Aviation Week

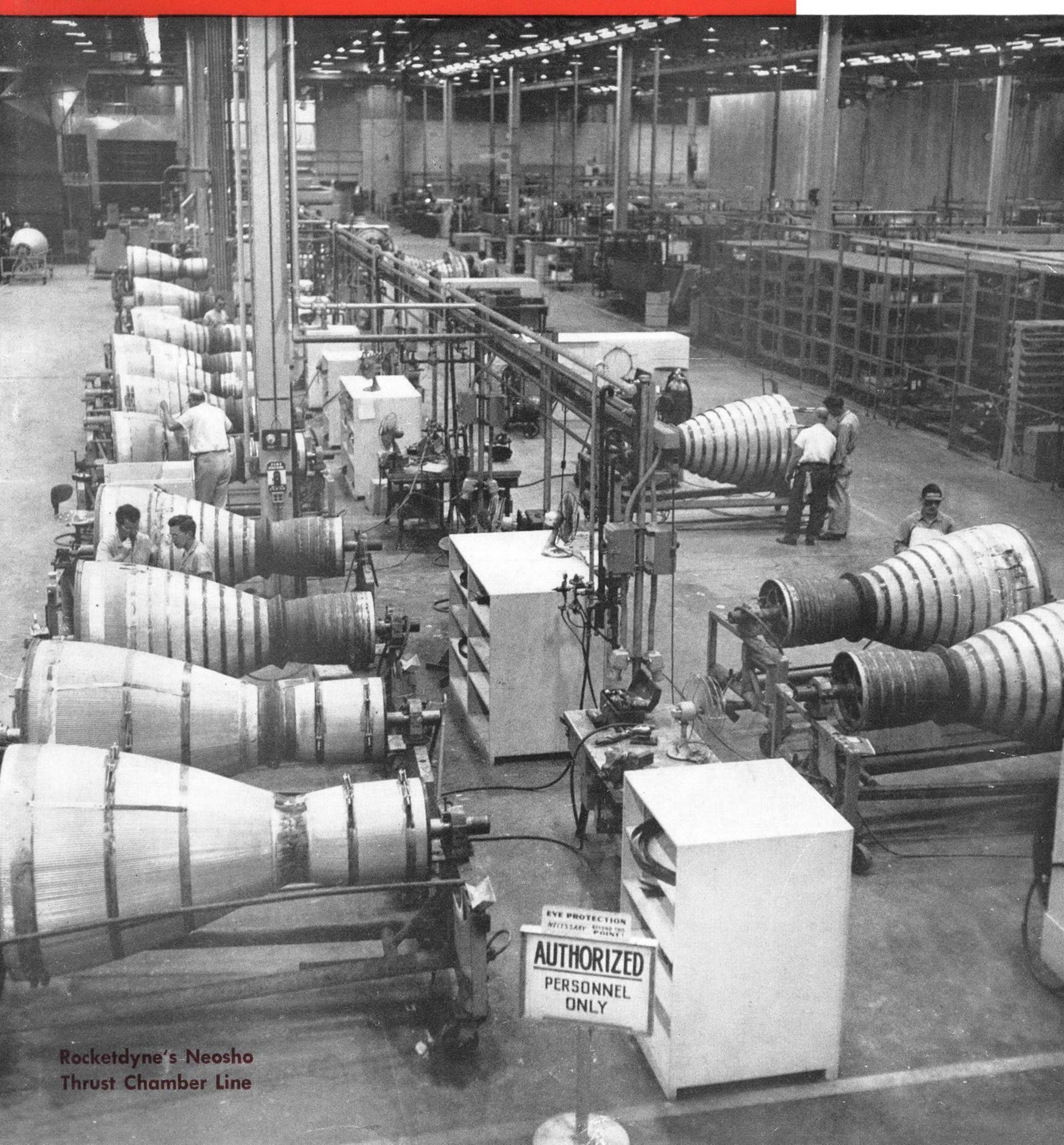
Including Space Technology

75 Cents

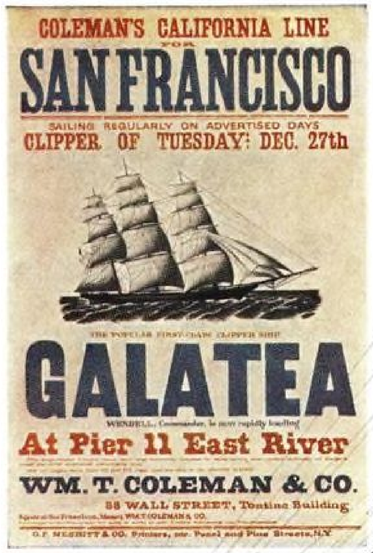
A McGraw-Hill Publication

January 12, 1959

Sperry Delivers X-15 Inertial Flight System



Rocketdyne's Neosho Thrust Chamber Line



POSTER AND **CLIPPER SHIP** MODEL COURTESY OF MARINE HISTORICAL ASSOCIATION, MYSTIC, CONN.

CONVAIR JET-LINERS

MASTERPIECES OF Craftsmanship

Just as craftsmanship a century ago made American Clipper Ships masters of that era's transportation; so today Convair's traditional craftsmanship is creating masterpieces for travelers in the new jet age. Designed with precision and built to perfection in every detail, Convair's 880 and 600 Jet-Liners will be the world's fastest and most luxurious passenger planes!

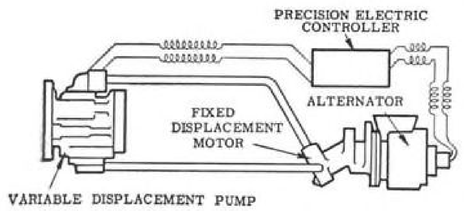
CONVAIR **A DIVISION OF GENERAL DYNAMICS CORPORATION**

First to offer Convair 880 or 600 Jet-Liner service will be TWA, DELTA, TRANSCONTINENTAL (Argentina), REAL-AEROVIAS (Brazil), S.A.S., SWISSAIR, AMERICAN

New VICKERS building block concept applied to CONSTANT SPEED DRIVES

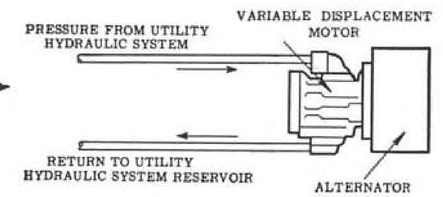
for 400 cycle A.C. electrical systems

1. Unlimited Versatility
2. High Efficiency
3. Fast Delivery
4. Low Cost



Frequency control ± 0.1%. Uses electronic frequency controller to regulate pump displacement. System pressure is function of load.

Frequency control ±0.25%. Uses load sensitive system to match infinitely variable electrical load. System pressure is constant, flow demand is load dependent.



- Using this "building block" construction, Vickers Constant Speed Drives are assembled to exact requirements from the abundance of Vickers standard and proven components. Practically any characteristics you need can be quickly adapted to the existing Vickers product mix. These include:

FREQUENCY CONTROL
± 3% with hydraulic control
± 0.1% with electronic control (or better if desired)

VERSATILITY
1 to 75 hp with standard hardware
Flexibility of package shape and location

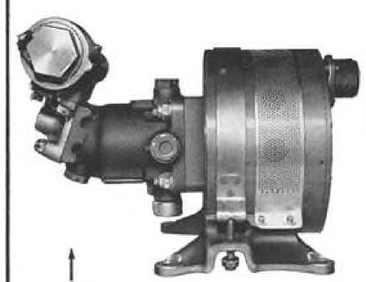
HIGH EFFICIENCY
Volumetric efficiency of either pumps or hydraulic motors is 96% at 3000 psi. This together with optimum matching of components results in very high system overall efficiency.

MINIMUM WEIGHT
Significant optimization engineering can be applied to your system design considerations from similar Vickers application experience.

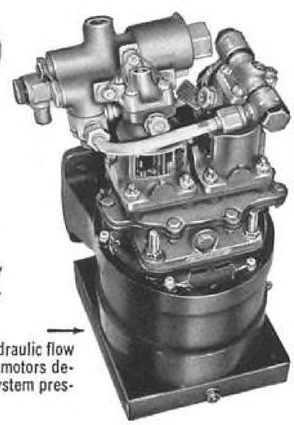
OVERLOAD CAPACITY
Depending upon system requirements, overload capacity of from 120% to 200% can be provided.

For further information, write for Bulletin SE-100.

Frequency control ± 0.1%. Uses electronic frequency signal to trim hydraulic flow control. System pressure is constant.



Frequency control ± 3%. Uses hydraulic flow control only. System pressure is constant.



Frequency control ± 3%. Uses hydraulic flow control to supply single or dual motors depending upon load variations. System pressure is constant.

VICKERS INCORPORATED
DIVISION OF SPERRY RAND CORPORATION
Aero Hydraulics Division—Engineering, Sales and Service Offices:
ADMINISTRATIVE and ENGINEERING CENTER
Department 1462 • Detroit 32, Mich.
TORRANCE, CALIFORNIA
3201 Lomita Blvd. • P.O. Box 2003
Torrance, California
Aero Hydraulics Division District Sales and Service Offices:
Albertson, Long Island, N. Y. • Arlington, Texas
Seattle 4, Washington • Washington 5, D.C.

AVIATION CALENDAR

Jan. 19-21—11th Annual Convention, Helicopter Assn. of America, Villa Hotel, San Mateo, Calif.

Jan. 21—1959 Annual Technical Conference, sponsored by the Professional Division's Council of the Los Angeles Section of the American Society of Mechanical Engineers, Huntington-Sheraton Hotel, Pasadena, Calif.

Jan. 21-23—South West Electronic Exhibit, Arizona State Fairgrounds, Phoenix, Ariz.

Jan. 26-27—Annual Meeting Assn. of Local and Territorial Airlines, National Aviation Club, Washington, D. C.

Jan. 26-29—27th Annual Meeting, Institute of the Aeronautical Sciences, Sheraton-Astor Hotel, New York, N. Y. Honors Night Dinner, Jan. 27.

Jan. 27-29—Fifth Annual Radar Symposium (classified), Rockham Bldg., University of Michigan, Ann Arbor, Mich.

Jan. 27-30—15th Annual Technical Conference, Society of Plastics Engineers, Hotel Commodore, New York, N. Y.

Jan. 28-29—Fifth Annual Midwest Welding Conference, sponsored by Armour Research Foundation, Illinois Institute of Technology, Chicago, Ill.

Feb. 3-5—14th Annual Technical and Management Conference, Reinforced Plastics Division, Society of the Plastics Industry, Inc., Edgewater Beach Hotel, Chicago.

