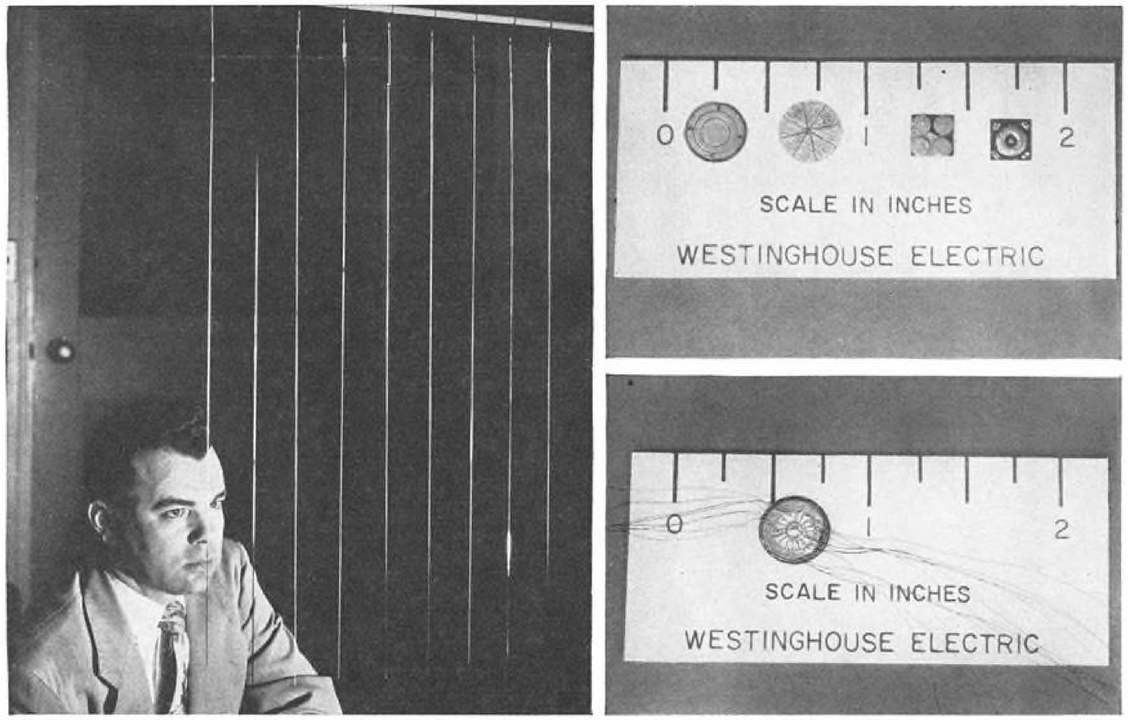
Lockheed's all-weather, multi-mission Starfighter is the world's outstanding fighter plane. Holder of the world's speed, altitude and seven time-to-climb records, the F-104 was recently purchased by West Germany for their own —and NATO'S—use as an intercepter, superiority fighter, fighter-bomber and advanced reconnaissance plane.

In addition to increased range and flexibility, the F-104 can be deployed to any combat area in the world within 24 hours. It is capable of delivering a wide variety of weapons, day or night, in any kind of weather. Despite this the F-104 is the most economical fighter plane currently available for U.S. defense needs, in terms of both initial purchase price and maintenance costs.

Never before has a single airplane done so many things so well. The F-104's performance and versatility are unmatched by any other operational aircraft, either flying today or programmed for the 1960-65 time period.

LOCKHEED

JET TRANSPORTS • JET FIGHTERS • JET TRAINERS • COMMERCIAL & MILITARY PROP-JET TRANSPORTS • ROCKETRY
BALLISTIC MISSILE RESEARCH & DEVELOPMENT • WEAPON SYSTEM MANAGEMENT • ANTI-SUBMARINE PATROL AIRCRAFT
NUCLEAR-POWERED FLIGHT • ADVANCED ELECTRONICS • AIRBORNE EARLY-WARNING AIRCRAFT • AIRPORT MANAGEMENT
NUCLEAR REACTOR DESIGN & DEVELOPMENT • GROUND SUPPORT EQUIPMENT • WORLD-WIDE AIRCRAFT MAINTENANCE



BREAKTHROUGH in semiconductor techniques which permits crystals to be grown at extremely high speeds in a convenient form of thin, highly polished ribbons with thin dimensions and flat surfaces (left), has been scored by Westinghouse Electric's Research Laboratory. At top right molecular electronic switching devices developed to date by Westinghouse include solid-state field effect units. At bottom is a multiple-contact commutator with no moving parts. A variety of other functions will be developed.

USAF Launches Molectronics Program

By Philip J. Klass

Washington—Major new program in molecular electronics, called "molectronics" for short, aimed at developing a fundamentally new approach to avionic equipment design and construction has just been launched at Westinghouse Electric Corp. by Air Force's Air Research & Development Command. Program objectives include the reduction of avionic equipment size and weight by factors of perhaps 1,000:1, with significant gains in reliability.

Westinghouse, which has been carrying on a company-financed program in "molectronics" for several years, has already achieved significant progress on its own. For example, Westinghouse has discovered a new process for making semiconductor crystals which could revolutionize the semiconductor industry and slash the cost of making transistors by 50 to 70% (AW Feb. 16, p. 23).

This new technique, one of the jumping-off spots for the new USAF molectronics program, makes it possible to grow semiconductor crystals in the convenient form of long, ⅛-in. wide ribbons, a few thousandths of an inch thick, which come out perfectly flat and very highly polished, eliminating many of the costly operations formerly required to produce transistors.

Another example of Westinghouse progress to date is a solid-state, light-modulated sawtooth oscillator demonstrated at the Institute of Radio Engineers convention by Col. C. H. Lewis, who has sparked the molecular electronics concept at ARDC headquarters.

Single Semiconductor

This complete function, which would require 14 separate components (including three transistors and a photocell) occupying one cubic inch if constructed with conventional miniaturized circuit techniques, is performed by a single button-shaped specially formed semiconductor which occupies only 0.001 cu. in.—one-thousandth of the conventional size. The Westinghouse device weighs only 0.02 gram, compared to 7 grams for a conventional circuit and has only two soldered connections, compared to 15 for a conventional circuit.

Although novel devices of this sort are expected to come out of the Air Force/Westinghouse program, for use in more conventional avionic circuitry, they are viewed only as byproducts. The program's basic objective is far bolder and far-reaching.

New program aims to develop an entirely new philosophy and framework for the design and fabrication of electronic equipment in which the basic building blocks will be electric fields, charges and spins, instead of the familiar resistor, capacitor, inductor, tube and transistor, according to Dr. George Sziklai, acting manager and coordinator of the program for Westinghouse.

Except for the transistor and several other solid-state devices, the electronic equipment designer today still uses essentially the same building blocks that have been used for at least 30 years. Despite significant reductions in the size of conventional components, the size and weight of equipment has mushroomed because of the increasingly complex military tasks assigned to electronics.

With the arrival of the space age, the problem has become even more critical. With payload limitations of the forseeable future, size and weight reductions of 100:1 or better are needed, with corresponding improvements in reliability.

Several years ago the Air Force recognized these trends and began a survey of leading industrial and university laboratories in search of a possible solution. It concluded that miniaturization of conventional components was fast approaching the point of diminishing returns and so the concept of molecular electronics was born.

ARDC concluded that the vastly increased knowledge of atomic and molecular structure of materials which had come out of recent research in semiconductors and Masers opened the door to using the basic building blocks of nature—the atom and molecule. This philosophy, and ARDC's plans to launch a molecular electronics program, were first reported by Aviation Week (June 2, 1958, p. 64).

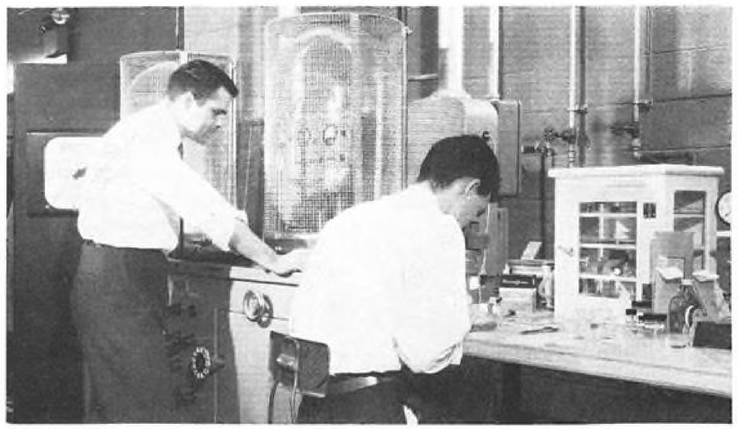
Company Funds

In its survey, ARDC found that Westinghouse Electric was already at work in this area using company funds. One of the earliest products of this effort was a tiny semiconductor which converted high-voltage a.c. to low-voltage d.c., performing a function that formerly required a transformer, rectifier tube and filter network. One portion of the device used the resistive characteristics of a semiconductor to convert incoming a.c. into heat, while an adjoining series of thermoelectric elements converted heat into low-level d.c.

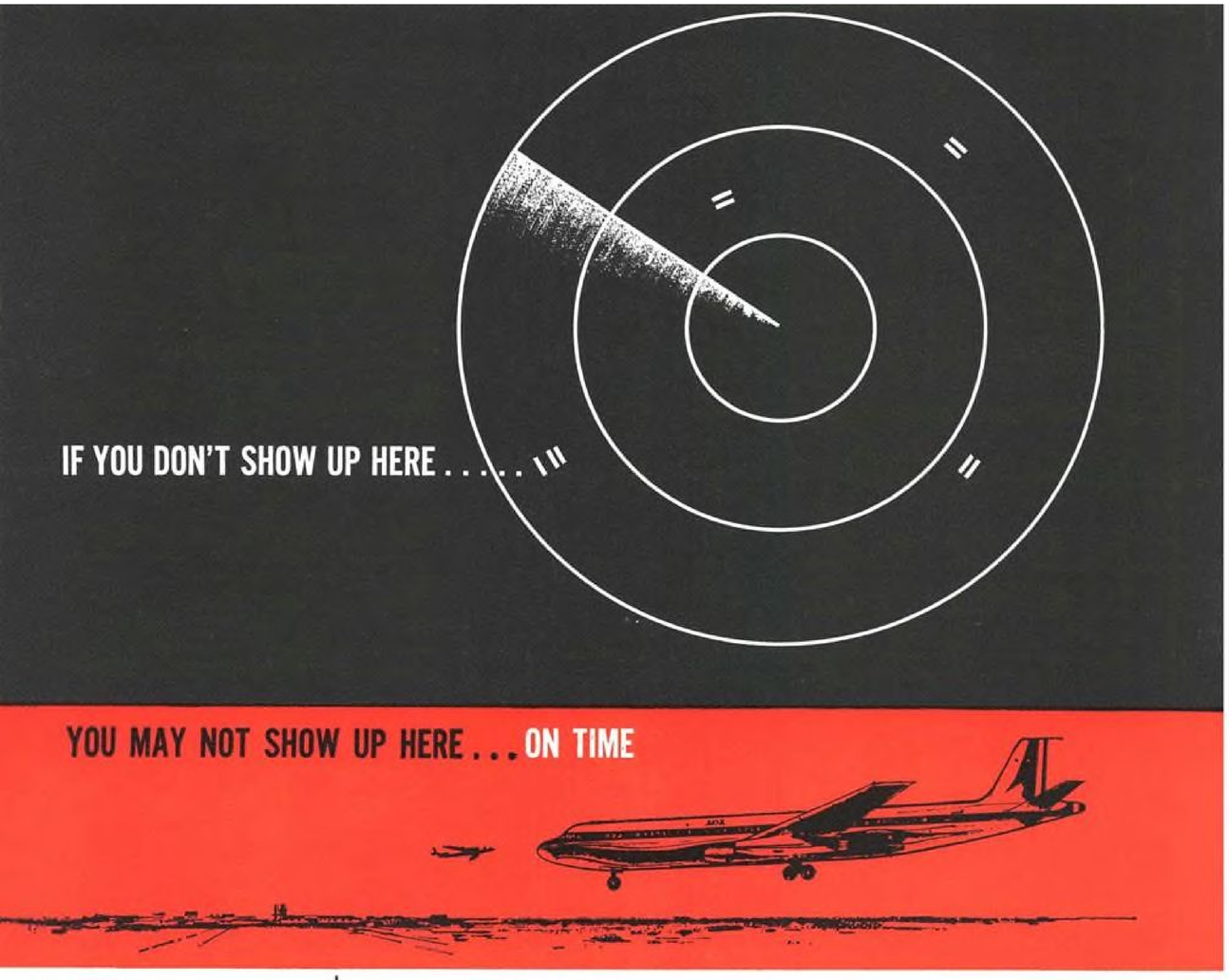
Although the device was not quite as efficient as a conventional rectifier, it demonstrated the size, weight and cost savings which could be achieved through the use of an integrated functional approach to circuit design. This also pointed out potential economies in the engineering effort required to design electronic equipment. Instead of requiring an engineer to design the transformer, another the rectifier tube, a third the capacitors, a fourth the inductor, and still another to design the complete circuit, a single engineer-physicist might design the complete functional block in one operation.

Approximately two years ago, Westinghouse scored a breakthrough with the discovery of a new technique for growing semiconductor crystals at an extremely high rate, instead of the slow

CONVENTIONAL technique for growing semiconductor crystals, which may become obsolete through use of the new Westinghouse process, produces a large ingot which must be cut into thick slices, then each slice must be diced (as shown above) into tiny bars each of which must then be lapped and polished to obtain a flat, mirror-like surface.



SOLID-STATE Advanced Development Laboratory has been set up at Air Arm Division in Baltimore to fabricate special molecular electronic devices for specific mission requirements of Air Arm avionic equipment designers. Laboratory is operated by the company's Semiconductor Division but is located in Baltimore to provide closer relationship between molecular electronic fabricator and equipment designer.



Unique high stability decoding and encoding circuits — fully shielded transmitter minimizes radiated interference — superior cooling design — expansion capabilities fully designed and tested

Write for complete technical specifications.

BE SEEN WITH COLLINS 621A-2 TRANSPONDER

With radar identification playing an increasingly important role in ATC procedures, it is to every operator's advantage to have radar beacon facilities aboard.

For airline or business aircraft, Collins 621A-2 ATC Radar Transponder provides a strong radar reply and rapid identification for precision ETA's and no-delay clearances in high density control areas.

Designed to the highest standards of performance, reliability and maintainability — proven by extensive airline evaluation — backed by the world's most experienced supplier of airlines communication and navigation equipment — Collins 621A-2 is today's best buy in ATC Transponders.

COLLINS

COLLINS RADIO COMPANY • CEDAR RAPIDS, IOWA • DALLAS, TEXAS • BURBANK, CALIFORNIA

Semantic Problems

With the launching of the new major Air Force/Westinghouse program, semantic problems rear their heads. Some ARDC and Westinghouse officials believe the new approach is so radically different from the existing electronic state of development that a fundamentally new nomenclature is needed. The term "molecular electronics" is favored in some ARDC circles to describe the new program. An abbreviated version is "molectronics."

The question of a generic term to describe such "things" as the miniscule light-modulated oscillator developed by Westinghouse or the tiny miltivibrator developed recently by Texas Instruments, poses a more controversial question. Texas Instruments call its development "semiconductor solid-circuitry." Varo Manufacturing Co. uses "integrated micro-circuitry." But some ARDC and Westinghouse officials object strongly to any term that includes "circuitry." They say this implies use of conventional interconnected components.

To convey the concept of electronic functions being performed internally within a single blob of material, these officials prefer "monolithic block," or "functional block." Other possible suggestions include: "Intrinsic micro-circuitry," "Intrinsic solid-circuitry," or "electrinsic circuitry."

drawing process now in use. In addition, the semiconductor crystal comes out in the form of a thin ribbon of the desired thickness and width, with surfaces that have optical flatness and a mirror finish. To produce a transistor it is only necessary to create junctions by conventional alloy or diffusion process, attach leads and slice off the transistors from the ribbon.

By way of comparison, a semiconductor crystal produced by conventional technique comes out as a large grenade-shaped ingot which must then be cut into slices about 0.1 in. thick. Then each slice must be diced into tiny rectangular bars, each of which must then be lapped and polished to achieve required flat, polished surface before junctions can be created and leads attached.

Westinghouse is close-lipped about the details of its new crystal-growing process. Company calls it "dendritic growth," a name which comes from the branching tree-like figure produced in a mineral by a foreign substance such as in moss agate.

Westinghouse's Semiconductor Division plans to use the new dendritic crystal growth process to manufacture conventional transistors, but the new technique has many more significant potentialities which company officials will only hint at, for competitive reasons.

One is the fabrication of complex multi-function semiconductors for performing sophisticated circuit tasks in Air Force's molecular electronics program.

During the initial year of the Air Force program, Westinghouse plans to develop eight different molecular electronic elements which perform functions of widely used conventional circuits. These will include an audio amplifier, a video amplifier and a multivibrator. In addition, company scientists will explore some of the promising potentialities of its dendritic crystal growth process.

During the subsequent year, the Air Force schedule calls for Westinghouse to tackle a representative cross-section of avionic equipments, across the frequency spectrum, according to Col. Lewis. These might include, for example, an infrared seeker, a data link receiver, a ferret reconnaissance receiver, a flight control system and a telemetry decoder.

Within the Air Force, Wright Air Development Center's Electronic Com-

Crystal Ball

Two years ago Aviation Week reported: "Revolution is brewing in the state of the electronic art, spurred by the avionic demands of guided missiles, space vehicles and high-speed aircraft. . . . A complete micro-miniaturized amplifier may consist of a multi-stage solid-state circuit in which semiconductor materials perform a variety of component functions. The entire amplifier might be mounted in a case no larger than tiny present-day transistors" (April 8, 1957, p. 86).

In the intervening period has come increasing evidence to substantiate this prediction: The evaporative-deposition techniques of Servomechanisms, Inc. and Varo Manufacturing Co. for producing integral micro-circuitry (AW Sept. 30, 1957, p. 70; June 2, 1958, p. 64). More recently, Texas Instruments has revealed significant progress in development of integral solid-state circuitry (AW Mar. 30, p. 33).

Now the Air Force's Air Research & Development Command has awarded a multimillion dollar contract to Westinghouse Electric to launch the most ambitious program to date aimed at this revolutionary advance in the electronic art. Details of this new ARDC program are revealed for the first time here.

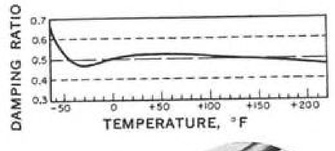
the SUBMINIATURE AND PRECISE

RATE GYRO

. . . three to four ounces in weight, this rugged unit has 0.5% linearity to half range, 2% to full range.

NEW LOWER DAMPING

. . . requiring NO HEATERS, with compensated damping 0.5 ± 0.1 from −45° to +210°F; AND, on special order from −60°F to +210°F.

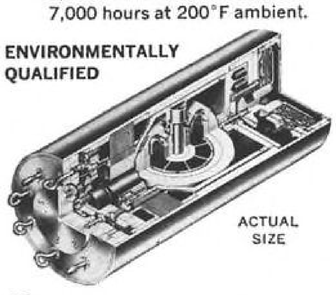


the LONGEST LIFE

RATE GYRO

. . . units on test exceed 10,000 hours at 150°F ambient, 7,000 hours at 200°F ambient.

ENVIRONMENTALLY QUALIFIED



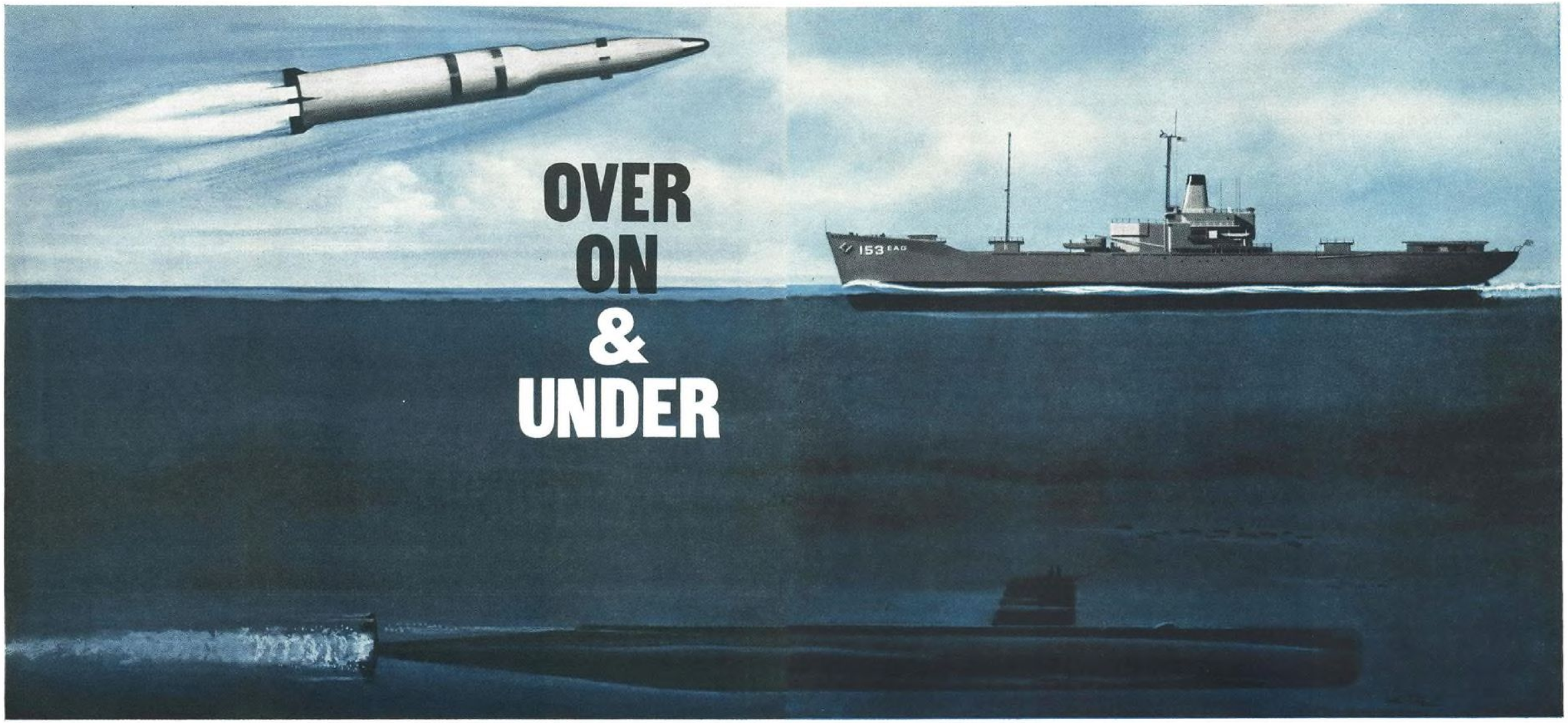
ACTUAL SIZE

the H-3 SERIES RATE GYRO

For full information, write AMERICAN-STANDARD®, MILITARY PRODUCTS DIVISION 100 Morse Street, Norwood, Mass.

®AMERICAN-Standard and Standard® are trademarks of American Radiator & Standard Sanitary Corporation.

AMERICAN-Standard MILITARY PRODUCTS DIVISION



A missile streaking through the sky . . . a ship plowing through the ocean swells . . . a submarine gliding through the depths . . . all guided with unerring accuracy by Autonetics' inertial navigation systems.

Twelve years ago development was under way on the first Autonetics' inertial autonavigator—a system to guide a supersonic missile to a distant target.

Since then, refined versions of this system have shown remarkable capability for guidance over, on and under the terrestrial surface in any craft, at any speed, under any conditions . . . a significant advance in the state-of-the-art.

It was an Autonetics' autonavigator that guided an aircraft on the first successful daylight cross-country flight by stellar-inertial autonavigation. Another version easily passed the Navy's exhaustive sea tests aboard the USS Compass Island in 1957. And in 1958, Autonetics' systems guided the USS Nautilus and Skate on their historic voyages under the polar ice.

Today Autonetics is producing in quantity the systems to guide the Air Force's GAM-77 missile. Its engineers are designing systems for America's Polaris-carrying subs and the Minuteman intercontinental ballistic missile. Even more advanced systems will provide the accurate stellar-navigation data needed to guide man on his travels through Outer Space.

But the imaginative engineering that brought inertial navigation so far, so fast, is only half the Autonetics' story. New ideas had to be implemented by new manufacturing techniques. Many components of inertial autonavigators—gyroscopes, accelerometers and computer elements—called for precision that was once impossible. Now Autonetics has put it on the production line.

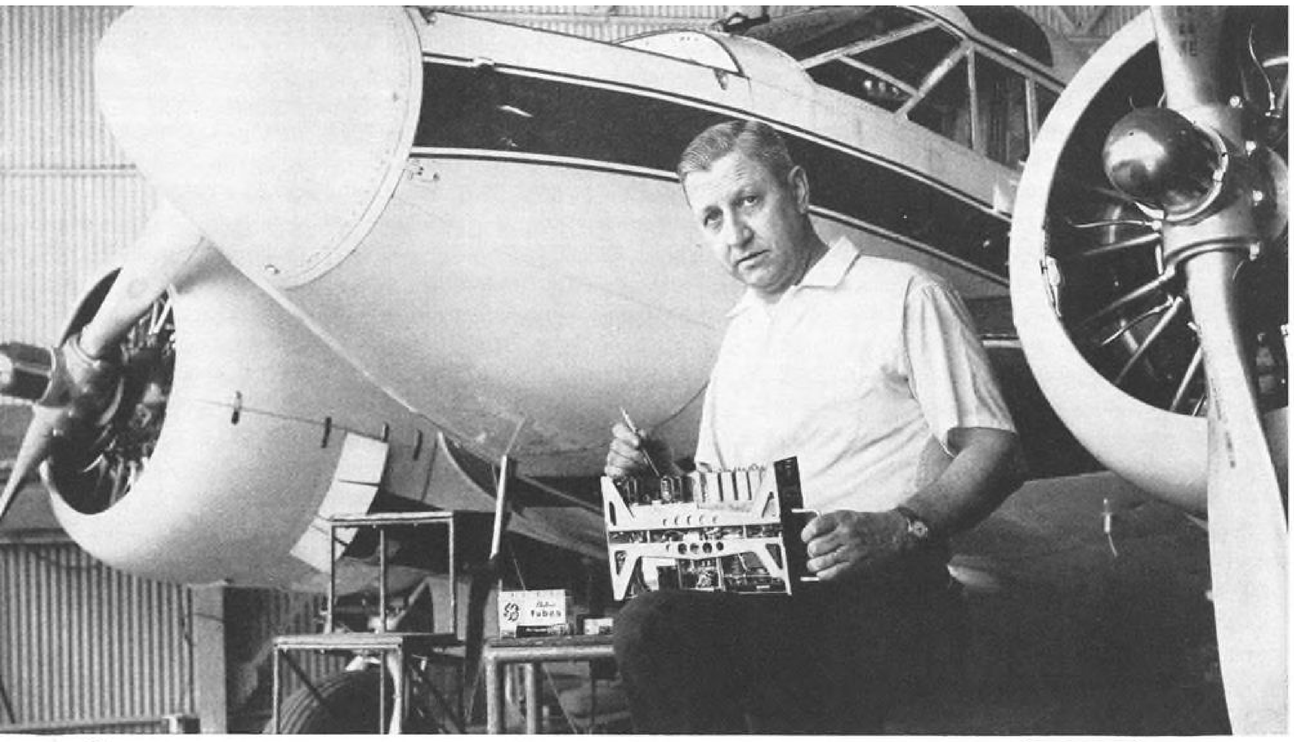
These are the achievements that have given here-and-now reality to inertial navigation . . . and have made Autonetics first in the field.

Inertial navigation

by Autonetics

A DIVISION OF NORTH AMERICAN AVIATION, INC., DOWNEY, CALIFORNIA • REGIONAL OFFICES: WASHINGTON, D. C. AND DAYTON, OHIO

INERTIAL NAVIGATION / ARMAMENT CONTROL / FLIGHT CONTROL / COMPUTERS AND DATA PROCESSING



Says **CARL H. FOX, President, Associated Radio Service Company, Love Field, Dallas:**

ASSOCIATED RADIO CO. CUSTOM LOVE FIELD DESIGN DALLAS

"This G-E 5-Star Tube is one of thousands we've recommended and installed!"

"'Let us put them in all critical sockets!' We make that request every day to our customers. Five-Star Tubes get our strong endorsement because we know how dependable they are, and our experience includes every type of commercial plane—privately-owned; executive plane; or passenger or cargo airliner that may need emergency service.

"Associated Radio enjoys a wide reputation for installations and repairs of electronic equipment, and General Electric 5-Star Tubes helped build our good name. Flyers know they can depend on these G-E tubes in every respect. They do the full electrical jobs they're rated for; they outlast regular receiving tubes by a substantial margin.

"By recommending 5-Star Tubes, we serve the best interests of pilot and passengers—and cut plane maintenance costs as well. Reliable tubes keep planes in the air and out of the shop. Look at 5-Star Tubes from any standpoint—increased flight safety, more hours in the air, fewer electronic repairs—and they more than pay for themselves!"

* * *

Associated Radio's experience echoes that of major airlines, who report the same benefits from 5-Star high-reliability tubes. Your nearby G-E tube distributor stocks these superior types. Phone him! *Distributor Sales, Electronic Components Division, General Electric Company, Owensboro, Kentucky.*

Progress Is Our Most Important Product

GENERAL ELECTRIC

2-311-101

ponents Laboratory will head up the new program. However, each of WADC's equipment laboratories will appoint a representative to a committee which will monitor the program and contribute ideas and problem areas for investigation.

Much of the basic research will be carried out by Westinghouse's Research Laboratory, Materials Engineering Laboratory and Semiconductor Division, but the company's Air Arm Division in Baltimore will head up the program. This will assure the necessary cross-flow of information between equipment designers and researchers and keep the program oriented toward specific mission objectives.

Coordination of research and application effort also would seem assured by the fact that Westinghouse Research Laboratory is now headed by Dr. S. W. Herwald who formerly was general manager of Air Arm Division. In his former position, Herwald was a staunch booster and one of the instigators of the company's molecular electronics effort as the only long-range hope for coping with mushrooming complexity of avionic equipment and need for greatly improved reliability.

Model Shop

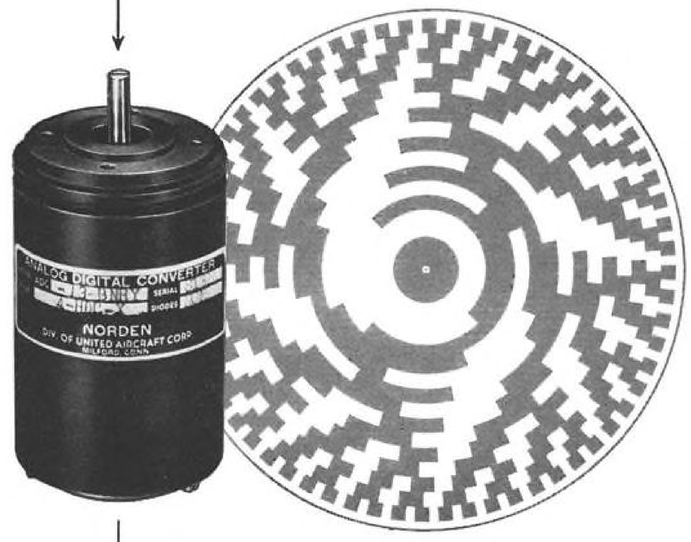
Air Arm already has set up in its Baltimore headquarters a Solid-State Advanced Development Laboratory, under Dr. Gene Strull. It will serve as a model shop for fabricating samples of molecular electronics to meet special Air Arm equipment applications. The new laboratory provides a bridge between the basic research effort being carried out in Pittsburgh and the hardware personnel in Baltimore. Organizationally, the laboratory is part of the Westinghouse Semiconductor Division at Youngwood, Pa., but is located in Baltimore "because we want to put the device designer in a systems environment," Dr. Strull says.

Dr. Strull and his small staff of scientists mix freely with Air Arm hardware designers to learn what conventional circuits are being designed whose function might be performed by a single multi-function semiconductor and to in turn educate equipment designers as to some of the novel molectronic functions that can be created.

The laboratory has been in operation for about five months, and is equipped to fabricate semiconductor devices using crystals produced by Semiconductor Division. The light-modulated oscillator demonstrated by Col. Lewis was produced by the Baltimore laboratory. One of its current efforts is a tiny solid-state tap-switch, or commutator, with no moving parts which can switch a central connection to any one of many output connections through application of suitable voltages which create inter-

GUIDANCE SYSTEM?

ANALOG DATA TRANSLATED



INTO CODED SIGNALS THROUGH

NORDEN DIGITAL CONVERTERS

Digital Converters are small, rugged precision instruments for translating analog mechanical information into digital electrical representation. Outstanding in the Norden line of Converters is the new V-Disc Shaft Position Encoder. Its V-disc and straight-line brush arrangement is a refinement of the familiar V-brush logic, giving superior control of assembly tolerances and switching angle tolerances. Tracking wear is reduced; signals are clearer. It offers precision and reliability, largest capacity in the smallest size (size 18 synchro mount), increased service life, serial or parallel readout, and clockwise or counterclockwise operation . . . all backed by Norden's engineering excellence and modern production facilities. Call TRinity 4-6721 or write for complete technical data or engineering consultation.

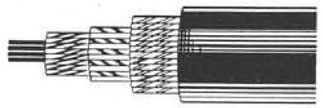
NORDEN Division of United Aircraft Corporation

Milford Department, Wiley Street, Milford, Connecticut

CABLE and WIRE LEADS

by HOWARD E. PENDERGAST
Technical Director, Rex Corporation

Identifying circuits and meeting mil-specs



COLOR CODING of the 51 insulated conductors in this telephone cable is achieved by a combination of solid colors and stripes.

Circuit identification is accomplished in three different ways:

1. ***Color coding*** by means of ten solid colors of primary insulation is the oldest and still most common method. It offers permanent and clearly different colors, although shades of colors vary among manufacturers. The ten standard colors are black, brown, red, orange, yellow, green, blue, violet, slate, and white.

2. ***Helical striping*** over color-coded insulation offers an almost unlimited number of color combinations. However, the visibility of stripes decreases as wire diameters become smaller. Then, too, the permanence of helical stripes is not so good on such high temperature materials as silicone rubber and tetrafluoroethylene as on vinyls. However, in the case of tetrafluoroethylene Rex offers a permanent, color code by literally extruding the colored stripe into the insulation. Because of the many possible combinations of stripes, wire manufacturers seldom stock striped wiring.

3. ***Numbering or lettering*** of cables and wires by printing machines during or just prior to assembly is a rapidly growing practice, especially since the quality of printing inks has been improved.

Military Specifications

Systems and equipment manufacturers prefer to specify and purchase insulated wire to existing military specifications whenever possible. The following most common specifications are offered as a guide:

MIL-W-12349—Kel-F insulated hook-up wire
MIL-W-17C—Coaxial cable
MIL-W-16878C—High temperature wire
MIL-W-76A—General purpose hook-up wire
MIL-W-12410—Call Rex.
MIL-W-8777—High Temperature wire
MIL-W-7139A—Abrasion resistant high temperature wire.

At your service! Our experienced corporation coding systems for circuit identification and in matching wires and cables to military specifications is yours for the asking. For an early get-together or further information, write:

THE REX CORPORATION
A Subsidiary of American Enka Corporation

WEST ACTON, MASS. — COlonial 3-7721

Insulated Wire & Cable · Mil-spec Wire

Molectronic Engineering

Design of molecular electronics will require new types of skills and lead to new breeds of electronic engineers, according to current Westinghouse thinking. For instance:

- Systems engineer will require considerable imagination and background in order to apply new concepts advanced by mathematicians and solid-state physicists.
- Logician will work out optimum arrangement of transfer function organization of molecular electronic functions.
- Topologist will be the architect, laying out various material domains to perform desired function and achieve required transfer function. Both topologist and logician will require strong backgrounds in information theory, Boolean algebra and theoretical physics.
- Material synthesist, working from topologist's blueprint, will create the molectronic circuit, putting together the desired material domains. Synthesist probably will be a solid-state physicist.
- Molecular engineer, with strong background in solid-state physics and quantum mechanics, will work with materials, extending knowledge of their behavior and seeking new functions which can be achieved through application of this knowledge.

nal electric fields within the semiconductor crystal.