Feb. 12-13—1959 Solid State Circuits Conference, sponsored by Institute of Radio Engineers' Professional Group on Circuit Theory, American Institute of Electrical Engineers' Committee on Electronics and University of Pennsylvania, Philadelphia.

Feb. 12-13—Computer and Data Processing in Industry, conference for manufacturing and engineering management. Purdue University, Lafayette, Ind.

Feb. 14—Meeting on Short Range Navigational Aids, International Civil Aviation

(Continued on page 6)

AVIATION WEEK Including Space Technology

January 12, 1959
Vol. 70, No. 2

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.

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.

AVIATION CALENDAR

(*Continued from page 5*)

Organization, International Aviation Bldg., Montreal, Canada.

Feb. 21-22—13th Annual Pacific Coast Mid-Winter Soaring Championships, Torrey Pines Gliderport, San Diego, Calif.

Feb. 26-March 1—1959 Engineering Exposition, Balboa Park, San Diego, Calif. Address inquiries to: 422 Land Title Bldg., San Diego, Calif.

March 3-5—1959 Western Joint Computer Conference, sponsored by Institute of Radio Engineers, American Institute of Electrical Engineers and Assn. for Computing Machinery, Fairmont Hotel, San Francisco, Calif.

March 5-6—Flight Propulsion Meeting (classified), Institute of the Aeronautical Sciences, Hotel Carter, Cleveland, Ohio.

March 5-7—Western Space Age Conference and Exhibit. For information: Domestic Trade Dept., Los Angeles Chamber of Commerce, 404 South Bixel St., Los Angeles 54, Calif.

March 8-11—Engineering meeting on the turbine in action, sponsored by Gas Turbine Division of the American Society of Mechanical Engineers, Cincinnati, Ohio.

March 16-20—11th Western Metal Exposition and Congress, American Society for Metals, Pan Pacific Auditorium and Ambassador Hotel, Los Angeles, Calif.

March 23-26—National Convention, Institute of Radio Engineers, Coliseum and Waldorf-Astoria Hotel, New York, N. Y.

March 31-Apr. 2—Polytechnic Institute of Brooklyn's Ninth International Symposium, Subject: Millimeter Waves. Auditorium, Engineering Societies Bldg., New York, N. Y. Cosponsors: Department of Defense Research Agencies and Institute of Radio Engineers.

March 31-Apr. 3—National Aeronautic Meeting, Society of Automotive Engineers, Hotel Commodore, New York, N. Y.

Apr. 2-3—Conference on Electrically Exploded Wires, sponsored by the Thermal Radiation Laboratory of the Geophysics Research Directorate of the Air Force Cambridge Research Center, Somerset Hotel, Boston, Mass.

Apr. 5-10—1959 Nuclear Congress, Municipal Auditorium, Cleveland, Ohio. For information: Engineers Joint Council, 29 West 39th St., New York 18, N. Y.

Apr. 7-10—1959 Welding Show and 40th Annual Convention, American Welding Society, International Amphitheatre and Hotel Sherman, Chicago, Ill.

Apr. 12-19—Air Force Assn.'s World Congress of Flight, Las Vegas, Nev.

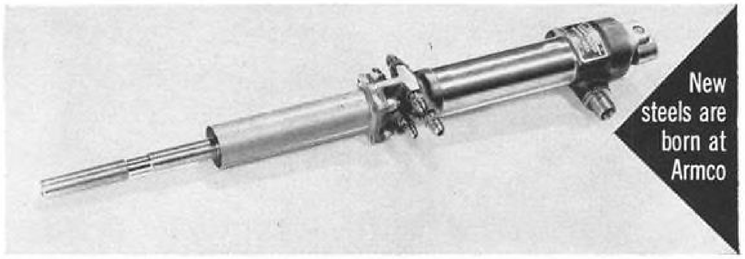
Apr. 18-22—Annual Meeting, American Society of Tool Engineers, Schroeder Hotel, Milwaukee, Wis.

Apr. 22-24—1959 Annual Meeting, Institute of Environmental Engineers, LaSalle Hotel, Chicago, Ill.

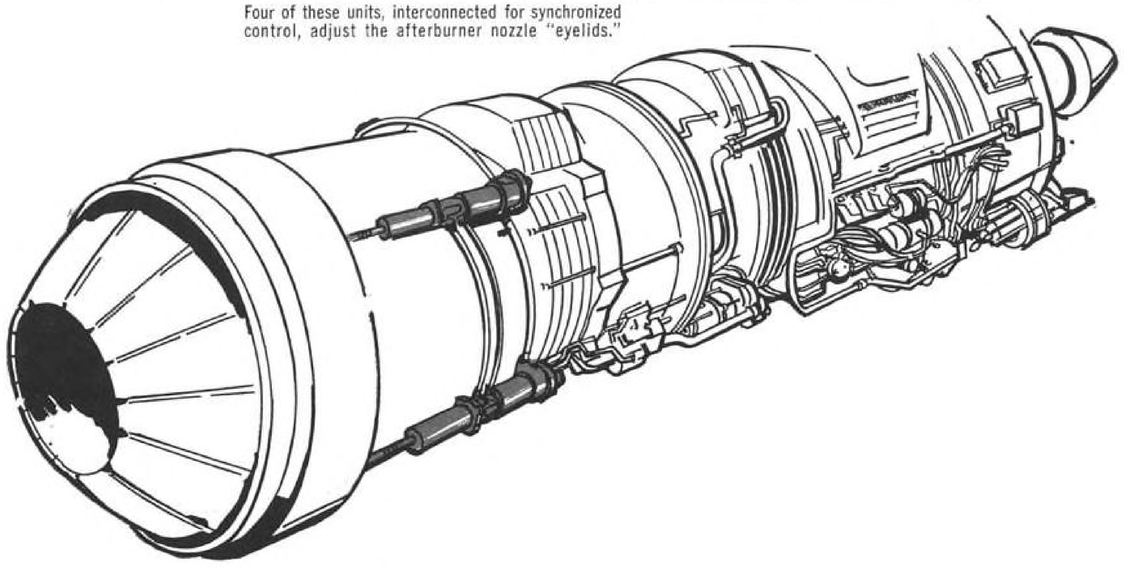
May 4-6—National Aeronautical Electronics Conference, Institute of Radio Engineers, Biltmore Hotel, Dayton, Ohio.

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

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



Four of these units, interconnected for synchronized control, adjust the afterburner nozzle "eyelids."



Why Armco 17-4 PH Stainless Steel Assures Dependable Thrust Control

Positioning afterburner "eyelids" to control jet engine thrust demands reliable delivery of power under severe conditions. Hydraulic actuators for this service, operating at pressures to 3000 psi and at ambient temperatures of −65 to 800F not only must be efficiently designed, but constructed of metals with unusually high mechanical properties and corrosion resistance.

That's why the manufacturer of this afterburner nozzle actuator, now in use on a new high-thrust engine, selected Armco 17-4 PH Stainless for the actuating rod, cylinder forging, and other severely stressed parts. It provides the high strength-weight ratio and hardness at elevated temperatures, the good corrosion resistance, and the excellent fabricating characteristics required to economically produce a smooth-acting, powerful, dependable unit.

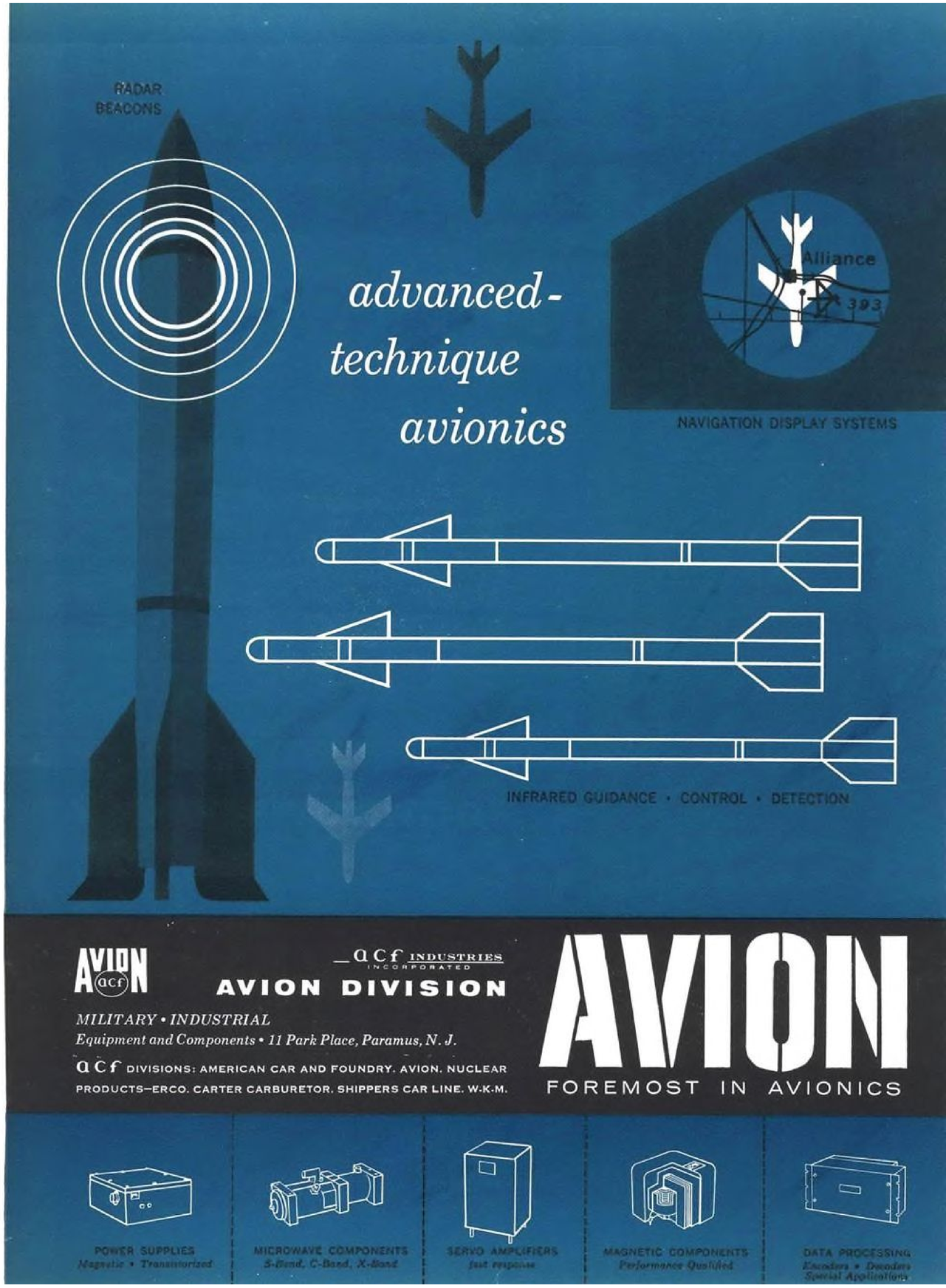
Meet Aircraft and Missile Requirements

Armco's space-age metals—17-4 PH, 17-7 PH and PH 15-7 Mo Stainless Steels —are used extensively in military and commercial aircraft and missiles for airframes, skins, tanks, power plants and accessories. They help satisfy the need for metals that withstand high stresses and heat and can be fabricated easily by standard production methods.

For design data and fabricating information on these special Armco Steels, just write Armco Steel Corporation, 1219 Curtis Street, Middletown, Ohio.

ARMCO STEEL

Armco Division • Sheffield Division • The National Supply Company • Armco Drainage & Metal Products, Inc. • The Armco International Corporation • Union Wire Rope Corporation • Southwest Steel Products



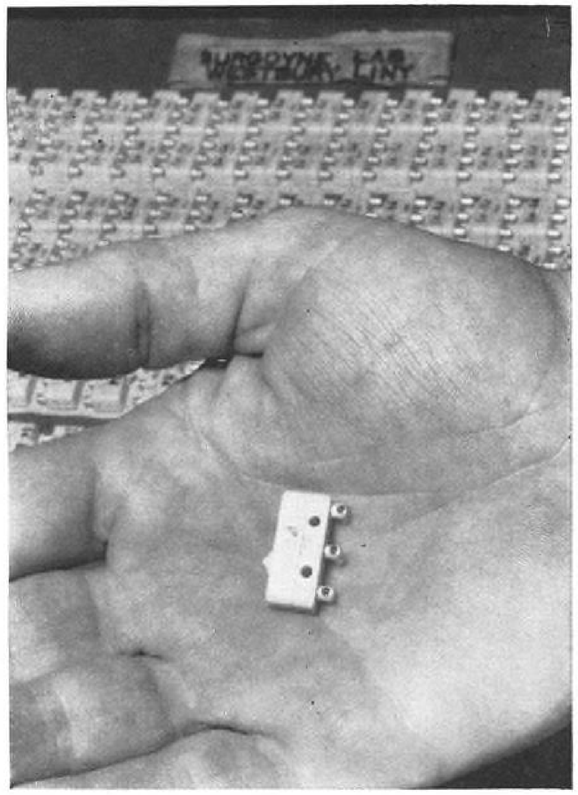
Sealed tight!

Yet inside contacts must be critically aligned and spaced

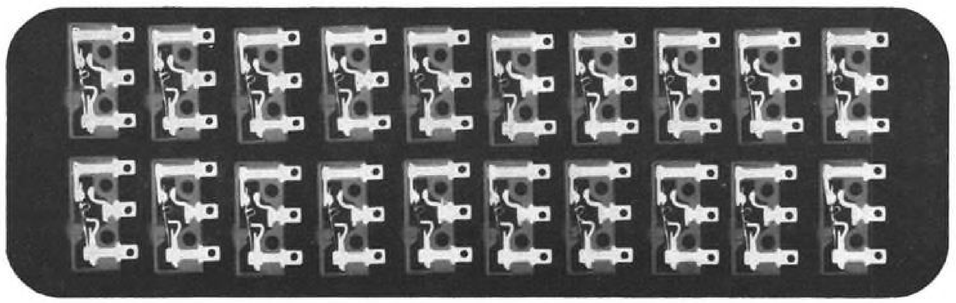
Specifications for these miniature switches are rigid. But one special military project (ballistic missiles) demands extra precision. Tolerances are reduced to a minimum.

What nondestructive test could be used to check the critical contact spacing and alignment? *The answer was radiography*—and the manufacturer assigned the inspection problem to the Burgoyne Testing Laboratory, Westbury, L.I. Radiographs of the switches—by lots—make it possible to select those that meet specifications.

In the quality control of cast or welded products and hidden assemblies, radiography plays an outstanding role. Perhaps it can help you to be sure that only acceptable items are delivered—a saving of time and money, and a great aid in building business. Why not call your x-ray dealer—or the Kodak technical representative—and talk it over.



One of the miniature switches about to be radiographed at Burgoyne Testing Laboratories, Westbury, Long Island.



Radiograph shows critical spacing of the switch contacts.

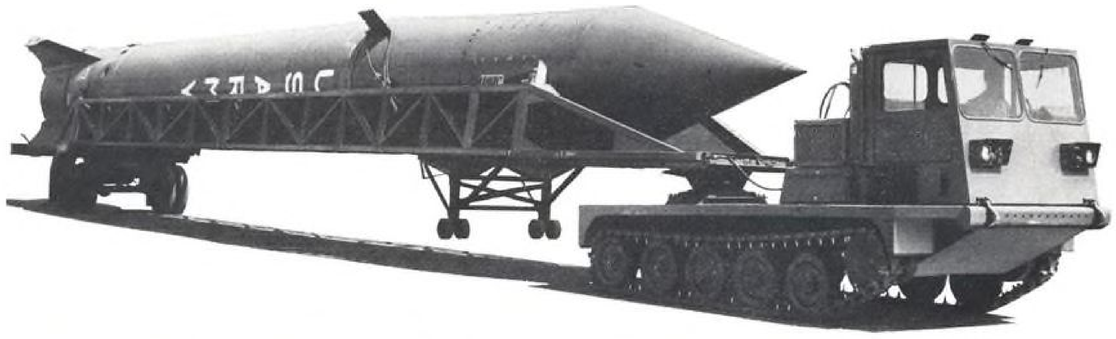
Read what Kodak Industrial X-ray Film, Type AA, does for you:

- Speeds up radiographic examinations.
- Gives high subject contrast, increased detail and easy readability at all energy ranges.
- Provides excellent uniformity.
- Reduces the possibility of pressure desensitization under shop conditions.

EASTMAN KODAK COMPANY, *X-ray Division*, Rochester 4, N. Y.

Kodak
TRADE MARK

...speaking of
Missile Ground Support **MOBILITY**



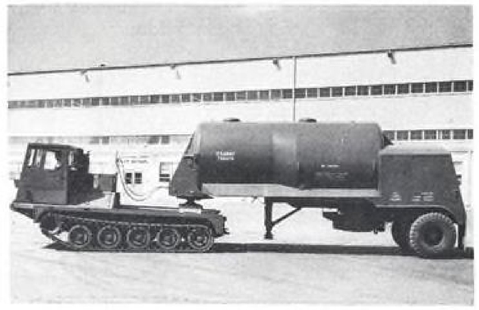
U.S. ARMY PHOTOS

WE MAY HAVE THE SOLUTION TO YOUR PROBLEM

When the Army Ballistic Missile Agency needed a small, lightweight prime mover sufficiently versatile to transport almost any size or kind of load, even over terrain inaccessible to other types of powered equipment, they came to FMC—and the ABMA Tractor was born.

This powerful multi-purpose tracked vehicle, conceived and produced by FMC for an Army development program, is another result of the more than 17 years experience acquired by FMC in designing and building more types of military-standardized tracked vehicles than any other company in America. FMC's accumulation of applied knowledge and experience in the field of mobility has led to the development and manufacture of missile ground support equipment—ranging from small tracked vehicles, transportable by helicopter, to complete missile launching systems.

From design concept through development, engineering and production—to delivery on schedule—FMC is qualified to help you solve your missile project problem. *Why not consult with FMC at the initial stage of project planning?* Contact us today for more information.



As a multi-service prime mover, the FMC-built ABMA Tractor is powered for moving heaviest loads on short or long hauls with ease and dispatch. This sure-footed, tracked vehicle handles all types of trailers, is equally capable on soft, rough or surfaced ground.

Creative Engineers: Find stimulating challenge at FMC's Ordnance Division.

Putting Ideas to Work

fmc
FOOD MACHINERY AND CHEMICAL CORPORATION ®

FOOD MACHINERY AND CHEMICAL CORPORATION
Ordnance Division
Missile Equipment Section 3-J
1105 COLEMAN AVENUE, SAN JOSE, CALIF.

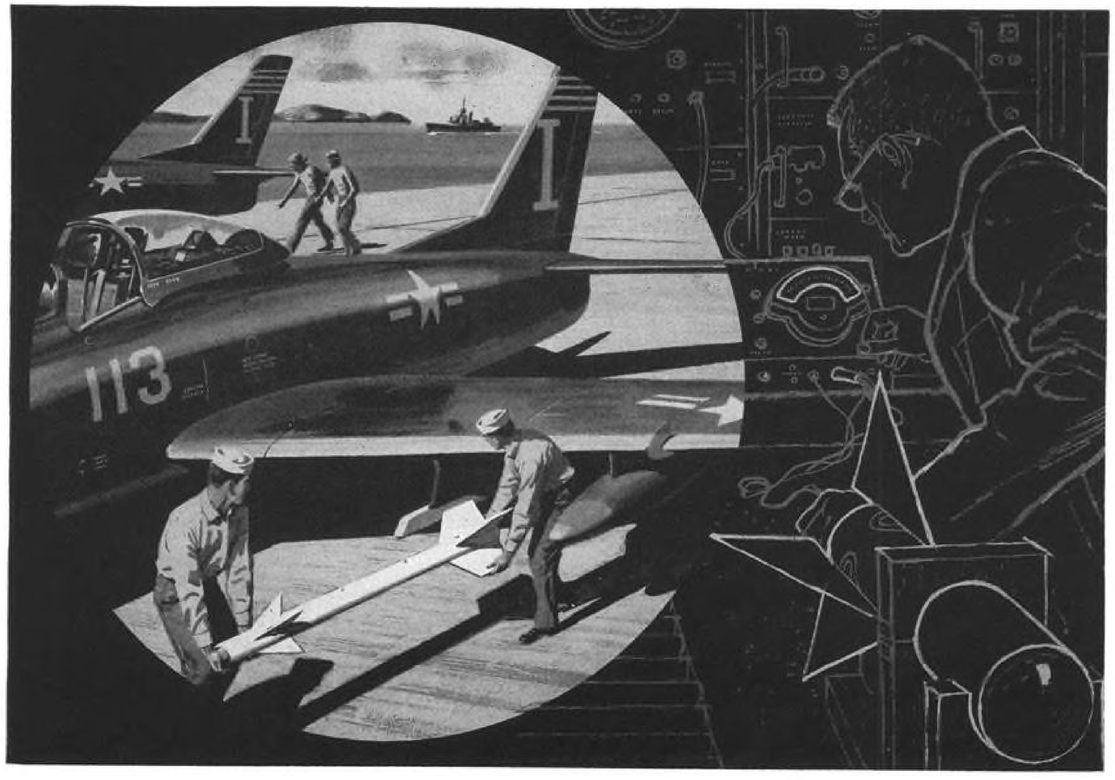
PHILCO IS **PEOPLE**

From advanced research and development to mass production, installation and servicing of countless electronic products and systems, Philco is people. Here is a closely integrated organization of scientists, engineers, installation and service specialists, ready to meet any challenge for creation of military, industrial and consumer electronics systems.