Air Arm also has set up a Molecular System Design group, under Dr. A. W. McCourt whose task is to look at military missions, determine what functions are required to perform them. With the function defined, the "topography" of a solid-state device which will perform the specified function is then worked out, then a sample is fabricated in the Solid-State Advanced Development Laboratory. Sample is then evaluated to see if it performs required function and is modified as necessary.

Although the miniscule size of molecular electronics is one of its obvious advantages, some of the less obvious by-products may prove even more important, Dr. Herwald points out. For example, bulk of the power consumed in most conventional circuits, which must then be dissipated as heat, performs no really useful function. This is particularly true of control and computer circuits. It is somewhat analagous to buying a hardware store in order to gain access to a screwdriver.

By making use of electric fields, charges and spins on the atomic and molecular level, many functions can be performed with but a tiny fraction of the electric power now required, greatly easing the joint problem of generating electric power and dissipating heat in satellites and space vehicles.

But possibly the most significant gain from molecular electronics may come from vastly improved reliability. By replacing the multitude of separate components with a single solid-state device that performs the same function, the over-all system reliability should go up sharply. This is not only because of the fewer components, but because of the corresponding reduction in number of soldered connections, each a major cause of unreliability.

In addition, the use of redundant circuit functions becomes feasible with the vast reduction in size, weight and power consumption offered through molecular electronics.

Compatible Omnirange Cuts Beam Scalloping

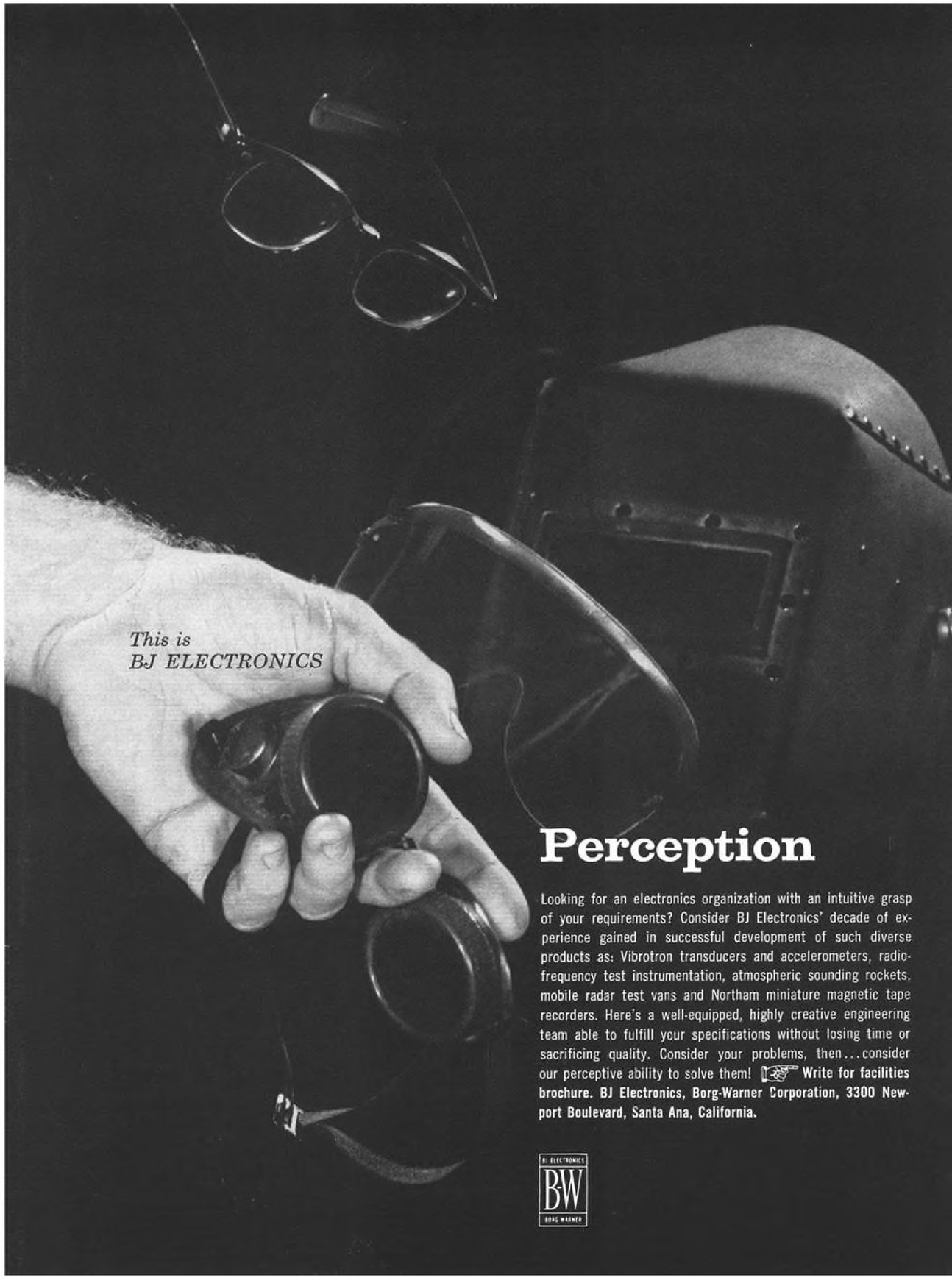
New York—Doppler-VOR, new compatible omnirange developed by Servo Corp. of America (AW April 6, p. 37) which largely eliminates beam scalloping in wooded and mountainous areas, will make it possible to obtain twice as many stations in the radio spectrum assigned for short-range navigation aids.

New type VOR, which can be used by existing airborne navigation receivers without any modification, is a single sideband system which requires only 50 kc. instead of the 100 kc. channel separation required for conventional omnirange transmitters.

Other features cited by Servo Corp.:

- **More channels:** Doppler-VOR is a single sideband system which requires only half of the 100 kc. bandwidth used by conventional VOR stations, should therefore permit twice as many stations in same frequency spectrum.
- **Poor Man's DME:** Addition of simple voltmeter, suitably calibrated, can enable a lightplane pilot to determine elevation angle between airplane and station. This, in combination with knowledge of the airplane's barometric altitude, makes it possible to compute the aircraft's distance from the station. It also enables a lightplane without conventional distance measuring equipment to orbit at a fixed distance and altitude from the ground station for stacking purposes.
- **Ground-speed determination:** By measuring time required for aircraft to fly from one preselected elevation angle over the station to the same angle on the opposite side, lightplane pilot can determine his approximate ground speed.

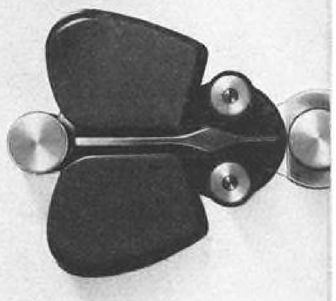
The new type VOR is an outgrowth of extensive Servo Corp. work in Doppler direction finders for military applications. Basic concept is credited to the company's Paul G. Hansel. Original suggestion for making the new omnirange compatible with all existing airborne VOR receivers came from Harry Davis, technical director of the



Perception

Looking for an electronics organization with an intuitive grasp of your requirements? Consider BJ Electronics' decade of experience gained in successful development of such diverse products as: Vibrotron transducers and accelerometers, radio-frequency test instrumentation, atmospheric sounding rockets, mobile radar test vans and Northam miniature magnetic tape recorders. Here's a well-equipped, highly creative engineering team able to fulfill your specifications without losing time or sacrificing quality. Consider your problems, then... consider our perceptive ability to solve them! ☞ **Write for facilities brochure. BJ Electronics, Borg-Warner Corporation, 3300 Newport Boulevard, Santa Ana, California.**

BJ ELECTRONICS
BW
BORG-WARNER



AMPEX increases signal/noise ratio

A real challenge to magnetic-tape sensitivity comes with frequency-multiplexed data. It is here that the tape's signal-to-noise ratio can mean success or failure. The high levels of occasional combined peaks can build up modulation noise between channels and seriously affect signal output.

Ampex meets this challenge by minimizing tape noise. Painstaking care in coating composition and thickness, plus the exclusive Ferro-Sheen process, gives Ampex Instrumentation Tape a completely uniform, hard, smooth surface that tangibly increases its dynamic range.

Ampex Instrumentation Tape offers other critical improvements, too. A high degree of linearity in its anhysteretic induction output greatly reduces signal distortion, further enhancing the signal-to-noise ratio.

Ampex Instrumentation Tape is available on hubs, NAB-type or die-cast magnesium-alloy Precision Reels. Widths of ¼", ½" and 1" are standard on either Mylar* or acetate base, in the following lengths, reel diameters, and base thicknesses:

AMPEX STANDARD TAPE LENGTHS (feet)

REEL DIAMETER	BASE THICKNESS (mils) 1.0	1.5
7"	1800	1250
10½"	3600	2500
14"	7200	5000

*DU PONT TRADEMARK

For complete specifications or additional tape literature, write

AMPEX MAGNETIC TAPE

934 CHARTER STREET, REDWOOD CITY, CALIF.

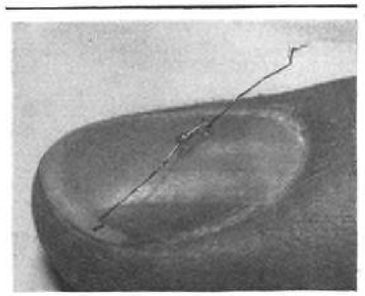
Rome Air Development Center. A conventional VOR ground station transmits a 30 cycle-per-second amplitude modulated variable-phase signal which is compared with a 30 cps. frequency modulated reference signal in the airborne receiver to determine airplane bearing to the ground station. In the new Doppler-VOR, these two functions are interchanged with the amplitude-modulated signal serving as the reference and the frequency-modulated signal serving as the variable-phase reference which indicates airplane bearing to station.

Doppler-VOR requires more elaborate antenna installation than conventional omnirange. Installation tested by FAA used an array of 50 loop antennas equally spaced around the periphery of a 44 ft. diameter circle. Each antenna is successively excited by means of a commutator with single sideband RF energy which is 9,960 cps. higher than the carrier frequency, producing the effect of a single antenna on a 22-ft. arm, rotating at a speed of 1,800 rpm.

This rotation produces a Doppler shift of 480 cps., corresponding to the 480 cps. frequency modulation deviation of the 9,960 cps. subcarrier employed in a conventional VOR station.

Because the frequency modulation is produced by Doppler shift due to apparent rotation of the ground station antenna, the FM deviation (modulation magnitude) will change as the vertical angle between airplane and ground station changes. It will be a maximum when the aircraft is out at long range and/or low altitude, and a minimum when airplane is directly over station.

This has no adverse effect on airborne receiver determination of VOR bearing, Servo Corp. says, and makes it possible to determine the vertical angle between airplane and the ground station with an accuracy of approximately 15 deg. at angles above 15 deg. by means of a suitably calibrated voltmeter connected across the airborne receiver's FM detector. Voltmeter is adjusted for maximum reading when VOR station is on the radio horizon. When the voltmeter reads 71% of full scale, for example, angle between airplane and station is 45 deg., or 60 deg. when meter reads half-scale.



World's Smallest Lamp

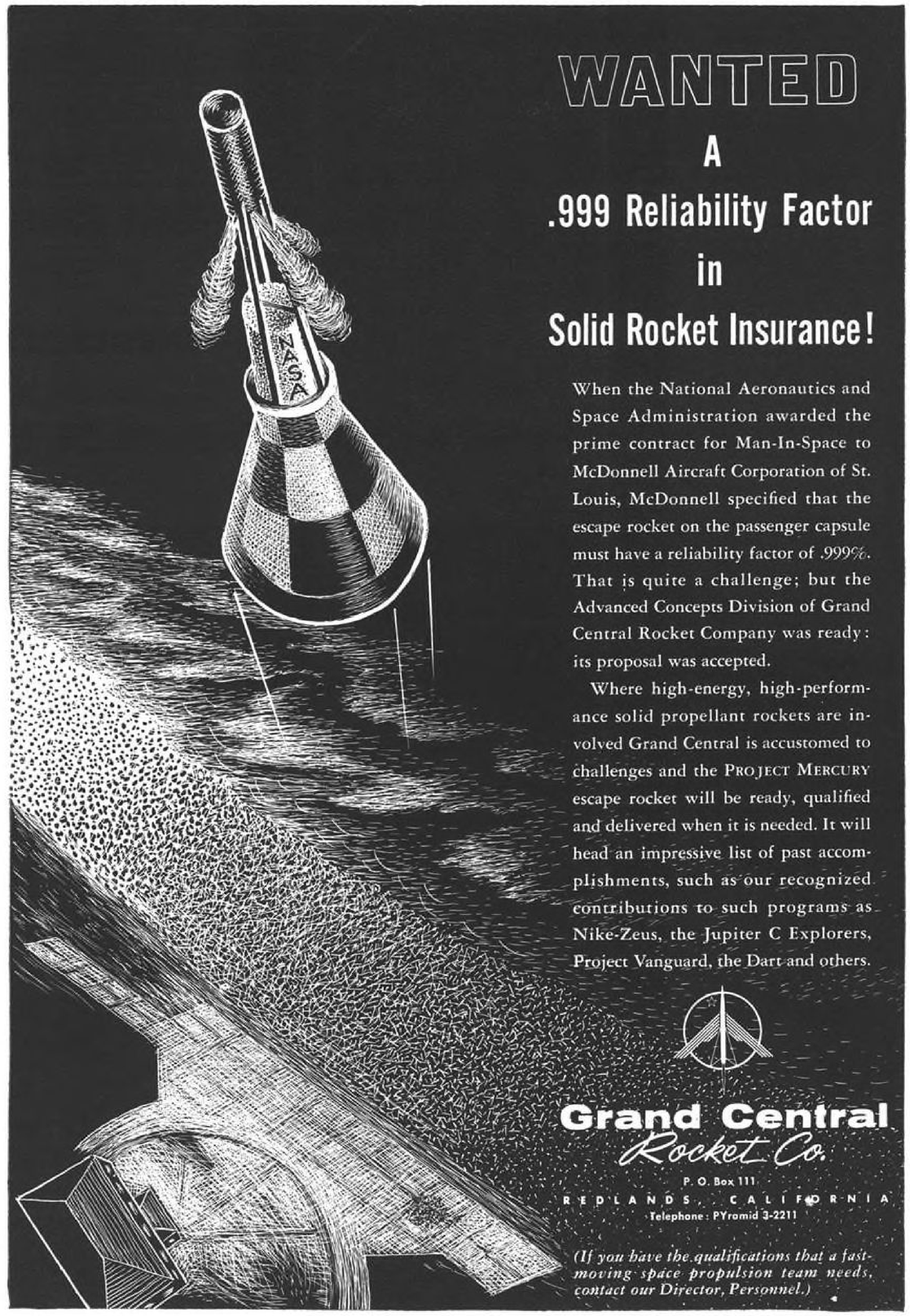
Tiny indicating lamp, measuring only 0.03 in. in diameter by 0.1 in. long, developed by Army's Diamond Ordnance Fuze Laboratory, consumes only 40 ma. current at 1½ v., making it suitable for use as computer flip-flop position indicator (AW Jan. 12, p. 67).

FILTER CENTER

► **Tubes Vs. Transistors**—Recent action by eight leading vacuum tube manufacturers in forming an Electron Tube Information Council to encourage equipment designers to use tubes "where they offer superior properties" over transistors, may be a case of locking the barn door after the horse is stolen. Nearly four years ago, an AVIATION WEEK survey of major avionics manufacturers revealed that solid-state devices already had replaced tubes in 22% of the sockets of equipment then under development and that figure was expected to rise to 50% by 1957. Receiving tube sales for 1958 were down 13% from the previous year, while transistor sales were 64% higher than in 1957, in terms of number of units sold.

► **Voice of Experience**—Human voice that automatically warns pilot of cockpit emergencies, tells him specifically what is wrong and what action to take, may replace the blinking lights and raucous horn now used to indicate an emergency situation. Automatic voice warning system under evaluation at Wright Air Development Center consists of 12 prerecorded taped messages each of 15 sec. duration. Typical message in event of engine fire might be as follows: "Fire . . . Fire in number three engine . . . Check engine operation to verify if fire is present . . . Feather number three engine . . . Pull number three engine fluid shut-off handle . . . Pull number three engine fire extinguisher." Idea was conceived by John W. Teegarden of WADC's Aeronautical Accessories Laboratory. Prototype equipment was constructed by Northrop's Nortronics Division.

► **New Type Transistors Coming**—Watch for the semiconductor industry to bring out a family of new very high temperature transistors and diodes, capable of operating at temperatures up to 400C, made of indium phosphide and gallium arsenide. Texas Instruments, first to hit the market with silicon transistors several years ago, already has announced a gallium arsenide diode for operation at 325C (AW Mar. 30, p. 33). New semiconductor materials are expected to yield transistors



CAN SYNCHROS BE MOISTURE-PROOFED?

Thanks to the special materials and construction of improved Ketay synchros, the moisture-resistance standards of Mil Spec 20708 (superseding all previous specifications) can be met *or exceeded.*

Many of these special materials and design features are exclusive with Ketay . . . the only source currently manufacturing and shipping a wide range of the new Mil-type synchros.

Stainless steel housing, shafts, and bearings . . . stators potted in anti-fungus epoxy resin . . . hermetically sealed windings . . . thru-bore construction for fewer parts and less space where moisture can collect . . . these and a variety of other Ketay features all give extra protection against moisture damage.

For high performance and dependability, despite extremes of humidity and temperature, specify Ketay synchros and other precision components, available in production quantities in sizes from 8 to 23. Sixty cycles per second units are available as small as size 15. Units one or more sizes smaller and lighter than previously required can often be used, because of Ketay's superior accuracy. Units of 3′ and 2′ accuracy are available for immediate delivery.

Ketay engineers are working with manufacturers whose prototype systems have unusual environmental and accuracy requirements. Call or write for help in solving your special problems.

Ketay precision components:
SYNCHROS
RESOLVERS
POTENTIOMETERS
SERVO MOTORS
TACHOMETERS
SERVO AMPLIFIERS
GYROMECHANISMS
Catalogues available

NORDEN Division of United Aircraft Corporation

KETAY DEPARTMENT, Commack, Long Island, N.Y.

Klystron Tube

Super-power klystron tube for pulsed radar use at L-band has been successfully tested at peak powers of 15 mw. with 22½ kw. average power level. General Electric, which developed new tube, says it is developing other models with higher power ratings and increased bandwidth.

with frequency response which is better than silicon, but probably not as good as germanium. Silicon carbide semiconductors, capable of operating at 500C or higher, appear to be still in the future, although diodes of the new material are nearly ready for the market.

► **Signed On Dotted Line**—Major contract awards recently announced by avionics manufacturers include:

• **Melpar** will design microwave antennas for Project Mercury manned satellite, under subcontract from Collins Radio which holds avionics system subcontract from McDonnell Aircraft, which is developing the Project Mercury manned space capsule.

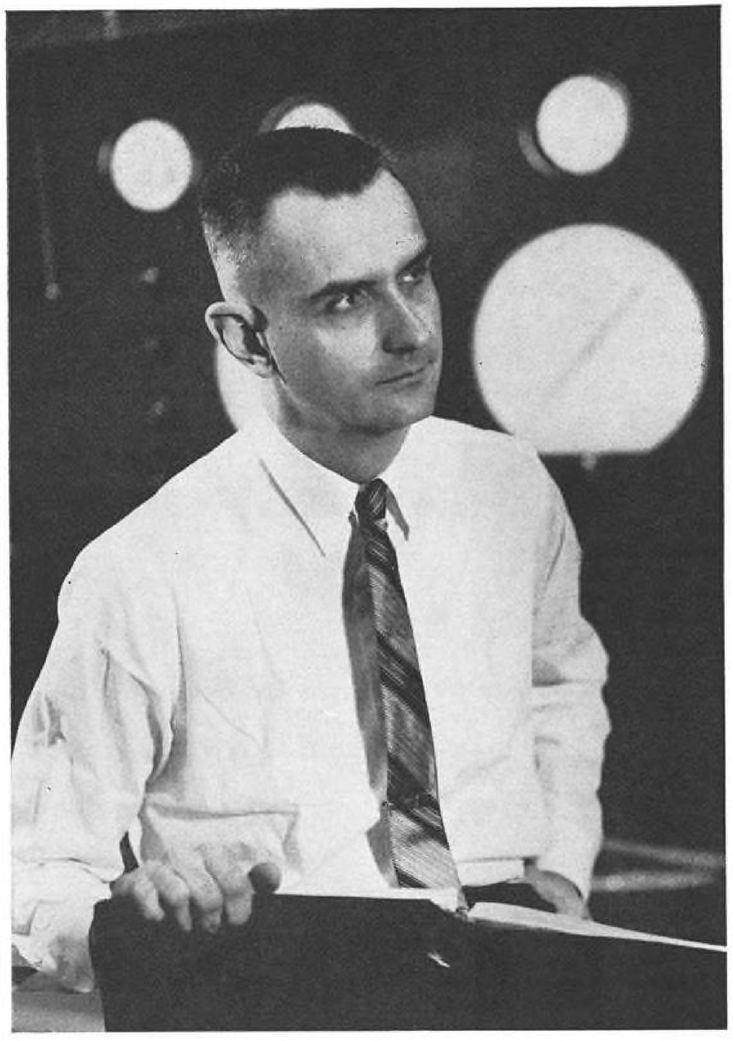
• **Sperry Phoenix Co.,** Phoenix, Ariz., contract for $7.5 million from Air Force for remote guidance and control systems for pilotless QF-80 jet drones.

• **Laboratory for Electronics, Inc.,** Boston, letter contract for $3.6 million for AN/APN-105 Doppler navigator systems. Final definitive contract is expected to be more than $18 million.

• **Beckman Instruments, Inc.,** $391,000 contract from Bendix Aviation for 30 data handling systems to be incorporated in automatic check-out equipment for Talos missile.

• **Motorola,** Military Electronics Division, Phoenix, Ariz., $280,000 from Space Technology Laboratories for advanced telemetry receiver employing phase-lock techniques.

• **Collins Radio Co.,** Cedar Rapids, Iowa, order for $8.4 million from Marine Corps for AN/TRC-75 single sideband systems for tactical field use.



Here is a man you should know he's a DELAVAN FUEL INJECTOR SPECIALIST

His name is Roger W. Tate. He did his doctoral research in the field of pressure atomization at the University of Wisconsin, has taught reaction kinetics, and worked on process improvements for petroleum refining.

Dr. Tate is Director of Research at Delavan. He has developed many atomizing devices and uniquely accurate test equipment for Delavan. He is widely known for his research on spray analysis and fuel injection.

Specialized talent like Dr. Tate's is the main reason for Delavan's leadership in fuel injection. If fluid metering and atomization are part of your product, take advantage of Delavan's specialized experience and ability to deliver aircraft quality. Send specifications to the address below for free recommendations.

DELAVAN *Manufacturing Company*
West Des Moines, Iowa
World's largest nozzle specialist

Honeywell puts man in space –at zero altitude

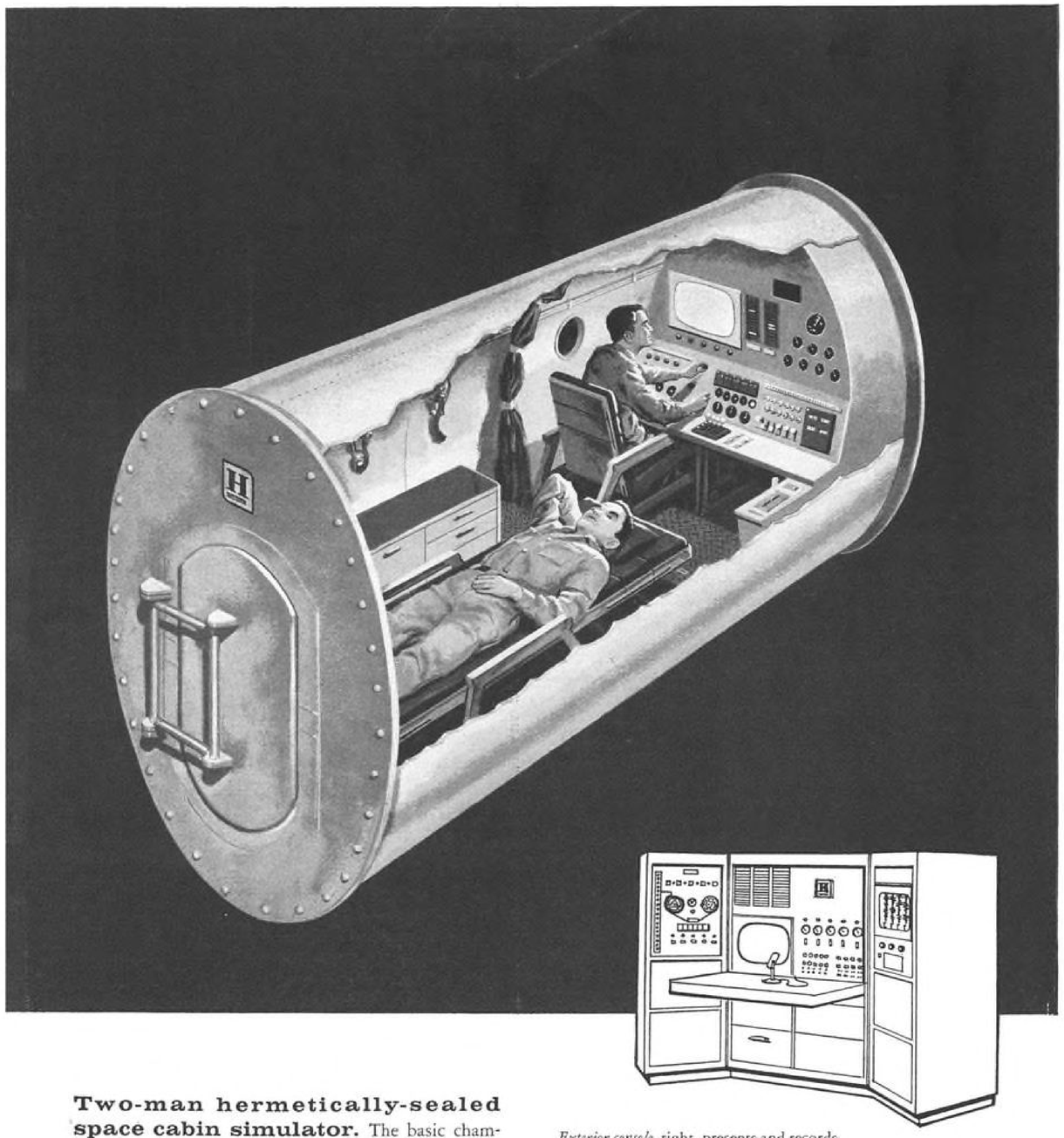
Advanced space environment simulator will isolate two men in Honeywell-controlled space flight environment during unprecedented 30-day test

As ANOTHER step toward man's conquest of space, Honeywell will provide the USAF School of Aviation Medicine with an environment simulator for use in researching human reaction to isolation in space. The test capsule developed by Honeywell will hold two men and all the life-sustaining materials they need for 720 hours. It provides a completely self-sufficient environment contained in a 12- x 6- x 5-foot package. When man travels space, the air he breathes, the food he eats, temperature control, waste disposal, and all other basic elements must be precisely planned and controlled. This poses intricate problems involving toxic gas, filtration, oxygen, lighting, and many others. In solving them Honeywell utilizes advanced engineering techniques developed during more than 70 years of leadership in environmental control.

Honeywell Capability

Human environment, however, is only one of many fields in which Honeywell can demonstrate space-flight capability. For example: *Guidance and Stabilization.* Honeywell's reference system is a remarkably accurate means of missile guidance and control proved in actual applications. *Flight Control.* Honeywell has more experience in the field of flight control than any other company. Proved systems include autopilots, reaction controls, jet vane controls, thrust vector controls and automatic landing systems. *Data Processing.* Honeywell capability includes sensing, recording, transmitting and interpreting. *Ground Handling.* Some of the most extensive and complex work done by Honeywell in the missile field concerns the development and operation of test and checkout equipment. This work includes depot overhaul and maintenance equipment, base level overhaul and maintenance equipment, and launch site checkout equipment. Additional Honeywell experience includes instruments, auxiliary airborne power systems and research into human factors, both biochemical and psychological.

If you have a problem in the design of systems or components in the field of space flight, call or write Honeywell, Military Products Group, 2753 Fourth Ave., South, Minneapolis 8, Minnesota.

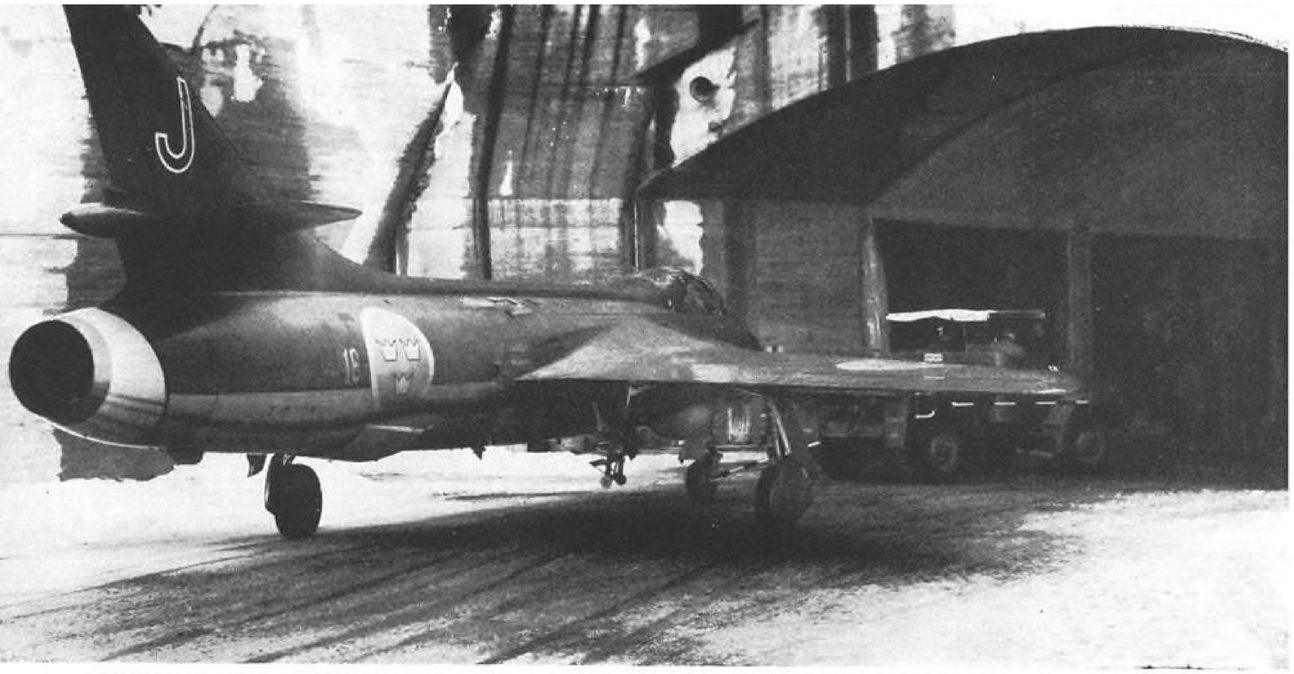


Two-man hermetically-sealed space cabin simulator. The basic chamber of the simulator will contain equipment that would be found in actual space flight. Oxygen, carbon-dioxide, toxic gases, temperature and humidity are constantly and individually sensed and compared to a set value. When safety limits are exceeded an error signal is amplified and corrective action is automatically begun. A sufficient water supply and facilities to insure personal cleanliness will be provided. Ample storage facilities for nonperishable foodstuffs will be provided for the 30-day isolation.

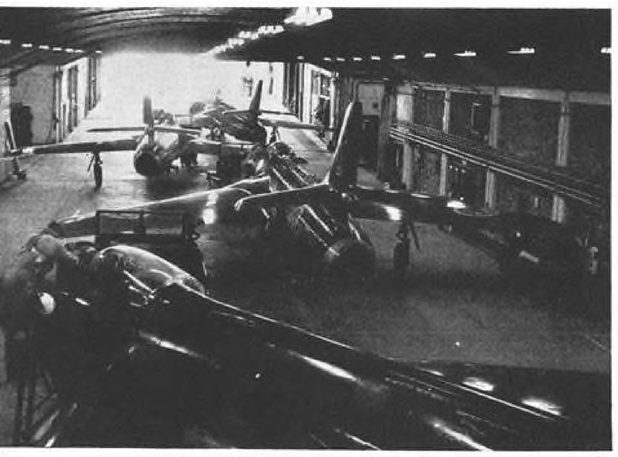
Exterior console, right, presents and records data concerning conditions inside the capsule. Permanent records will be kept by audio recording, TV kinescopes, and camera equipment.

Honeywell

Military Products Group



REFUELED HAWKER HUNTER returns to underground hangar to be checked and made ready for the next scramble.



PILOTS AND AIRCRAFT of the 18th Day Fighter Wing's first flight of four stand in the main gallery leading to the ramp (above), ready to roll on word from the control center. Ground crew manhandles a Hunter (below, left). Towing vehicle is hooked to nose-wheel. Planes are towed part way up ramp (below, right); pilots start engines and tow vehicles run ahead of aircraft to turnoffs.

ROYAL SWEDISH AIR FORCE Mk. 50 Hunters of the 18th Fighter Day Wing at Tullinge take off in a scramble over trees surrounding field, 16 mi. south of Stockholm. Wing comprises three flying squadrons; letter on tail identifies aircraft within a squadron.

Swedish Air Defense, Part I:

Swedish Planes Stand Alert Below Ground

By David A. Anderton

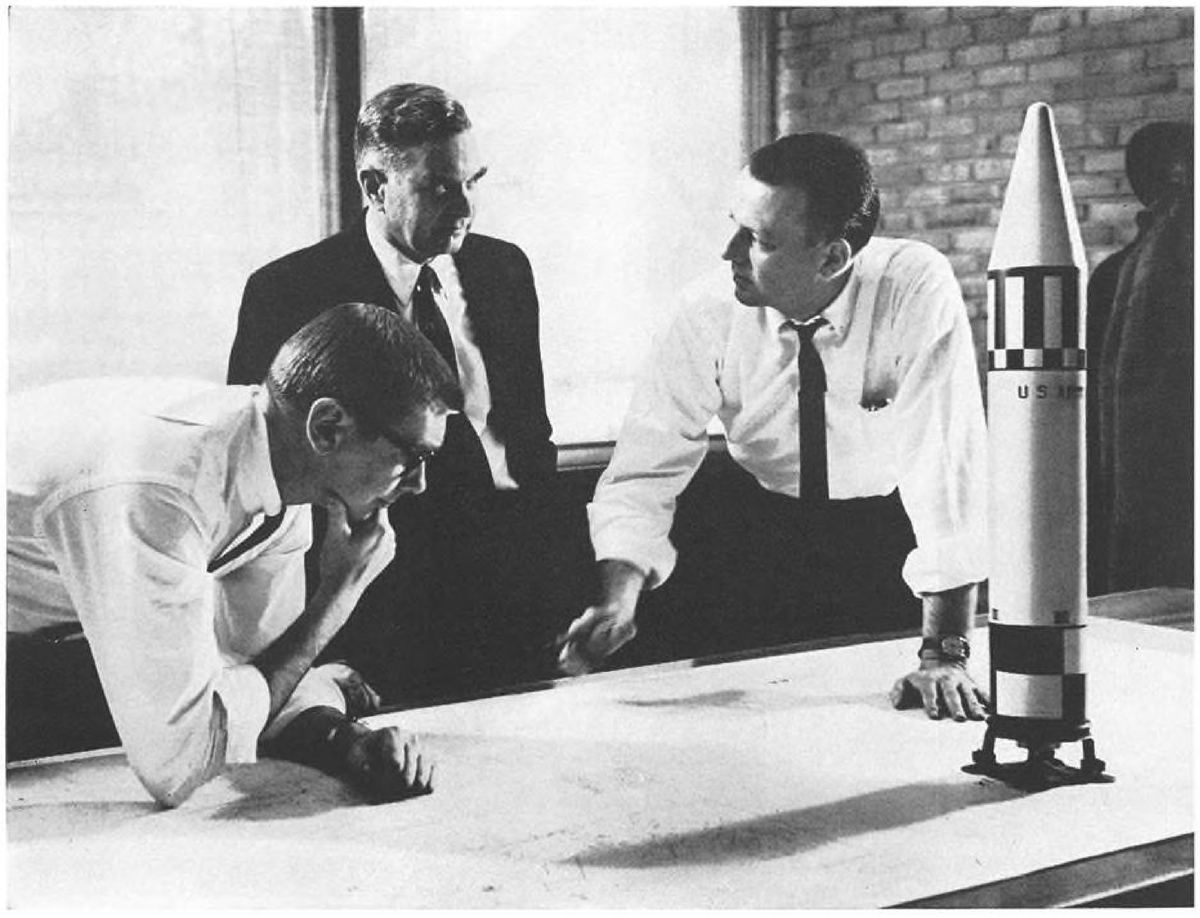
Air Base F18, Sweden—Pilots and planes of the Royal Swedish Air Force stand alerts in the underground hangars blasted out of the deep strata of solid granite here.