PHILCO IS **FACILITIES**

To assist this outstanding organization of skilled and dedicated people, Philco has amassed millions of dollars worth of intricate equipment in plants and laboratories from coast to coast. Philco facilities include: the world's most advanced research labs; environmental test facilities; specially equipped design and engineering labs, plus prototype and model shops; and the most advanced mass production facilities.

PHILCO IS **CAPACITY**



At Philco the world of tomorrow is *NOW!* Here are human resources, plus ultra-modern facilities, plus tremendous accumulated experience in research and development. Here too, are unlimited career opportunities in the fields of missiles and guidance, weapons systems, All-Transistor computers, infra-red, advanced radar techniques and communications systems. At Philco, versatility is the key to tremendous capacity in advanced technology. Make Philco your prime source for prime contracts from development to delivery.

PHILCO®

GOVERNMENT & INDUSTRIAL DIVISION

4700 Wissahickon Avenue
Philadelphia 44, Pennsylvania

Now, Fluoroflex®-T hose of Teflon®

for **4000**

psi service

The only assemblies that could pass the rigid test established for a 4000 psi hydraulic system, Fluoroflex-T ¼" lines again *proved* their reliability for high pressure service.

In punishing impulse tests by both the aircraft manufacturer and Resistoflex, the ¼" assemblies were subjected to 550,000 impulse cycles, then proof pressure tested at a sustained 10,000 psi. There were *no* failures at all.

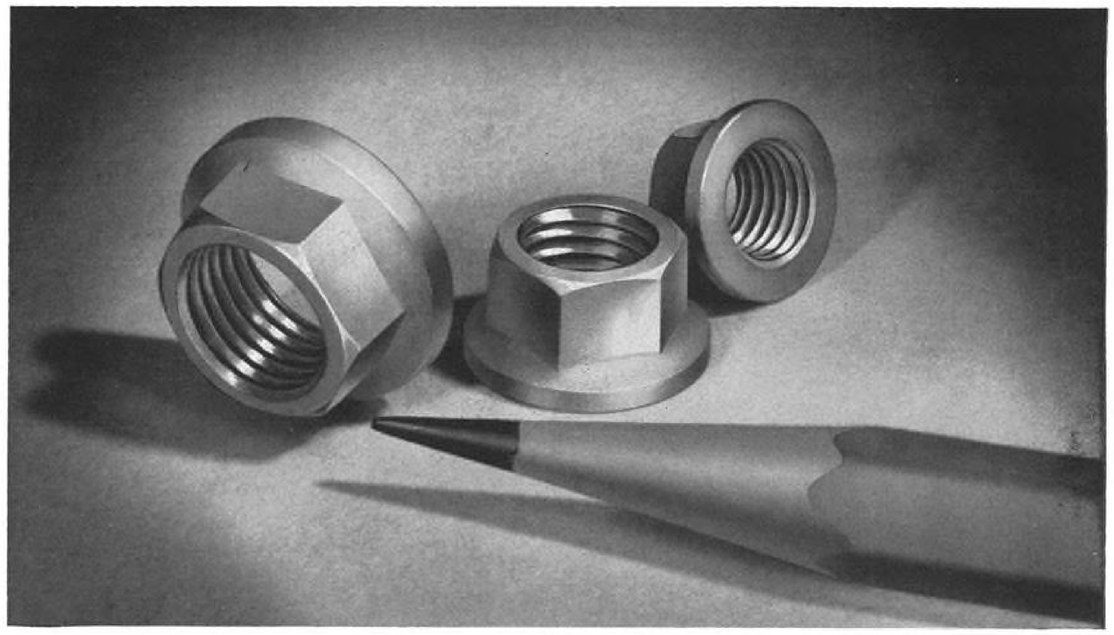
The severest service always singles out the hose with the highest performance capabilities. If you're now planning a 4000 psi system, write for test data. Dept. 182, RESISTOFLEX CORPORATION, Roseland, New Jersey.

®Fluoroflex is a Resistoflex trademark, reg., U.S. pat. off.
®Teflon is DuPont's trademark for TFE fluorocarbon resins.

Originators of high temperature fluorocarbon hose assemblies.

Resistoflex

ROSELAND, NEW JERSEY • WESTERN PLANT: BURBANK, CALIF. • SOUTHWESTERN PLANT: DALLAS, TEX.



New FN-12 Series Featherweight Locknuts provide 125,000 psi minimum at temperatures up to 550°F, yet weigh 12% to 72% less than comparable sheet metal (NAS 679) and AN Series nuts. The FN-12 is installed with standard tools, incorporates new burr-free locking feature which permits highly accurate torquing.

New SPS Featherweight locknuts save you up to 72% in locknut weight

Smaller hex also requires less installation area —helps you design more compact bolted joints

Designed for fastening structural skin and panel assemblies, the new SPS FN-12 Series Featherweight Locknut offers you weight savings of 12% to 72% over widely used sheet metal and AN Series nuts. Yet despite its light weight, the cold forged FN-12 sacrifices none of the static or dynamic properties of its heavier counterparts. Meeting all requirements of MIL-N-25027, it has a tensile strength exceeding 125,000 psi. Its vibration resistance is 150% of specification minimum. And it gives greater bolt tension-tension fatigue strength than any other lightweight locknut tested.

Besides offering you valuable weight savings combined with high strength and reliability, the FN-12 locknut, because of its new configuration, can be installed closer to vertical bulkheads than any other aircraft nut now in use. This permits further weight reductions through miniaturization of joints to be fastened.

FN-12 Series Featherweight Locknuts are available in heat treated alloy steel in sizes #4 through ⅜ in. They are furnished cadmium plated, with optional molybdenum disulfide coating. For complete information request new Bulletin 2426. Aircraft/Missiles Division, STANDARD PRESSED STEEL Co., Jenkintown 3, Pa.

We also manufacture precision titanium fasteners / write for free booklet

SPS Jenkintown • Pennsylvania

Standard Pressed Steel Co. • The Cleveland Cap Screw Co. • Columbia Steel Equipment Co. • National Machine Products Co. • Nutt-Shel Co. • SPS Western • Standco Canada Ltd. • Unbrako Socket Screw Co., Ltd.

WEIGHTS OF FN-12 AND COMPARABLE LOCKNUTS

(all weights expressed as pounds per 1000 pieces)

Size	FN-12	NAS 679*	% Weight Saved by FN-12	AN Series†	% Weight Saved by FN-12
#4-40	0.4	0.8-1.0	50%-60%	1.3	69%
#6-32	0.7	1.3-1.7	50%-60%	1.8-2.5	61%-72%
#8-32	1.2	2.1-2.5	43%-52%	2.8-4.2	57%-71%
#10-32	1.5	2.5-2.8	40%-47%	3.3-4.6	55%-67%
¼-28	3.5	3.9-4.7	12%-26%	5.4-8.5	35%-59%
5/16-24	5.4	6.4-7.2	16%-25%	8.7-11.8	38%-54%
⅜-24	7.3	9.3	21%	11.5-19.5	37%-63%

*Range of four most commonly used sheet metal nuts of NAS 679 type
†Range for AN 363, 364, 365

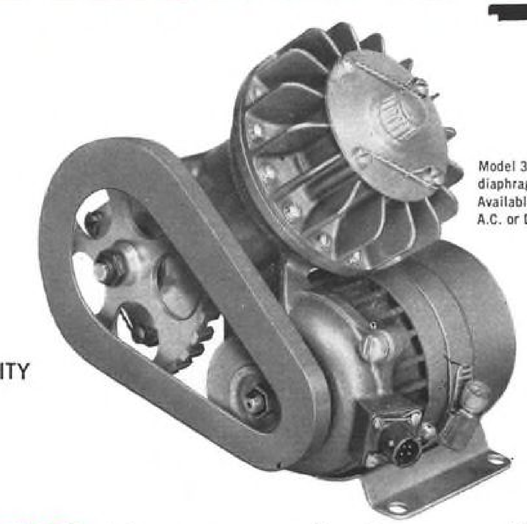
HIGH RELIABILITY

SPS research is continually developing fasteners with higher standards of predictable performance. By installing SPS high-reliability fasteners in your assemblies, you increase overall product reliability.

For more information on the full meaning of reliability, write for a copy of the new SPS booklet "High Reliability."

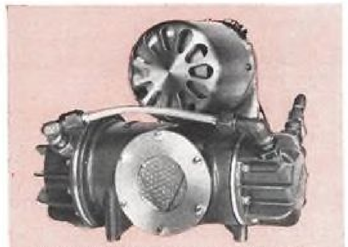
YES, THE ANSWER IS NO!

NO FRICTION
NO HEAT
NO LUBRICATION
NO CARBON DUST
NO "OILY" AIR
NO LOSS OF CAPACITY



Model 373 Single Stage diaphragm pump. Available with A.C. or D.C. motor

with the *NEW* 4 pound Cornelius Air Pressurization Pump



Model 283 two stage Cornelius pressurization pump for service to 60,000 feet without aid of inlet pressurization. Weight: 6.5 lbs. Delivers 200 cu. in. per minute of standard air at 25 psi at 60,000 feet.

This single stage Cornelius diaphragm pump has many advantages. It's miniature, it's lightweight (only 4 pounds complete with explosion proof motor). It is rated from 0-25 psig at 1 CFM of standard air at sea level and is designed for 1000 hours of continuous operation at temperatures from −65° F. to 165° F. Designed primarily for low altitude aircraft (10,000 feet or less) it will operate at altitudes to 60,000 feet with engine bleed air or supercharge.

Units are now being delivered for pressurizing water systems on jet liners and for pneumatic de-icer systems on cargo and transport aircraft. The pump's advantages also make it a "candidate" for pressurizing auxiliary fuel systems, as well as electronic or radar wave guide systems and hydraulic reservoir pressurization.

For detailed performance information and prices, contact us today. A Cornelius sales engineer will give you complete data about this remarkable new pump.

THE Cornelius COMPANY
AERO DIVISION
554 - 39th Avenue N. E. • Minneapolis 21, Minnesota

Pioneers in pneumatic systems for aircraft.

the spirit of '76...

THE SPIRIT OF '76 . . . exemplifying strength —dependability—determination to move forward through the years.