This base, partly buried under the rolling land near Tullinge, 16 mi. south of Stockholm, is home for the 18th Day Fighter Wing (Kungl. Södertörns Flygflottilj). This unit and the 8th DF Wing, stationed at Barkarby, are assigned to the air defense of Stockholm. Both are equipped with Hawker Hunter Mk. 50 interceptors bought from Britain a few years ago, and now rearmed with American Sidewinder infrared homing missiles.

Deep under the tree-covered con-

IN GOOD WEATHER Hunters wait outside the underground hangars on the hardstand area.

DOW | MAGNESIUM



a comparison:

4 MAGNESIUM ALLOYS for elevated temperature service

A wide variety of elevated temperature alloys extends the use of lightweight magnesium into the critical 300°-800°F. temperature range.

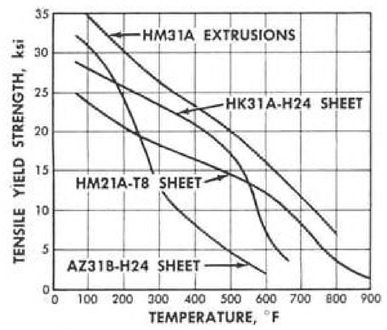
Name your weapon—Jupiter C, Polaris, Talos, Discoverer, Falcon or Bomarc. All make extensive use of elevated temperature magnesium alloys. Improved resistance to creep, increased stiffness and strength and exceptional shop characteristics are the long suit of these materials. At elevated temperatures they maintain a high ratio of fatigue strength to static strength. (About the same ratio as standard magnesium alloys at room temperature.)

SHEET AND PLATE

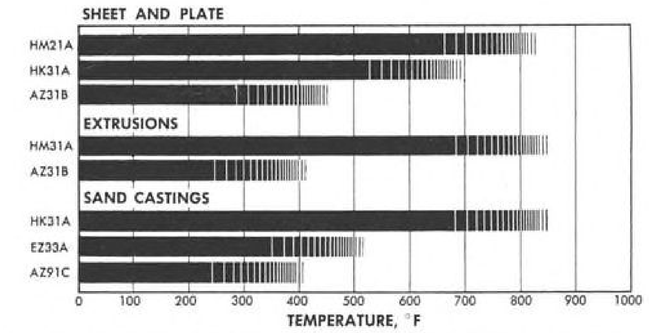
Alloys HK31A and HM21A have been widely used for many different parts in missiles, rockets and aircraft. Some of the most common applications include body skins, engine air inlets and ducts, nose cowlings and cones, external and internal skins on control surfaces. HK31A extends the usefulness of light-weight magnesium to a temperature of 500°F. and above. HM21A withstands temperatures up to 700°F. and higher for short time periods. And it exhibits better creep resistance above 350°F. and better static properties above 550°F., than does HK31A.

FORGINGS

At operating temperatures up to 800°F., HM21A offers excellent mechanical properties, optimum creep resistance. HK31A has better room and elevated temperature properties up to 400°F. Both have good forgeability.



New alloys have extended magnesium's useful service temperature range.



A comparison of short-time tensile yield strength exhibited by a standard magnesium alloy and the commonly used elevated temperature alloys.

CASTINGS

Engine air inlets and ducts and housings for electronic guidance systems are examples of the many applications of cast magnesium alloys HK31A and EZ33A. EZ33A has good general properties in the 350°-500°F. range. HK31A is recommended up to 700°F. and above. Components of military systems weighing as much as 105 lbs. have been cast in one piece with HK31A. A new elevated temperature alloy for die casting is now in development and will soon be available.

EXTRUSIONS

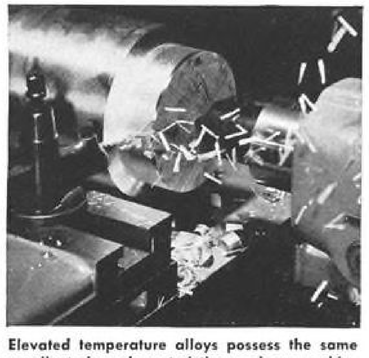
Alloy HM31A has put the many benefits of elevated temperature magnesium into extrusion form. This alloy is used as ribs and horizontals in missile bodies, instrumentation booms and external tunnel fairings for wiring and plumbing, etc. HM31A maintains high elastic modulus, excellent creep resistance and strength at elevated temperatures. Elevated temperature exposure at 600°F. for 1,000 hours causes no change in room temperature properties and only a slight drop in creep strength.

ELEVATED TEMPERATURE MAGNESIUM EXCELS IN PRODUCTION

The elevated temperature alloys possess the best welding characteristics of all magnesium alloys. Arc welded joints can be easily made and welding compatibility of magnesium alloys is excellent. For example, HK31A sheet can be welded to HM31A extrusions.

Weld efficiencies at room temperature range from 70% to 80%. At temperatures above 400°F., HK31A has a weld efficiency of 100%. The same goes for HM21A above 500°F. In general, preheating and stress relieving are unnecessary with these alloys. They can be readily spot welded and are not subject to cracking.

Machining operations can be carried out at extremely high speeds, with heavier depths of cut and higher rates of feed than are possible with other metals. All chemical treatments used to finish standard magnesium alloys are applicable to the elevated temperature alloys, with the exception of Dow 7, which does not coat satisfactorily on magnesium-thorium alloys. For extended service above 400°F., the anodic treatments are preferred.



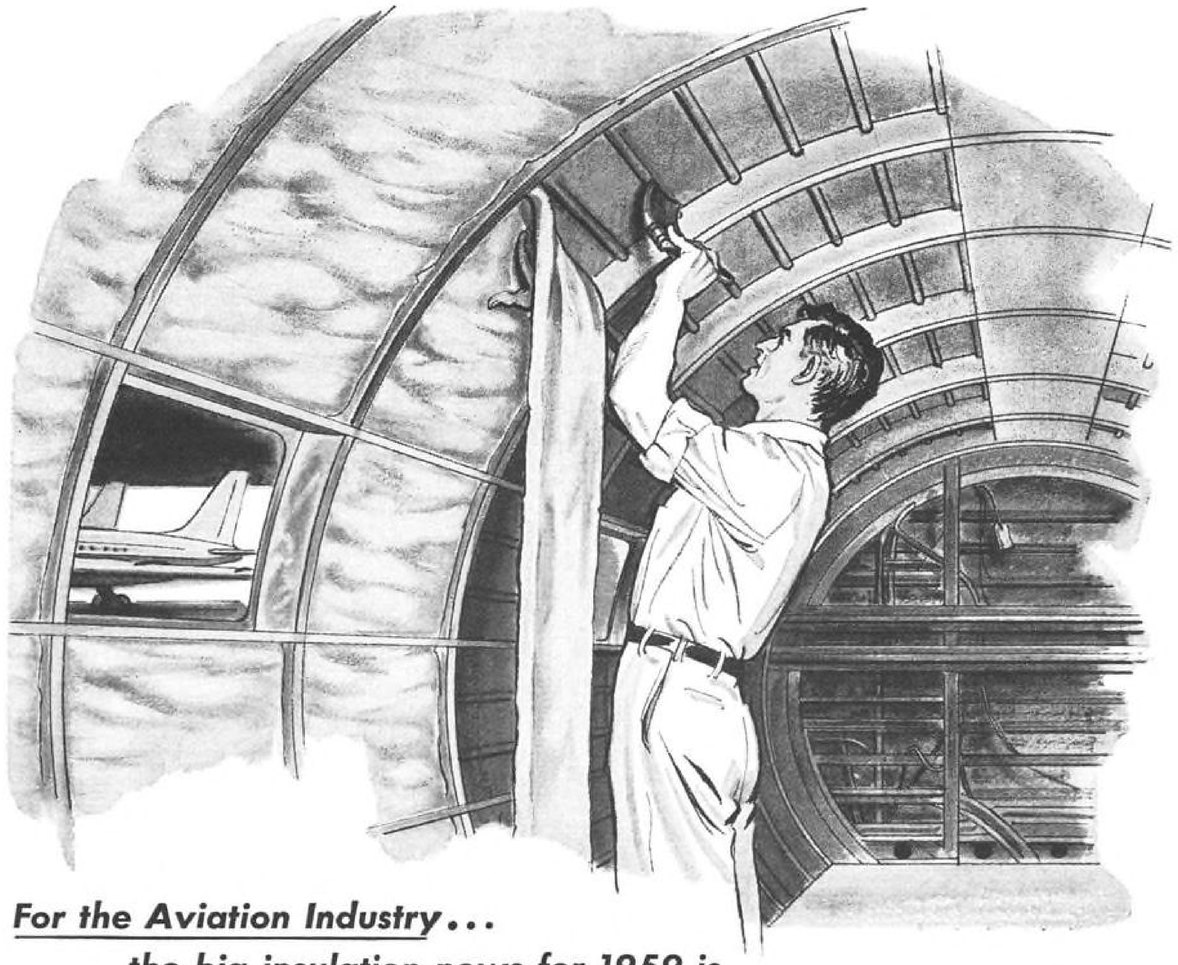
Elevated temperature alloys possess the same excellent shop characteristics—such as machining, forming and welding—as the standard magnesium alloys.

MAGNESIUM ALLOYS FOR ELEVATED TEMPERATURE APPLICATIONS

SHEET	HK31A HM21A
PLATE	HK31A HM21A
FORGINGS	HK31A HM21A
CASTINGS	HK31A EZ33A
EXTRUSIONS	HM31A

WRITE TODAY for this new 27-page illustrated brochure on magnesium alloys in aircraft and missiles.
THE DOW CHEMICAL COMPANY,
Midland, Michigan,
Magnesium Sales Dept.,
1301X3-30.

THE DOW CHEMICAL COMPANY · MIDLAND, MICHIGAN



For the Aviation Industry...

the big insulation news for 1959 is

JOHNS-MANVILLE FIBER GLASS

With L·O·F Glass Fibers Company joining the Johns-Manville family, your J-M representative can now supply numerous fiber glass materials for thermal and acoustical insulation in aircraft.

For pre-fabricated insulations—the up-to-the-minute engineering and production facilities of the newly acquired J-M plant at Corona, Calif., are at your service. Backed by advanced research and starting with our own high-quality insulating materials, the modern J-M machinery and skilled personnel can help you meet production schedules at lowest unit cost. Typical operations include: completely formed metallic jacketed components; preformed insulation panels; blankets with non-metallic covering such as coated glass cloth and plastic films.

For high, medium and low temperatures—a complete line of Thermo-Jet insulations gives efficient thermal resistances up to 3000 F. Bulk or felted *Micro-Quartz*®—vibration-resistant, binderless insulations with unusually low density and high thermal-resistance-to-weight ratio—for service in the order of 2000 F continuous, 3000 F intermittent. Glass *Micro-Fibers*—in same forms—for service up to 1000 F (1500 F in some cases). Lower cost *Unbonded B Fibers*, approaching the 1000 F limit, work well with the above as a second or third stage in "breaking down" extreme temperature differentials.

For aircraft noise-reduction—a complete line of J-M Coustic-Aire fiber glass insulations, pre-fabricated into between-frame and over-frame blankets—laminated, quilted or tufted, with a wide selection of facings, septums and fasteners.

In the aviation industry, as in many others, buyers of fiber glass products will now be served by an enlarged staff of J-M sales and technical personnel operating out of 56 sales offices . . . by expanded distribution facilities . . . by the addition of 7 strategically located plants and by expanded research and development of fiber glass products.

Call your J-M representative or write to Johns-Manville, Box 14, New York 16, N. Y. In Canada, Port Credit, Ont.

JOHNS-MANVILLE

JOHNS-MANVILLE JM PRODUCTS

tours are hangars and shops, fanning out in long galleries, like fingers on a distorted hand, from heavy doors at the feet of shallow ramps coming down from F18's taxiways.

Ranged in rows inside, fueled and armed and ready to fight, are the dark green and gray Hunters bearing the three golden crowns of Sweden on their wings and fuselages. Off in side galleries are spares, weapons, ammunition and a Hunter or two under maintenance.

Four of the Hunters are lined up behind the blast-proof door that shuts off the tunneled hangars from the outside world. Towing gear is attached to their nosewheels, and a jeep is hooked to the first in line. Other vehicles stand at the side of the hangars ready to tow the next planes in line. This will be the first flight to scramble from this entrance.

When the alarm rings, ground crews run for the vehicles, move the first Hunter toward the opening door, and hook up on the next plane in line. Pilots burst from the passageway coming from the ready room and hit the plane ladders at a run from one side, their crew chiefs springing to the steps on the other side.

Check List

They call off the takeoff check list while the plane is being towed out of the door and onto the ramp. The crew chief inspects harness, mask and other personal gear, finishes his list and jumps off. The pilot punches the engine starter button and the Rolls-Royce Avon starts a whine that grows to a shriek as the plane and its tow vehicle mount the ramp.

Behind them is another Hunter and a third and fourth, the distance between them on the order of 100 ft. All will have their engines running before they are clear of the ramp, and then the tow vehicles will break loose and streak up the taxiway ahead of the Hunters, turning off at the first opportunity and heading back to pick up the next flight.

Within a matter of a minute or so, the first flight of four is lined up and ready to take off. They scramble in pairs, the Hunters clawing for altitude at the end of the 2,000-meter strip, hurtling up and over the tall evergreens that surround the runway.

This is the alert-and-scramble pattern typical of the units based beneath the surface of the tree-covered earth of southern Sweden.

This underground base at F18, like others scattered through Sweden, like air raid shelters in southern cities, and like portions of the Saab Aircraft Co.'s plant at Linköping (AW Mar. 31, 1958, p. 64), was designed on the basis of early knowledge about the effects of nu-

TANK TRUCK replenishes fueling points, replacing fuel drawn by aircraft after sorties.

MK.50 HUNTER next to its portable fueling tank farm is readied for a flight.

THREE IDLE HUNTERS stand by taxiway at F18 in shrouds to keep ice off surfaces and to camouflage the planes. Snowfall serves as natural camouflage for the installation.

Now 4 CHR High Temperature TEFLON® Tapes

Temp-R-Tape adheres securely to bar heated to 520°F during high temperature resistance test.

Pressure-Sensitive TEFLON Tapes

easy to apply in both electrical and mechanical applications

The electrical uses of Temp-R-Tape include slot lining, interlayer and interphase insulation, harness bundling, wrapping for microwave components, transformer coils, capacitors and high voltage cables, etc.

As a low friction, non-stick facing, Temp-R-Tape applications range from facings for film guides in sensitive electronic instruments to the facing for heat sealing bars, forming dies, chutes, guide rails, etc.

Chemical resistant facing applications include masking tape in high temperature dipping operations.

All four of these pressure-sensitive Teflon tapes are available from stock in rolls and in sheet form. In addition to Teflon tapes, CHR also makes a fiberglass tape with thermal curing, pressure-sensitive silicone adhesive (Temp-R-Tape GV) and silicone rubber coated fiberglass tape with thermal curing, pressure-sensitive silicone adhesive (Temp-R-Tape SGV).

FREE SAMPLES and folder — write, phone or use inquiry service.

— *−100°F to 500°F applications*
— *Class H and Class C insulation*
— *Non-stick and low friction facing*
— *Chemical resistant facing*

TEMP-R-TAPE T is a .006" pressure-sensitive Teflon tape with −100°F to 400°F (−70°C to 200°C) temperature range. It has high dielectric strength, low power factor, negligible moisture absorption, high elongation, is non-corrosive and non-contaminating. Meets Class H Temperature requirements.

TEMP-R-TAPE TH is a .013" pressure-sensitive Teflon tape with −100°F to 400°F temperature range. It is similar to Temp-R-Tape T except that it is made of .010" Teflon film to which .003" silicone polymer adhesive has been added. Often used where a single, thicker dielectric barrier is desired or where a more rigid, abrasion resistant wrap is required.

TEMP-R-TAPE C is a .002" pressure-sensitive, thermal curing Teflon tape with −100°F to 500°F temperature range. It is made with a cast Teflon film which provides dielectric strength (2750 v/m) higher than any other type of Teflon film. When cured in place, it will operate at temperatures up to 500°F and will withstand much higher temperatures for short periods. Meets Class H and Class C temperature requirements.

TEMP-R-TAPE TGV is a thermal curing, pressure-sensitive Teflon impregnated fiberglass tape with −100°F to 500°F temperature range. Although it is used extensively for mechanical and electrical applications, its dielectric strength is lower than other Temp-R-Tapes.

CHR products include:

COHRlastic Aircraft Products — *Airframe and engine seals, firewall seals, coated fabrics and ducts*

COHRlastic Silicone Rubber Products — *Silicone rubber moldings and extrusions, silicone rubber sheets, silicone sponge rubber*

Temp-R-Tapes — *Pressure sensitive, thermal curing Teflon and silicone tapes*

Allied Products — *COHRlastic silicone cements and conductive gasketing*

CHR Leader In Fabrication of Silicone Rubber

CONNECTICUT HARD RUBBER COMPANY

Main Office: New Haven 9, Connecticut

TOW vehicles are used to haul aircraft out of hangars and up ramp until engines are started.

clear weapons. First of the bases went underground about 11 years ago.

In contrast, construction for a similar type of underground base, to house a combat operation center for North American Air Defense Command, will start this coming July.

No major centers or bases in the United States are currently underground, although there is growing realization of the need.

These bases were designed when only conventional nuclear weapons were the threat; the hydrogen-bomb hammer was yet to be demonstrated. But conservatism in the basic planning has paid off; Swedish engineering experts believe the bases are proof against anything but a near hydrogen-bomb hit or a heavy atomic bomb.

In addition to the obvious defensive protection of a fighter base or a ground control center, these underground buildings serve practical, essential purposes in a country where winter is as much an enemy as any strike force out of the East.

Three-Part Series

This is the first of three articles on the Royal Swedish Air Force's air defense operations by David A. Anderton, European editor of Aviation Week, who was officially invited to inspect two Swedish air defense installations.

Part II will cover the work of the winter test establishment at Lulea, Sweden's northernmost permanent air base, and the reconnaissance squadron there.

Part III will describe how the Swedish Air Force maintains operational status in a cold weather environment.

Underground there is no ice on the apron, no biting wind, no freezing cold.

Camouflage of an air base, one of the most difficult tasks facing military engineers, is somewhat simplified by an underground layout. The runways still stand out like sore thumbs, but even their signposting effect can be minimized by eliminating standard runway markings and by some judicious use of paint.

Snow Camouflages

Snow, which covers the ground for a large portion of the year, is the best answer. Plowed and properly cleared runways are quite difficult to spot from the air. This field, for example, lies almost under the flight path of commercial transports approaching Stockholm's Bromma airport from the south. The non-professional observer is apt to dismiss it, as we did, as an abandoned field.

Highly trained observers or bombardiers might not be completely sure on first sight, and the hesitation might be enough to abort the first run over a target area.

F18 has storage capacity for part of its wing of Hunters and their supporting services of maintenance, overhaul and repair in underground hangars. The base itself has some surface structures which will be used until the underground complex is completed.

The subterranean structure was blasted out of the granite in long tunnels, with high arched ceilings like standard surface hangars. Each gallery of the structure is big enough to take perhaps four Hunters, and the separate galleries are angled away from each

A Personal Invitation to

ENGINEERS

from ROBERT McCULLOCH
President

"If you would like to be a member of a select corps of Engineers, working for an interesting, growing company . . in one of the country's most stimulating areas . . I invite you to write to Temco. Temco's growth is sound and planned, its products are diversified and challenging, our facilities are modern. Every benefit, for you professionally and in good living for you and your family, is here. Below are some of the areas in which jobs are open now."

MISSILE WEAPONS SYSTEMS
(Senior Sales Engineer)

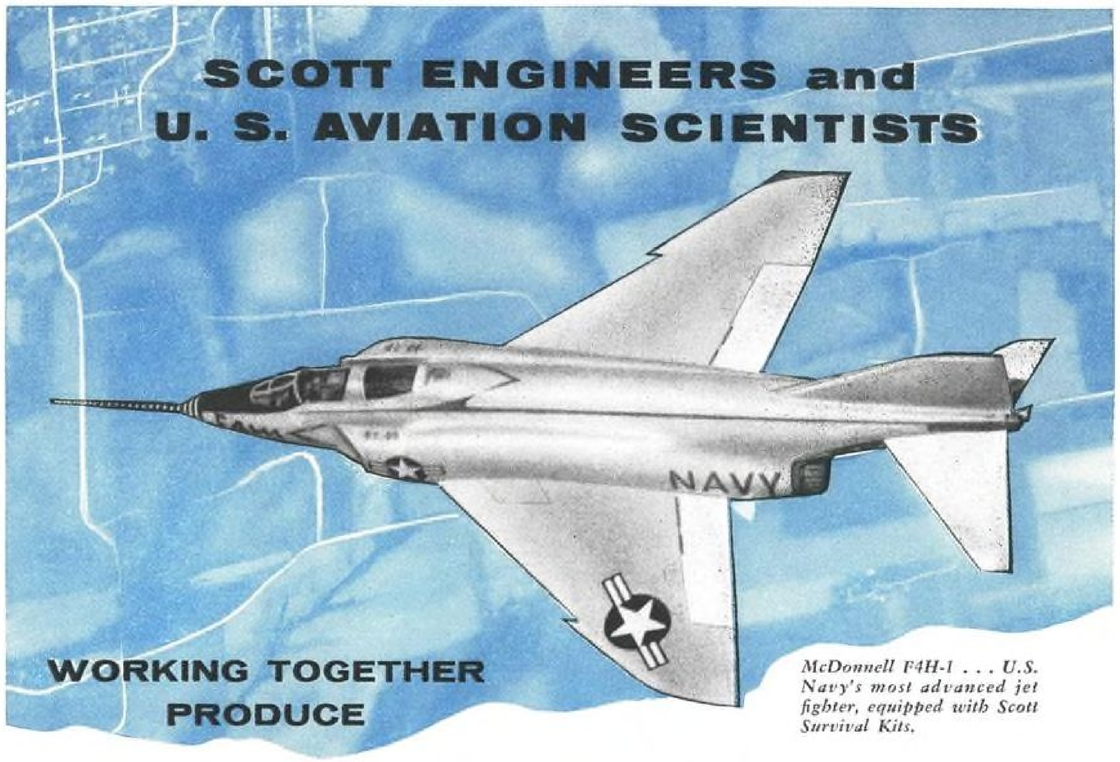
Opportunity exists for graduate engineer with ten to fifteen years' industry and military service background, emphasizing missile weapons systems sales and electronics systems applications. As Senior Sales Engineer, he will be responsible for contacting military agencies for determination of weapons systems requirements, coordinating the preparation of company proposals, and presenting the proposals to the prospective customer.

ELECTRONIC PRODUCTS AND SYSTEMS
(Sales Engineer)

Opportunity exists for graduate Electronics Engineer with eight to ten years' of industry and military service background in sales and/or design of electronic products and systems, emphasizing radar, antennae, and computers. As Sales Engineer, he will contact military agencies and commercial organizations for determination of electronic products and systems requirements.

Write BILL G. HICKEY
Supervisor Technical Employment
Room 204A, P. O. Box 6191

TEMCO
AIRCRAFT CORPORATION • DALLAS 22, TEXAS



McDonnell F4H-1 . . . U.S. Navy's most advanced jet fighter, equipped with Scott Survival Kits.

The Most Advanced Oxygen Systems and Survival Kits

Scott research and development combined with the knowledge and experience of U. S. Aviation Scientists have produced new, completely integrated oxygen systems for use with full and partial pressure suits in military aircraft ejection seats. In flight or ejected, his life is Scott protected.

OTHER SCOTT CONTRIBUTIONS TO THE SAFETY OF MILITARY AIRCRAFT

SCOTT PORTABLE TESTER FOR GLOBAL SURVIVAL KITS

Model 20600 FSN: 4920-654-8452

Eliminates aborted flights caused by malfunction of oxygen equipment. Provides preflight cockpit testing of survival kit oxygen systems. Completely portable and self-contained — no external power source or connections required.

SCOTT AIR-PAK — 6000A2MS
FSN 4240-542-4087

Quickly donned protective breathing equipment for aircraft fire fighting and missile ground handling. Wearer breathes cool fresh air, comfortably . . . easily. Scottoramic Mask gives wearer unlimited vision in all directions to minimize danger.

SINCE 1932 Scott FOR SAFETY—FOR SERVICE

SCOTT AVIATION CORP.
275 ERIE STREET • LANCASTER, N. Y.
Export: Southern Oxygen Co., 250 W. 57th St., New York 19, N. Y.
West Coast Office:
Fulton-Ventura Bldg., 13273 Ventura Blvd., Studio City, Calif.

other so that a blast in one would be contained within that area and not cause damage to the others.

Each group of galleries has an entrance door, a heavy blastproof structure that slides back into the surrounding granite. From the door, an inclined ramp leads up and out to the nearest taxiway. This ramp is angled, and the rocky ground on either side of it forms a banked protection shielding the entrance from blast effects from almost any angle except, of course, directly in front.

The angular layout of the ramp protects the largest part of the hangar area also, and even a high-explosive burst practically at the front door would cause minimal damage.

F18's underground base was one of the first and, as such, lacks some of the complex systems being planned for newer bases and for the expanded galleries here. For example, fire extinguisher systems will be installed in new bases, but F18 is currently with standard CO_2 carts at many locations throughout the work and storage area.

Ventilation is ample in the F18 complex, but not enough to permit starting engines underground. Newer bases coming along will have air and baffle systems that will allow engine starts while planes are still inside the hangars.

Pilots' ready rooms, shops and other auxiliary areas are also underground.

Perhaps the closest comparable station is a modern aircraft carrier. To the observer, the comparison between these lofty well-lighted work areas underground and the hangar deck of a modern carrier is surprisingly apt.

F18 at Home

The 18th Wing, commanded by Col. K. E. G. Raab, is typical of any of the units of the Royal Swedish Air Force, and F18 is a typical base. It's an operational base only; there are no family housing units, just hangars, shops, headquarters building, barracks, a small BOQ for duty pilots standing alerts, and mess halls.

Here as throughout Sweden married officers and enlisted men live on the economy and off the base. Total personnel attached to the wing is approximately 500-600, a figure that increases substantially in wartime.

Organization of the wing is also standard for the RSAF: There are three flying squadrons and one ground squadron to handle support, guard duties and base housekeeping. Squadron designation is uniform throughout the RSAF. The three flying units are called No. 1 (Red), No. 2 (Blue) and No. 3 (Yellow).

Planes within the squadrons are identified by a single letter painted in the squadron color on the vertical tail. Radio identification for each plane is

Heli-Coil® Stainless Steel Screw-Lock Insert is easily wound into tapped hole in lightweight aluminum housing. Spring tension of the locking coil retains screw securely, meets military specifications for locking torque and vibration.

How Carrier Corporation
Saves 40% in weight • 30% in assembly time
...with *HELI-COIL*® SCREW-LOCK INSERTS*

Use of aluminum lightens Carrier refrigeration system in Douglas DC-8 Jetliner

To reduce weight in the refrigeration system designed for air conditioning the giant Douglas DC-8 Jetliner, Carrier engineers used aluminum alloy compressor castings. To obtain maximum performance and reliability of threaded connections exposed to heat and vibration encountered at 600 mph, they selected the *Heli-Coil* stainless steel wire thread, *internal locking* Screw-LOCK Insert.

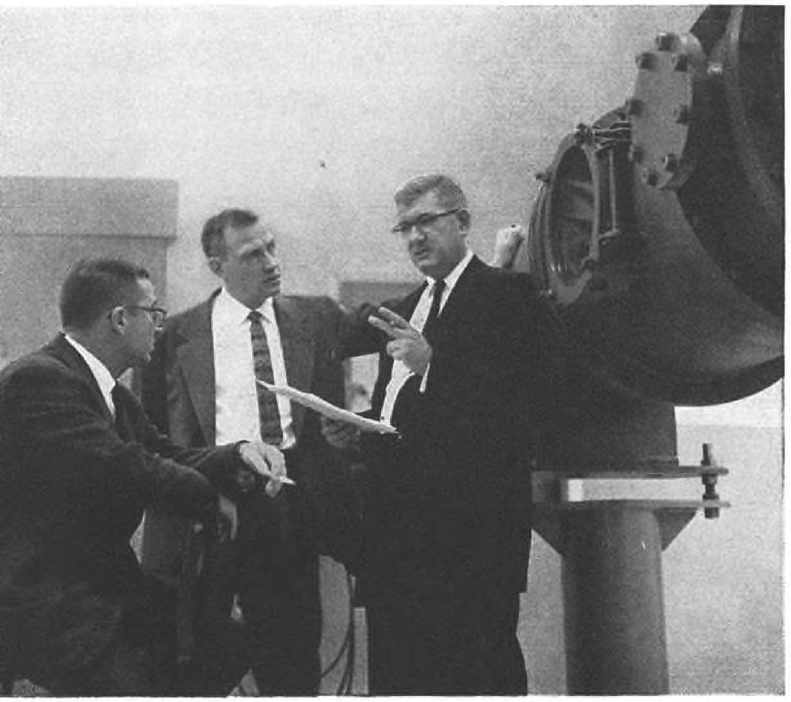
The results: design simplified, boss areas minimized, weight reduced as much as 40%, lock nuts and lock wiring eliminated. Now one man assembles the entire unit in 30% less time than before ... and danger of thread failure and screw loosening has ended!

Manufacturers in every field are relying on one-piece, stainless steel *Heli-Coil* Screw-LOCK Inserts to meet torque and vibration specs... protect threads against wear, stripping, galling and corrosion... save costs, space and weight. *Patented

HELI-COIL CORPORATION
DANBURY, CONNECTICUT

HELI-COIL CORPORATION, 204 Shelter Rock Lane, Danbury, Connecticut
I'd like more information on *Heli-Coil* Screw-LOCK Inserts
NAME_____TITLE_____
FIRM_____
ADDRESS_____
CITY_____ZONE____STATE_____ 1598

IN CANADA: W. R. WATKINS CO., Ltd., 41 Kipling Ave., S., Toronto 18, Ont.



(right) Part of giant capacitor bank used to fire "hotshot" tunnel. Bank is capable of 5 million kilowatt jolt.

(above) Lockheed's "Hotshot" tunnel – only one in private industry.

(right) Research and Development facilities in the Stanford Industrial Park at Palo Alto, California, provide the latest in technical equipment.

THERMODYNAMICS

Expanding the Frontiers of Space Technology

Lockheed capabilities in thermodynamics and gas dynamics are unsurpassed in private industry. Basic work is being performed on problems relating to missiles and spacecraft under simulated conditions of upper atmosphere and outer space. Studies include: boundary layer flow and heat transfer; cooling and insulation; thermodynamic instrumentation for flight test; design of rocket motor controls and nozzle structures; re-entry thermal protection; materials specification; and thermal environments of electronic, mechanical and hydraulic equipment. Also under study are new methods and improved techniques of thin film thermometry, measurements of dissociation and combination of nitric oxide and high-speed shock wave flows.

Equipment includes the fastest wind tunnel in industry, fired by 20 million kilowatts; a hydromagnetic tube which produces velocities of over Mach 250 and temperatures approaching 500,000°K; a "hotshot" tunnel for shock wave, gas and heat studies, capable of velocities of 16,500 mph and temperatures above 12,000°F; and a ballistic range on which projectiles are fired at speeds up to 20,000 ft/sec.

Scientists and engineers of outstanding talent and inquiring mind are invited to join us in the nation's most interesting and challenging basic research programs. Write: Research and Development Staff, Dept. D2-17, 962 W. El Camino Real, Sunnyvale, California.

"The organization that contributed most in the past year to the advancement of the art of missiles and astronautics." NATIONAL MISSILE INDUSTRY CONFERENCE AWARD

Lockheed / MISSILES AND SPACE DIVISION / SUNNYVALE, PALO ALTO, VAN NUYS, SANTA CRUZ, SANTA MARIA, CALIFORNIA CAPE CANAVERAL, FLORIDA ALAMOGORDO, NEW MEXICO

based on a three-word phrase that identifies the wing, squadron and plane. For example, Romeo Blue Delta would be the fourth plane (Delta is the fourth letter in the international phonetic alphabet) of the second or "Blue" squadron of the 18th wing (Romeo is the 18th phonetic letter).

Mk. 50 Hunters are equivalent to the Mk. 4 furnished to Britain's Royal Air Force and since phased out of production. Sweden bought a few more than 100 of the planes, assigned them to the two day-fighter wings near Stockholm.

Standard squadron makeup is 12-15 Hunters, which is theoretical strength. Maintenance and overhaul keep some airplanes out, but there are reserve airplanes available, so that an over-all high availability is achieved.

There have been a few more maintenance problems with the Hunters than with Swedish-built Saab aircraft, but part of this is attributable to the simple fact that the Hunters are a foreign breed.

One operational problem with the Hunters is the cost of training ammunition for the 30-mm. Aden cannon. Ammunition cost is roughly proportional to the weight of the rounds, and a 30-mm. round weighs about three times as much as the 20-mm. rounds from the other cannon in the RSAF. Young pilots are apt to linger overly long on the trigger to make sure of getting the burst on the target, and as a result costs of gunnery training have soared.

Aside from these problems, the RSAF and this wing is pleased with the performance of the Hunters.

Tactical mobility is one of the operational doctrines of the RSAF. Even the fixed bases such as this one, with the exception of the underground hangars, are apt to have a temporary look. Everything is on wheels or runners.

On the flight line here, planes are fueled from a portable tank farm system, set down as an individual unit for each airplane. The basic component is a cylindrical fuel tank with a simple wheeled steel chassis, looking like a miniature European railroad tank car.

Refueling Position

Four of these make up the refueling station for one position on the line. They are mounted on a simple frame of steel construction and stand on sections of railroad rail so that they can be easily wheeled off and replaced or moved.

The advantage of a refueling point for each airplane is obvious. Planes coming back from a mission taxi to their spot on the line. Ground crews wheel a simple pump between the plane and the tank, hook it up on both sides, and start fuel transfer.

The fully-fueled aircraft are ready to fly again, and the four depleted tanks are refilled or topped later by a small number of high-volume fuel trucks.

Four of these individual tanks, one airplane unit, fit sideways on a standard Swedish railroad flat car. They can be transported this way when a squadron is moved, or they can even be towed for short distances behind a truck or tractor.

A modification of this scheme is used when the station is on "high alert." Two standard underwing drop tanks, mounted on a four-wheeled trailer that can be hauled around by a jeep or light vehicle, are pulled to the end of the duty runway where the interceptors will stand during the alert condition. Each plane is connected to a pair of these drop tanks and draws fuel for its idling engines from them. If the pilots get the scramble signal, fuel lines are automatically disconnected as the planes start to roll, in shorter time than after a normal start. Thus each plane takes off with full internal fuel for the extra few minutes of operation that might mean the difference between success and failure of the mission.

In the orderly transition of the RSAF to a mixed force of manned and unmanned weapon systems, the place of

NEW GENISCO MINIATURE ACCELEROMETER

Weighs only 3 ounces; measures just 1 1/16" x 1" x 1 7/8"!

The new Model GMA Accelerometer is a fluid damped, potentiometer output instrument, particularly suited for flight and fire control and telemetering applications. Now in production.

Brief Specifications

Range: ±0.5 g to ±100 g's
Natural Frequency: 12 cps to 75 cps
Linearity: ±1% of full scale
Damping: Nominally 0.7 of critical at ±75°F.
Temperature: Operates to specifications between −20°F and +185°F.
Vibration: 10 g's, 10-20,000 cps, any axis
Shock: 50 g's for 7 ms, any axis

MODEL GMA

Send for complete specifications to the Instrument Division: Genisco INCORPORATED
2233 Federal Avenue, Los Angeles 64, California

marion
advancement in instrument design

actual size
Model HCM 7/16

MINIATURE 7/16" INDICATOR

Micro-miniature moving coil, core magnet indicator; 7/16" diameter, 31/32" length. Weight 10 grams; sealed. Available with a pointer or flag display in a wide variety of electrical sensitivities and functions. Data on request. *Marion Instrument Division, Minneapolis-Honeywell Regulator Co., Manchester, New Hampshire, U.S.A.*
Copyright © 1959, Marion

marion meters
"WHERE ELECTRONICS MEETS THE EYE"

AiResearch Interiors for the "Executive Ayer-Liner"

Your office can be this pressurized, efficient business aircraft

AiResearch Aviation Service has been selected to convert a large number of Convair 240s for Frederick B. Ayer & Associates, world-wide aircraft dealer, into Executive Ayer-Liners, the first pressurized aircraft ever offered to the corporate market at a realistic price.

Custom interiors, like the demonstrator shown above now on a nation-wide tour, are designed by AiResearch engineering specialists and interior stylists to meet individual company requirements. AiResearch conversion has increased the range of this superior business aircraft 50 percent over the commercial model and has increased the gross weight. Outer wing panel fuel tanks assure you one-stop, coast-to-coast flights with ample fuel reserve for instrument weather.

Other modifications include installation of auxiliary power units, new instrumentation, new electrical, hydraulic and pneumatic systems, plus radar and auto-pilot (optional). These improvements, exterior painting and relicensing of the aircraft are done by AiResearch specialists meeting all CAA regulations.

AiResearch Aviation Service has performed more executive modification programs on Convair 240s, 340s and 440s than any other company. You are invited to inspect our more than 150,000 square feet of floor space representing the finest conversion, modification and servicing facilities available. Free brochure mailed on request.

THE GARRETT CORPORATION

AiResearch Aviation Service Division

International Airport, Los Angeles, Calif. • Telephone: ORegon 8-6161

Ground Support • Conversion and Modification • Custom Interiors • Instrument, Radio, Electronics • Airline Service • Turn-Around Service

the day fighter seems increasingly clear: It is obsolescent. Only all-weather systems will be of any real value in a future conflict.

For this reason Sweden is pushing production of the Saab J35 Draken (AW Mar. 24, 1958, p. 46), a single-seat all-weather interceptor capable of Mach 2 in level flight and armed with four U.S. Navy-developed Sidewinder infrared homing missiles.

This little double-delta is to replace the aging Saab J29 Flying Barrels that have been recently rejuvenated with afterburners.

After these, the Hunters will be replaced, perhaps, by J35 Drakens or perhaps by missiles.

But though these day fighters will have seen their day, their underground bases will still serve. They could house attack wings, or they could house mobile anti-aircraft missiles, and avoid the new expenses of providing hard bases of a different design for a new family of pilotless aircraft.

Either way, the strength and utility of these subsurface galleries, blasted out of the tough ground to house a rugged fighting force, will continue to underline the technical foresight and military engineering abilities of the Royal Swedish Air Force.

XV-3 Convertiplane Completes Gear Shift

Fort Worth—Bell helicopter XV-3 convertiplane has completed its first gear shift in flight, an advance which permits the VTOL aircraft to cruise more efficiently in the airplane configuration.

High rotational speed which makes the XV-3 rotorprops efficient as lifting rotors during takeoff is too fast for efficient cruise after the rotorprops have been converted to forward flight.

Gear shifting reduces rotational speed by 40%, allowing the rotorprop to revolve more slowly and take a deeper bite.

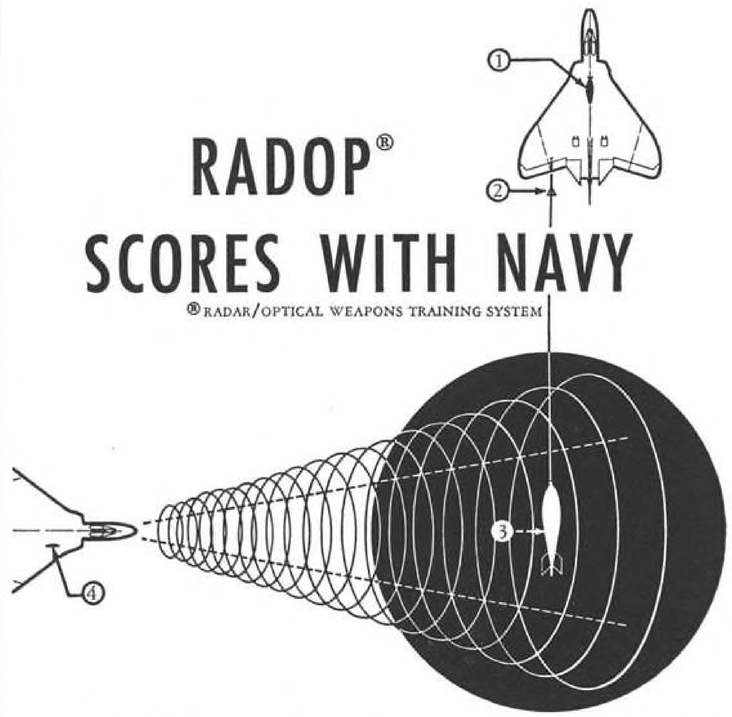
Shifting is done in the main transmission with a clutch system. It had been done several times in wind tunnel tests, and now has been accomplished in full forward flight.

Use of a free turbine powerplant, in place of the present piston engine, would simplify the shifting operation if such an engine should be included in the XV-3 research program, Bell engineers said.

Bell XV-3 has made several full and partial conversions since the first full conversion was made (AW Dec. 29, p. 24). The convertiplane has made three full conversions above 10,000 ft., which Bell says is above the altitude capability originally expected for the aircraft.

RADOP® SCORES WITH NAVY

®RADAR/OPTICAL WEAPONS TRAINING SYSTEM

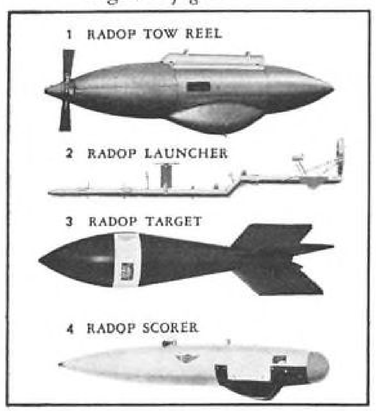


Del Mar Engineering Laboratories' *Radop Weapons Training Systems* are used extensively in the training of U. S. Navy Pilots. By firing rockets and missiles at inexpensive Radop Tow Targets and by using Radop Scorers to measure miss-distances in three-dimensions, the Navy saves U. S. taxpayers millions of dollars and introduces *a higher degree of realism* into training than is possible with other more costly systems.

RADOP SYSTEM COMPONENTS

1. RADOP TOW REEL — First to reel a target out in excess of *seven* miles ...and in less time than required for the tow plane to reach its firing range.

2. RADOP LAUNCHER — First launcher used to eject, tow, and recover targets *in flight*.



3. RADOP TARGET — First lightweight target to contain a special radar reflector capable of being picked up on GCI radars at slant ranges up to 65 miles. Targets also available with flares for missile exercises.

4. RADOP SCORER — First unit to utilize motion picture and radar techniques to provide a positive measurement of miss-distances during rocket firing runs.

For more information on Del Mar Radop Systems, write for Data File AW-539-3.

Engineers: Investigate employment opportunities with this steadily growing company.

Del Mar | ENGINEERING LABORATORIES

international airport • los angeles 45, california

Now . . . an old company presents a new face . . . an image . . . a dynamic trademark to match the many changes that are making Titeflex the most progressive company in the flexible hose business

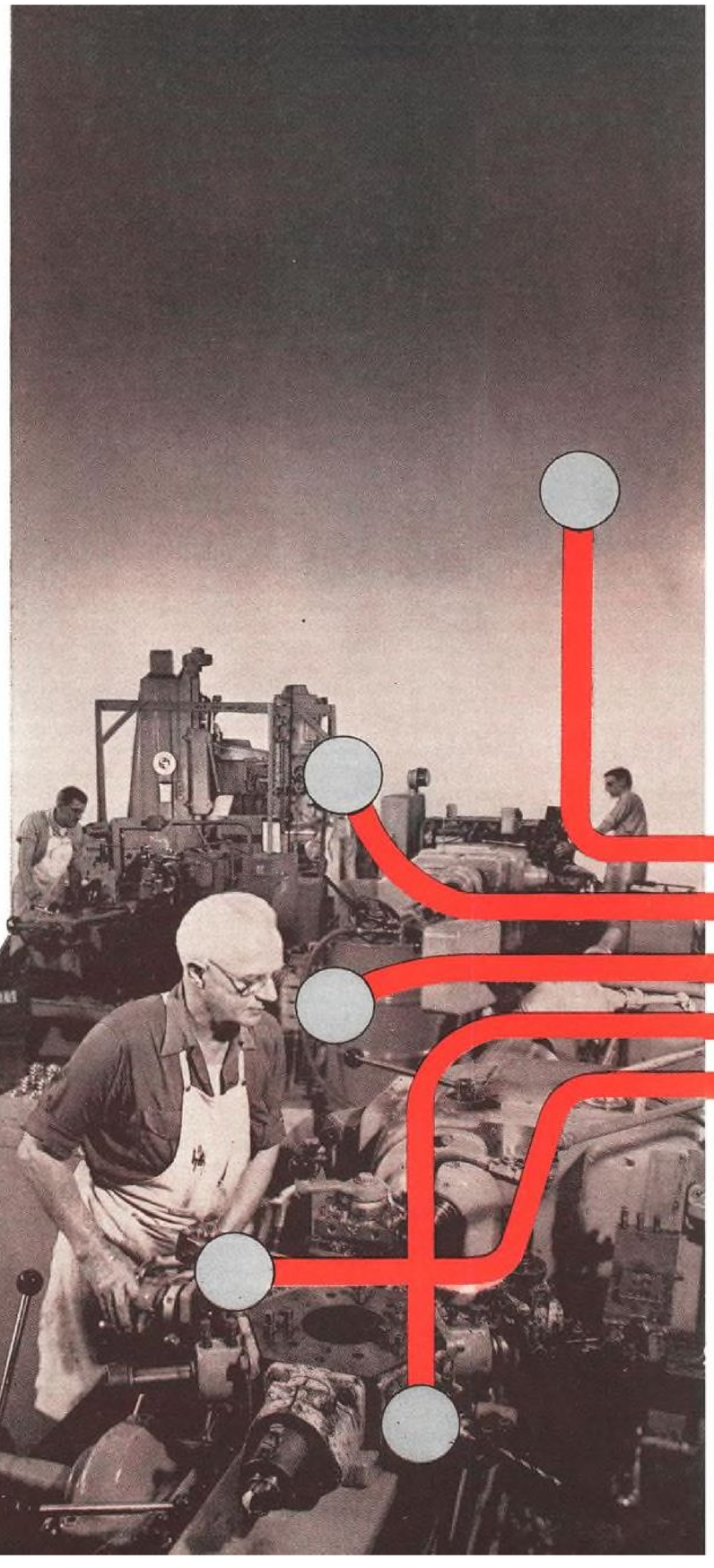
titeflex

titeflex incorporated springfield 4 massachusetts

PACIFIC DIVISION • SANTA MONICA, CALIFORNIA

Flying Crane Shows Load Carrying Uses

Sikorsky S-60 flying crane, being flown by rearward facing pilot (above), completes hooking sequence before hoisting a mockup of the Army's Honest John missile. Ground crewman aids the pilot with signals and actually snaps the hook to the hoist. Two-ton telephone pole (below, left) and 4,500 lb. bridge section (right) also are carried.



POINT OF MANUFACTURING DECISION...

IBM manufacturing control center gives management the facts for executive action

Now . . . through IBM data processing . . . large and small companies can control manufacturing operations with precision. Manpower, materials and machines are used where you want them, when you want them, in quantities you want for the optimum scheduling.

With new abilities to record, process and evaluate current data, your manufacturing management can base requirements directly on market demands. Decisions are swiftly reflected all the way back through assemblies to parts and raw materials, manpower and machines.

Applied to inventory control, production scheduling, sales forecasting, and cost control, this new method brings tighter control and substantial operating savings. Now, new techniques such as job shop simulation become practical and enable you to look into the future with a minimum of trial and error.

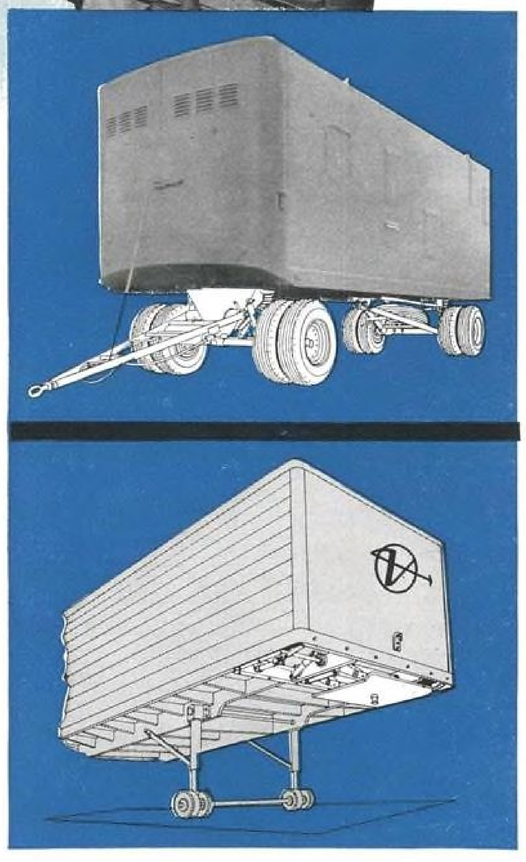
Typical results of the application of this IBM method: One manufacturer does a complete monthly material requirements breakdown for the next twelve months in just twelve hours; service parts production is calculated in just one hour; perpetual inventory updated on a daily basis in one hour. Other controls include weekly machine load forecast and summary inventory evaluation reports.

IBM Data Processing systems may be purchased or leased. To get the facts, call your local IBM representative.

IBM
DATA PROCESSING®

Here is "Engineering with Vision"

READY TO HELP YOU WITH YOUR PROBLEM



"Engineering with Vision" is best illustrated by the many important projects for both government and industry which have been successfully carried out through DESIGN ... DEVELOPMENT and in many cases PRODUCTION.

As an example ... a VISIONEERING designed "soft ride" van undercarriage permits the safe handling of delicate electronic instruments at high speed over the roughest terrain.

Now ... a new VISIONEERING "soft ride" development is a torsion-sprung 5th Wheel Plate which makes it possible to cushion against shock to the most sensitive communications equipment hauled in a semi-trailer. This unit has wide potential military and commercial uses.

Both of these pieces of Ground Support Equipment are in PRODUCTION in our plant.

VISIONEERING has also DESIGNED, DEVELOPED and is PRODUCING, precision-built cabinets in light alloys and magnesium for housing electronic and communications equipment.

If you have a project on which you need help in DESIGN, DEVELOPMENT or PRODUCTION ... call VISIONEERING. Brochure available.

VISIONEERING "ENGINEERING WITH VISION"

11830 Brookpark Road

Cleveland 30, Ohio Tel. CL 2-2100

Potential of Ground Effect Vehicles Studied by Defense Department

Washington—Increased interest is being given to the military potentials of ground effect vehicles that ride on cushions of air (AW Jan. 12, p. 74). Defense Department officials recently told the House Committee on Science and Astronautics. J. B. Macauley, Deputy Director of Defense Research and Engineering, said factors influencing the increased interest include:

• "**Technological competition** between the East and the West had demanded the investigation of any natural phenomena that might improve our military and economic systems.

• ". . . **Capability of an enemy** to use nuclear weapons in any kind of conflict will require dispersal of installations and inhibit concentration of troops. Consequently, our armed forces must have a much greater degree of mobility than ever before.

• "**Possibility that Free World** forces will have to [fight] in less developed areas where inadequate transportation systems exist. This factor again indicates the need for increasing the mobility forces and reducing their dependence on such prepared facilities as roads, railroads, airfields and port facilities."

Possible Uses

Macauley said the use of ground-cushion phenomenon by air vehicles can be classified in the following categories:

• "**Conventional airplane and** helicopter and their more sophisticated vertical takeoff and landing derivatives that make the transition through ground effect very rapidly and make little or no beneficial use of the ground-cushion phenomenon.

• "**Aerial-vehicle type** of VTOL aircraft that operates within the ground cushion as a vehicle riding on air but, after obtaining a minimum velocity, functions as an aircraft and is supported by aerodynamic forces generated by its forward motion.

• "**A minimum ground-pressure** vehicle that operates at all times within the ground cushion over open land or sea areas. The movement of this vehicle is not restricted by mud, snow, ice or other similar surface obstacles that impede the movement of wheeled vehicles. Military interests center around this category.

• "**A vehicle that operates on** the air-bearing concept . . . friction with surface terrain is significantly reduced by a thin film of air between the surface of the vehicle and the support."

Macauley said the Defense Department is now coordinating the research and development activities of the services in order to provide an understanding of the phenomenon.

A technical review and analysis of known programs that make use of the phenomenon is scheduled to be held early next month at Princeton University's Forrestal Research Center. Later in the year, Macauley said, an international technical symposium on the work being accomplished in the West is planned.

Rear Adm. Rawson Bennett, chief of naval research, told the committee that the Navy also can foresee a number of possible uses for such vehicles, including an amphibious transport or an assault boat that would travel four or five feet above the waves at speeds of 50 mph. and be capable of negotiating beaches with slopes of up to 15%.

Another possible use, Adm. Bennett said, would be in anti-submarine warfare. He said studies are being conducted which may lead to a radio-controlled platform that can ride high enough to clear the waves and travel 20% faster than nuclear-powered submarines. The vehicle, he said, must be capable of floating in the water for extended periods and be equipped with automatic lifting and tracking facilities so that it could seek out an enemy submarine, hover over the top and drop a bomb and then move off to await another command to attack.

Still another possible use, Adm. Bennett said, would be an ocean-going transport—a circular ship platform 1,000 ft. in diameter that would be capable of speeds up to 150 kt. and operate 50 ft. above the waves.

Status of Programs

Here is a report on the status of Navy programs to explore the possibilities of using air cushion vehicles as supplied by Adm. Bennett:

• **$30,000 contract** with the Aerophysics Co. to continue detailed theoretical analyses of the flow processes in the curved jet in both hovering and forward flight and to continue correlations and evaluations of available experimental results.

• **$21,000 contract** with the University of California to test small models over water at varying forward speeds and different simulated wave conditions was recently signed.

• **$30,000 contract with** the State University of Iowa to study the influence on performance of changes in various geometric parameters by small model wind tunnel and water table tests is in progress.

• **$2,500 contract with** Swiss designer

for those really tough aircraft or missile applications

specify BRUNING

QUICK DISCONNECT COUPLERS

Self-Sealing or Open Flow

Aluminum • Steel • Stainless

- ¼" to 2" capacities
- Simple, rugged and dependable locking mechanism.
- Excellent flow characteristics.
- Positive valve and seal action.
- Extremely high working pressures.
- Wide operating temperature range.
- Minimum bulk and weight.
- Highly competitive prices.

SEND FOR FREE SAMPLE

(Please clip coupon to letterhead)

THE BRUNING COMPANY

615 So. 9th, Lincoln, Nebraska

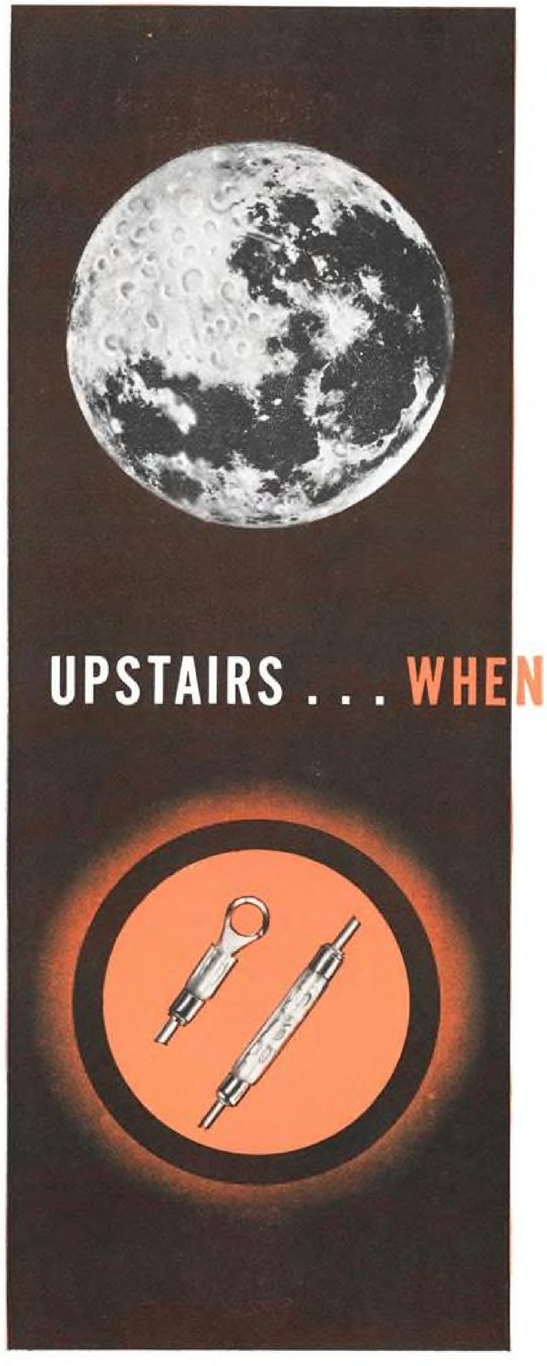
Please send me free — Aircraft Coupler sample.

NAME _____

COMPANY _____

ADDRESS _____

HYDRAULIC, PNEUMATIC AND FUEL SYSTEM COMPONENTS



PROTECT AGAINST CORONA, HEAT AND ALTITUDE . . .

AMP's new Post Insulated Stratotherm Terminals and Splices are designed for gruelling circuit environments "upstairs." Post Insulated Stratotherm overcomes difficult heat and high altitude problems confronting aircraft and missile enginering . . . combine the outstanding electrical performance of compression crimping with the new insulating qualities of sealed Teflon* sleeves which deter corona effects and moisture entrapment in a wide temperature range.

UPSTAIRS . . . WHEN THE HEAT'S ON

OUTSTANDING FEATURES:

- temperatures as high as 500°F
- fits varying insulation diameters in a wire size range from #22 through #10 AWG
- crimped insulation ring seals termination point against corona and moisture
- high flex and impact strength
- crimp attachment by either A-MP portable power tool or manually operated A-MP hand tool

*Du Pont Trademark

Complete technical data available on request.

AMP INCORPORATED

GENERAL OFFICES: HARRISBURG, PENNSYLVANIA

A-MP products and engineering assistance are available through subsidiary companies in: Canada • England • France • Holland • Japan

Carl Weiland to purchase certain theoretical and experimental model test results of a unique variation of the annular jet principle is in early negotiation stages.

• **$100,000 contract with** Aerodynamics Laboratory of David Taylor Model Basin to continue theoretical studies and to build test models in wind tunnels is under consideration.

• **$50,000 contract with** Gyrodyne Co. to construct and test static and dynamic characteristics of man-carrying testbed hovering machine of about six feet diameter is actively in progress and first flight test is expected in August.

• **$30,000 contract with** Convair to study design feasibility of a very large flying vehicle for over-water operations, employing aircraft type structures and the possibility of employing a nuclear power source has been negotiated.

• **$30,000 contract with** David Taylor Model Basin Hydrodynamic Laboratory to construct and test models of catamaran ship type vehicles in a towing tank has been started as a first phase program.

Brig. Gen. F. H. Britton, director of developments, Office of Chief of Army Research and Development, said the Army has been exerting considerable effort over the past three years to develop what he termed minimum ground pressure vehicles to operate around trees and over rough terrain. He said it is essential that such vehicles be able both to hover or move in ground effect and to fly at altitudes of at least 50 to 100 ft.

Gen. Britton told the committee that the Army is now moving toward the use of aerial vehicles as actual replacement for ground vehicles in combat units.

After the Korean War, Gen. Britton said, the Army began experimenting with the Hiller flying platform. While it was not suitable for Army field use, he said, it did illustrate the possibility of using the ducted fan principle in larger vehicles which might be more suitable such as the Piasecki Aircraft Co. flying vehicle, which might lead to a suitable vehicle for field use.

Gen. Britton said two similar projects are under way—one by Aerophysics Development Corp., a subsidiary of Curtiss-Wright Corp.; the other by Chrysler Motor Corp. All projects utilize different techniques for stability and control. Another feasibility study is under way at National Research Associates.

One project, he said, that appears to offer a possibility of increasing mobility is the Avrocar, a joint Army-Air Force sponsored program with Avro Aircraft Ltd. of Canada. He said the development is now in advanced stages and that ground testing should begin soon.

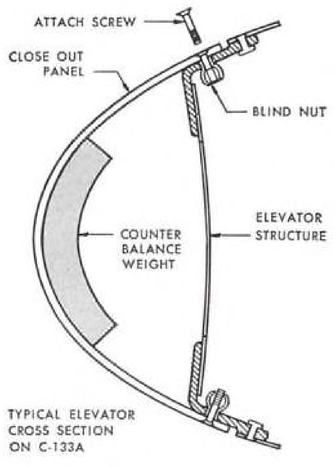
Work and testing on a number of other vehicles will be finished in 1960, Gen. Britton said.

LET Blind Nuts* CUT YOUR MANHOURS 40%

Up to 40% savings in manhours can be realized by using Blind Nuts requiring only one installation step compared to conventional nutplates or gang channel nuts, each requiring four installation steps.

Blind Nuts already have saved a substantial number of manhours on the huge C-133A turboprop transport built by Douglas Aircraft Company, Long Beach Division. In one application alone, more than 1000 Blind Nuts are used to attach the heavy counterbalanced close-out panels to the leading edges of the elevators and rudder.

Because its expander nut is drawn and locked into the sleeve, use of the Blind Nut also eliminates possible rework time during the installation of access or close-out panels when an entire gang channel must be replaced if a nut is knocked out.

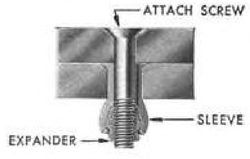


TYPICAL ELEVATOR CROSS SECTION ON C-133A

Stainless steel Blind Nuts are quietly installed at about ten per minute by one man using a lightweight hydraulically operated gun. Hand installation tools are also available. Blind Nuts will accommodate screw or bolts in sizes ranging from 4-40 to ⅜-24.

BLIND NUT INSTALLATION STEP, —

1. Insert sleeve and expander nut through hole and operate gun.



TYPICAL BLIND NUT INSTALLATION

GANG CHANNEL NUT INSTALLATION STEPS

1. Temporarily screw gang channel in place.
2. Drill and countersink rivet attach holes through work and channel.
3. Install attach rivets.
4. Remove temporary screws.

Learn how Blind Nuts can reduce your manhours. Write for details.

U. S. PATENT PENDING. FOREIGN PATENTS GRANTED AND PENDING *TRADEMARK

hi-shear RIVET TOOL COMPANY

2600 WEST 247TH STREET • TORRANCE, CALIFORNIA

COMPLETE ROCKET MOTORS

High altitude research rocket motors built by Diversey in their final check out before shipping. Another example of how Diversey Engineering integrates the finest and most advanced contour machining techniques into the building of complete rocket motors.

We make everything from special components to complete rockets. In the area of missle hardware Diversey knows and uses modern techniques that would startle you.

You have the largest facilities and the most modern equipment for your hardware problems at Diversey Engineering. In this field we know what works and what won't. Contact us on your rocket motor problems.

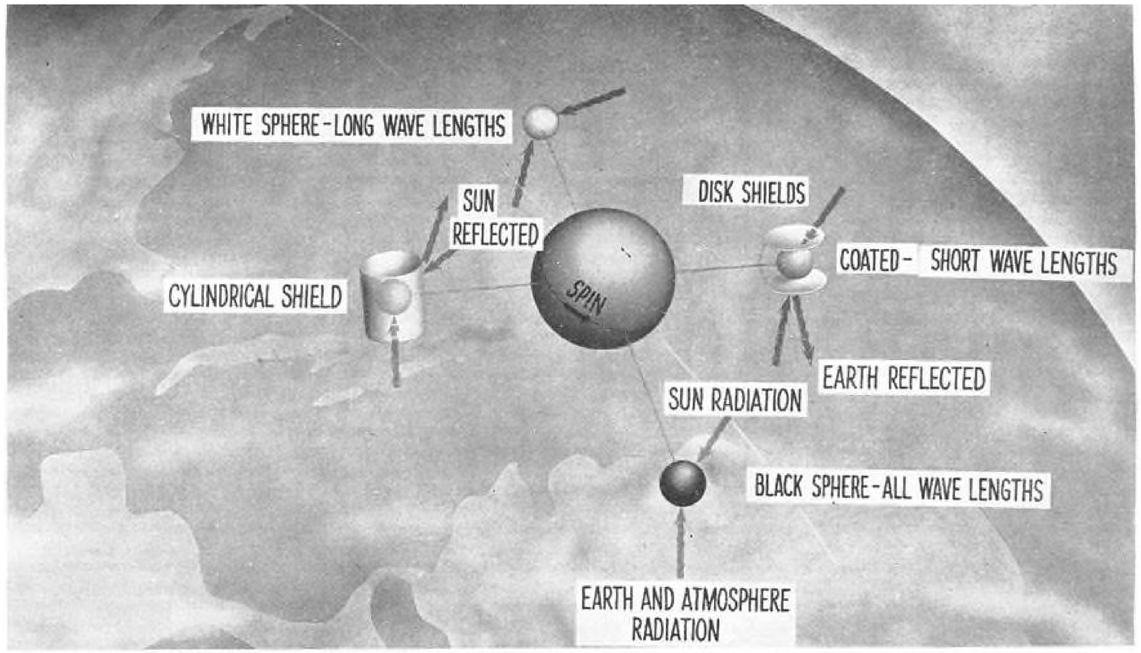
SEND FOR FREE BOOKLET

LEADERS IN CONTOUR MACHINING

Diversey ENGINEERING COMPANY

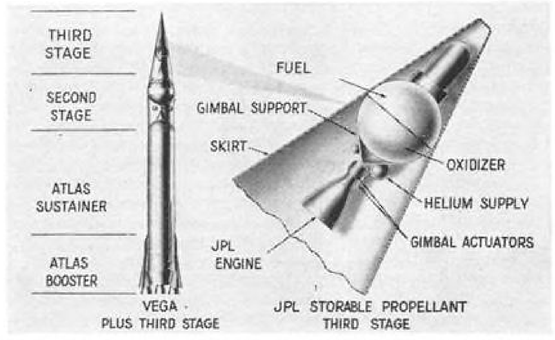
10550 WEST ANDERSON PLACE
FRANKLIN PARK, ILLINOIS • *A Suburb of Chicago*

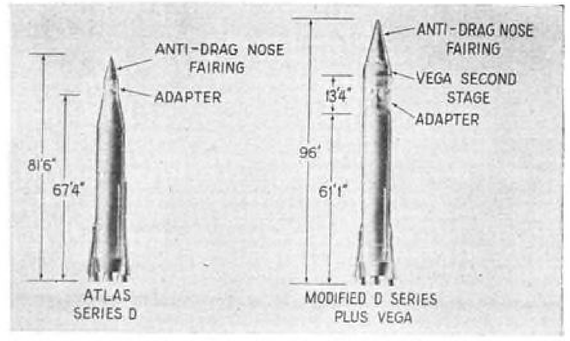
FROM NOSE TO NOZZLE, FROM FIN TO FIN, CONTOUR TURNED PARTS—WITH PRECISION BUILT IN



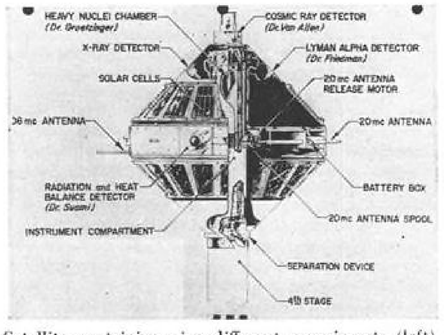
By midsummer National Aeronautics and Space Administration hopes to put into orbit a satellite that will measure the heat transferred to and from earth. It will be basically a Vanguard scientific satellite with small spheres mounted on the tips of four antennas to measure solar energy in various wavelengths and from various directions to provide full transfer data.

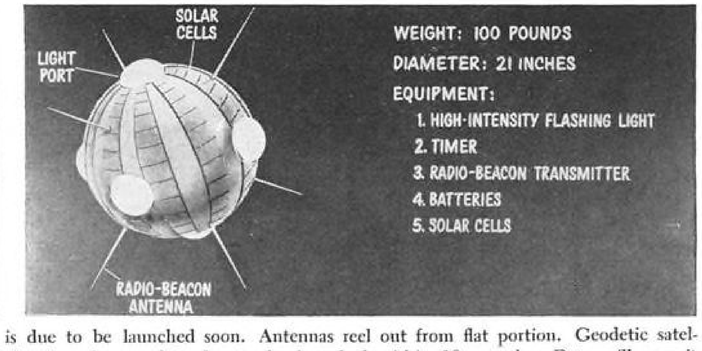
NASA Plans Scientific Satellite Shots



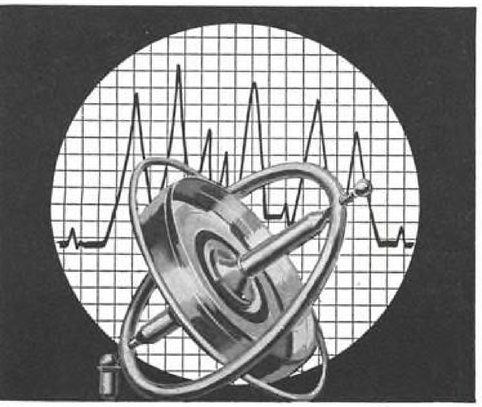


Vega third stage engine (left), using storable propellants and producing 6,000 lb. of thrust, is being developed by NASA's Jet Propulsion Laboratory. Engine and payload fit under an anti-drag fairing. Vega is a modified Atlas (right) plus modified General Electric Vanguard engine plus a Jet Propulsion Laboratory engine. It will be used for lunar, planetary and two-man vehicle shots.

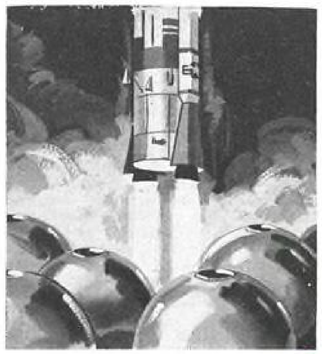




Satellite containing nine different experiments (left) is due to be launched soon. Antennas reel out from flat portion. Geodetic satellite (right), now under development, would be a high-density sphere and is due to be launched within 18 months. Data will permit refinement in accuracies of continental geodetic survey networks, important to missile target location.



b

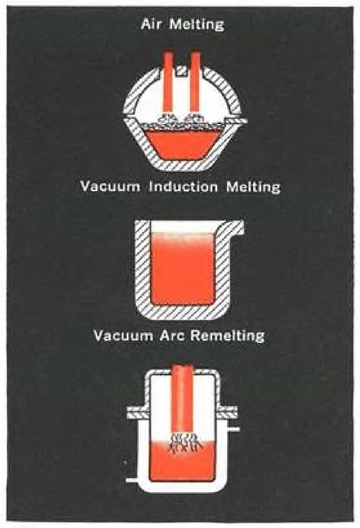


c

a. Titanium slabs are heated prior to rolling into continuous sheet coils. Crucible's increased capacity for producing high purity metals, in all sizes and mill forms, is substantially reducing costs and delivery times.

*b. **Vacuum Melted Alloys** are specified for gyroscope balls used in navigational and fire direction systems. The metals' improved properties facilitate miniaturization.*

*c. **Titanium** helium storage bottles for ICBM Atlas. Titanium, which must be vacuum melted, was selected because of its high strength weight ratio, cold-resistant properties and corrosion resistance.*



d

*d. **Basic Melting Processes.** Vacuum induction melting produces "purer" metals than conventional air melting because it eliminates all sources of contamination except the crucible. Vacuum arc remelting eliminates the crucible and permits production of ingots up to 18,000 lbs.*

a

VACUUM MELTING CREATES SUPER-DUTY METALS

Marked improvements in properties produced by High-Purity Metallurgy

Behind the development of space-age metals with entirely new characteristics is vacuum melting — a series of processes that produce "purer" metals with better properties.

Why Vacuum Melt? Vacuum melting protects molten metal from contact with air. It also provides closer control of composition, helps eliminate inclusions, and minimizes center porosity and segregation in ingots.