Wyman-Gordon enters its 76th year still forging ahead with new forging techniques—still meeting the challenge of the seemingly impossible in this age of power and speed on the ground—in the air—and in outer space.

It is a far cry from the modest beginning in 1883 to the forging industry's most modern testing and research facilities in the extensive laboratories of Wyman-Gordon today—assurance of the ultimate in forging quality.

From the high wheel bicycle through the "horseless carriage" days to the "Mach era" of aircraft and space vehicles, Wyman-Gordon has marched under the standard of "The Greatest Name in Forging."

WYMAN-GORDON COMPANY

Established 1883

FORGINGS OF ALUMINUM • MAGNESIUM • STEEL • TITANIUM

WORCESTER 1, MASSACHUSETTS
HARVEY, ILLINOIS • DETROIT, MICHIGAN

NEW TAKE-OFF MONITOR GIVES CRITICAL PERFORMANCE DATA

Sperry indicator aids pilot's Go, No-Go decision

With the new Sperry Take-Off Monitor, the pilot gets an *instantaneous and continuous* indication of the performance of his aircraft from the moment take-off begins.

This simple and extremely accurate system is based on aircraft acceleration. Data is *computed instantly, presented instantly*. Without having to make allowances for wind, the pilot knows at all times whether the take-off should be continued.

Consisting of two small units, an integrally-lighted indicator and computer, this system can be easily retrofitted into existing aircraft. With simple computer adjustment, it is suitable for either jet or turbo-prop aircraft.

← **ONLY ONE PRE-TAKE-OFF ADJUSTMENT** is required in Sperry's Take-Off Monitor. With the knob on lower right pilot sets acceleration index and gross weight of aircraft. So long as pointer remains in "safe" area, pilot knows his aircraft is performing as expected. A simple "push to test" feature is provided to indicate proper system operation prior to take-off run. In addition, a warning flag monitors system power.

AERONAUTICAL EQUIPMENT DIVISION

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

January 12, 1959

Aviation Week
Including Space Technology

Vol. 70, No. 2
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

COVER: Thrust chambers for Thor and Jupiter intermediate range ballistic missiles are on production line at Neosho, Mo., facility of North American Aviation's Rocketdyne Division. Plant is a production facility, with research and development work done in California (AW Oct. 6, p. 60). Tubular construction used in these thrust chambers was developed by North American for the Navaho booster and later applied to Thor, Jupiter and Atlas engine thrust chambers, cutting chamber weight about in half.

PICTURE CREDITS

Cover—Rocketdyne; 32, 74, 75 (top)—Aviation Week; 33—U. S. Navy; 34—Grumman; 38—American Airlines; 47—Convair; 53—Sperry Gyroscope Co.; 61—Bell Helicopter Corp.; 74, 75—(bottom)—Spacetronics, Inc.; 77, 83—Bristol Aeroplane Co.; 117—Wide World.

75,292 copies of this issue printed

EDITORIAL

Putting Man into Space

(National Aeronautics and Space Administration is scheduled to take a major step this week in its program to place man into space with the award of a contract for the development of a manned capsule. Dr. Hugh L. Dryden, deputy administrator of NASA, outlined some of the problems inherent in manned space travel which must ultimately be overcome in a recent speech at the annual meeting of the American Astronautical Society in Washington. Because of the pressing need to find answers to these problems, and particularly in view of Soviet strides in this field, AVIATION WEEK *is reproducing below significant extracts.)*

. . . It was announced on Dec. 17 by Dr. T. Keith Glennan, administrator of NASA, that the national program includes a manned satellite project called Project Mercury. Its objective is to begin the manned exploration of nearby space with special reference to the technology needed for the safe performance of such a mission and the reactions of man in the space environment.

Propulsive systems will soon be available of reasonable reliability and of sufficient capacity to launch the required weight into orbit. There are many other problems to be solved.

The obvious engineering problems are those of providing a safe environment to protect man from the low temperature and presence of space, from harmful accelerations on takeoff and re-entry, from the heating of the vehicle during re-entry, providing deceleration and safe landing. The motion of the capsule must be aerodynamically stable or artificial damper provided. It must be controllable in attitude. Retrorockets must be fitted to return the capsule from orbit. A suitable pilot-escape system must be provided for use in event of a malfunction on launch. These problems are suitable for attack by straightforward engineering methods and for experimental check-out and demonstration.

There are many other factors which require additional research and study, although much work has already been done probably sufficient for Project Mercury. We have already mentioned the discovery of the Van Allen layer of ionizing radiation which is known to include some heavy particles of high energy. If man is to explore space to great distances, we must know much more than we do now about the radiation environment, shielding methods, effects of heavy primary cosmic rays on man, etc. The psychological factors in the space mission environment have received considerable study. Here again no difficulty is expected for the early short time missions with carefully selected personnel, but as space exploration extends to longer durations, this area of research must receive increased attention.

. . . The exploration of space differs greatly from the exploration of the air. For many years following the flight of the Wright brothers it was possible for an individual to learn and know all there was to be known, to personally build an airplane, sometimes with his own resources, and as pilot to explore the new element. A little later, flight was still an area for a single enthusiast with the support of a patron or of a small group. The exploit of Charles Lindbergh in the New York-Paris flight of the Spirit of St. Louis was a typical example.

Aeronautics changed character rapidly. Science and engineering assumed a predominant role. Knowledge developed far beyond the capabilities of any one individual to digest and use. A social invention was made, that of the design team consisting of many individuals with differing qualifications and specialized knowledge. The leader of the team broke down the development task into specialized problems which could be assigned to different individuals. As progress continued, the specialized individuals became specialized teams. With the coming of guided missiles the complexity of the task brought the necessity for complete system analysis and functional coordination of all the components. Today, the group engaged in the development of one of our ballistic missiles comprises thousands of persons. . .

This remarkable social and technological development reflects two sides of the same coin. As the task grew more difficult, a more complex organization was required. And conversely, as the methods of organization and management developed, the greater the magnitude and complexity of the task that could be undertaken and the greater the possible accomplishment. Accomplishments hitherto unrealizable became practical engineering projects. It is this evolution in our technology and its management which has brought us to the door of space exploration.

At one stage in his plans, Christopher Columbus took his project to the Count of Medina Celi. Although interested enough to entertain Columbus for two years, the Count decided that the enterprise was too vast for the resources of one individual and referred Columbus to Queen Isabella. The proposal was then referred to a committee, which reported that the new project was vain and impracticable. I repeat this incident not to indicate that the government still functions in the same manner but that large enterprises required the support of the government.

I do not foresee any projects in space similar to Lindbergh's flight across the ocean. Space exploration is the prerogative of the largest and most powerful nations of the world. . .

Many persons have outlined the milestones of space exploration far into the future. About a year ago Jimmie Doolittle listed them as (1) unmanned rocket to the moon; (2) scientific instruments landed on the moon; (3) manned earth satellite and return to the earth; (4) trip around the moon and return; (5) man landed on moon and brought back; (6) establishment of space platform; (7) instruments landed on Mars or Venus; (8) man or men landed on Mars or Venus and brought back; (9) permanent observation station on the moon; (10) interplanetary travel.

. . . (The) welter of mathematics and the accompanying physics, chemistry, celestial mechanics, geophysics, biophysics, space medicine, psychology, electronics, propulsion, guidance, control, instrumentation, are the necessary foundation on which to build successful missions, whether for scientific measurements of the space environment, for study of the sun and planets and distant galaxies, or for exploration of space by man himself. By experience we learn that there are few short-cuts. Let's get on with the job, using the best scientific, engineering and managerial talent available to us.

WHO'S WHERE

In the Front Office

George M. Bunker, president and board chairman of The Martin Co., a director, Bulova Watch Company, Inc., Flushing, N. Y.

August C. Esenwein, executive vice president, Convair, a division of General Dynamics Corp., San Diego, Calif. Also: **J. G. Zevely,** vice president-contracts and commercial sales, and **Elmer P. Wohl,** vice president for planning. **Frank W. Davis** succeeds Mr. Esenwein as vice president-general manager of Convair's Fort Worth Division. **Robert H. Widmer** succeeds Mr. Davis as chief engineer of the Fort Worth Division.

R. E. Lenhard, president, Air Reduction Sales Co., a division of Air Reduction Company, Inc., New York, N. Y. Mr. Lenhard succeeds **J. H. Humberstone,** vice president of Air Reduction Co., who will devote full time to corporate matters.

Wyle Research Corp. has been merged into Wyle Laboratories, El Segundo, Calif., and the following appointments have been announced: **Robert S. Gardner,** vice president-engineering and production; **Edward Rubin,** a vice president; **Robert J. Garon,** vice president-contracts; **David D. Stone,** assistant vice president-contracts; **Clarence H. Wyle,** treasurer; **Alvin Samuels,** secretary. **Frank S. Wyle** continues as president.

William H. Preston, executive vice president, Chase Brass & Copper Co., Inc., Waterbury, Conn.

Howard S. Kaltenborn, vice president, assistant to the president and a director, Westinghouse Electric Corp., Pittsburgh, Pa. Also: **Dr. S. W. Herwald,** vice president in charge of research.

Alexander S. Basil, vice president-manufacturing, Rockbestos Products Corp., New Haven, Conn.

Albert E. Edwards, a vice president, The W. L. Maxson Corp., New York, N. Y.

R. N. Harder, first vice president and treasurer, General Precision Equipment Corp., New York, N. Y. The company also elected the following presidents of its subsidiaries as officers of the parent company: **D. W. Smith** of Kearfott Co. and **D. D. Mason** of Link Aviation, group vice presidents; **J. W. Murray** of General Precision Laboratory, vice president-financial; **L. W. Imm** of Librascope, Inc., a vice president for special projects-Western U. S.

Honors and Elections

Dr. Robert R. Bennett, program director-Minuteman ICBM system, Space Technology Laboratories, Inc., Los Angeles.

Named to serve on a newly organized Ad Hoc Advisory Panel on Army Aviation Research and Development, which is headed by Gen. Kelsey, are: **Prof. Rene Miller** of the Massachusetts Institute of Technology; **Prof. A. A. Nikolsky** of Princeton University; **Dr. August Raspet** of Mississippi State University; **Jerome F. Lederer** of Flight Safety Foundation; **Richard V. Rhode** of the National Aeronautics and Space Administration.

(*Continued on page 123*)

INDUSTRY OBSERVER

► Advanced Research Projects Agency's Project MIDAS, Missile Defense Alarm Satellite, is aimed at development of satellites which can detect ballistic missile launchings by means of the latters' infrared and possibly other techniques. Program is not directed toward satellites for more conventional reconnaissance.