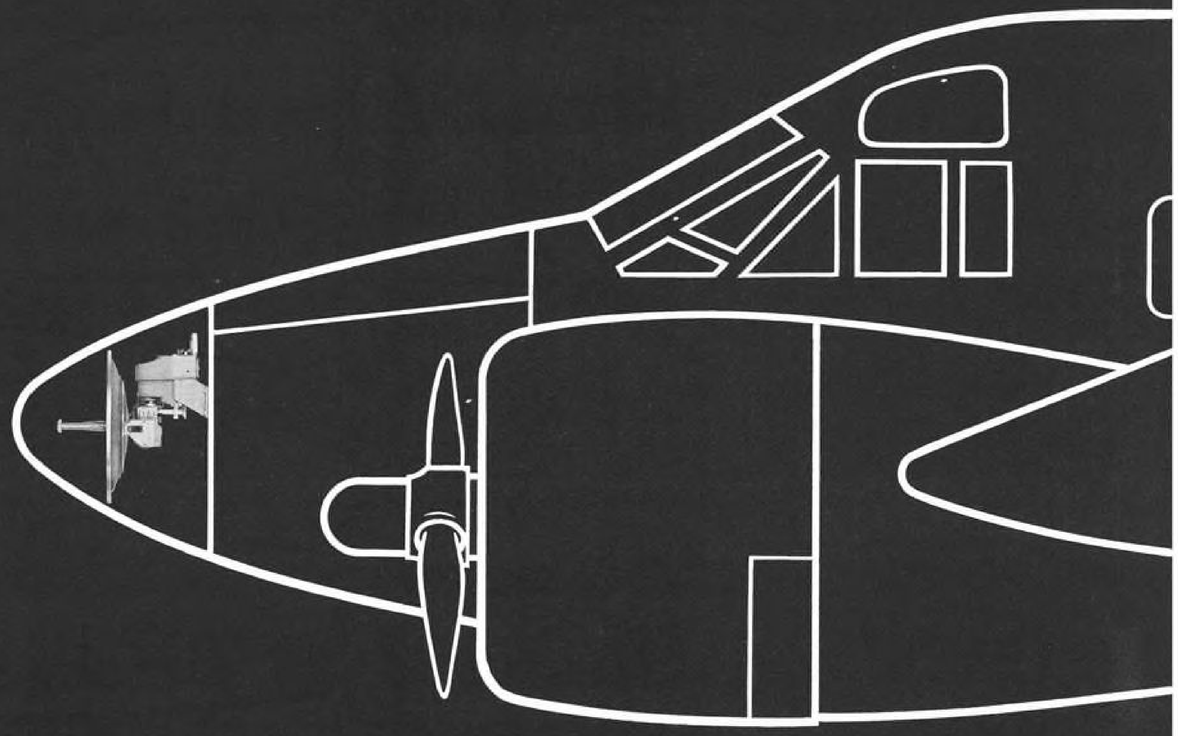
In the field of vacuum melting, Crucible's position is unique. As the leading producer of special purpose steels, Crucible's experience in high-quality steelmaking is unsurpassed. Through formerly affiliated companies, now fully integrated with it, Crucible led in the development and commercial production of vacuum-melted steels, iron, nickel, copper — and titanium. Therefore, Crucible's breadth of experience, together with its extensive facilities, places the company in the best position to provide the "super-quality" metals most suitable for any given application.

The three vacuum-melting processes — One of the Crucible processes is VIM — *vacuum induction melting*. It starts with very high-purity raw materials, produces extremely pure ingots. A second is VAR — *vacuum arc remelting*, or the consumable electrode process. This process, starting with air-melted electrodes, produces large ingots — up to 32″ diameter x 18,000 lbs. It provides metal with low-gas content and greatly improved uniformity of properties. The third process is VIR — *vacuum arc remelting of vacuum induction melted electrodes*—a double-melting technique. It permits manufacture of super-pure metals in the full range of ingot sizes.

Crucible's experience with all three processes, and its facilities for vacuum arc remelting its own specially air- or vacuum-melted electrodes, provides industry with a complete range of vacuum-melted metals at the lowest possible cost. Only at Crucible is there available this experience, flexibility and the facilities for vacuum-melting titanium, super-alloys, heat-resisting alloys, bearing steels, tool steels, stainless steels, electronic alloys and nuclear reactor materials.

If you'd like to know more about Crucible's work in High-Purity Metallurgy, read: "Quality Aspects and Properties of Vacuum Induction Melted and Vacuum Arc Remelted Steels and Super Alloys" and "Titanium for Aircraft and Spacecraft". Write: *Crucible Steel Company of America, Dept. AD17, The Oliver Building, Mellon Square, Pittsburgh 22, Pa.*

CRUCIBLE STEEL COMPANY OF AMERICA

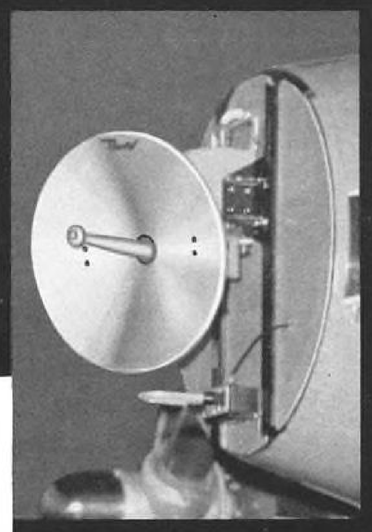


NOW... FULL RANGE WEATHER RADAR

available for the Twin-Beech

With the introduction of the new Bendix 18-inch *stabilized* radar antenna, operators of D-18 and E-18 Twin-Beeches can now enjoy the safety and convenience of a *full 135-mile*† range weather avoidance radar system. Scanning 120 degrees ahead of the aircraft, this new antenna is designed to be used with the Bendix* RDR-1D Radar System. Weather targets are clearly visible on a large five-inch indicator. The entire system weighs only 90 pounds. Radomes are readily available for easy installation.

For further information, contact your local dealer or write Bendix Radio, Dept. 281, Baltimore 4, Maryland. †Nautical miles *Reg. U.S. Pat. Off.



Bendix Radio Division

Baltimore 4, Maryland

Bendix AVIATION CORPORATION

Export Sales & Service: Bendix International Division, 205 E. 42nd St., New York 17, N. Y.

TAIL empennage of the Mooney Mark 20-A moves for trim purposes. Gear tread is 9 ft., ¾ in. Shock in this aircraft is absorbed by knee action of the gear compressing rubber doughnuts. Ground and air visibility is good.

Aviation Week Pilot Report:

Mark 20-A Shows Good Aileron Control

By Robert I. Stanfield

Dallas—Mooney Aircraft's single-engine, four-place Mark 20-A is a high-performance "aileron" airplane that shows excellent stability and control from a cruise speed of 181 mph. through slow flight and power-off stall at 55 mph.

The Mark 20-A is powered by a four-cylinder Lycoming O360-A1A rated at 180 hp. at 2,700 rpm. at takeoff. Engine compression ratio is 8.5 to 1 Fuel grade is 91 octane. The McCauley propeller is constant speed and, with spinner, is all metal. The governor is a Woodward.

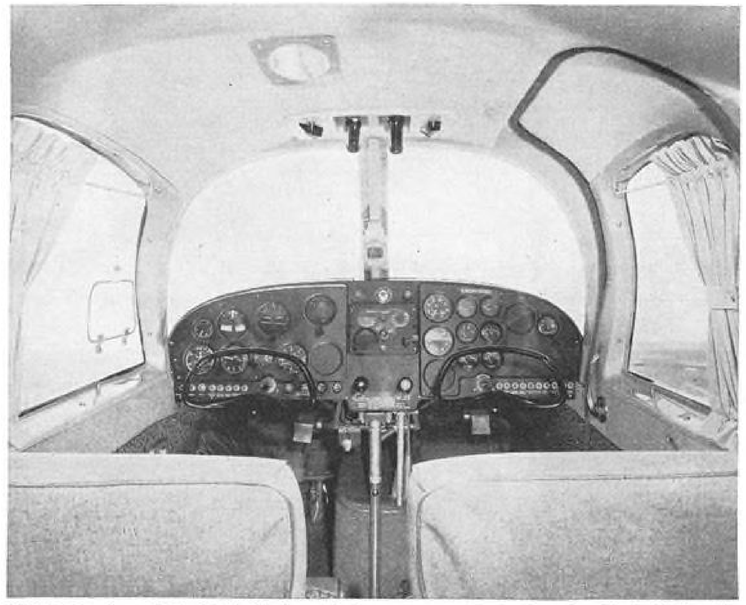
Laminar flow wing and empennage are constructed of pressure-bonded, laminated, aircraft spruce. The fuselage is all metal. Maximum range, with 35 gal. of fuel, is 760 stat. mi. With an optional 14-gal fuel tank installed, range is increased to 1,075 mi. Cost of the standard Mark 20-A is $14,850.

Performance characteristics evidenced during flight evaluation by AVIATION WEEK included:

• **Takeoff and climb.** Grossing about 2,352 lb., at an elevation of 642 ft. into a 2 kt. wind, the Mark 20-A was pulled off at 60 mph. after 500 ft. of roll. Initial rate of climb exceeded 1,000 fpm. At 100 mph. indicated and 2,500 rpm., the airplane ascended through 3,500 ft. at 800 fpm.; 6,000 ft. at 600 fpm.

• **Aileron control.** No rudder was used during slow-speed maneuvers at 80 mph. indicated, clean, and 60 mph., dirty (gear and full flaps), at 7,000 ft. The ball remained centered during moderate and steep turns controlled only by ailerons. Porpoising was encountered at 60 mph.; at 80 mph. the airplane could be trimmed hands-off in turns.

• **Stall characteristics.** Steady buffet—no clean break—resulted from stalls in clean and dirty configuration at 7,000 ft. There was no tendency to fall off on the wing; control was entirely by aileron. Clean, pulling 14 in. mani-



INTERIOR view of the Mark 20-A emphasizes roomy cockpit. Gear handle, locked under center on instrument panel, folds back flush with the floor, between the seats.

Airwork

Airwork CORPORATION

ORDER FROM YOUR NEAREST BRANCH

Factory Authorized Distributor For:

CLEVELAND, O.
6366 Eastland Road
Berea, Ohio
BErea 4-3251

ATLANTA, GA.
P. O. Box 713
Municipal Airport
POplar 6-3606

NEWARK, N.J.
307 Sherman Avenue
Newark 8, New Jersey
TAlbot 4-3400

MIAMI, FLA.
PO 48-194
Miami, Florida
TUxedo 8-3467

WASHINGTON, D.C.
5821 Seminary Road
Alexandria, Virginia
JEfferson 3-8118

NEW YORK, N.Y.
153-41 Rockaway Blvd.
Jamaica 34, New York
Fieldstone 1-1000

- A C SPARK PLUG
- AEROQUIP
- AIRBORNE ACCESSORIES
- BENDIX ECLIPSE-PIONEER
- BENDIX FILTER
- BENDIX FRIEZ
- BENDIX MONTROSE
- BENDIX PACIFIC
- BENDIX PRODUCTS (Stromberg & Landing Gear)
- BENDIX RED BANK
- BENDIX SCINTILLA
- BENDIX UTICA
- B. F. GOODRICH
- CANADIAN PRATT & WHITNEY AIRCRAFT
- CONTINENTAL MOTORS CORPORATION
- CO-OPERATIVE INDUSTRIES
- DELCO-REMY
- HELI-COIL
- HOLLEY CARBURETOR
- KOLLSMAN
- LEECE NEVILLE
- MARVEL-SCHEBLER
- MINNESOTA MINING & MFG.
- NEW YORK AIR BRAKE
- PACKARD CABLE
- PESCO PRODUCTS
- PRATT & WHITNEY AIRCRAFT
- WINSLOW AEROFILTER

NOW—A JET ACCESSORY OVERHAUL SHOP IN MIAMI

FACTORY AUTHORIZED
Engine, Accessory and Instrument Overhaul Sale or Exchange

- ★ CONTINENTAL MOTORS CORP.
- ★ LYCOMING Division of AVCO Mfg. Co.
- ★ ENGINE DRIVEN ACCESSORIES
- ★ FLIGHT INSTRUMENTS
- ★ GENERAL ELECTRIC Instrument Service Station

FIREPROOF

...with Skydrol-resistant cover

Construction: Fluoroflex®-T tube, AISI Type 304 stainless steel wire braid, specially impregnated asbestos shield which resists hydraulic and cleaning solvent fluids. Dash 4 through –24Z with swaged type or Seal-Lock*reusable fittings. *Trade Mark

dept. 252 **RESISTOFLEX** Corporation,
Roseland, N.J.

fold pressure and 2,300 rpm., the airplane stalled at 60 mph. and buffeted down at 500 fpm. In landing configuration buffet and porpoising down came between 50-55 mph. indicated.

• **Straight and level speeds.** At 7,000 ft., pulling 22.5 in. and 2,450 rpm.—about 73% power—the Mark 20-A indicated 158 mph. With outside air temperature 60F, the airplane trued out at 181 mph. At 22.5 in. and 2,300 rpm. —about 68% power—indicated airspeed was 154 mph. for a true airspeed reading of 176 mph.

The Mark 20-A is a smart looking airplane. Its laminar flow wing, the spar and all frames, are covered with yellow poplar, a hardwood plywood, which is ventilated so there are no sealed chambers.

The main spar is made of Sitka spruce. It is laminated with synthetic polyresin glue which adds 150% to the strength, according to Mooney. The entire wing is immersed in a vat of synthetic sealant, where both interior and exterior soak up seven gallons of this material. The objective is to control the flow of moisture during dry and wet seasons and to prevent both dry and wet rot.

Fabric Coating

Aircraft fabric is applied with one coat of clear dope, followed by six more coats. The fabric is then painted with four coats of silver and three coats of white dope. The next application is of fire-resistant butyrate dope. Mooney says the life of the wing should equal or exceed that of the metal fuselage.

Lack of concern about wing bending was apparent when, before flying the demonstrator, three persons sat on the wing; one sat on the stabilizer. The strength of both was evident at this point.

The baggage door, on the right side of the aircraft aft of the cabin, opens to a 120-lb. capacity compartment. The door is air and water-tight through a full-length piano hinge, rounded corners and rubber moulding.

Behind the baggage compartment is the radio equipment area. A removable outside panel on the tail cone allows direct access to the power supply rack and other accessory equipment.

The whole of the tail assembly moves for trim purposes; when the elevator trim is rolled back the entire tail empennage moves. This design adds to stability at low speeds and allows for minimum drag at high speeds.

The airplane is entered via a retractable foot step operating independently from the landing gear system. The step retracts completely into the wing fairing, eliminating drag. The cabin, complete with side curtains (optional) was comfortable and roomy. The front

RANGE of the Mooney Mark 20-A, with 49 gal. of fuel, is 1,075 mi. Maximum cruise speed is 180 mph. Service ceiling is 20,000 ft.

seats adjust fore and aft to three places.

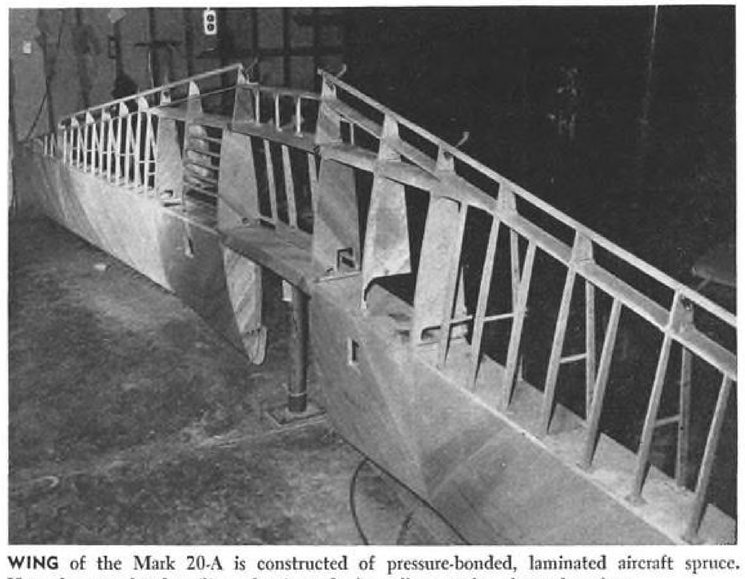
Flight instruments are on the left side of the shock-mounted instrument panel. Radio controls are centered. Engine instruments are located to the right side. Landing gear, wing flap and cowl flap controls are located directly below the center panel. Two main tanks hold 17.5 gal. each. The optional 14-gal. rear tank costs $190.

The demonstrator flown by AVIATION WEEK, N1046B, had but five hours of flying time. Empty weight, with equipment, was 1,483 lb. With four persons aboard, plus 34 gal. of gasoline and 30 lb. of luggage, the airplane grossed 2,352 lb.

The engine fired up quickly and we rolled out to runup. Visibility in this tricycle-geared airplane is good in the air and on the ground. The windshield is of tinted plastic glass, standard equipment on all Mooneys. The wide gear makes for good ground-handling characteristics. Shock in a Mark 20-A is absorbed by knee action of the gear compressing rubber doughnuts.

The steerable nose wheel ties in to rudder pedals. All linkage to control surfaces is push-pull (torque-tube).

The propeller and magnetos were checked at 1,800 rpm. (the vernier throttle is rotated for power adjustments) and we were ready for takeoff. Elevation of Red Bird Field is 642 ft. Wind was but 2 kt. Outside air temperature was 77F. Sea level pressure was 29.78 in.



WING of the Mark 20-A is constructed of pressure-bonded, laminated aircraft spruce. Here the completed trailing edge is ready for yellow poplar plywood surface.

First Takeoff

The first takeoff was "normal"; the airplane, at full power, accelerated to 60 mph. when the nose was pulled off. Slight back pressure is required on takeoff due to the negative angle of the airplane in roll. The Mark 20-A flew itself off at 70 mph. (During a subsequent short-field takeoff, full flaps were dropped as the airplane got rolling to 45 mph. In this manner we were airborne in 500 ft. at about 60 mph.)

Power reduction for climb-out was to 2,500 rpm., following retraction of gear. The gear is retracted manually (as are the flaps) and can get up or down in only two to three seconds. The manual feature, Mooney says, eliminates the need for separate electric or hydraulic systems and cuts costs.

The gear handle is a long bar extending from the floor between the front seats. With gear down, the handle locks in place under the center in-

USAC TRANSPORT INC

IF YOU HAVE SOMETHING BIG TO MOVE WE ARE THE SPECIALISTS YOU NEED

DOES YOUR TRAFFIC DEPARTMENT KNOW US?

WRITE FOR BROCHURE

457 WEST FORT ST.
DETROIT 26, MICH.
WO. 3-7913

Mooney Mark 20-A Performance

Maximum cruise speed (75% power at 6,500 ft.)	180 mph.
Top speed (100% power at sea level)	190 mph.
Economy cruise speed (55% power at 10,000 ft.)	165 mph.
Stall speed (gear-flaps down, power off, sea level)	57 mph.
Rate of climb (100% power at sea level)	1,150 ft. per min.
Takeoff run (10 mph. wind, sea level)	600 ft.
Landing run (10 mph. wind, sea level)	575 ft.
Service ceiling	2,900 ft.
Absolute ceiling	22,000 ft.
Range (still air, 15 min. reserve):	
Normal (35 gal. fuel)	630 mi.
Maximum (35 gal. fuel)	760 mi.
*Normal (49 gal. fuel)	900 mi.
*Maximum (49 gal. fuel)	1,075 mi

Engine: Lycoming, four cylinder, Model 0360, rated 180 hp. at 2,700 rpm.
Propeller: McCauley, 74 in., metal, constant speed, controllable pitch.
*Auxiliary fuel tank of 14 gal. is optional item.

strument panel. To raise the gear, the up-lock is released with the fingers, then the handle is pulled back and down in one movement into a locking device flush with the floor.

The handle initially comes back from the panel about 12 in. with very little pressure; then a sharp pull is necessary to get it through the "hard spot" that actuates the mechanical springs. The technique is one that requires a few applications for smooth operation.

Normal climb was made to 7,000 ft., holding 2,500 rpm. The mixture was leaned en route. Speed in climb was 100 mph. indicated. Rate, as mentioned earlier, was 800 fpm. at 3,500 ft.; 600 fpm. at 6,000 ft. Climb angle was good and the airplane was trimmed for hands-off flight during ascent.

Noise Level

Noise level was moderate through climb and succeeding phases of flight. Temperature level was comfortable; the airplane is equipped with a vent and defroster system. A Brittian air conditioner, an evaporator cooler type which holds 6 qt. of water, is available as an optional item.

Climb was continued a few hundred feet beyond cruise altitude, the nose was dropped and the aircraft put in a shallow dive to get it "on the step." At 7,000 ft. with outside air temperature at 60F, cruise speeds varied from 181 mph. (true airspeed) at 73% power to 166 mph. (TAS) at 54% power.

Aileron control was marked throughout this flight. The airplane was easily flown hands-off in turns, with the ball holding to the center. Control again was evident during stall demonstrations.

Spoilers located near the wing root allow the outer portion of the wing to keep flying when the root has stalled. The Mark 20-A was stalled clean and dirty, half flaps and full flaps, power off and power on. At best we could get a steady buffet and porpoising, and stall speeds varied with power and configuration: from 50-55 mph. in landing configuration, power off, to 60 mph. (clean) pulling 14 in. and 2,300 rpm.

Stalls in the Mark 20-A run to buffeting and porpoising; the airplane is quite docile. There is no wing dropping and no rudder application is necessary. Another aid to slow-flight stability is the 21 ft. of flaps, which span 70% of the 35-ft. wing spread. Flap control is three-position—quarter, half and full.

With gear and flaps up, the Mark 20-A has a 15 to 1 glide angle. The ratio was demonstrated when, at 4,500 ft., about 8 mi. out of the field, the mixture was pulled to idle cut-off, propeller control was brought full back (as close to full feathering as possible),

BAGGAGE compartment of the Mark 20-A has 120-lb. capacity and is both air and water-tight with a full-length piano hinge, rounded corners and rubber molding.

READY

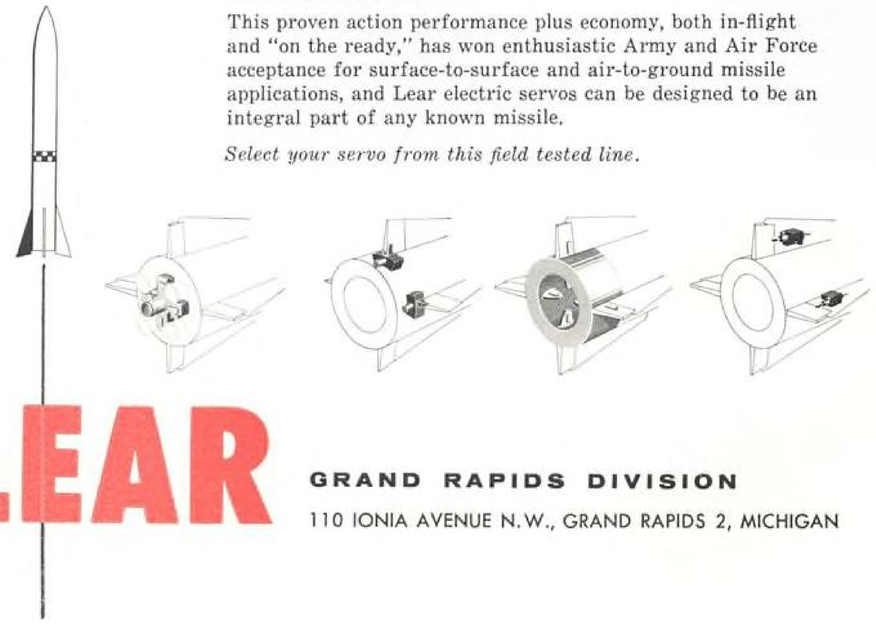
ONLY LEAR ELECTRIC SERVOS ARE MAINTENANCE-FREE AND *ALWAYS* ON THE ALERT

To help keep the peace, today's missiles must be instantly ready to fire as the Sheriff's six shooter of old. Delay or failure is fatal. Lear Electric Servos—even after "standing by" for three to five years—give this sure fire readiness to the nation's missile arsenal.

Lear Electric Servos provide more fire power per dollar by eliminating constant, high-cost maintenance required by other types of missile actuators. Lear's servo actuators save manpower, equipment and money. They are field tested and stand ready to "take over" instantly in missile jet vane, air vane or elevon actuation.

This proven action performance plus economy, both in-flight and "on the ready," has won enthusiastic Army and Air Force acceptance for surface-to-surface and air-to-ground missile applications, and Lear electric servos can be designed to be an integral part of any known missile.

Select your servo from this field tested line.



LEAR

GRAND RAPIDS DIVISION

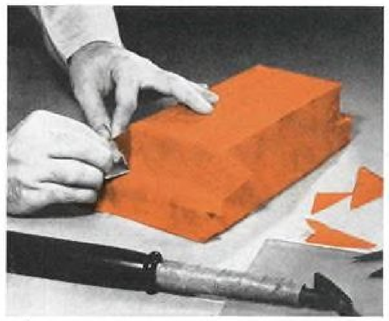
110 IONIA AVENUE N.W., GRAND RAPIDS 2, MICHIGAN

G-4

HOW TO MOLD HEAT-STABLE LAMINATES WITH DOW CORNING SILICONE RESINS

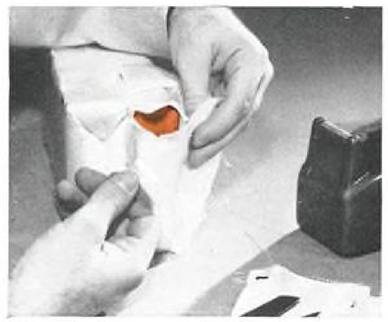
Complex parts, such as hot air ducts and radomes, can be made easily with Dow Corning silicone laminating resins. Finished parts are lightweight, and retain high strength after prolonged aging at 500 F. Silicone-glass laminates have excellent wet electrical properties and low dielectric losses at radar frequencies. They can be drilled, machined, sawed or sanded. Here is the step-by-step procedure for vacuum bag molding of silicone-glass laminates.

STEP 1
Pre-impregnated glass cloth is hand tailored to a form. The form can be made of metal, plaster, or any heat-stable material. Where necessary, the cloth is tacked in place with a sealing iron. The pre-impregnated cloth has good drape and can be used to make complex parts.



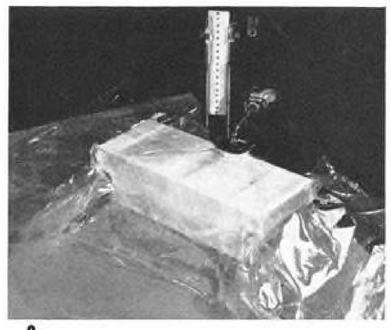
1

STEP 2
The lay-up is surrounded by bleeder cloth, which allows even distribution of the vacuum.



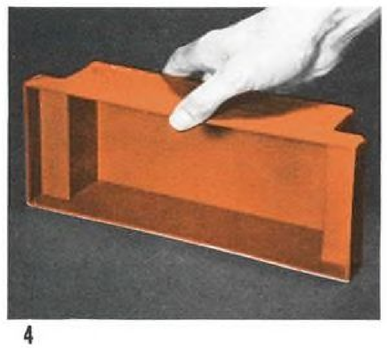
2

STEP 3
The covered lay-up is placed in a PVA bag, and a vacuum drawn on the bag with a mechanical pump. The bag is then sealed, and the whole assembly placed in an oven. The part is cured through 350 F.



3

STEP 4
Following the initial cure, the bag and bleeder cloth are removed. The part is then afterbaked through 480 F, trimmed, and finished. Complete operation is simple and economical.



4

For ***FREE BOOKLET*** *describing applications and typical properties of silicone-glass laminates,* ***WRITE DEPT. 0916a.***

first in silicones

Dow Corning CORPORATION
MIDLAND, MICHIGAN

Convair Executive

AYER-LINER

airline speed . . . dependability

office in the air . . .

office while there

pressurized comfort

The Convair 240 Executive Ayer-Liner originally flown and maintained by American Airlines, with increases in range and weight and deluxe custom tailored interiors by world famous AiResearch . . . $385,000. Standard 40 seat airline configuration . . . $250,000. For a demonstration flight, technical data, trade, lease or lease-purchase information on the most proven and modern executive aircraft in the world, telephone or write:

FBA

FREDERICK B. AYER & ASSOCIATES, INC.
250 Park Avenue • New York 17, N. Y.
MUrray Hill 7-1800
WORLD WIDE AIRCRAFT DEALER

Mooney Mark 20-A Specifications

Dimensions:	
Wing span	35 ft.
Length	23 ft. 2 in.
Height	8 ft. 4.5 in.
Tread	9 ft. 3 in.
Area:	
Wing	167 sq. ft.
Aileron	11.1 sq. ft.
Flaps	17.2 sq. ft.
Horizontal stabilizer	21.5 sq. ft.
Elevators	12 sq. ft.
Rudder	7.9 sq. ft.
Vertical fin	5 sq. ft.
Weights and loadings:	
Maximum gross weight	2,450 lb.
Empty weight	1,440 lb.
Useful load	1,010 lb.
Maximum baggage capacity	120 lb.
Usable fuel capacity (two tanks)	35 gal.
Wing loading	14.7 lb./sq. ft.
Power loading	13.6 lb./hp.

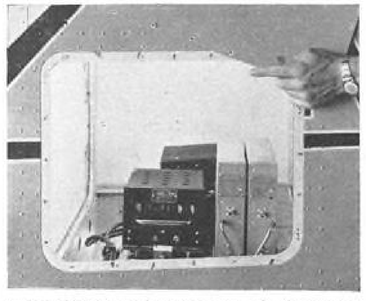
Wing: Low position, fully cantilevered wood construction; modified laminar flow. Design employing NASA sections 641-415 at tip and 632-215 at root.

Fuselage: Cabin section—steel tube frame, aluminum covered. Aft section—aluminum monocoque frame.

Empennage: Wood construction, adjustable for trim.

and the switch turned off. Initially we had some doubts about making the field, but we went over it well on the high side. Holding an indicated airspeed of about 100 mph., the airplane had a very flat glide. Rate of descent was 900 fpm. With gear and flaps down, the glide angle of the Mark 20-A is 9.8 to 1.

The engine was brought back in and the airplane slowed to 80 mph. indicated airspeed after the gear was dropped. This speed was held while turning on to final approach, and again the high glide ratio was evident. It wouldn't be hard, with the flat glide, to



ACCESSORY equipment area, aft of baggage compartment, provides access to radio power supplies in Mooney Mark 20-A.

Space Age Specifications

Are Right In Line With The Thinking And Ability That Marks The Quality Of

TMI Tubing

We set these custom standards long before interplanetary dreaming reached its action stage:. For Stainless Steel and Special Alloy Tubing cold drawn with infinite accuracy to .050" to 1.250" O.D. with tolerances as close as .0005" when you need it . . . you can depend on TMI to deliver as promised . . . so you can keep your promises, too.

The Mark of Quality TMI

TUBE METHODS INC.
METALLURGISTS • ENGINEERS • MANUFACTURERS
BRIDGEPORT (Montgomery County), PA.

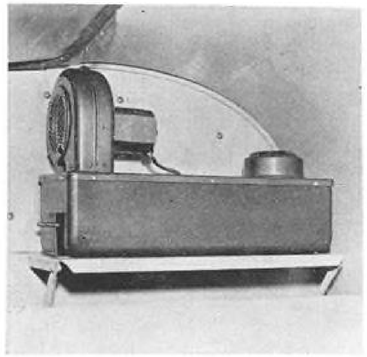
overshoot the first time around. The airplane was brought over the fence at 70 mph.; the landing run approximated 500 ft. A short-field "drag" approach, holding 80 mph. with power, will result in an easy stop within 400 ft. Once rolling on the runway, only slight rudder pressure is necessary for nose-straight control.

Mooney's current production at its Kerrville, Tex., plant is all Mark 20-A (the company is no longer building the 150-hp. Mark 20). Production is at the rate of one a day, or about 250 a year. Sales are currently limited only by production, Dick Martin, sales manager, told AVIATION WEEK.

1960 Model

The company also will introduce the Mark 21 as a 1960 model, with initial production coming in the fall and initial deliveries scheduled for November or December (at Mooney's annual meeting).

The Mark 21 is essentially a Mark 20-A powered by a six-cylinder Lycoming O540-A1A 250-hp. engine. The prototype is rebeefed to handle higher speeds and higher gross weight but the general dimensions are unchanged from the Mark 20-A. The exception is the nose, which is eight inches longer to handle the bigger engine. The airplane will be in the $18,000 and-up price category.



BRITTAIN air conditioner, shown in installed position, is evaporator cooler type and holds 6 qt. of water.

A third model, the Mark 22, is scheduled for introduction in 1961. This is a light twin with the general Mark 20 dimensions, but with two 180-hp. engines.

Mark 20-A total operating cost per hr., specified by Mooney, runs to $17.71 for 300 flight hours per year; $12.83 for 500 flight hours; $10.73 for 700 hr., and $9.17 for 1,000 flight hours per year. Cost per mile, with cruising speed of 175 mph., is estimated

NEW!
GLO-ESCENT LIGHTING

... the practical application of the phenomenon of ELECTROLUMINESCENCE

Miller GLO-ESCENT Lamps are laminations of many materials. Basically, they consist of a layer of phosphor between two electrical conductors. When current is applied, the entire surface of the panel emits light. They are ideal for use as dials, control panels, signs or decorative effects. New, patent-applied-for manufacturing techniques make it possible to fabricate these panels into virtually any shape for incorporation into your product.

GLO-ESCENT Lamps operate on AC only, 25 cycles or more. Direct current may be used in conjunction with inverters or oscillators. There are no expendable lamps, filaments or gases and average life is 30,000 hours. Current consumption is only 0.1 milliamp per square inch of lighted surface.

Miller Dial & Name Plate Company provides complete custom fabrication and design services to meet your particular problems.

SPECIAL OFFER: An actual GLO-ESCENT Lamp will be sent to you on a $5.00 memo billing basis, which will be credited on your first production order or cancelled on return of the lamp. Technical brochure available on request.

MILLER DIAL & NAME PLATE COMPANY
4400 Temple City Blvd., El Monte, Calif.
OFFICES IN PRINCIPAL CITIES

Manufacturers of FOILCAL, light weight metal name plates; FOTOFOIL, custom name plate process, edgelited panels and a full line of custom identification products.

Specialists in Machining
EXOTIC
Metals!

- Discaloy
- Hastaloy
- Udimet 500
- Rene'
- Waspaloy
- Inconnel 700
- Timken 16-25-6

Houston Fearless has developed new techniques for precision machining of these and other extremely hard, tough, high-temperature materials. Phone or write today for help on your problem.

HOUSTON FEARLESS
11819 West Olympic Blvd.
Los Angeles, Calif. BR 2-4331

ROTORS • NOZZLES • INDUCERS • EXDUCERS • PRESSURE VESSELS • IMPELLERS • SPECIAL WELDMENTS

FROM GENERAL MOTORS...TEMPERATURES MADE TO ORDER

FOR NEW BEECHCRAFT *Travel Air!*

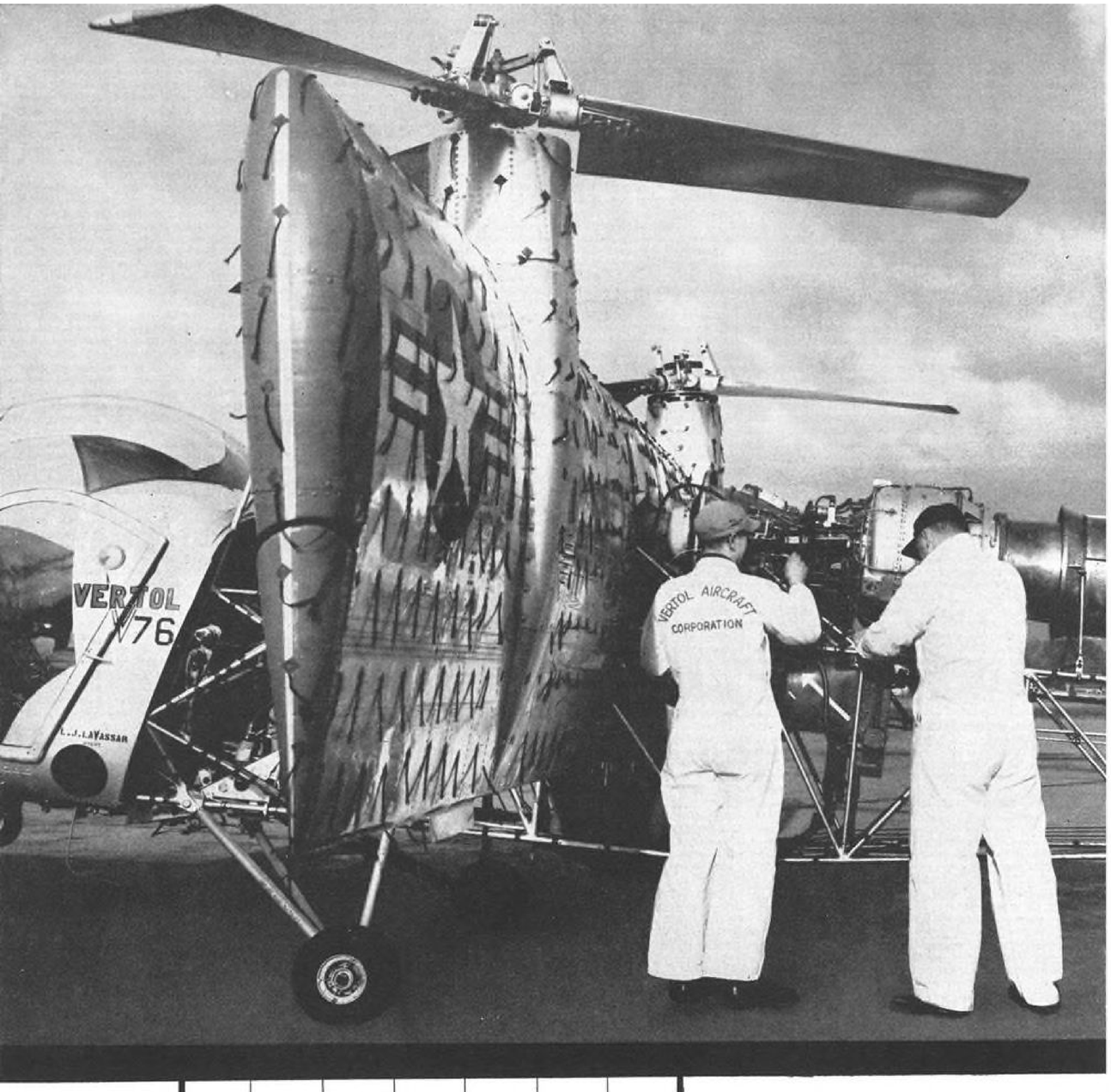
Harrison aircraft oil coolers—engineered & built to General Motors standards of quality.