► **Aeronutronic Systems Inc., Glendale, Calif., has received a study contract for analysis of Pacific Missile Range instrumentation requirements following a competition in which more than 20 industry members were invited to bid and approximately 15 submitted bids. Four subcontractors will aid Aeronutronic in the analysis—Eastman Kodak, Dunlap Associates, Page Communications Engineers and Cook Electric Co.**

► Navy contract for the Douglas F4D Skyray is terminating, and no replacement is indicated for the plane. Final aircraft, now coming off Douglas' El Segundo Division production line, is scheduled for delivery early this month.

► **Decision on choice of contractor for Air Force's new airborne early warning and control (AEW&C) airplane is expected within the next several weeks. Proposals from six bidders—four airframe companies and two avionics companies (AW Dec. 15, p. 23)—reportedly have been evaluated and results will be presented to the Air Council this week. Final decision is due Jan. 15.**

► Proposals submitted by Convair, Lockheed, Douglas, Boeing and Hughes for the Air Force's early warning and control aircraft, which is designated Weapon System 214-L, call for a radar designed by General Electric under USAF contract as a slightly more sophisticated version of its three dimensional AN/APS-91 airborne early warning radar. General Electric anticipates that the new radar will have a missile detection capability sufficient to detect a target the size of an Atlas ICBM seen broadside at a range of 700 mi.

► **Air Force will shortly announce its choice of an avionics contractor for expansion and updating of its global communication system designated the 456-L, barring complications which have plagued the program in the past (AW Dec. 8, p. 34).**

► Convair's San Diego Division has formed a new missile predesign group which will project weapons for possible Air Force, Army and Navy applications. New group will function outside of Convair's Astronautics Division.

► **Atlas missile that traveled 6,355 mi. on a recent test flight over Atlantic Missile Range (AW Dec. 8, p. 29) carried no re-entry nose cone. Although the tracking system followed the vehicle for 1,500 sec., nothing actually fell into the water at the end of the flight. Impact predictor reported, however, that the nose cone would have impacted only 6 mi. from a coordinate point, and not all available facilities for ensuring accuracy of impact were used.**

► U. S. satellite instrumentation scientists who recently had an opportunity to examine Russian satellite instrumentation say that Soviets do a fine job of miniaturization where required, but, where space and weight are not at a premium, they use construction techniques that are obsolescent by U. S. avionics standards. At least one U. S. scientist concludes that the U. S. has no significant lead over Russia in avionic miniaturization.

► **Twin turbojet engines on Russia's Mi-6 helicopter were developed by P. A. Soloviev, who also was codesigner of the 1,700 hp. ASh-82V piston engine used in the Mi-4.**

► Hamilton Standard propellers will be used on General Electric's T64 engine now under development for Navy at the company's Small Aircraft Engine Department, Lynn, Mass. Powerplant, rated at 2,600 eshp., will have better than three-to-one power-to-weight ratio and features turbopropturboshaft convertibility. Engine is now on the test stand, and special test cells are nearing completion for it at Lynn.

Washington Roundup

Soviet Nuclear Plane Progress

Rep. Melvin Price (D.-Ill.), chairman of the Subcommittee on Research and Development of the Joint Committee on Atomic Energy, said last week that "a new-type aircraft" has been sighted in Russia which "conceivably could be" adapted to nuclear power. After a closed session with officials of the Central Intelligence Agency, Price said, however, that he did not believe the Soviets have yet flown an aircraft under nuclear power.

Existence of the aircraft and details of initial test flights employing both turbojet and nuclear power were described in an exclusive AVIATION WEEK story in the Dec. 1 issue (p. 26). Price said that, if the Soviets are to fly an aircraft under full nuclear power sometime this year, as he believes they will, they must already have an airplane available.

The U.S., Price added, is at least three-to-five years behind the Soviets in this field.

Earlier, in a prepared statement issued at the close of the hearing, he said:

"I think it would be misleading to state categorically that the Soviets are in fact flying a nuclear propelled plane at the present time.

"On the other hand, I personally think there is a good possibility that the Soviets are well down the road in their nuclear plane program and have the capability of producing a flying nuclear-powered aircraft in the near future.

"I think this underlines the importance of the United States pressing forward vigorously with its own ANP program. In particular, I think we have got to give our hard-working scientists and engineers the level of financial support they need to get the job done.

"It is also vitally important to the success of our program that clearcut objectives are established and that target dates for a ground test prototype and nuclear flight are set up as an effective guide to the program."

Nuclear Tests

The Joint Congressional Committee on Atomic Energy also will focus on U.S. policy in international negotiations for cessation of atomic weapons tests at closed hearings this week. The committee is particularly concerned with evidence developed from underground tests last fall in Nevada indicating that underground explosions are difficult to identify. It casts doubt on the dependability of the detection system proposed by the U.S. last summer. Witnesses will be Dr. Norris Bradbury, director of the Los Alamos Laboratory; Dr. Edward Teller, director of the University of California Radiation Laboratory; Herbert B. Loper, assistant to the Secretary of Defense on atomic energy; and Brig. Gen. Alfred Starbird, director of the Atomic Energy Commission's Division of Military Applications.

Change in Attitude

The Administration's reaction to Soviet Russia's technical successes has changed considerably during the last year. President Eisenhower made the following statement after the Russian moon rocket (see page 26) was fired:

"The successful launching, as announced by the Soviets, of a vehicle designed to pass near the moon, represents a great stride forward in man's advance into the infinite reaches of outer space. To the scientists and engineers assigned to this undertaking, a full measure of credit is due and we congratulate them on this achievement."

This attitude contrasts with the remarks made by Administration officials in the fall of 1957 after the launching of Sputnik I. Charles E. Wilson, former Secretary of Defense, called the Soviet satellite a "scientific trick," and former Assistant to the President Sherman Adams said the Russians had achieved "high score in an outer space basketball game." Former Budget Director Percival Brundage predicted that the Sputnik would be forgotten in six months, and Presidential Adviser Clarence B. Randall characterized it as a "silly bauble." The President said: "Now, so far as the satellite itself is concerned, that does not raise my apprehensions, not one iota." The only significance he attached to Sputnik was the demonstrated fact that the Russians had powerful rockets, and that they had achieved a propaganda advantage.

Space Appointee

Henry Edmund Billingsley last week was named new director of National Aeronautics and Space Administration's Office of International Cooperation. Billingsley comes to NASA from the Department of Defense where he served with the Office of Internal Security Affairs as chief of the Western European Division. He will coordinate NASA's research and development programs with those of other nations and international organizations.

Airport Aid Bill

Legislation extending and expanding the Federal Airport Aid construction program was introduced on the first day of the new Congress last week by Rep. Oren Harris (D.-Ark.), chairman of the House Commerce Committee. For the next five years, the bill would authorize $100 million in federal aid each year, rather than the present $63 million.

Airline Fare Debate

Charges from both within and outside the airline industry that airlines have failed to develop a "mass air travel market" which will serve as a panacea for the industry's economic ills were challenged last week by an industry executive with the suggestion that there is no such thing as a mass market. Speaking at the National Conference of American Marketing Assn., United Air Lines senior vice president Robert E. Johnson said suggestions that "the airlines have just scratched the surface and should turn to the development of 'mass air travel' are far from realistic." The air travel market is limited, he said, because the majority of people lack the "means to undertake air trips" and added that, because of excessive competition, attempts to open new markets by cutrate tariffs and new merchandising schemes will be tried out in an effort to attract new customers. Johnson said he doubted that such moves would change the "basic characteristics of the airline market."

—Washington staff

Soviet Moon Success Follows Failures

First successful launching to vicinity of moon attained after 11 or 12 earlier Russian failures.

By Evert Clark

Washington—Soviet Union's successful launching of the first rocket to reach the vicinity of the moon came after 11 or 12 earlier Russian attempts had failed.

First Russian attempt to hit the moon was made shortly after Sputnik I was put into orbit on Oct. 4, 1957 (AW Aug. 25, p. 23). Attempts followed at the rate of almost one a month in 1958. A number of shots contained warheads and were attempts to touch off an explosion on the moon.

The successful shot was launched on Jan. 2 and passed within 4,660 mi. of the moon at 9:57 p.m. EST, Jan. 3. Velocity as it passed was 5,472 mph. Final stage of the rocket weighed 3,245.76 lb. without fuel.

It was "equipped with a container" for instruments. Weight of the container, instruments and power supply was 796.67 lb. Wording of Radio Moscow's announcement indicated the 797 lb. was included in the 3,246 lb. figure given for final stage weight. Radio contact was maintained for 62 hr. The rocket then had travelled 373,125 mi.

The rocket became the first man-made asteroid, assuming an elliptical orbit estimated by the Russians to have its major axis at an angle of 15 deg. to the major axis of the earth's orbit; an eccentricity of 0.148; an aphelion of 122,540,080 mi.; a perihelion of 90,972,960 mi., and a maximum diameter of 213,513,040 mi.

It was to reach its closest point to the sun about Jan. 14; its farthest distance about the beginning of next September. Closest approach to the earth will occur five years from now and be repeated every five years. For at least a part of the time, its orbit is expected to lie between the orbits of earth and Mars. Period of its orbit is to be 450 days.

Propaganda Push

Russia used the success to gain the utmost propaganda advantage possible. Although no mention was made of earlier failures, no Soviet scientist so far has been quoted as saying this was the first attempt to launch a rocket toward the moon.

In its initial broadcasts, Radio Moscow referred to the launching as the "first successful interplanetary flight."

At a two-hour press conference held by scientists in Moscow on Jan. 6, Academician Anatoli A. Blagonravov, chairman of the Academy of Sciences' Department of Technical Sciences, was asked if the Jan. 2 firing was "the first attempt in the Soviet Union to launch a rocket toward the moon."

"I can tell you that this was our first attempt to launch a new interplanetary rocket," Blagonravov said. In using the word "new," Blagonravov probably had in mind an improved launching vehicle over those used in earlier attempts.

Improved rocket engines for lunar vehicles were referred to recently by Prof. Vitaliy Bronshtayn, a scientific adviser to the Moscow Planetarium, as quoted in an official Polish magazine (AW Dec. 15, p. 31).

Bronshtayn said two improved models of the engine were built to calculations made by V. Yegorow of the Mathematical Institute of the Academy of Sciences and said the thrust had been thoroughly calculated to avoid the "blunder" committed by U. S. scientists in early Pioneer moon probe launchings.

Bronshtayn also said at that time that launching of a half-ton Russian lunar satellite was imminent and that a lunar landing and a probe that would orbit the moon and return to the earth's vicinity were due in the near future.

This offers the possibility that the Jan. 2 launching was the first test of the improved vehicle, and that Russian claims that it was an attempt to pass the moon rather than to hit or circle it might be true.

Flight's Object

Object of the flight was not announced until many hours after the official announcement that a successful launching had been accomplished. Scientists were quoted initially as saying it was too early to tell exactly what the rocket would do.

At the Jan. 6 press conference, scientists denied that they had intended either to hit or to circle the moon. They said the rocket did exactly what it had been intended to do.

Scientists in many other countries expressed the belief that the shot was an attempt to hit the moon. Most credited the Russians with having accurate guidance in order to come within the distance they achieved on a 34-hr. flight of more than 219,000 mi. Others believed an orbit was intended, since instruments to measure magnetic field and radioactivity were aboard.

One indication that it may have been intended as an impact-and-explosion shot was a statement attributed to Soviet moon expert Alexander Khabakov that the rocket was expected to send back data on sediments of the lunar surface, properties of the moon's inner strata and the moon's magnetic field. Deductions could be made on the inner strata based upon the presence or absence of a magnetic field, but the reference to sediments is not as easily explained. The rocket apparently contained no photographic equipment.

One report from Paris shortly after the launching was announced quoted Alexander Ananov—identified as a founder of the International Astronautical Society—as saying that the rocket was launched with too high a velocity, and on a miscalculated flight path, and that it would not hit moon.

Blagonravov told the Moscow press conference: "The definite task of the rocket was to pass near the moon and since its velocity was slightly more than 25,000 mph., it was quite obvious that on passing the moon it would continue its movement into the solar system."

Prof. Vladimir Dobronravov spoke last October of firing Sputniks to "the zone of the moon." Prof. Kyril Stanyukovich wrote in Sovetskaya Aviatsiya on Jan. 1, 1958, that "before a rocket flies to the moon, a number of artificial satellites will be launched along increasingly elongated elliptical orbits which will draw nearer and nearer to the moon. Instruments installed in such satellites will make it possible to closely study and to photograph the lunar surface and to learn the nature of its mysterious relief."

While a series of satellites launched on trajectories short of the moon seem to be unprofitable, such a program would help to explain the dozen or so unannounced space probes fired by Russia.

Significant Achievements

Most significant achievements are that the one and one-half ton rocket reached escape velocity and that it passed so close to the moon. It carried instruments designed to measure:

- **Magnetic field of the moon.**
- **Intensity and variation in intensity** of cosmic rays beyond the earth's magnetic field.
- **"Registration" of photons** in cosmic radiation.
- **"Discovery of the radioactivity** of the moon."
- **Distribution of heavy nuclei** in cosmic radiation.
- **Gas components of interplanetary** matter.
- **Corpuscular solar radiation.**
- **Meteoric particles.**
- **Temperature of skin** and instrument chamber.
- **"Special instruments designed** to create a sodium cloud of an artificial comet." The sodium cloud was to be visible for two to five minutes in the apparent position of the center of a triangle formed by the stars Alpha Bootes, Alpha Virgo and Alpha Libra in the constellation Virgo.

Soviet announcements said the observatory at Alma Ata in Khazakstan photographed the sodium cloud.

Rocket also carried the coat of arms of the Soviet Union and the inscription, "U.S.S.R.—January 1959." The launching was dedicated to the upcoming 21st congress of the Soviet Communist party. The popular name "Lunik," coined from "Lunu" (moon) and Sputnik, later gave way to "Mechta," or "dream."

Russia said this about transmitters in the rocket:

- **"For observation of the flight** of the last stage of the cosmic rocket there have been installed in it a radio transmitter emitting on two frequencies—19.997 and 19.995 mc.—telegraphic messages of a duration of 81.6 sec.
- **"A radio transmitter working** on a frequency of 19.993 mc. emitting telegraphic messages of a variable duration of 50.9 sec. by means of which the data of scientific observations are being emitted.
- **"A radio transmitter working** on a frequency of 183.6 mc. is being used for measuring the coordinates of the movement and the transmission to earth of scientific information."

U.S. tracking stations also picked up the rocket on 70.2 mc. and 212 mc. First U.S. station to receive was the one established in Hawaii for tracking USAF Pioneer probes. Others included USAF stations in Singapore, at Millstone Hill, Mass., and the Air Force Missile Test Center, Fla.; the Army Signal Corps station at Ft. Monmouth.

Soviets Announce Nuclear Plane Plan

Washington—Soviet Union reports that 1959 "will see the first trials" of "atomic engines for civil aviation."

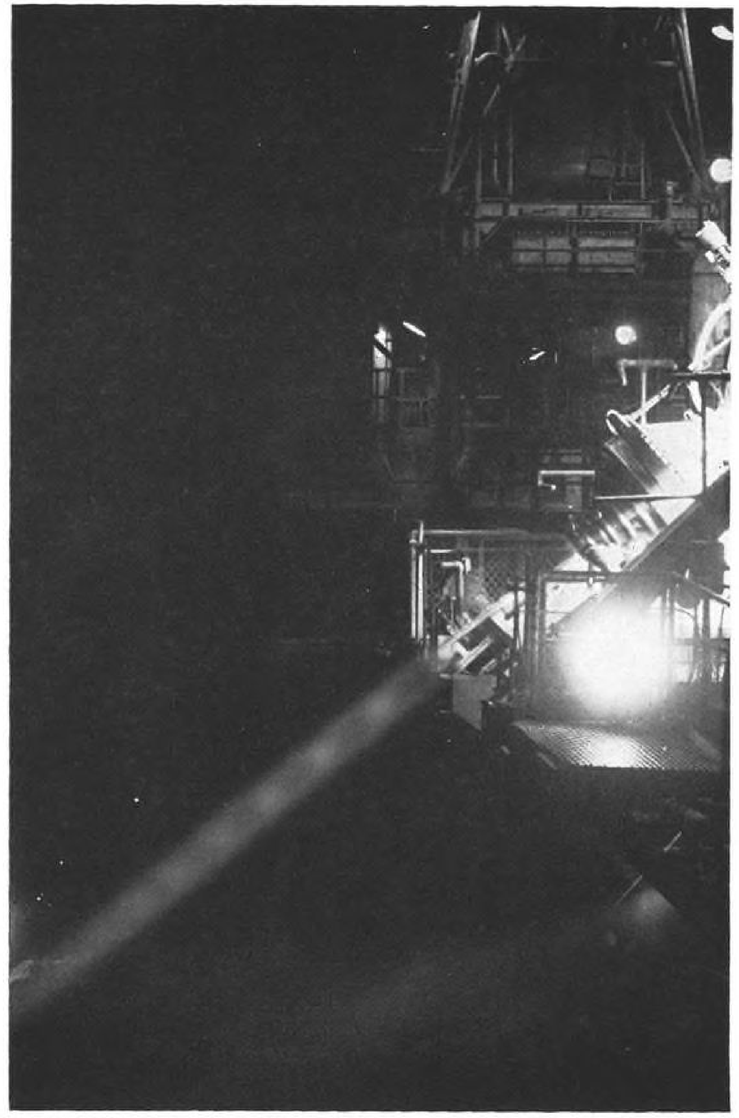
Aviation Week reported last Dec. 1 that initial flight tests of a Soviet nuclear-powered bomber are now under way.

In a French-language broadcast monitored in London, Moscow said on Jan. 1 that Soviet scientists are concentrating on nuclear reactors. The broadcast was entitled "Soviet Science in 1959."

"The prospects of conquering these (atomic) sources of concentrated power are closely linked with the problem of penetrating into cosmic space," the broadcast said.

"Soviet scientists have been working for a long time on the problem of efficient use of atomic engines for civil aviation and the results already obtained make it possible to state that 1959 will see the first trials in this field."

The same broadcast, one day before Russia successfully launched a rocket toward the moon, said "progress of technology and automation will without doubt make it possible to send an interplanetary rocket around the moon in 1959."



Kiwi-A Tested With Conventional Propellants

Shock diamonds are visible in the exhaust emanating from nozzle developed for Kiwi-A, the first U.S. reactor designed for feasibility tests of nuclear rocket propulsion. Conventional propellants were used in test, conducted by Rocketdyne Division of North American Aviation at its Propulsion Field Laboratory, Santa Susana, Calif. Rocketdyne designed and developed the nozzle and delivered it to the Atomic Energy Commission Nevada Test Site where Project Rover (AW Oct. 13, p. 33) field tests will be conducted by the Los Alamos Scientific Laboratory.

N. J.; Radio Corp. of America's station at Riverhead, L. I., N. Y., and a number of others reporting to "Project Space Track" at the Air Force's Cambridge Research Center.

An undisclosed number of U.S. tracking stations are assigned to monitor the frequencies usually used by Russian satellites and space probes.

Prof. Herman Oberth, who recently completed three years of work with missile and space scientists at Army Ballistic Missile Agency, said in Germany that he was not surprised at a statement that the U. S. knew about the launching before it occurred.

"During my stay in America we always received excellent advance intelligence information on Soviet space probes," Oberth said.

Propaganda aspects included issuance of a postage stamp depicting Russia's three Sputniks and an artist's concept of a space rocket. Stamp was issued "to mark the conquest of the cosmos by the Soviet people."

Soviet Premier Nikita Khrushchev said his people "are the first in the world to map out the way from the earth to the moon" and said he felt "like hugging the man who has produced this, the first cosmic rocket, a new victory for the Soviet Union."

Success of the flight led to a number of predictions of things to come. The most poetic of these, although not as ambitious as statements that Russian space ships may be sent beyond the solar system, was Prof. Blagonravov's belief that young Russians some day "will walk along the edge of a crater of the moon, unravel the age-old secret of the canals on Mars, and see Venus unhampered by her cloak of cloud."

Russia's Mechta, which its scientists are calling "Planet 10" of the solar system, joins many thousands of natural asteroids in space. They range up to 480 mi. in diameter and most lie between the orbits of Mars and Jupiter.

Aerobee Charge

But Mechta may not be the first man-made object to go into interplanetary space. On Oct. 16, 1957, scientists from the Air Force Cambridge Research Center fired an Aerobee rocket to an altitude of 54 mi. above Holloman AFB, N. M., and a shaped charge expelled two small aluminum pellets to measured speeds of 33,000 mph.—well above escape velocity. Although they were infinitesimal in size compared to Mechta, they are believed to have traveled into interplanetary space.

Artificial production of a bright cloud such as the one Mechta produced also has been done before. On Mar. 19, 1956, AFCRC scientists released nitric oxide gas from an Aerobee over Holloman and produced a brilliant glow, formed by unlocking stored sunlight in the atmosphere, that grew to 3 mi. in width before it faded.

Propellants Contract

U. S. Navy Bureau of Ordnance has awarded a contract to Monsanto Chemical Co. for research on high energy solid propellants.