Harrison-Cooled "Light Twin" Climbs 1360 Feet Per Minute!

Cruises over mountains . . . cruises over weather at 200 mph! Flies over 1400 miles without refueling! Carries 1420 pounds of useful load! Gets more than 11 miles per gallon! That's the amazing performance story of Beechcraft's new *Travel Air* . . . a modern executive's dream plane come true. And, of course, it's *Harrison cooled!* Dependable, lightweight heat exchangers by Harrison handle the vital job of cooling the engine oil on this ultra-modern craft. Cool performance in every flying situation is assured by Harrison. That's why you'll find Harrison heat exchangers on every type of advanced aircraft. That's why it's smart to look to Harrison if you have a cooling problem!

TEMPERATURES MADE TO ORDER
HARRISON
GM GENERAL MOTORS
AIRCRAFT, AUTOMOTIVE, MARINE AND INDUSTRIAL HEAT EXCHANGERS

HARRISON RADIATOR DIVISION, GENERAL MOTORS CORPORATION, LOCKPORT, NEW YORK



Vertol's
VTOL/STOL Aircraft

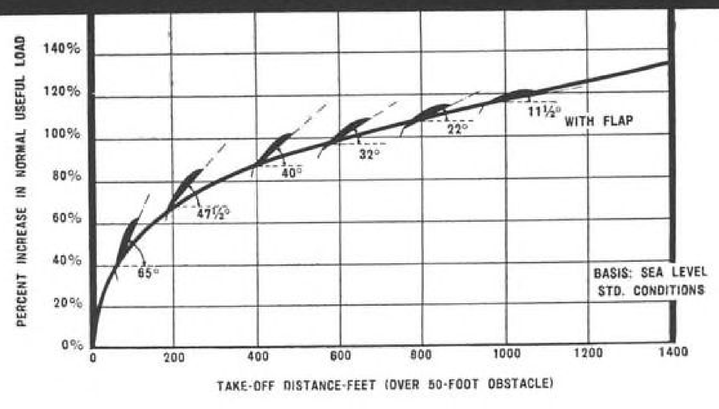
Built today.... in preparation for tomorrow

Vertol achieved a major breakthrough in aircraft development during 1958, when its Model 76 (Army VZ-2) became the world's first tilt-wing vertical take-off and landing (VTOL) research aircraft to successfully complete conversion flights. In extensive tests since the first conversion flights, this tilt-wing design concept has also shown its effectiveness as a short take-off and landing (STOL) aircraft. Because the Vertol tilt-wing design qualifies in this dual role as a VTOL/STOL vehicle, it has tremendous potentials for both military and commercial aviation.

As a next step, Vertol can now build an operational type aircraft incorporating the tilt-wing principle, to explore more practically – through evaluation – the mission usefulness of any VTOL/STOL type aircraft.

In anti-submarine work, this versatile VTOL/STOL vehicle offers high forward speed plus the hovering characteristics necessary for effective completion of all phases of such missions, thus replacing – with one aircraft – the several different types currently required. The broad capabilities of the Vertol tilt-wing design also include application as an air truck. In an STOL role, it can take off and land with substantially increased gross weights and payloads. This unique capacity, combined with VTOL performance, permits the user to "custom tailor" his take-offs to altitude, temperature, available runway and load.

This development of the tilt-wing is the latest example of the foresight and skill in research and development which Vertol has demonstrated over the past 15 years.



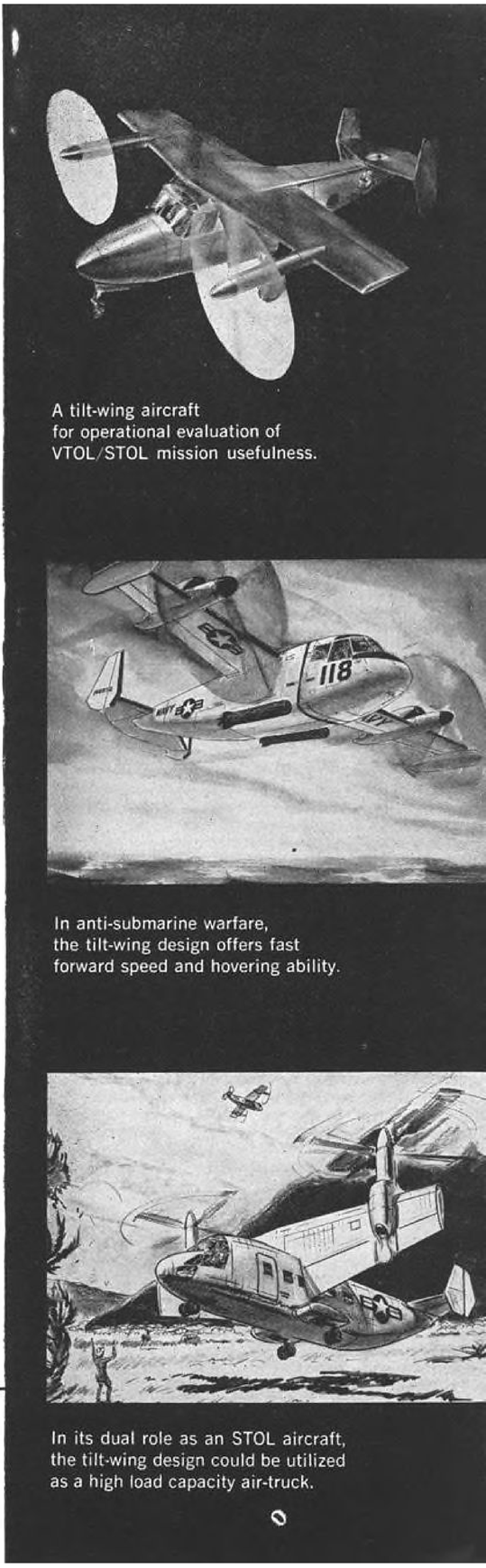
Increase in Useful Load of Tilt-Wing VTOL when operated as STOL.

Engineers: Join Vertol's advanced engineering team

VERTOL Aircraft Corporation

MORTON, PENNSYLVANIA

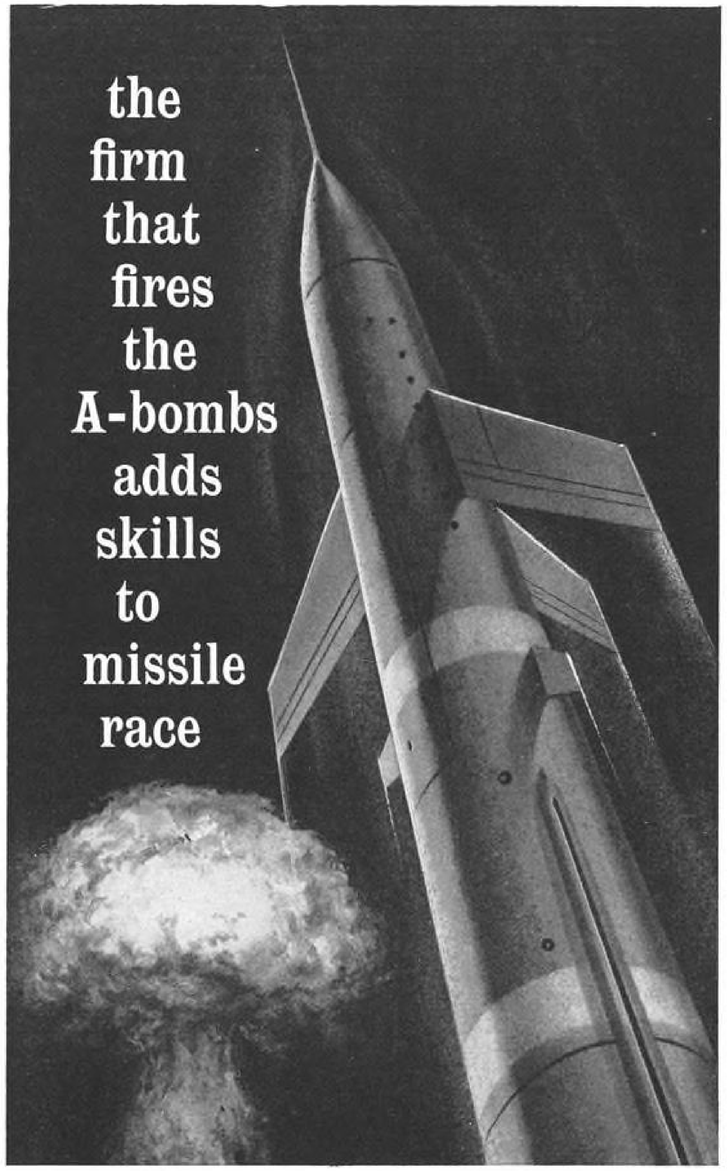
SUBSIDIARIES:
ALLIED RESEARCH ASSOCIATES, INC., BOSTON, MASS.
VERTOL AIRCRAFT CO. (CANADA), LTD., ARNPRIOR, ONTARIO



A tilt-wing aircraft
for operational evaluation of
VTOL/STOL mission usefulness.

In anti-submarine warfare,
the tilt-wing design offers fast
forward speed and hovering ability.

In its dual role as an STOL aircraft,
the tilt-wing design could be utilized
as a high load capacity air-truck.



In the timing, firing and instrumentation of nuclear devices, a single error in judgment or mistake in technical operation can lose a costly experiment or worse.

Yet Edgerton, Germeshausen & Grier, Inc., has helped to control, measure and photograph every nuclear test detonation for the Atomic Energy Commission. Its record — more than 100 shots in 10 years — **and EG&G has never lost an experiment!**

The unmatched capabilities proved by this remarkable record are applicable directly to the firing, instrumentation and tracking of missiles and satellites, as well as to other Space Age problems. Edgerton, Germeshausen & Grier, Inc. offers expert support to the missile man in:

Test facility operations • Test instrumentation systems • Nuclear warhead technology
Precise detonator timing • Flash systems for optical tracking • Technical field photography

Scientific and engineering positions, in physics and electronics are available. Additional information will be furnished upon request.

EDGERTON, GERMESHAUSEN & GRIER, INC.

160 BROOKLINE AVENUE, BOSTON 15, MASS. • 1622 SOUTH "A" STREET, LAS VEGAS, NEV.

at 10.1 cents for 300 hr.; 7.3 cents for 500 hr.; 6.1 cents for 700 hr. and 5.2 cents for 1,000 flight hours per year

The Standard Mark 20-A is fairly well equipped. Optional items, at additional cost, include packaged radio units, full panel instrument installation and miscellaneous items including dual controls for $80 and a Grimes rotation beacon for $150.

The demonstrator flown was equipped with Narco Superhomer (VHT-3) with VHF transmitter with 122.1, 122.5 and 122.8 crystals, VHF receiver, omni converter and indicator, headphone and microphone. The package costs $610. Full panel instrumentation, costing $550, includes an engine-driven vacuum system directional gyro, horizontal gyro, clock and suction gage. A 12-v. battery and 35-amp. generator are standard with the Mark 20 series.

Private Operator Buys First Ag-Cat

Calverton, N. Y.—Grumman Aircraft Engineering Corp. has sold its first Ag-Cat crop duster and spray plane to a private operator who had been called in during development to evaluate the biplane.

The first Ag-Cat went to Alden Robinson, operator of Millis Air Service at Accord, N. Y. Robinson will use the plane, which is convertible to both spray and dusting, on orchards, row crops, mosquito control and fertilizing.

Ten Ag-Cats have been built for Grumman by Schweizer Aircraft Co., at Elmira, N. Y., according to Randy Moore, Ag-Cat sales manager. Schweizer will put the plane on an eight-a-month production schedule, starting early in May.

The Ag-Cat costs about $18,000 equipped with a Continental W-670 engine of 200 hp. The plane, however, will be sold for about $16,500 if the purchaser furnishes his own engine and propeller for installation on the production line.

Moore said Grumman will assist potential purchasers in financing, probably through note endorsement, but final financing plans have not been made. He said the company probably will not be interested in lease-back arrangements.

Grumman last week gave the airplane its first public demonstration, spraying a 2,300 ft. swath of Calverton Field grass with a mixture of urea, ammonium nitrate and water, a fertilizer developed by Allied Chemical Corp., called Uran 30.

The aircraft was flown by Grumman pilot Harry DeMayo at altitudes from 5-10 ft. and speeds of about 75 mph. in a stiff crosswind. DeMayo made his end turns at altitudes of about 100 ft., turning 180 deg. in little more than the plane's radius. Earlier that day, the Ag-Cat had completed fertilizing of 450 acres in a bit less than 4 hr. Aircraft dispensed 13.5 gal. per acre in high density spraying; DeMayo landed several times to reload his hopper and usually was off the ground again within 5 min. The Ag-Cat was loaded from a Grumman tank truck which used an auxiliary pump towed behind the truck.

Ag-Cat carried about 1,000 lb. payload in the hopper, located immediately in front of the pilot's cockpit on the sloping nose section. A wind-driven motor, slung beneath the engine, provides 20 psi. pressure to the hopper. Hopper is baffled to prevent sloshing and fertilizer is vented to 24 spray nozzles located beneath the lower wing. System was developed for Grumman by Spraying Systems Co., of New York City.

Conversion to dusting takes less than 45 min.

The Ag-Cat recently completed an extensive tour of Latin American dusting and spray operations and DeMayo said operator reaction was "excellent." Aircraft handled well at South American altitudes and sales pitch probably will be directed toward these countries.

Terrell Kirk, assistant sales manager at Elmira, said an Ag-Cat will be displayed and demonstrated at the French International Airshow at Paris, June 12-21 as opener to a European sales campaign.

Airplane is 24 ft. 8 in. long, has a gross weight of 3,750 lb. and empty weight of 2,179 lb. (AW May 12, 1958, p. 115). At maximum gross weights, takeoff distance is 676 ft.

Yak-12A for Aeroflot

Three-passenger Yak-12A, a higher-performance version of Yak-12M, has completed its test program and will be used by Aeroflot for local services. Powered by a 240-hp. nine-cylinder aircooled engine, the Yak-12A has maximum range of 621 mi. compared to Yak-12M's range of 297 mi. Cruise speed of the newer model is 118 mph., compared with 99 mph. for earlier version. Top speed is reported as 134 mph. Design changes includes single-strut wing brace (Yak-12M has V struts), revised horizontal tail surfaces, use of a control wheel instead of a stick, revised instrument panel, additional side windows in the cabin and an improved cabin heating and ventilation system.

Avionics Engineers

New projects at the Columbus Division have created openings for electronic engineers and scientists in many fields.

Acoustics Test Analysis
Analog Analysis of Systems
Antenna Development
Data Processing
ECM and Reconnaissance
Flight Test Telemetering
Photographic and Optics
Radar Development
Servo Analysis and Control

Consider a permanent association with our engineering staff, among the finest in the aircraft missile industry.

Electronic engineers are invited to write:

H. Keever
Engineering Personnel Manager, Box AW-127
North American Aviation, Inc.
Columbus, Ohio

THE COLUMBUS DIVISION OF
NORTH AMERICAN AVIATION, INC.
Home of the T2J Jet Trainer and the A3J Vigilante

Sturdy MIL-SPEC **CABINETS**

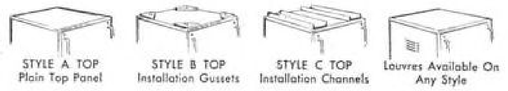
CUSTOM-BUILT
FROM
STANDARD STOCK PARTS
DELIVERED WITHIN THIRTY DAYS

Features –

- Maximum utility, pleasing appearance, low cost
- Adaptability to RETMA and Western Electric panels
- Lightweight, sturdy aluminum alloy construction throughout
- Built-in cooling ducts and protected harness ways
- Variation in size and load capacity to meet customer requirements
- Top and bottom styles as determined by environmental requirements
- Shock mounts as required

DESIGNED TO COMPLY WITH MIL-T-17113
AND COMPARABLE SPECIFICATIONS

FOR A QUICK PRICE and delivery quotation write or call our Sales Department



AIRCRAFT ARMAMENTS, inc.
COCKEYSVILLE, MARYLAND
A SUBSIDIARY OF THE UNITED INDUSTRIAL CORPORATION

proven again and again: Burroughs 205 Computer

Designed to handle with ease a wide range of computational problems, the Burroughs 205 is delivering results daily in a great variety of scientific and business applications... from refinery design to inventory control, wind tunnel test analysis to insurance premium billing, telemetered data reduction to operations research. The 205 was selected to work on these and countless other tasks because of its speed, 4080 words of memory, ease of program loading, vast magnetic tape storage capacity and multiple-card processing versatility... features which make the 205 today's best dollar-for-dollar computer value. The 205 is just one part of a complete line of Burroughs electronic data processing equipment, helping hundreds of industrial users to save precious man-hours and to solve important problems. Write for 205 brochure, ElectroData Division, Pasadena, California.

Burroughs Corporation

"NEW DIMENSIONS/in electronics and data processing systems"

PRIVATE LINES

Combined navigation-communications set, designed especially for light aircraft, is being engineered by newly established King Radio Corp., Kansas City, Mo. President of the new company is Edward J. King, former president-founder of Communications Accessories Co., Lee's Summit, Mo.

Italian petroleum company, Metanodotti, has ordered a Morane-Saulnier MS-760 four-place twin-jet business plane from the French manufacturer to be used in transporting executives.

Deliveries: Fairchild delivered the sixth executive version of the F-27 turboprop transport to Noland Co., Inc., Newport News, Va. . . . 400th Beech Super 18 has been delivered to H. L. Noble Construction Co., Greensboro, N. C. . . . 1,000th Cessna 310 and first 1959 model 310C was delivered to Stephens-Adamson Manufacturing Co., Aurora, Ill. . . . 1,500th Mark V VHF transmitter-receiver radio was delivered by National Aeronautical Corp. (Narco) to Van Dusen Aircraft Supplies, Teterboro, N. J.

Helicopter dealer: Philadelphia Helicoper Airways, Inc., Valley Forge Airport, Pa., has been named Hiller Aircraft Corp. factory dealer for Pennsylvania, Delaware, Maryland and Washington, D. C.

Van Dusen Aircraft Supplies established a southwest division with warehouse, salesroom and offices at Love Field, Dallas, Tex. Manager is Donald R. McCann.

More than 400 students, in addition to representatives from airlines, industry, military and private flyer organizations are expected to attend the annual meeting of National Intercollegiate Flying Assn. being held May 7-10 at University of Illinois Airport near Champaign.

New Speed Record

Las Vegas—World's speed record of 226.148 mph. was set here over a 1,242.7-mi. course by Miss Jerrie Cobb in an Aero Design 680-E twin-engine business airplane. Miss Cobb's flight which bettered a 223.713-mph. mark set by Soviet flier Petre Zakhoudamine in a Yak-11 in 1953, has been submitted to Federation Aeronautique Internationale for confirmation (AW Mar. 23, p. 93). U. S. record course was from McCarran Field, Las Vegas to Pescadero, Calif., to San Diego and back to Las Vegas.

Structural Engineers

The Columbus Division of North American offers immediate positions for career-minded structural engineers.

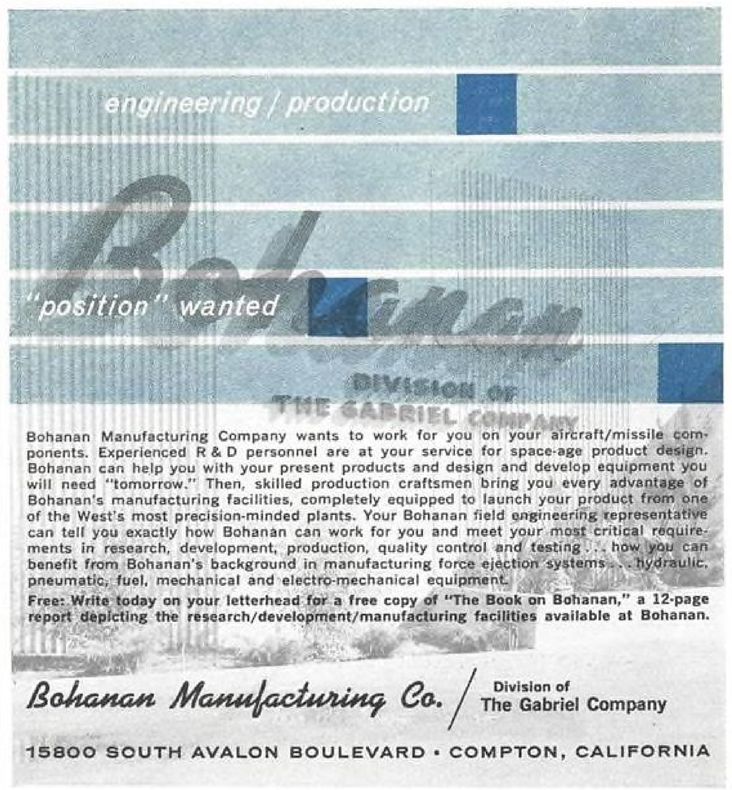
Structural Analysis Engineers: Ability to derive internal load distributions and/or perform structural analyses of complex components of aircraft and missile structures. High temperature stress experience desirable.

R & D Engineers: To improve and optimize structural analysis methods and techniques. Current studies include development of fatigue criteria, nuclear effects on structures, thermal cycling, and associated problems of creep, cooling, and insulation. The R & D group provides structural support to Advanced Design.

Increased R & D activity and expanding work loads have caused this expansion. If your degrees or degree and professional experience qualify you, please write to:

H. Keever
Engineering Personnel Manager, Box AW 126
North American Aviation, Inc.
Columbus, Ohio

THE COLUMBUS DIVISION OF
NORTH AMERICAN AVIATION, INC.
Home of the T2J Jet Trainer and the A3J Vigilante



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:

Waldorf Instruments Division, F. C. Huyck & Sons, Huntington Station, N. Y., simulated flight instruments and drawings, (PR 56461), one ea., $41,164.

Sperry Gyroscope Co. Division, Sperry-Rand Corp., Great Neck, N. Y., various components of radar set AN/APN-59, spare parts and data for Navy aircraft and Project Black Knight, (MIPR R59-1731-50-NO as; PRs MD9-16K1-55157 and MD9-16K1-55140), $332,896.

Eclipse-Pioneer Division, Bendix Aviation Corp., Teterboro, N. J., 26 ea., controller, flight autopilots, P/N-15711-1F used in the C-121 aircraft, (PR MA-8-05F-756 and amendment No. 1), $28,027.

Collins Radio Co., Cedar Rapids, Iowa, Components of Collins Type VHF, 101 communications system, used in the T-37A and C-133B aircraft, (PR's PE-9-16A-4321, MD-9-5821-36016 and EC-9-16A-4451), $480,300.

Abrams Instrument Corp., Lansing, Mich., 57 ea., type B-8B camera exposure limiting intervalometers, used in the B-52 aircraft, (FR PE-9-10A-4164), $67,028.

Collins Radio Co., Cedar Rapids, Iowa, 104 ea., indicators, Collins Part No. 331C-4A; 60 ea., couplers, Collins Part No. 161B-1, 60 ea., mountings, Collins Part No. 349L-2, for support of B-52 aircraft and Navy aircraft, (PR EC-9-16A-4412 and MIPR R58-1485-154 NOas and amendment No. 1), $103,579.

General Precision Laboratory, Inc., Pleasantville, N. Y., product improvement program for the AN/APN-81 for the B-52 aircraft, (PR EC-9-16K1-4677), $110,000.

Industrial Products Division, General Tire & Rubber Co., Wabash, Ind., 400 ea., oxygen masks to be used as part of an operational personal equipment assembly, to be used by pilots to improve SAC combat capability on Project Headstart, (PR 64929), $86,456.

Small Aircraft Engine Department, General Electric Co., West Lynn, Mass., 32 ea., YJ85GE-5 turbojet engines for T-38 aircraft, (PR EP-9-2840-4339), $1,-500,000.

J. W. Fecker, Inc., Pittsburgh, PA., O-11 viewfinder and spare parts applicable to the RB-57D aircraft, (PR's MO-9-6760-2146; MO-9-6760-2123; MO-9-6760-2193; MO-9-6760-32601), $242,534.

Allison Division, General Motors Corp., Indianapolis, Ind., 36 ea., T56A-7 turboprop engines for C-130B aircraft; 1 ea., T56-A-7 turboprop engine for M.T.U.; 6 ea., turboprop engines for W2-E aircraft (PR's EP-9-2840-4332; WR-9-MAINT-46; MIPR-R59-1920-12-NOas), $3,946,540.

The Martin Co., Baltimore, Md., increase in funds for expansion of TM-76B missile program, (PR TM-9-1410-7248), $2,400,000.

Borg Equipment Division, Amphenol-Borg Electronics Corp., Janesville, Wis., 3,391 Indicators, ID-250A/ARN, for C130B, C-133B, et al aircraft; Navy Tacan; Navy Tacan retrofit program for various fighter, bomber and cargo aircraft, IFB 33-600-59-95, (PR's PE-9-16A-4294; MD-9-16A-35352 and amendment No. 1; MIPR's R59-1711-35-NOas and R59-21042-SC-SMD24), $492,-132.

Link Aviation, Inc., Binghamton, N. Y., increase in quantity of F-106 flight simulators from three to seven, (PR DC-9-28A-7274), $500,000.

Air Arm Division, Westinghouse Electric Corp., Baltimore, Md., flight test of radar set AN/APG-55(XY-1), (PR PE-8-ST-3762), $459,988.

Southern, Waldrip and Harvick, Long Beach, Calif., 4 ea., maintenance docks for servicing C-130 aircraft, 3 ea., for KC-97 aircraft, 1 ea., for B-52 aircraft, 4 ea., for B-58 aircraft and 1 ea., for C-124 aircraft, (IFB 33-600-59-103), (PR's EM-9-F-6210; EM-9-F-6204; EM-9-F-6200; EM-9-F-6206; EM-9-6208), $1,733,993.

General Electric Co., West Lynn. Mass., amplifiers, synchro style, temperature, type ASU-1/A, supply spares, Aerno. 61-8859, IFB 33-600-59-138, (PR MA-9-05D-486), 129 ea., $116,100.

Norair Division, Northrop Corp., Hawthorne, Calif., N-156 flight test articles, 3 ea., static test article, spare parts, ground support equipment and technical data, 1 ea., (PR 65860), $7 million.

John Oster Manufacturing Co., Racine, Wis., indicators, temperature, Type EHU-1/A, Aerno. 61-8860, used on C-130B aircraft, IFB 33-600-59-138, (PR's MA-9-05D-486 and EA-9-05D-4572), 140 ea., $28,000.

Andrea Radio Corp., Long Island City, N. Y., dynamotors, DY-76A/AIC-10 for replenishment, supply spares support, (PR MD-9-16A-35308), 1,000 ea., $129,660.

Stencel Aero Engineering Corp., Ashville, N.C., 8 ea., ultra fast opening parachute assemblies, XMP-2 platform style and spare parts sets; one ea., anti-coning device (prototype); one ea., improved safety rod (prototype), (PR 56459), $40,000.

Petroleum Contracts

Washington—Following is a list of unclassified contracts for $25,000 and over as released by the Military Petroleum Supply Agency, Washington 25, D. C.:

Allied Materials Corp., Oklahoma City, jet fuel JP-4 IFB 59-75), 2,500,000 gal., $244,200.

Bell Oil & Gas Co., Tulsa, Okla., jet fuel JP-4 (IFB 59-75), 33,500,000 gal., $3,294,-234.

Cardinal Transports, Inc., San Antonio, Tex., jet fuel JP-4, (IFB 59-75), 6 million gal., $606,300.

Mid-America Refining Co., Inc., Chanute, Kans., jet fuel JP-4 (IFB 59-75), 5,500,000 gal., $590,975.

Federal Oil Co., San Gabriel, Calif., jet fuel JP-4 (IFB 59-75), 4,500,000 gal., $502,245.

MacMillan Petroleum Corp., Los Angeles, Calif., jet fuel JP-4 (IFB 59-75), 3 million gal., $288,630.

Colbro Corp., Los Angeles, Calif., jet fuel JP-4 (IFB 59-75), 2 million gal., $215,970.

American Petrofina Company of Texas, Dallas, jet fuel JP-4 (IFB 59-75), 12,594,-000 gal., $1,149,013.

Howell Refining Co., San Antonio, Tex., jet fuel JP-4, (IFB 59-75), 18,383,000 gal., $1,875,810.

Gladieux Oil Sales and Refinery, Inc., Fort Wayne, Ind., jet fuel JP-4 600,000 gal., $60,000.

Monarch Refining Co., San Antonio, Tex., jet fuel JP-4 (IFB 59-75), 7,200,000 gal., $703,440.

Petrochemical Division, Great Western Producers, Inc., Irving, Tex., jet fuel JP-4 (IFB 59-75), 4 million gal., $408,-000.

Standard Oil Company of Texas, El Paso, Tex., jet fuel JP-4 (IFB 59-75), 3 million gal., $300,000.

Petroleum Refining Co., Lueders, Tex., jet fuel JP-4 (IFB 59-75), 5 million gal., $522,500.

Texas Calgary Co., Abilene, Tex., jet fuel JP-4 (IFB 59-75), 2 million gal., $214,800.

Shell Caribbean Petroleum Co., New York, jet fuel JP-4 IFB 59-75), 52,500,000 gal., $3,643,500.

Pure Oil Co., Chicago, jet fuel JP-6 (IFB 59-123), 600,000 gal., $73,080.

Carter Oil Co., Billings, Mont., jet fuel (IFB 59-75), 31,576,800 gal., $3,545,872.

Sinclair Refining Co., New York, jet fuel JP-4, (IFB 59-75), 6,300,000 gal., $614,250.

Continental Oil Co., Houston, Tex. jet fuel JP-4, (IFB 59-75), 26,823,000 gal., $3,-066,085.

Triangle Refineries, Houston, Tex., jet fuel JP-4, (IFB 59-75), 12,600,000 gal., $1,-200,276.

Espanda Corp., Dallas Tex., terminalling (2) grades of government owned aviation fuels in the Gladstone-Escanaba, Mich., area, (RFP 59-N-99), $2,807,500.

Verona Petroleum, Inc., Plattsburgh, N. Y., terminalling (2) grades of government owned aviation fuels in the Rome, N. Y., area, (RFP 59-N-108), $2,200,162.

FLIGHT DATA and CONTROL ENGINEERS

Cross new frontiers in system electronics at The Garrett Corporation.

High-level assignments in the design and development of system electronics are available for engineers in the following specialties:

1. ELECTRONIC AND FLIGHT DATA SYSTEMS AND CONTROLS A wide choice of opportunities exists for creative R & D engineers having specialized experience with control devices such as: transducers, flight data computers, Mach sensors, servo-mechanisms, circuit and analog computer designs utilizing transistors, magamps and vacuum tubes.

2. SERVO-MECHANISMS AND ELECTRO-MAGNETICS Requires engineers with experience or academic training in the advanced design, development and application of magamp inductors and transformers.

3. FLIGHT INSTRUMENTS AND TRANSDUCERS

1) DESIGN ANALYSIS Requires engineers capable of performance analysis throughout preliminary design with ability to prepare and coordinate related proposals.

2) DEVELOPMENT Requires engineers skilled with the analysis and synthesis of dynamic systems including design of miniature mechanisms in which low friction freedom from vibration effects and compensation of thermo expansion are important.

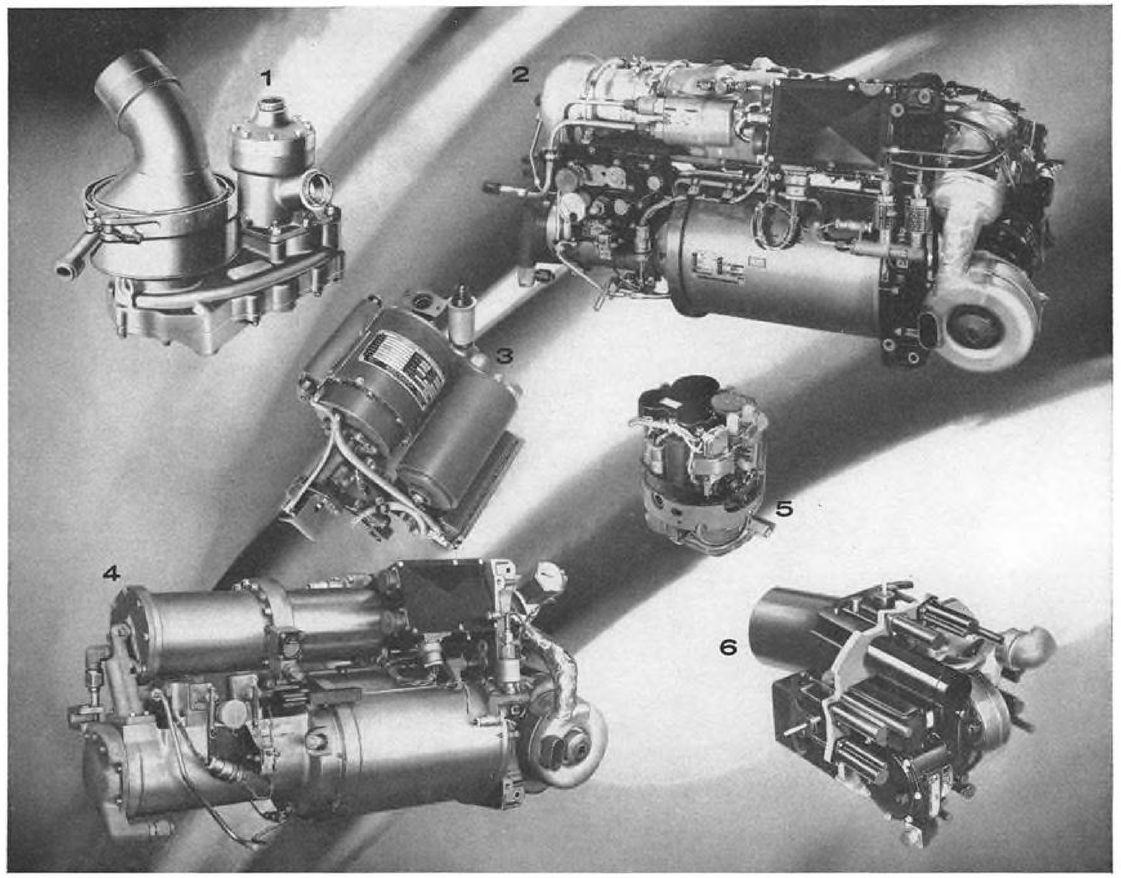
4. PROPOSAL AND QUALTEST ENGINEER For specification review, proposal and qualtest analysis and report writing assignments. Three years electronic, electrical or mechanical experience required.

Forward resume to:
Mr. G. D. Bradley

THE GARRETT CORPORATION
9851 S. Sepulveda Blvd.
Los Angeles 45, Calif.

DIVISIONS:
AiResearch Manufacturing—Los Angeles
AiResearch Manufacturing—Phoenix
AiResearch Industrial
Air Cruisers • Airsupply
Aero Engineering
AiResearch Aviation Service

DELIVERED—thousands of missile APUs



1. *Solid propellant—hydraulic output* 2. *Liquid propellant—hydraulic and electric output* 3. *Solid propellant—electric and mechanical drive output* 4. *Liquid propellant—hydraulic and electric output* 5. *Solid propellant—hydraulic and electric output* 6. *Solid propellant—hydraulic, electric and steering outputs*

AiResearch has designed, developed, manufactured and delivered thousands of missile accessory power units. Extremely reliable and lightweight, these various solid and liquid monopropellant APUs are completely self-sustaining within the missile system. Designed to minimum space and weight requirements, they are built to withstand high G loading and severe temperature extremes.

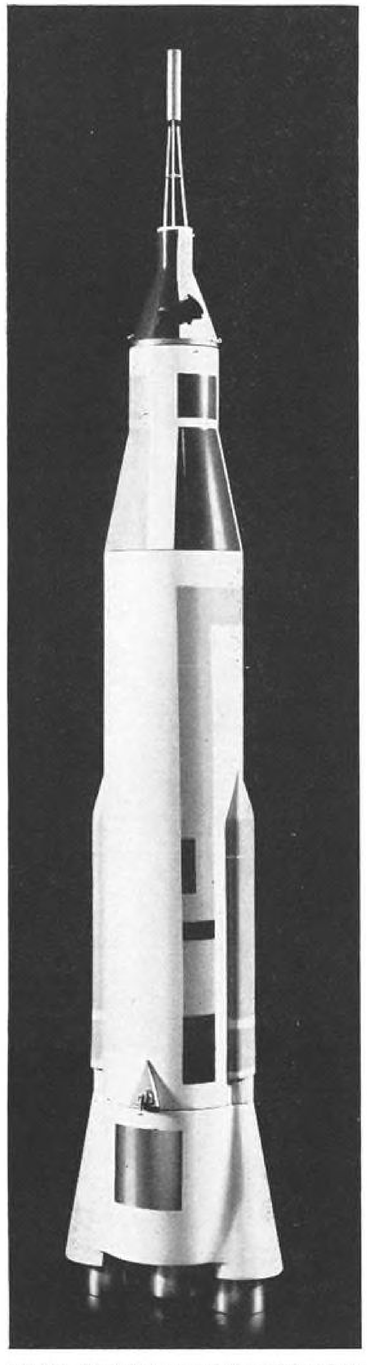
The several units pictured above provide hydraulic, electrical and/or steering surface control depending on the customer's requirement. Delivered horsepower ranges from 1.2 to 35 h.p. over hot gas operating durations from 30 seconds to 20 minutes. Electrical regulation is maintained as closely as ±½%. A significant advance in missile APUs is unit #6 pictured above. This package represents the first integrated hydraulic and electrical power unit providing a steering surface actuation system.

These tailored systems utilize the extensive hardware experience and complete laboratory, test and production facilities of AiResearch needed for quick and efficient quantity production of complex APU systems. AiResearch is the world's largest and most experienced manufacturer of lightweight turbomachinery—the key component of its APU systems. Your inquiries are invited.

THE GARRETT CORPORATION
AiResearch Manufacturing Divisions
Los Angeles 45, California • Phoenix, Arizona

Systems, Packages and Components for: AIRCRAFT, MISSILE, ELECTRONIC, NUCLEAR AND INDUSTRIAL APPLICATIONS

Radioplane Develops Mercury Parachute



MODEL shows how capsule is positioned on modified Atlas for manned space flights. Upper structure is emergency escape tower.

Las Vegas—Details of the two-stage parachute system which will slow Project Mercury's manned space capsule for a safe letdown after re-entry from orbit were outlined to the World Congress of Flight here by Thomas Beresford, head of Northrop Corp.'s Radioplane Division Paradynamics Group.

Paradynamics Group is designing and developing the landing system for McDonnell Aircraft Corp., capsule contractor for National Aeronautics and Space Administration.

Preparation for landing will be initiated either by pilot or ground control stations firing retrorockets to decrease capsule velocity and program the re-entry trajectory.

At 60,000 ft. altitude, the automatic chute system will be initiated by deployment of a drogue chute expelled from a mortar triggered by dual altitude controls. Drogue chute will provide stabilization for the capsule and remain attached until the capsule descends to 10,000 ft., when it will be released by automatic altitude controls (AW April 20, p. 28).

The main landing chute will then be deployed and will provide an impact velocity of 30 fps. when the capsule reaches 5,000 ft. for its final letdown. Upon landing, the primary chute will be released and various recovery and locating acids, such as SOFAR bombs, dye-marker, radio beacon flashing light and smoke signals, will be ejected.

Reserve System

In addition to the automatic sequence, the landing scheme will incorporate an independent reserve letdown system which will be able to be operated manually by the capsule pilot.

Feasibility of establishing world-wide telephone, television and telegraph communications with a "24-hr." satellite circling 22,300 mi. above the earth was underscored by Donald M. Culler, director of International Telephone and Telegraph Corp.'s Missile and Space Systems Laboratory.

This type of system would be feasible in the near future using today's technology, Culler declared. Two principal problems would be development of reliable satellite-borne equipment with high transmitter output and adequate electrical energy, and development of a guidance and control system for the ascent and orbiting phases, he said.

Culler's concept embraces three of the satellites 120 deg. apart, positioned stationary with respect to the earth because orbiting speed would match that of the earth's rotation. Three ground relay stations he cited as examples were Houston, Tex., Athens, Greece, and Tokyo, Japan, to provide almost complete global coverage. Only limited areas around the polar regions would be below the line-of-site horizon for the satellites.

One configuration of a 24-hr. satellite cited as an example would be a 4-ft.-diameter cylinder 7 ft. long, weighing 400 lb., incorporating a 16-in. antenna dish and affording a 96-voice channel relay. Solar energy collectors for storage batteries would be located on the periphery of the cylindrical satellite. Propellant jets would control the vehicle's orientation.

Budget Share

With the continuing shift from manned aircraft to missiles and increasing emphasis on space vehicles, the electronics industry should continue to get a larger share of the defense budget, according to A. J. Catapano, industry specialist for Merrill Lynch, Pierce, Fenner and Smith, investment brokers, who discussed the changing defense industry from the investors' viewpoint.

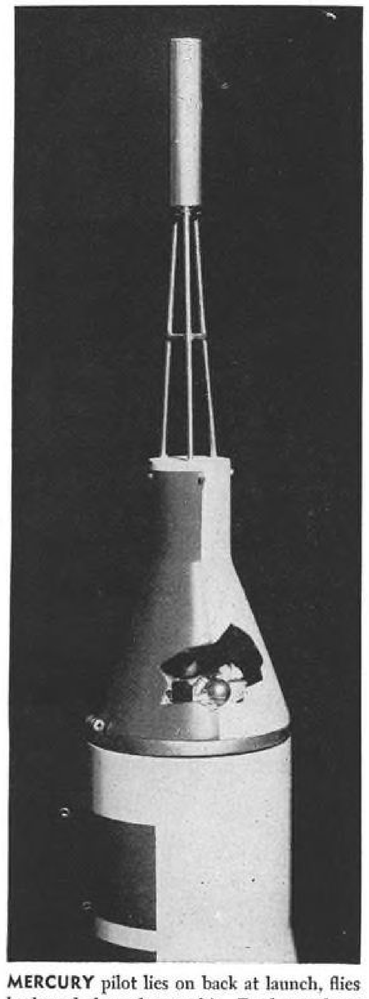
Basically, the market has decided that the major beneficiaries of the missile-space age will be the electronics and propellant companies, Catapano declared. Since the launchings of Sputnik I, the defense electronics group, as measured by the Merrill Lynch price index of 540 stocks, has outpaced the general market by some 400% and the shift from manned aircraft to missiles has outperformed every other major group in the market, he said.

With a continuing shift from manned aircraft to missiles and the increasing emphasis on space vehicles, the electronics industry should continue to get a larger share of the defense budget, he claimed. Dollar volume in the electronics industry could easily double by 1965, he pointed out, even assuming only moderate increases in the over-all defense spending. This is an impressive potential, comparing favorable with long established growth areas such as the chemical and drug industries which are expected to expand by 10 to 15% annually, he explained.

Catapano said that a "shake-out" undoubtedly will happen over the next decade as weaker companies either disappear or are absorbed, and the result will be a greater industry concentration with the emergence of several large industry leaders. He qualified this by adding that since the industry probably is more dependent upon ideas and the human equation than any other industry in U. S. history, the degree of concentration perhaps will be less than seen in most industries, with continuing opportunities for new small but soundly-based enterprises.

Stock Factors

Outlining stock selection factors in the defense industry field, Catapano declared annual research and development expenditures in relation to sales should be substantial. "We prefer to see a situation where at least a good portion of these outlays are company-sponsored because of the greater proprietory interest it derives from such activities. Nevertheless, large government-sponsored R&D programs can be extremely important as well," he said.



MERCURY pilot lies on back at launch, flies backward throughout orbit. Dual parachute system provides pilot-operated back-up.

Engineers and Scientists

...for creative work!

- ASTROPHYSICS
- SPACE MECHANICS
- SYSTEMS DYNAMICS
- MAGNETO HYDRODYNAMICS
- AEROPHYSICS

We need men who can make original contributions in stability and control analysis, studies in space environment and navigation, magnetism, other problems in flight. In return we offer recognition of your ability, advancement commensurate with your accomplishments. Write or phone William Spangler, Manager, Professional Employment, Dept. AW-3, The Martin Company, Baltimore 3, Md.

Baltimore

The best of city and country living . . . 20 unhurried minutes from your office . . . at Martin, Baltimore.

MARTIN
BALTIMORE

where the North ... the Sou...

BASIC TEST FOR MEDIA SELECTION:

Ask anyone, anyone you're trying to sell in the aviation market, what publication he reads and respects most.

A powerful editorial force is a powerful selling force.

Aviation Week

Including **Space Technology**

A McGraw-Hill Publication, 330 West 42nd St., New York 36, N. Y.

Aviation's largest engineering-management audience.

ABC PAID CIRCULATION 71,950

How far can an engineer go at AC?

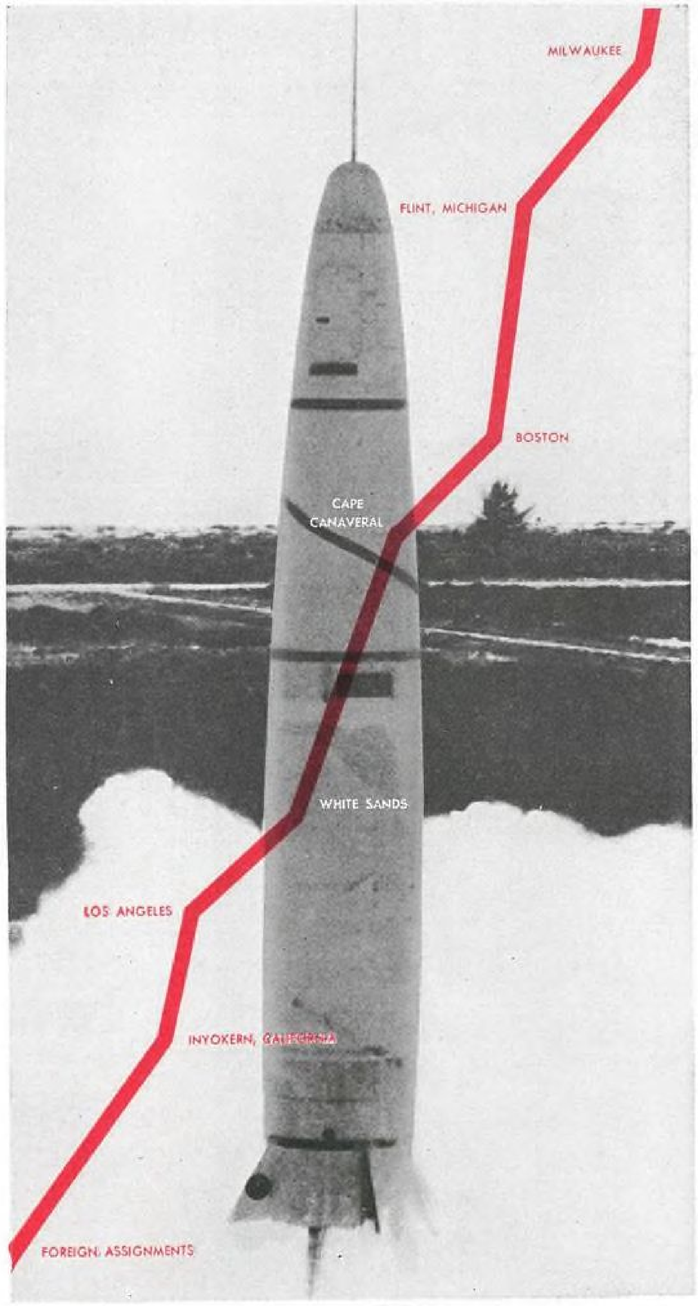
Your career can go up and up with missiles and space vehicles. For AC, new leader in the instrumentation business, is building more and more AChievers—one of the world's finest inertial guidance systems—plus a host of other remarkable electro-mechanical, optical and infra-red devices.

If you are a graduate engineer in the electronic, electrical or mechanical fields, *you can go places at AC, because AC is going places.*

Do you want new and different assignments?—Look to AC. Professional status?—AC assures it. Interesting location?—You can go across the country or around the world. A top management position?—The door is always open. Long-range security?—AC and General Motors are famous for it.

Investigate these opportunities now. Just write the Director of Scientific and Professional Employment: Mr. Robert Allen, Oak Creek Plant, Box 746, South Milwaukee, Wisconsin.

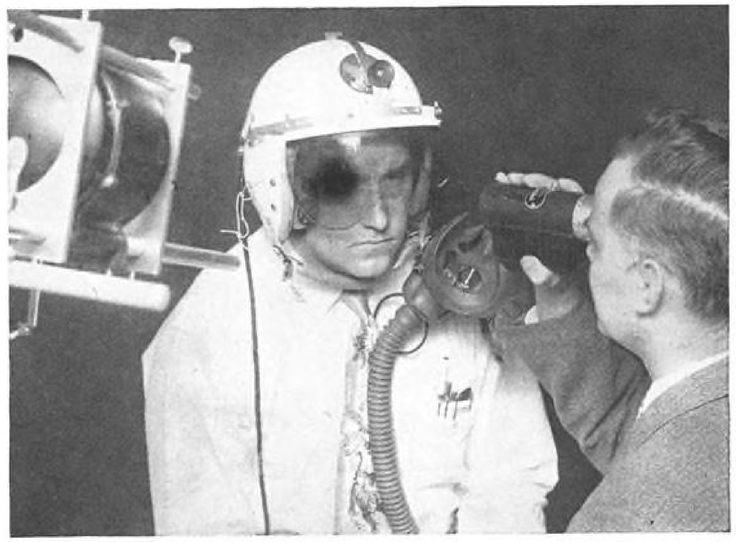
INERTIAL GUIDANCE SYSTEMS • AFTERBURNER FUEL CONTROLS • BOMBING NAVIGATIONAL COMPUTERS GUN-BOMB-ROCKET SIGHTS • GYRO-ACCELEROMETERS • GYROSCOPES • SPEED SENSITIVE SWITCHES • SPEED SENSORS • TORQUEMETERS



The Thor, launched on a cushion of flames, is guided by the AChiever. And the AChiever does its job so well that the demand for AC products is constantly increasing.

AC SPARK PLUG
THE ELECTRONICS DIVISION OF GENERAL MOTORS

NEW AVIATION PRODUCTS



Chemical Ultraviolet Shield Studied

Transparent dye, undergoing evaluation for use on visors of space helmets, turns dark blue when exposed to ultraviolet light, forming a barrier against the rays. Dye is being developed under a USAF aeromedical research project seeking ways to protect space travelers from intense sunlight unfiltered by the atmosphere. Chemical, effective only when in the liquid state, must be encapsulated in plastic. Developer of the material is the National Cash Register Co., Dayton, Ohio.

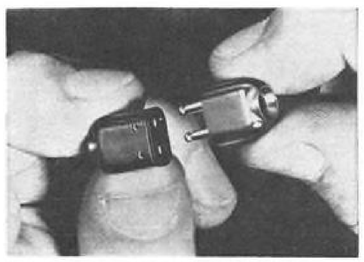
Barometric Altitude Control

Altitude controller for aircraft and missile application operates in unengaged mode as an altimeter, and engaged as an altitude controller.

Standard operating range is from sea level to 100,000 ft. with temperature errors of ±3 ft. between −55 and +71C. Velocity errors are effectively zero when engaged and under 50 fpm.

for rate of climb of 180,000 fpm. when unengaged. In unengaged mode linearity and hysteresis are ±0.25% or 100 ft. up to 80,000 ft. When engaged, linearity over ±500 ft. excursion is ±3% and hysteresis under 3 ft. upon return to engage altitude. Weight of controller is 43 oz. and dimensions are 4½ x 4½ x 6 in.

General Controls Co., 801 Allen Ave., Glendale 1, Calif.



Electrical Connector

Nylon miniature connector, weighing .053 oz., is used for Air Force pilot helmet earphones and other applications where size and weight are important factors.

The male and female sections are .490 and .580 in. in length respectively; .306 in. wide and .453 in. deep.

Fluorocarbon Products Inc., Division of United States Gasket Co., Camden 1, N. J.

High Temperature Lubricant

Aluminum magnesium silicate compound provides lubrication to temperatures of 1,900F with high load-carrying strength and acid resistance. Lubricant has application in both aviation and industrial fields, the manufacturer says.

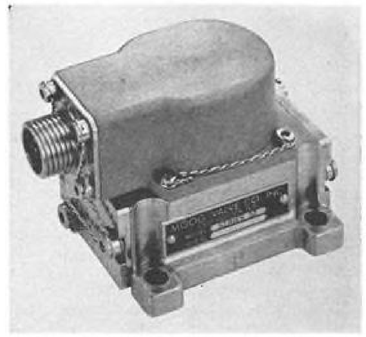
Almasol is a tan powder that is compatible with petroleum. It is not water soluble and does not react with ferrous metals. Lubricants are available in five grades ranging in cost from $.60 per lb. for general use to $7.40 per lb. for aircraft applications.

Lubrication Engineers, 2709 Race Ave., Ft. Worth, Tex.

Servovalve

Electrohydraulic servovalve is intended for use in flight control systems of aircraft and missiles.

Valve, available in series 31 and 32, employs a double-nozzle-flapper hydraulic amplifier and has internal mechanical feedback from the second stage sliding spool to the first stage torque motor. Standard valves are suitable for



−65 to 350F operation with flow capacities to 16 gpm. at 3,000 psi. Special models are available for hydraulic or pneumatic control to 600F. Valves are built to meet specific applications; however, shelf quantities are available at rated flows of 1,2,4, or 8 gpm. at 1,000 psi. valve drop.

Moog Valve Co. Inc., East Aurora, N. Y.

Airport Cleaner

Airport cleaner, designed to clean runways, taxiways and ramp areas, cleans at a rate of 2,000,000 sq. ft. per

THE NEW U.S. ARMY MOVES

and there's a BELL in the Picture

Mobility . . on the ground and in the air . . that's today's new Pentomic Army. Well-equipped, hard-hitting Battle Groups . . geared for independent action . . can strike, disperse, concentrate . . with instant flexibility and control.

Mobility is vital to success on the modern battlefield . . and one key to the Army's mobility is its air vehicles. Bell, long a member of the Army team, helps the new Army see and move. Battle proven, battle tough, the Bell H-13H helicopter supports ground operations. And now, the Army's own turbine-powered Bell HU-1 helicopter . . a joint Army-Air Force-Bell triumph . . gives the Army greater air mobility . . gives it greatly improved performance and reduced maintenance. Bell is proud to be a part of the new Army's arsenal.

SUBSIDIARY OF BELL AIRCRAFT CORPORATION FORT WORTH, TEXAS

BELL HELICOPTER CORP

*

THE STORY OF TODAY'S NEW ARMY IS A STORY OF PROGRESS..AND

BELL

is helping make Americans aware of the vital necessity of this modernization program in keeping our Army strong, *mobile*, and ready to combat the threat of nuclear warfare.

**One of a series of ads currently appearing in such opinion-making publications as Fortune, Business Week and U. S. News & World Report.*

FORT WORTH, TEXAS | SUBSIDIARY OF BELL AIRCRAFT CORPORATION

BELL HELICOPTER CORP.

hr. at maximum cleaning speed of 35 mph.

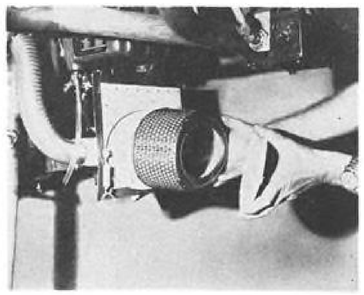
Sabre 58C cleaner combines a 65,000 cfm. vacuum flow rate with a 6,200 cfm. blower flow rate. Separate gasoline engine is used to power the fan. Cleaner truck, weighing 36,000 lb., is operated by one man.

Sabre Aviation Equipment Co., 9126 Ogden Ave., Brookfield, Ill.

Dry Type Air Filter

Dry type carburetor air filter is standard equipment on the Piper Pawnee agricultural airplane.

Filtronic filter is said to have a dust removal efficiency of 99.5% and is



99% effective when overloaded with contaminant. Filter is secured with two spring clips permitting fast replacement.

Fram Corp., Providence 16, R. I.

Fuel Moisture Monitor

Monitoring instrument which continuously measures the quantity of moisture in liquids will detect quantities as low as one part per million. Primary application will be the monitoring of jet fuels.

Instrument employs an inert strip-

ping gas to pull the water from the liquid. Electrolytic analysis of the gas detects the presence of moisture in trace or percentage quantities.

Consolidated Electrodynamics Corp., Pasadena, Calif.

Runway Gaslight

Gaslight is designed to provide low cost runway lighting for private airstrips.

Lights, mounted atop 11 in. international yellow cones, may be turned

ROHR CONTROLS THE CLIMATE

for professional engineers

Engineers find a climate of close-knit coordination interwoven with wide individual responsibilty at Rohr.

The many assignments within our medium-sized engineering department mean more scope per man – more personal potential.

Rohr, world's largest producer of major aircraft components, has its largest backlog in history – more than 60% in commercial contracts – more diversified than ever.

In this short-sleeve climate of opportunity for seasoned engineers Rohr needs men now in the fields of:

STRUCTURES, BRAZING, WELDING, BONDED STRUCTURES, LIAISON, INDUSTRIAL

Please forward your complete resume at once to: Mr. J. L. Hobel, Industrial Relations Manager, Rohr Aircraft Corp., Chula Vista, California.

World's largest producer of components for flight

ROHR AIRCRAFT CORPORATION

Chula Vista and Riverside, California

A jet-age classroom for the future men in space ... Cessna's T-37

Pilots of the latest Air Force ultrasonic aircraft are already on the threshold of space. The jet pilots now in training will surely go beyond—and they will have been more quickly prepared for their duties by the newest U.S.A.F. jet trainer—the Cessna T-37.

The T-37 with combat jet characteristics and side-by-side seating simplifies instruction and increases student proficiency. As a result, the Air Force now speeds jet instruction at substantial savings.

Cessna Aircraft Company, Wichita, Kansas.

Cessna

on automatically by a light sensitive photoelectric cell which controls gas pressure. Copper tubing coiled inside the conc reduces the possibility of line breakage should an aircraft strike one of the lights. Cost of a 50-light system, installed in Arkansas, was $1,000.

Arkla Air Conditioning Corp., 812 Main St., Little Rock, Ark.

Navigation Instrument

Tacan/VOR instrument displays two relative bearings, distance and magnetic heading on a single indicator face.

Three BDH indicators, Type 9813-02, may be used in conjunction with one Oster coupler. Operating temperature range is from −55 to +71C; weight is 2.6 lb. Instrument operates on 26 v., 400 cps. and 28 v.d.c. and meets applicable portions of MIL-E-5400.

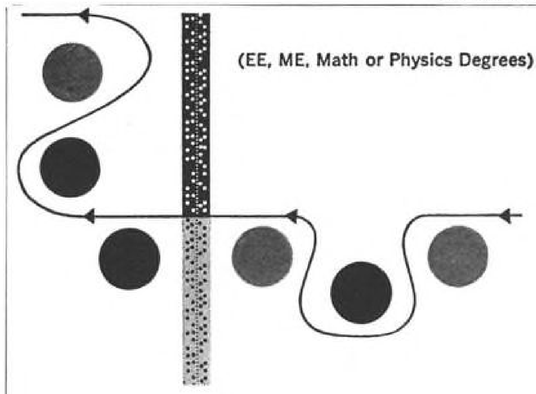
John Oster Manufacturing Co., Avionic Division, 1 Main St., Racine, Wis.

Metal Seal

Metal-to-metal valve seal is intended for applications involving varying degrees of pressure, flow and temperature.

Valve has been tested as a pilot-operated shutoff valve, with 10,000 psi. nitrogen and as a check valve with gases, hydraulic fluids, fuels, ammonium nitrate and methyl ethyl ketone, at temperatures from − 20 to + 650F. Seal is designed so that small pressures will deflect any irregularity and give a seal between the seat and the poppet.

Hydraulic Mechanisms, Inc., 1047 61st St., Brooklyn 19, N. Y.



OPERATIONS ANALYSTS

Which of these 3 assignments—on large-scale USAF Data Processing System with hitherto unrealized capabilities lies within your competence?

1/ Construct mathematical models for information and retrieval system designed to transcend all present day concepts in MAN-MACHINE RELATIONSHIPS.

2/ Develop and synthesize new concepts for extremely high-volume, high-speed data processing system to greatly enhance human prediction capabilities.

3/ Coordinate with computer engineers to assure optimum equipment applications. Prepare specifications. (Present state of equipment art will in no sense limit ultimate system.)

These opportunities are with General Electric's Computer Dept.—now engaged in the design and development of a comprehensive DATA PROCESSING SYSTEM, handling problems which cannot be stated in terms of standard technologies.

Staff expansion is under way. Immediate openings exist for operations and systems analysts at both the Washington, D. C. office and the Phoenix, Arizona headquarters.

Write for further information on the scope of the USAF Data Processing Program and the exceptional opportunities it offers for career development.

Replies will be held in confidence.
Mr. J. E. Torrey, Div. 64-WQ
COMPUTER DEPARTMENT

GENERAL ELECTRIC

13430 N. Black Canyon Highway, P.O. Drawer 270, Phoenix, Arizona

ENGINEERS

with experience in

AIRCRAFT DUCTING SYSTEMS

ROCKET ENGINE SUBSYSTEMS AND COMPONENTS

ALL-METAL HONEYCOMB STRUCTURES

Solar offers exceptional opportunities at this time for creative engineers. The right men joining now will gain key positions in their fields of interest, will work on exciting projects of the most advanced type. It will be to your advantage to learn the complete details immediately.

SOLAR SPECIFICS

Solar is a medium-size company (2500 people in San Diego) with a successful history since 1927. It is big enough to offer the most advanced personnel policies, yet small enough so you don't get lost in the crowd. Salary and performance reviewed semi-annually. Liberal relocation allowances. Solar is making many significant contributions to space age technology, including development and production of some of the most advanced solid fuel rocket cases and nozzles in the U. S. The special professional status of engineers is fully appreciated and recognized. A new 60,000 sq. ft. engineering building, necessitated by expanding research and development, will be completed in 1959 on the edge of San Diego Bay. A huge new furnace for heat treating and brazing will also be completed this year.

IDEAL LOCATION

Solar is located in sunny San Diego with the finest year-around climate in the U. S. Recreational, cultural and educational facilities are superb. The new advanced science branch of the University of California offers exceptional opportunities for further study. Outdoor living and sport can be enjoyed all year long. You and your family will really "live" in San Diego!

SEND RESUME

Please send resume of your qualifications at the earliest opportunity to Louis Klein, Dept. E-355, Solar Aircraft Company, 2200 Pacific Highway, San Diego 12, California.

SOLAR AIRCRAFT COMPANY — SAN DIEGO, DES MOINES

ALSO OPENINGS FOR: Research Engineers (high temperature materials) . . . Metallurgists . . . Gas Turbine Engineers . . . Publications Editors . . . Engineering Writers . . . Engineering Drawing Checkers.

WHO'S WHERE

(Continued from page 23)

Changes

Walter C. Shaw, head of the newly established Advanced Product Planning Group, Engineering Department, Hamilton Standard Division of United Aircraft Corp., Windsor Locks, Conn. Also: **George R. Urquhart**, advanced product design engineer; **Walter E. Arnoldi** and **Samuel J. Loring**, senior technical specialists; **David C. Jennings**, senior analytical engineer.

George S. Cooke, assistant director of European operations (Wiesbaden, Germany), The Martin Co., Baltimore, Md. **Nicholas M. Voorhies** succeeds Mr. Cooke as Air Force requirements manager, and **Howard F. Dunlap** succeeds Mr. Voorhies as Army requirements manager.

Jack Gilley, staff specialist-safety engineer, Georgia Division, Lockheed Aircraft Corp., Marietta, Ga. **Alvan W. Barrett** succeeds Mr. Gilley as chief flight engineer.

Leonard Mautner, project manager for special systems, Hughes Aircraft Co., Culver City, Calif.

Robert J. Wright, director of marketing, Mechanical Division of General Mills, Minneapolis, Minn.

Dr. Richard H. Valentine, director of research and development, New Departure Division, General Motors Corp., Bristol.

R. H. Carpenter, special consultant on aircraft and aircraft operations, Avionics Division, General Precision Laboratory, Inc., Pleasantville, N. Y.

Frank G. Denison, manager-vehicle technology, Space Technology Division, Aeronutronic Systems, Inc., subsidiary of Ford Motor Co., Glendale, Calif.

K. Buchele, chief of quality control, Douglas Aircraft Co., Inc., Santa Monica.

George B. Freeman, manager-electronic and fire protection products, Fenwal, Inc., Ashland, Mass.

Hugh Mease, Jr., manager-market research and product planning, General Electric Co.'s Heavy Military Electronics Department, Syracuse, N. Y.

Dr. Ervin H. Bramhall, chief of weapon systems analysis, Solar Aircraft Co., San Diego, Calif.

Milton Shapiro, manager of the newly established corporate Market Research Department, Vickers, Inc., Detroit, Mich.

William T. Smither, general manager of the Los Angeles operations, Servomechanisms, Inc., Hawthorne, Calif.

Floyd F. Rechlin, structures research specialist, Research and Development Division, Narmco Industries, Inc., San Diego, Calif.

Thomas A. Combellick, chief engineer, Military Division, Lenkurt Electric Co., San Carlos, Calif. **Paul E. Meier** succeeds Mr. Combellick as manager of Lenkurt's Washington, D. C., office.

Edward E. Foster, assistant technical director-administration, Cornell Aeronautical Laboratory, Inc., Buffalo, N. Y. Also: **Edward B. Chester**, chief of information services.

Dr. L. B. Valdes, director of research, Rheem Semiconductor Corp., subsidiary of Rheem Manufacturing Co., Mountain View, Calif.

Professional Personnel Requisition

Controls & Instrumentation Engineers

Marquardt Aircraft — a leader in air and space propulsion and control systems, high altitude rocket research and weapon support systems — offers a creative engineering environment in which you will find significant active projects. These include engine control systems for nuclear turbojet, inlet control systems for the North American F-108 and Hound Dog missile, control systems for the supersonic ramjet engine, feasibility studies of advanced and unique engine cycles, nozzle control for advanced ballistic missile components and other power system actuators. These control units include fluid and gas operated servo systems suited for environments above one thousand degrees.

If you are an engineer experienced in fluid dynamics or fluid operated controls and interested in mechanisms designed for severe environmental conditions, you should consider one of the following engineering opportunities at Marquardt:

CONTROLS DESIGN

To create components for pneumatic and hydraulic control systems. Work ranges from simple piston actuators to complex speed computing devices. All designed for high sensitivity, fast response, extreme environmental conditions and light weight. Should be experienced in machine design and have an understanding of basic design analysis.

CONTROLS ANALYSIS

To investigate aircraft and missile control problems through the application of analysis methods in mechanics and dynamics, heat transfer, compressible flow, and servomechanisms. Position offers opportunity for creative engineering.

CONTROLS DEVELOPMENT

Opportunity to create workable controls components. Must have a "feel" for hardware and desire to undertake broad engineering responsibility. Opportunity to solve "on-the-spot" engineering problems utilizing pneumatic and hydraulic control analysis techniques.

ENGINEERING STANDARDS

Implement, establish and/or originate the use of standards both design and hardware for reduction of time and cost of engineering effort. Must have knowledge of hydraulic and pneumatic design and components. Should be capable of setting up an evaluation program as required. Requires ability to work with many engineering groups both in advisory and service capacity.

CONTROL RELIABILITY

To predict reliability of control of units and recommend appropriate design changes. Knowledge of servomechanisms and feedback theory desirable. Should have background in statistics and experience in reliability field.

INSTRUMENTATION

Specification and design of instrument components and systems for ground testing of supersonic ramjet engines, jet engine components, inlet controls, nuclear powerplant controls and emergency power units. Prefer instrumentation experience, including data acquisition and processing equipment. Familiar with process control systems.

For additional information, please write
Mr. Floyd E. Hargiss, Manager
Professional Personnel, Dept. A-3
Marquardt Aircraft Co.
16555 Saticoy Street
Van Nuys, California

Marquardt AIRCRAFT CO.

VAN NUYS AND POMONA, CALIFORNIA—OGDEN, UTAH

COOPER DEVELOPMENT CORP.—MONROVIA, CALIFORNIA—A MARQUARDT SUBSIDIARY

PERFORMANCE ENGINEERS

AIRCRAFT & SPACE VEHICLE SYSTEMS EVALUATION

Diversified projects include the evaluation of advanced propulsion concepts for subsonic, hypersonic, and space vehicles in terms of system performance capabilities.

Sustained program with excellent management support—digital computer services—and contributing efforts by experienced component specialists.

Minimum qualifications for these positions include a B. S. degree in aeronautical engineering plus three years' related experience.

For information write to

Mr. J. A. Farrell

RESEARCH DEPARTMENT

UNITED AIRCRAFT CORPORATION

400 Main Street — East Hartford 8, Conn.

ENGINEERS & SCIENTISTS

Join In Developing A New Regime Of Power Plants AT

FLIGHT PROPULSION DIVISION

Commercial Engine Operation
Flight Propulsion Laboratory Dept.
Jet Engine Department
Production Engine Department

GENERAL ELECTRIC

Cincinnati, Ohio

Teams of engineers and scientists in our division are working on far advanced jet and rocket engines and new approaches to space propulsion.

IMMEDIATE NEEDS FOR:

VIBRATION/MECHANICAL ANALYSIS: AE or ME with 2 years experience in applied mechanics, to establish experimental programs for development engines.

CYCLE ANALYSIS: ME with 4 years experience in thermo design, for cycle analysis programs to improve development engines and predict the effect of modifications and performance of "paper" engines.

COMBUSTION ENGINEER: ME with 2 years development experience for J93 Project (powering the B-70).

CONTROL MECHANICAL DESIGN: ME with 3-5 years experience to design hydraulic or hydromechanical controls for jet and rocket engines.

MECHANICAL DESIGN RELIABILITY: ME or AE with 3 years gas turbine experience, to review designs for reliability and carry out reliability program for development engines.

SCIENTISTS: MS or PhD and related experience for major programs in plasma jet, ion propulsion, other advanced concept programs.

MAIL YOUR RESUME OR THIS COUPON TO THE ADDRESS BELOW:

Mr. Mark Peters
Bldg. 100, Dept. 64-WQ
Flight Propulsion Division
General Electric Company
Cincinnati 15, Ohio

I want to learn more about FPD research and engineering. Please send "Thrust & Progress" brochure.

NAME .....

ADDRESS .....

.....

.....DEGREE .....YEAR.....

ENGINEERS:

The kind of work you want in MISSILE ELECTRONICS

The kind of life you want for your family

GET *BOTH* AT

BENDIX YORK

ELECTRONIC ENGINEERS

PHYSICISTS

MECHANICAL ENGINEERS

• Challenging opportunities in Circuit Design, Pulse & Video Circuitry, Microwave, Digital & Analog Computers, Semi-conductors, Component and Circuit Reliability.

Interesting work on Fuzing Techniques, Beacons, Simulators, Special Test Equipment.

• Bendix York offers you the opportunity for rapid professional growth and advancement. Enjoy the small-company atmosphere of an expanding division of one of America's largest engineering and manufacturing corporations . . . And the way of life in and around York, Pennsylvania is ideal for the entire family. It combines the charm and grace of rural living with the many advantages of a dynamic and progressive community.

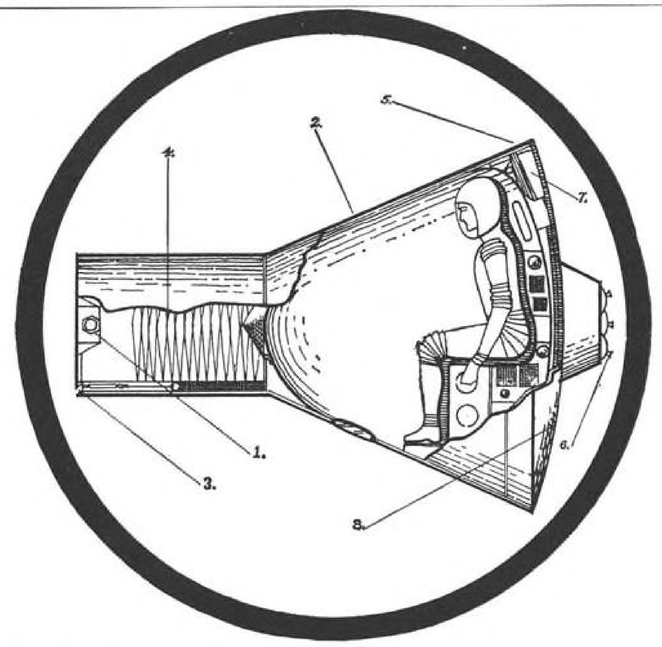
Let us hear from you!
Address replies to: Dept A
Professional Employment

Bendix
AVIATION CORPORATION
York Division
York, Pennsylvania

"The way of work for you, the way of life for your family!"

NASA Manned Satellite Capsule

1. Horizon Scanner
2. Entrance Hatch
3. Pitch & Yaw Jets
4. Packed Parachute
5. Roll Jets
6. Retro-Rockets
7. Inflatable Landing Impact Bag
8. Heat Shield



NASA has urgent need for scientists and engineers to assume responsible positions on

PROJECT MERCURY

Project Mercury, our effort to send man into orbital flight and return him safely to earth, is being prosecuted with great vigor by NASA. The contract for the construction of the capsule shown above has already been awarded. The selection of astronauts to man our first Mercury is under way.

We invite scientists and engineers to join our technical staff in pursuing this historical step in space exploration. Exceptional opportunities for rapid professional and personal advancement are available in the following areas of endeavor:

OPERATIONS Mission Planning • Projectory Analysis Launch Operations • Recovery Operations

COMMUNICATIONS Range Systems Integration • Long Range Communication • Lang Range Telemetry • Long Range Tracking

FLIGHT TEST Component and Systems Development • Development Testing • Instrument Development and Check Out Equipment Development and Check Out • Test Planning, Scheduling, Coordinating

HUMAN FACTORS Pilot Training • Animal Operations Biophysical (Radiation, Vibration, Noise)

ENGINEERING & DESIGN Mechanical Design • Instrument Design • Air Frame Design • Weight Analysis • Stress Analysis Cost Analysis • Engineering Specifications • Metallurgy

FLIGHT SYSTEMS First Flight Testing • Heating Analysis Aerodynamics • Propulsion • Performance Analysis • Re-entry Flight Control • Space Navigation • Space Mechanics • Human Engineering • Space Systems Power Supply Engineering Avionics • Environment Control

Address your inquiry to:

Personnel Director, Project Mercury, NASA, Hampton, Virginia

NASA National Aeronautics and Space Administration

ENGINEERS & SCIENTISTS

FOR

RESEARCH PROGRAMS IN IONOSPHERIC PROPAGATION & HF COMMUNICATIONS

Our accelerated growth in these fields offers attractive opportunities to join senior engineers and scientists of stature now involved in challenging, advanced projects. Responsible assignments furthering the state-of-the-art in these fields, plus competitive salaries and outstanding growth potential are offered to men who can contribute to the progress of these important programs.

SENIOR IONOSPHERIC PHYSICIST

Ph.D preferred plus several years experience in the study of ionospheric phenomena. Should be familiar with present knowledge of upper atmosphere physics and possess an understanding of current programs using rockets and satellites for studies in F-region and beyond. Qualified man with supervisory abilities will have an exceptional opportunity to assume project leadership duties on an HF project already under way involving F-layer propagation studies backed by a substantial experimental program.

SENIOR ELECTRONIC SCIENTIST

Advanced degree in E.E. or Physics preferred. Must be familiar with present state-of-the-art in the design of advanced HF receivers and transmitters, and possess working knowledge of modern HF networks employing ferrites and metallic tape cores. Strong theoretical background in modern linear circuit theory desired. Will carry out laboratory development implementation of new HF communication systems.

STAFF ELECTRONIC ENGINEERS (RADAR)

Advanced degree in E.E. preferred. Must be familiar with conventional pulse circuit designs and applications. Technical background should include substantial experience in data process and data recovery systems using both analog and digital techniques. Knowledge of principles and application of modern information theory including correlation techniques helpful. Will be responsible for the design of sub-systems.

GLOBAL COMMUNICATIONS SPECIALISTS

BS degree plus 5 to 10 years' experience embracing theoretical as well as practical knowledge of communications systems design involving F-layer ionospheric propagation techniques. Working knowledge of modern high-power HF transmitters and HF receiving systems.

DEVELOPMENT ENGINEER

Advanced degree in M.E. or physics preferred. Must be skilled in advanced laboratory techniques in rocket motor development. Strong background in applied thermodynamics, aeroballistics and rocket propulsion desired. This is a new project in planning stage. Opening requires person capable of assuming duties of assistant project manager.

EXCELLENT SALARIES

Commensurate with education & experience

MODERN COMPANY BENEFITS

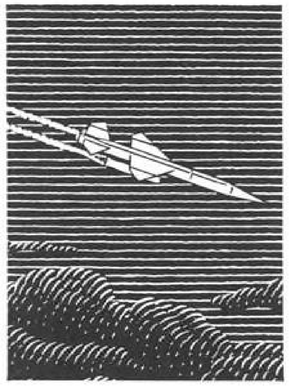
including educational assistance plan

RELOCATION ASSISTANCE

Ideal Living Conditions in Suburban Washington D. C. Expense-Paid Interviews with Selected Applicants.

Send resume Stating Education & Experience to:
Mr. R. J. REID, Technical Employment Manager

RESEARCH & DEVELOPMENT GROUP
NUCLEAR PRODUCTS—ERCO
DIVISION OF ACF INDUSTRIES INCORPORATED
Riverdale, Maryland — Warfield 7-4444



SENIOR INDUSTRIAL ENGINEERS

Expanding jet aircraft and advanced missile programs at Boeing have created a number of outstanding career opportunities for Senior Industrial Engineers. These are rewarding, long-range openings, with plenty of opportunity for advancement.

Assignments include schedule planning, methods analysis, and research in connection with operations and systems and other areas associated with industrial engineering activities.

Requirements: a degree in one of the engineering sciences, preferably a Bachelor of Science in EE, ME or CE. Experience in methods, time study, production scheduling, machine tooling, statistics, long-range planning, operations research and other phases of engineering is desirable.

At Boeing, you'll work with the most advanced methods, materials and techniques in the industry... in a forward-striding environment that's conducive to rapid advancement.

For full details, write: Mr. Stanley M. Little, Boeing Airplane Company, P.O. Box 3822-AVG, Seattle 24, Washington.

BOEING

an invitation to the CREATIVE engineer!

Opportunity offered in two rapidly expanding R and D fields. Challenging problems call for creative engineers with initiative and imagination. Individual capabilities determine level of responsibility. Liberal company benefits, ideal small town living and the opportunity for company-paid graduate study at neighboring Pennsylvania State University are some of the many advantages.

Openings for:

ENGINEERS and PHYSICISTS

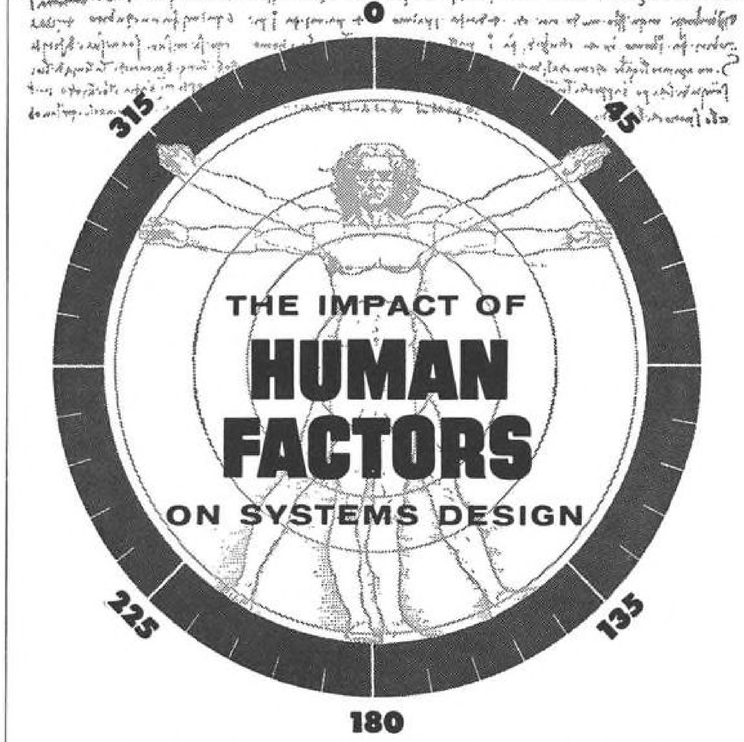
Qualifications

- **Design experience related to infrared systems or transistorization of electronics systems.**
- **Degree in physics or electrical engineering.**
- **Two years experience.**

Investigate by writing directly to:

HRB PERSONNEL DIRECTOR

HALLER, RAYMOND, and BROWN, Inc.
Science Park, State College, Pa.
A Division of
The Singer Manufacturing Co.



Why the insights of Experimental Psychologists count for so much at General Electric's Heavy Military Electronics Department...

Systems in development at Heavy Military Electronics Department encompass mission parameters of great multiplicity and diversity. A single program may envisage the coordinated functioning of far-flung Data Gathering, Data Processing, and Communications Elements. In systems of such complex character, experience here has repeatedly demonstrated the value of investigating and controlling in depth the interaction of man-machine-environment relationships.

The Human Factors Group works closely with engineering contributors, exercising a vital influence on the design of systems and equipments. Experimental Psychologists here shape basic concepts at all points where Human Factors impinge — whether in regard to operator vs. machine capabilities, data flow, or personnel selection and training. The Experimental Psychologist at Heavy Military knows the stimulation of extremely diverse problems, combined with professional responsibility for decisions of far-reaching consequence.

Senior Positions Open Now In:

Systems Philosophy • Data Flow • Design • Component Development
Evaluation • Simulation • Personnel Selection and Training

Inquiries are invited from Experimental Psychologists with broad backgrounds in systems development from the standpoint of Human Factors. A PhD degree is preferred. Familiarity with engineering concepts in electronics and/or with military operations problems is highly desirable. Write in confidence to: *Mr. George Callender, Dept. 64-WQ*

HEAVY MILITARY ELECTRONICS DEPARTMENT

GENERAL ELECTRIC

Court Street, Syracuse, N. Y.

Aeronautical wind tunnel
located at University of Michigan

FOR A SCIENTIFIC CLIMATE...

There's a devotion to creative thinking that you sense the minute you walk through the front door of the Bendix Systems Division.

Located in Ann Arbor, Michigan —a university town with big city advantages—you may enjoy all four seasons to the fullest. The year-round sports and outdoor recreation mean fun for you and your family. Within the buildings that house the Bendix Systems Division, the climate is scientific all year 'round.

If you are an able engineer or scientist seeking to apply your imagination and ingenuity to the problems involved in developing new weapons systems, you will enjoy the scientific climate at Bendix Systems Division.

If you are interested in doing advanced study, you will find the University of Michigan's fine Engineering College next door. Bendix encourages you to take advantage of this opportunity by attending daytime classes.

For information on a career in systems research and development, as well as a better way of life, you are invited to write for our new recruitment brochure. Bendix Systems Division, Dept. A4-27, Ann Arbor, Michigan.

Bendix Systems Division
ANN ARBOR, MICHIGAN

Bendix
AVIATION CORPORATION

flight test
NAVIGATORS

Exceptional long-range career opportunities are available *now* for qualified flight navigators at Boeing-Wichita. You'll be working on advanced flight test projects for the B-52G missile-platform bomber, including high performance transmission systems for extreme altitudes and speeds, electronic countermeasures and counter-countermeasures, active airborne defense systems and flight communication security systems. You'll be backed by the finest, most complete flight test facilities in the industry.

If you have had broad flight or flight test experience, including time in multi-engine and jet aircraft or have an engineering degree and flight experience, send your resume, including flight-time record to:

Mr. R. J. B. Hoffman
Chief Personnel Engineer
Boeing Airplane Company
Dept. AVH
Wichita, Kansas

BOEING

ADDRESS BOX NO. REPLIES TO: Box No.
Classified Adv. Div. of this publication.
Send to office nearest you.
NEW YORK 36: P. O. BOX 12
CHICAGO 11: 520 N. Michigan Ave.
SAN FRANCISCO 4: 68 Post St.

POSITIONS VACANT

Director of Engineering for medium size airline—Washington, D. C. area. Must have previous experience and be experienced in airline operations. Required to design and supervise aircraft modifications programs. Familiar with government regulations, aircraft specifications, aircraft and power plant service engineering. Submit resume and minimum salary to P-1501, Aviation Week.

Aircraft Sales Expert. Fast growing N. Y. Aviation Export Firm with warehouses now principally engaged in buying and selling aircraft and engine spares seeks experienced executive for position of Aircraft Sales Manager able to plan and execute the buying and selling of DC3, DC4 type aircraft nationally and internationally. Replies will be strictly confidential and inquiries will be made unless authorized by you. Unusual opportunity. P-1530, Aviation Week.

POSITIONS WANTED

Commercial with ATR ratings on Constellation, DC-4, DC-3, B26 & Lodestar. Total time 13,726 hrs. with 690 jet. Will travel anywhere, prefer west coast. PW-1477, Aviation Week.

Challenging South American assignment and/ or flying position desired. Airline Transport Pilot, 7900 hours, DC-3, DC-4, DC-6, CV 340, light twins. Age 31. Excellent Spanish. PW-1282, Aviation Week.

Pilot-Salesman—Diversified flying, selling experience. Age 28, single, college background. Commercial SEL (1200 hours), instrument, Helicopter (1800 hours). Have passport, will travel. PW-1288, Aviation Week.

Sales representation offered in San Diego area for manufacturer of aircraft and/or missile parts. Can devote full time. Prefer long range salaried connection involving sales and follow through. PW-1525, Aviation Week.

A&E 23 years, experience, manufacturing, overhaul, maintenance, inspection. Desires responsible position. PW-1489, Aviation Week.

RESUME SERVICE

Job Seekers—Is your resume doing you justice? Our staff expertly transforms it into a dynamic presentation that commands attention and gets results. Fee only $25.00. Mail work history and check (or indicate COD) Dept. V. Effective Resume Service, 5 Centre St. Hempstead, N. Y.

New "EMPLOYMENT" Advertisements

received by 10 A.M. May 1st will appear in the May 18th issue, subject to space limitations.

AVIATION WEEK
Classified Advertising Division
P. O. BOX 12
NEW YORK 36, N. Y.

Lockheed means **LEADERSHIP** in....

- *nuclear products*
- *aircraft design*
- *operations research*
- *special products*

At the GEORGIA Division of LOCKHEED positions of significant scope and responsibility are open to qualified Engineers and Scientists in the fields of:

PRELIMINARY DESIGN
FLIGHT TEST
ELECTRONICS
TECHNICAL WRITING
STRUCTURES—WEIGHT

THEORETICAL PHYSICS
NUCLEAR ENGINEERING
MATHEMATICS

OPERATIONS RESEARCH

SPECIAL PRODUCT DESIGN

for immediate consideration write in confidence to
W. P. Key
Engineering and Technical Placement
Lockheed Aircraft Corporation
834 W. Peachtree St., N.W.
Atlanta 8, Georgia

LOCKHEED AIRCRAFT CORP.
GEORGIA DIVISION
· marietta, georgia

MARKETING MANAGER
AIRCRAFT INSTRUMENTS

Progressive aircraft electronic equipment manufacturer has an immediate opening for top-notch executive sales manager to assume full responsibility for its marketing operations, headquarters N. Y. C.

....Dynamic salesman & administrator who, given full support of the organization, can build on his company's established position.
....Open New Markets
....Develop New Products
....Intimate knowledge of the overall military field with established buying contacts in it.
....Proven sales & administrative ability plus imaginative talent for broad sales planning are essential.
....Operate as a member of top management staff & responsible for department of 40 persons.

For the qualified person, an imaginative compensation program.

Please forward work history, education, earnings, etc., to:

MANAGER INDUSTRIAL RELATIONS

58-15 Northern Blvd. **AVIEN, INC.** Woodside, L. I., N. Y.

ELECTRONIC ENGINEER
SENIOR

B.S. in E.E. or Physics
Advanced degree preferred

Heavy experience and proven ability in Systems design & development of Instrumentation, Automatic Control, Computation & Communication systems, in areas of AVIONICS, GUIDED MISSILE flight & ground support or related fields.

Desirability to create and sell development ideas to military and commercial customers and to supervise small electronics group in execution of resultant engineering projects.

Excellent living conditions—Liberal co benefits
Unsurpassed professional growth potentials.
Send resume in confidence; *Mr. TOM DALTON*

STANLEY AVIATION CORP

2501 Dallas Street — Denver, Colorado

WHERE TO BUY

NEW! STARTLING!

Scientific Break-thru. Acclaimed by Space Experts as the Most Comprehensive Visual Tracking Aid ever devised to show you How, When and Where to look for Satellites . . . beautifully illustrated in Full Color. Easy to use . . . Simple to understand. Now! Only $2.00 Postpaid . . . . . Anywhere!

HOLMES SATELLITE TRACKER
Send $2.00 to
The World's ONLY COMPLETE HOME TRACKING STATION

RESEARCH PUBLICATIONS, INC.
1687 Laurel, San Carlos, Calif.

Enclosed $..... Please send me.....
Satellite Trackers Postpaid to:
Name .....
Address .....
City..... State.....
Dept. AW-427 Satisfaction Guaranteed!

A. B. MURRAY CO. INC. EST. 1845
AIRCRAFT STAINLESS STEEL TUBING FROM STOCK
Elizabeth, N. J. • Bristol, Pa. • McKeesport, Pa.

CLASSIFIED SEARCHLIGHT SECTION ADVERTISING

BUSINESS OPPORTUNITIES — EQUIPMENT - USED or RESALE

FOR SALE
High Altitude Aircraft
FOUR LOCKHEED P-38's
Altitude Capabilities to 40,000 Feet

Aircraft have modified nose section suited for technician and instruments. Ideal for economic high altitude testing. Operating costs are diminutive compared to that of jet aircraft. Reasonably priced.

Write or Wire:

HYCON MFG. COMPANY
1030 South Arroyo Parkway
Pasadena, California

FOR SALE
GRUMMAN MALLARD
Executive Aircraft

Always received best in maintenance. Interior recently refinished. 3500 hours total A.F. time. Right engine 0 S.O.H. Left engine 650 hrs. S.O.H. Good radio. Two spare engines. One spare propeller. plus numerous other spares.

Deal directly with owner. Write

FS-1414, Aviation Week
Class. Adv. Div., P.O. Box 12, N.Y. 36, N.Y.

HILLER HELICOPTER

Modernized UH12B with complete agricultural spray equipment. *Very low terms*

EAST COAST AVIATION CORPORATION
Lexington 73, Massachusetts

WANTED PBY

Previously licensed. To be used in CAR-43 operations.

Johnson Air Interests, Inc.
Horlick Racine Airport
Racine, Wisconsin
Melrose 7-1102

Immediate Delivery

We stock, overhaul, and install

PRATT & WHITNEY: **R1830** –75, –92, –94; **R985** **R1340**
WRIGHT: **R1820** –202, –5, –72; **R2000**

and our most popular DC3 engine
R1830 - SUPER - 92

ENGINE WORKS INC.

Lambert Field Inc. — St. Louis, Mo.

WANTED DC-3 or C-54

Corporation wants executive DC-3 P & W fully equipped or DC-4. Send complete details. Principals only.

W-1461, Aviation Week
Class. Adv. Div., P.O. Box 12, N.Y. 36, N.Y.

EXCITING NEWS in BUSINESS AIRCRAFT See Page 103

ADVERTISERS IN THIS ISSUE

AVIATION WEEK, APRIL 27, 1959

A. C. THE ELECTRONICS DIV., GENERAL MOTORS CORP. 118
Agency—D. P. Brother & Co.
AIRCRAFT ARMAMENTS, INC. 109
AIRWORK CORPORATION 98
Agency—Gene Wyble Advertising
AMP INCORPORATED 90
Agency—M. Russell Berger, Inc.
AMPEX CORP., MAGNETIC TAPE DEPT. 64
Agency—McCann-Erickson, Inc.
AUTONETICS DIV. NORTH AMERICAN AVIATION, INC. 58-59
Agency—Batten, Barton, Durstine & Osborn, Inc.
AVIATION WEEK 116-117
Agency—Gaynor & Ducas, Inc.
AVCO MANUFACTURING CORP., CROSLEY DIVISION 7
Agency—Benton & Bowles, Inc.
AYER & ASSOCIATION, FREDERICK B. 103
Agency—Burke Dowling Adams, Inc.

B. J. ELECTRONICS, BORG-WARNER CORP. 63
Agency—Leland Oliver Co.
BARDEN CORP., THE 24
Agency—Gaynor & Ducas, Inc.
BELL HELICOPTER CORPORATION 120
Agency—Rogers & Smith Adv., Inc.
BENDIX RADIO DIV., BENDIX AVIATION CORPORATION 96
Agency—MacManus, John & Adams, Inc.
BOEING AIRPLANE COMPANY 46
Agency—Calkins & Holden, Inc.
BOHANAN MFG. CO. 111
Agency—Weir Advertising
BREEZE CORP. 13
Agency—Burke Dowling Adams, Inc.
BRISTOL AEROPLANE CO. LTD. 48-49
Agency—Young & Rubicam, Ltd.
BRUNING CO. 89
Agency—Ayres, Swanson & Associates, Inc
BURROUGHS CORPORATION, ELECTRO DATA 110
Agency—Carson, Roberts, Inc.

CANADAIR, LTD. 44-45
Agency—Walsh Advertising Company, Ltd.
CANNON ELECTRIC COMPANY 17
Agency—Anderson-McConnell Adv., Inc.
CESSNA AIRCRAFT COMPANY 122
Agency—Gardner Advertising Company
COLLINS RADIO CO. 56
Agency—W. D. Lyon Co.
COLUMBUS DIVISION NORTH AMERICAN AVIATION, INC. 109, 111
Agency—Batten, Barton, Durstine & Osborn, Inc.
CONNECTICUT HARD RUBBER CO. 76
Agency—Troland, Inc.
CRUCIBLE STEEL CO. 94-95
Agency—G. M. Basford Co.

LIBBEY OWENS FORD GLASS COMPANY 8
Agency—Fuller & Smith & Ross, Inc.
LINDE COMPANY—DIV. UNION CARBIDE CORPORATION 18
Agency—J. M. Mathes, Inc.
LOCKHEED AIRCRAFT CORPORATION 53
Agency—Foote, Cone, Belding Adv.
LOCKHEED AIRCRAFT CORPORATION 80
Agency—Hal Stebbins Adv.

MARION INSTRUMENT DIV., MINNEAPOLIS-HONEYWELL 81
Agency—Culver Advertising, Inc.
MARTIN COMPANY, THE 115
Agency—Vansant, Dugdale & Company, Inc.
MILITARY PRODUCTS DIV., AMERICAN-STANDARD 57
Agency—S. Gunnar Myrbeck & Co., Inc.
MILLER DIAL & NAME PLATE CO. 104
Agency—Cole, Fischer & Rogow, Inc.
MINNEAPOLIS HONEYWELL REGULATOR COMPANY 68-69
Agency—Foote, Cone & Belding
MOOG SERVO CONTROLS, INC. 36
Agency—N. Gorham & Co., Inc.

NORDEN—DIV., UNITED AIRCRAFT CORP. 61, 66
Agency—Lennen & Newell, Inc.

PESCO PRODUCTS DIV., BORG-WARNER CORP. 9
Agency—Jayme Organization, Inc.

RAYTHEON MANUFACTURING COMPANY 4
Agency—Donahue & Coe, Inc.
RESISTOFLEX CORPORATION 98
Agency—Marsteller, Rickard, Gebhardt & Reed, Inc.
REX CORP. 62
ROHR AIRCRAFT CORPORATION 121
Agency—Barnes Chase Company
ROLLWAY BEARING COMPANY, INC. 11
Agency—Barlow Adv., Inc.

SCINTILLA DIVISION—BENDIX AVIATION CORPORATION 20
Agency—MacManus, John & Adams, Inc.
SEARCHLIGHT SECTION 123-132
SCOTT AVIATION CORP. 78
Agency—Melvin F. Hall Adv. Inc.
SOLAR AIRCRAFT COMPANY 10
Agency—The Phillips-Ramsey Company, Inc.
SUNDSTRAND MACHINE & TOOL COMPANY—AVIATION DIV. 35, 133
Agency—Howard H. Monk & Associates

TEMCO AIRCRAFT CORP. 77
Agency—Rodgers & Smith Adv.
TEXAS INSTRUMENTS INCORPORATED 5
Agency—Don L. Baxter, Inc.
TITEFLEX, INC. 84
Agency—G. M. Basford Co.
TOWNSEND COMPANY 6
Agency—Bond & Starr, Inc.
TUBE METHODS INC. 103
Agency—John Miller Adv.

UNION CARBIDE CORPORATION 18
Agency—J. M. Mathes, Inc.
U.S.A.C. TRANSPORT, INC. 100
Agency—Wines & Dewitt Adv. Inc.

VARIAN ASSOCIATES ..... 4th Cover
Agency—Boland Assoc.
VERTOL HELICOPTER CORPORATION 106-107
Agency—Gaynor & Ducas, Inc.
VISIONEERING CO. 88
Agency—David R. Buschman & Assoc.

CLASSIFIED ADVERTISING
F. J. Eberle, Business Mgr.

EMPLOYMENT OPPORTUNITIES 123-132
EQUIPMENT
(Used or Surplus New)
For Sale 132
WANTED
Miscellaneous 132
WHERE TO BUY
A. B. Murray, Inc. 132
Research Publications Inc. 132

ADVERTISERS INDEX

Avien, Inc. 132
Ayer & Assoc., Frederick B. 132
Bendix Aviation Corp., York Div. 126
Bendix Systems Div. 130
Boeing Airplane Company 128-130
East Coast Aviation Corp. 132
Engine Works 132
Erco Plant 128
General Electric Company 123-126-129
Haller, Raymond & Brown, Inc. 129
Hycon Manufacturing Co. 132
Johnson Air Interests, Inc. 132
Lockheed Aircraft Company 131
Marquardt Aircraft Company 125
NASA 127
Remmert-Werner Inc. 132
Solar Aircraft Company 124
Stanley Aviation Corporation 132
United Aircraft Corp. 126

SUNDSTRAND AVIATION

B-70, F-108 Secondary Power Generating Sub-System Manager

ENGINEERS

- Electrical System • Stress Analysis • Testing
- Bearing Evaluation • Electronic Packaging
- Aircraft Ground Support Equipment
- Advanced Rotating Electrical Equipment

Other projects include constant speed drives, hydraulic motors, pumps and other components for commercial and military aircraft and missiles.

Send Resume and Technical Background Data to:

SUNDSTRAND Personnel, Dept. A, 1401-23rd Ave., Rockford, Ill.

SUNDSTRAND AVIATION

LETTERS

NBAA's Role

I have just read your "Business Flying's Future" editorial (AW April 6, p. 21) with understandable interest and appreciation.

The closing paragraph could well be taken as a succinct statement of this association's reason for existence and continued growth.

"As the business aircraft gains greater utility and performance, pilot standards must be improved commensurately." It was for this reason that NBAA published its "Recommended Standards Manual" last year. Aiming not only to provide the individual business pilot, but his management as well, guide lines for improvement in safety and efficiency in operation—the manual has been well accepted by the business aircraft owner and pilot.

"Proficiency with new navigation and flight control instruments will become a necessity instead of a professional luxury." It is for this purpose that NBAA holds annual meetings and regional meetings. For instance, NBAA's part in the World Congress of Flight, which brought top-notch government and industry experts to meet with NBAA members, military and air carrier personnel, was on "Advanced Air Traffic Control" and "Advanced Navigational Aids."

The closing sentence regarding the government groups considering the growing requirements of business aviation points directly to NBAA's daily liasion with FAA and CAB bureaus and personnel on diverse and important matters such as air space allocations—NBAA has been a member of the Air Coordinating Committee's air space division for many years and has local representatives at regional level; on airport requirements—NBAA has been a member of the ACC Airport Division for a number of years; Air Traffic Control—NBAA works closely with the Bureau of Air Traffic Management in Washington and has more than 25 NBAA representatives attending regional Air Route Traffic Control Center meetings; safety regulations—NBAA circulates for return comment to each member every proposal for rule-making that emanates from CAB and now from the FAA, if it concerns business aircraft operation; the list can continue for pages.

This active participation by NBAA has been accomplished without fanfare, without "whoop-de-do" publicity, and—we justifiably feel—has been not only accepted but welcomed by the governmental agencies.

The increased recognition of business aviation by the FAA's Bureau of Flight Standards which categorized civil aviation into three entities: scheduled air carrier, business aviation, and general aviation will further accentuate NBAA's services to the business aviation community and to the governmental agencies.

Business aviation, as you so ably emphasize, has reached a tremendous stature. The policy of NBAA is to encourage each and every business aircraft owner and operator to recognize his responsibilities, to actively participate in all governmental affairs which affect his operations, and to share his knowledge with other business aircraft owners and operators. It is through such a program that the stature of business flying will be better recognized—rather than just through sheer weight in numbers of aircraft and in hours flown.

AVIATION WEEK's business flying reporter Erwin J. (Pete) Bulban is one of the outstanding reporters in the aviation field. We, at NBAA, feel most fortunate that you have Pete on your staff and that he has business aviation as his assignment. Pete's coverage of the business aviation field, including NBAA meetings, has proven to have that rare reportorial quality—qualitative and quantitative analysis—which is so greatly needed in this aviation writing field.

As in the past, we at NBAA will be most pleased to work closely with AVIATION WEEK in providing facts, figures and background information on the great American business aircraft fleet.

WILLIAM K. LAWTON
Executive Director
National Business Aircraft Assn., Inc.
Washington, D. C.

Aviation Week welcomes the opinions of its readers on the issues raised in the magazine's editorial columns. Address letters to the Editor, Aviation Week, 330 W. 42nd 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.

Business Flying Facts

Congratulations on the fine and factual editorial in the April 6 issue of AVIATION WEEK. You laid out the most important facts about general aviation, and of business flying in particular, in fine fashion.

It so happens that the Utility Airplane Council met April 7 and I took this occasion to read it to them—they had traveled to Washington April 6 and had not yet seen it. So in writing this note I am also expressing the appreciation of our Council members.

JOSEPH T. GEUTING, JR.
Manager
Utility Airplane Council
Aircraft Industries Assn.
Washington, D. C.

Helicopter Research

Your recent article "Sikorsky Broadens Its VTOL Research" (AW Feb. 2, p. 66) brings the merits of rotating-wing aircraft, or helicopters for short, into unusually good perspective. It is curious, however, that what may well be the helicopter's primary reason for long-term continued growth was somehow omitted, namely, the relatively low downwash velocities which, in contrast to what the article terms the "blast-off vehicle" types, permit operation in truly unprepared areas and in populated areas. The fact that the more heavily-loaded helicopters can stir up dust to an extent producing serious visibility problems should serve to emphasize the inevitably more severe problems for the more compact types of direct-lift aircraft.

The relation between wind (or slipstream) velocity and the amount of dust or loose rock thrown about, and similarly the air velocity in which a man can walk or work, do not seem much affected by technological advances. To glue down all the loose objects in the world which would become missiles under the many-times-hurricane velocities produced by the special-purpose "blast-off" types would be quite a project. Your article recognizes the helicopter's advantage as to low installed power, an advantage which will mean a great deal for some years, at least, but the point I would like to add is that if we some day get powerplants which weigh nothing, cost nothing, and use no fuel, we will still need helicopters for use over unprepared areas and where relatively unhindered operation near unprotected people is required.

If this permanent value of helicopters is thoroughly recognized, it follows that research on helicopters and related types should be increased with proportionate vigor. Certainly the helicopter needs to be improved (reduced vibration, provision of complete blind-flying capability, determination of basic design approaches to reduced first cost and maintenance, and increased performance are important current goals), but the over-all research effort is still comparatively small. This increased research should be sponsored in such a way that all who have need for it would receive immediate benefit of the results. The resulting long-range effort should then lead to the achievement of both needed refinements and radical improvements in an increasingly essential air-transportation vehicle.

NASA ENGINEER
Hampton, Va.

Approach Lighting

In your Aviation Week editorial for Feb. 9, I read with great interest the repeated remarks of the necessity of additional installations of both the ILS and high intensity approach lights—the condenser discharge type.

To a man, every responsible person in aviation whom I have contacted has stressed the effectiveness of these condenser discharge approach lights—foul weather and fair.

Yet, it is impossible for myself, Bill Atkins or Bill Matsen to obtain approval for our condenser discharge anti-collision lights. Through the provisions of SR-392B, we have each installed 15 units on various type and weight class of aircraft, our individual anti-collision light systems. We have proven through the most severe testing, under all flight conditions, the positive and effective conspicuity as is afforded runways that are similarly equipped.

The flight activity in these high density areas demands just as much identity as do the runways. Must we wait until we have another midair collision before public indignation and congressional action forces our hand into foolish regulations, made by uninformed, hysterical persons?

DON HOSKINS
Chicago, Ill.

From proposal — to prototype — to production . . . in Navigation, Radar and Surveillance, and Data Handling Systems . . .

in Components and Microwave Instruments . . .

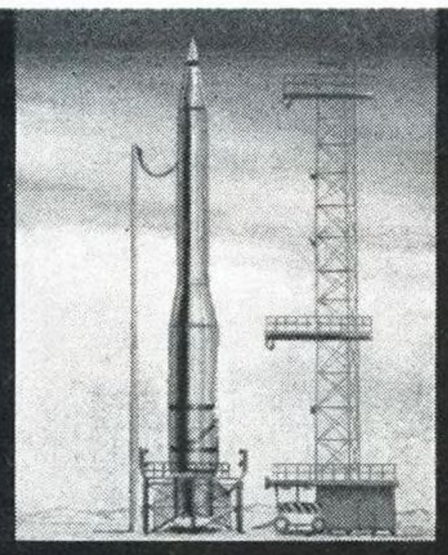
the LFE monogram means *Leadership from Experience.*

LFE

Leadership from Experience

LABORATORY FOR ELECTRONICS, INC. 1079 COMMONWEALTH AVENUE • BOSTON

ENGINEERS — LFE offers outstanding opportunities for employment in the fields outlined above.



FOR RADAR AND
MISSILE TRACKING

ANOTHER VARIAN FIRST

INTERNAL CAVITY PULSE AMPLIFIER
KLYSTRON with 75 KILOWATTS
average output

- RUGGED
- NON CRITICAL
- HIGH PERFORMANCE
- SINGLE PUSH-BUTTON OPERATION

1.25 MEGAWATTS PEAK POWER

Varian's VA-842 is the world's largest internal cavity Klystron. It produces the tremendously high average power of 75 kilowatts for long pulse radar and missile tracking. Features include a pulse duration time of 2000 microseconds; tunable frequency range of 400 to 450 megacycles; 40 db stable RF power gain.

Varian makes a wide variety of Klystrons and Wave Tubes for use in Radar, Communications, Test and Instrumentation, and for Severe Environmental Service Applications. Over 100 are described and pictured in our new catalog. Write for your copy—address Tube Division.

VARIAN associates
PALO ALTO 22, CALIFORNIA
Representatives thruout the world

KLYSTRONS, TRAVELING WAVE TUBES, BACKWARD WAVE OSCILLATORS, HIGH VACUUM PUMPS, LINEAR ACCELERATORS, MICROWAVE SYSTEM COMPONENTS, R. F. SPECTROMETERS, MAGNETS, MAGNETOMETERS, STALOS, POWER AMPLIFIERS, GRAPHIC RECORDERS, RESEARCH AND DEVELOPMENT SERVICES