Emanating from BuOrd's Research and Development Division, the contract will seek to exploit a new processing technique for making solid solution systems, which the Navy hopes will lead to high impulse solid rocket propellants. Monsanto discovered the technique in another area of its research activities and will now try to apply it to propellants.

The work, which marks Monsanto's entrance into the rocket propellant field, will be carried out at the company's special projects department in Everett, Mass.

Space Technology

House Group Says U.S. Needs Five Years to Overtake Soviets

By Ford Eastman

Washington—Current Russian achievements in space can be matched by the U. S. within 12 to 18 months, but it will take at least five years of intensive effort to reach an equal status with the Soviet Union, the House Select Committee on Astronautics and Space Exploration reported yesterday.

The comparison between the U. S. and Russian space efforts was the final report of the committee which will soon be replaced by a new standing Committee on Science and Astronautics.

The report said the estimate of a 12-to-18 month Russian lead may be overly optimistic since the Soviet effort in ballistic missiles has been conducted on a continuous basis since 1946 while the American effort did not really get under way until after a small sized thermonuclear warhead became a strong possibility in the mid 1950s.

Committee Chairman John W. McCormack (D.-Mass.) said the critical feature is not the present time gap between Soviet and American space capabilities but the time that will be required to close it. He pointed out that, even if the Soviet rate of progress were no greater than that of the U. S., the gap would never close, but would progressively widen.

Program Support

Sufficient progress has been made in 1958, the report said, to give the committee confidence that the U. S. and free world are capable of mounting a successful space program. What remains to be achieved, it added, is the necessary understanding and support for implementation of a program of sufficient scope to attain the goals that must be met.

After considering all aspects of the national space effort over the past year, the report said the question still unanswered is whether the programs now under way are bold enough to overtake and surpass the Soviet Union. The committee said it had constantly strived to see that Congress fully appreciates the stakes that are involved in the new space age. But, the report added, the committee is concerned whether the executive branch has told the public "the realities we face in a way which will create the broad based support needed to carry on the national effort.

Dangers Ahead

"We would not preach alarm for the sake of sensationalism, nor counsel despair," the committee said. "But we would not gloss over the difficulties and the dangers which lie ahead of us. Presenting a fair balance requires the most careful attention to policies of public information by the committee, the Congress, the executive branch and others in a position to influence the public.

"True technical secrets which are of military value should not be given away," the report said, "but the public must be told enough to understand in general where our nation stands in this important race. Neither successes nor failures should be overblown for the sake of immediate sensation, if our own public and the world at large is not to be left in a state of confusion and doubt."

Other conclusions drawn by the committee:

• **"Short-run budget pressures** should not be the primary basis for decisions on space programs which are inherently long-range and which involve the very survival of the nation.

• **"Inventions cannot be scheduled** in advance. This means that mere setting of a timetable and appropriating money will not automatically permit us to achieve certain important goals. Programs must be flexible enough to take advantage of scientific breakthroughs when they occur, both as to direction of development and rate of expenditure.

• **"Crash programs** are the most expensive kind to undertake. Money cannot buy back all the time which has been lost by neglecting a foreseeable need. It also creates the chance of irrevocable commitment to faulty designs, undue waste later in attaining operational reliability and wear and tear on key individuals which reduces their long-run total contribution to national progress.

• **"The early design-study** phase of research is relatively cheap in money, but it may not be cheap in amount of time required. If certain deadlines are important to national security in years ahead, it is a blunder to save moderate amounts of money in the first years by neglecting the research phase.

• **"The pace of development** has been so rapid and the complexity of many projects is growing so that their planning requires programing of efforts over a longer span of years. Such long-range planning involves reconciling our traditional practice of appropriating money year by year with the funding, subject to safeguards, of certain important programs over a number of years.

• **"Long-range flexible planning** should entail approval of programs which are not yet certain in every detail and a system of followup and reappraisal leading to program revision when necessary. In both respects, the process of decision requires improvement.

• **"Although engineering secrets** relating to national defense deserve the utmost protection, the greater part of the space program will progress more rapidly without the shackles of an undue security control. Free exchange of information among scientists and engineers is particularly important for a country which is making a late start in developing its space capabilities.

• **"Full scientific and technical** cooperation among the nations of the free world is essential to their joint survival and to the fastest growth of the American space program.

• **"Scientific education in the U.S.** stands in need of critical review. It is the view of this committee that prudent and imaginative steps must still be taken to give to mathematics and science the needed emphasis in school curricula but not to the neglect of humanities."

Stockholders Approve Aircraft Radio Sale

Boonton, N. J.—Stockholders of Aircraft Radio, Inc., have approved acquisition of ARC by Cessna Aircraft Co., according to William F. Cassedy, Jr., ARC president. Under the plan, Cessna stockholders will vote on the acquisition at a meeting set for Jan. 27.

Administration Faces Battle in Try To Hold Line on Defense Spending

Washington—Administration plans to hold the line on defense and space spending in Fiscal 1960 in the face of recent Soviet scientific advances will find little support from the 86th Congress which convened last week.

Following a White House briefing on the new budget earlier, congressional leaders expressed "deep concern and disappointment" over the Administration requests which will be submitted to Congress next week with no significant increases expected for either national defense or space programs.

The total 1960 defense budget calls for approximately $40.9 billion in new money, about the same as the Fiscal 1959 budget. Of this amount, $450 million is being requested for the Defense Department's Advanced Research Projects Agency to fund military space programs. For Fiscal 1959, Congress approved $520 million for ARPA, of which $117 million was later transferred to the National Aeronautics and Space Administration. ARPA received additional funds through transfers from the military services, however.

For civilian space projects during Fiscal 1960, the Administration probably will ask for $475 million in new funds, a figure considerably lower than NASA had originally requested.

Last year, the President requested a Fiscal 1959 NASA budget of $346 million. Congress, despite criticism by many of its members that even this sum was too low, cut the appropriation to $301 million.

The total space budget for the coming fiscal year for both civilian and military projects will be about $925 million as compared with about $700 million plus transfers for the current year.

The $40.9 billion defense budget to be requested will contain little or no provision for funds for air breathing missiles and already has forced cancellation of a number of programs, including the Air Force's Fairchild Goose countermeasures missile, the air-to-air Bell Rascal and the Navy's Chance Vought Regulus II submarine-launched surface-to-surface missile. In addition, the budget requests would only provide for a total of approximately 1,000 new military aircraft—600 for the Air Force, 400 for Navy. Under present plans, the individual services would receive approximately the same amounts as those authorized for the current year.

The new budget will contain, however, requests for substantial increases in both foreign aid and international loan funds. The Administration asked

Bell XV-3 Converts to Forward Flight

Bell XV-3 experimental convertiplane flies fully converted to normal forward flight, with rotor masts in airplane configuration. Photo was taken on second full conversion flight; XV-3 takes off with masts vertical and rotorprops acting as helicopter rotors (AW Dec. 29, p. 24). Bell is developing XV-3 for U. S. Army.

Gyrodyne Contract

Washington—Navy's Bureau of Aeronautics last week awarded Gyrodyne Co. of America Inc., St. James, L. I., N. Y., a $2.75 million contract for further development and initial production of the company's remotely controlled helicopter.

A Gyrodyne spokesman said vehicles to be procured under the contract will be used for "tactical evaluation of a classified nature." One of the most promising uses for a remotely controlled helicopter appears to be as anti-submarine detection vehicles operating off destroyers and other small Navy ships.

The contract, under present plans, will lead to the "immediate employment of about 200 engineers and technicians with experience in airframe, powerplant, electronics and avionics fields," the spokesman said.

about $3.9 billion for foreign aid during the current fiscal year, but this was reduced by Congress to $3.2 billion.

After the President's briefing of congressional leaders on the new budget, Sen. Lyndon Johnson (D.-Tex.), majority leader, called for an intensive review of the nation's defenses and the national space program by the Senate Preparedness and Space Committees. He is chairman of both groups. The Senator said he is disappointed that the U. S. is not pushing farther and faster in its military and space programs.

Sen. Hubert Humphrey (D.-Minn.), a member of the Senate Foreign Relations Committee, termed the President's plans "a sick budget." He added it would not provide for needed scientific progress and that between four and one-half to five million persons would remain unemployed if it is not increased.

Rep. George Mahon (D.-Tex.), chairman of the House Military Appropriations Committee, said the amount suggested "could be too little" and added that his committee would examine budget proposals carefully.

Rep. John W. McCormack (D.-Mass.), chairman of the House Committee on Astronautics and Space Exploration, earlier called for a bold creative space program regardless of cost.

Sen. Henry M. Jackson (D.-Wash.), demanded a crash program to seize space leadership from Russia this year or risk losing the cold war.

Congressional leaders said they would not hesitate to approve additional funds over and above those requested by the President if they were found to be in the national interest or vital to national security.

They admitted, however, that while Congress can provide more money than asked, there is no guarantee that the Administration will spend it.

Reorganization Shifts Ordered by Defense

Washington—Armed services' eight unified and specified commands were placed under direct control of the Joint Chiefs of Staff and the Secretary of Defense on Jan. 1.

The organizational change, which climinates the service secretaries as administrators of the commands, was provided for in the defense reorganization legislation (AW June 30, p. 22).

In the implementing order, Defense Secretary Neil McElroy continued the status quo on the roles and missions of the three services. "It does not make any shift in the roles and missions as previously delineated," Deputy Defense Secretary Donald Quarles said. "It merely realigns them in line with the new command structure."

The eight commands are: U. S.-European; Alaska; Caribbean; Atlantic; Continental Air Defense; Pacific; U. S. Naval Forces Eastern Atlantic and Mediterranean; Strategic Air Command.

Another directive implementing the reorganization law tightens the relationship between the Joint Chiefs of Staff and the Secretary of Defense. It states:

"All elements of the organization of the JCS shall cooperate fully and effectively with appropriate offices of the office of Secretary of Defense. In all stages of important staff studies, the organization of the JCS shall avail itself of the views and special skills in the office of the Secretary."

Chiefs of Staff are authorized to delegate service duties to the vice chiefs of staff in order to devote more time to over-all JCS planning and activities.

The three services have until Feb. 6 to reshuffle the functions of their four assistant secretaries and reduce the number to three each, as provided in the reorganization law. Navy Department has said that the post of "Assistant Secretary for Air," now occupied by Garrison Norton, will be abolished in the reorganization.

Industry Retains Rank As Leading Employer

Washington—Aircraft industry continued as the largest manufacturing employer during the first nine months of 1958, although employment was down to 760,000 in September from a peak 892,000 in April, 1957, according to the Aircraft Industries Assn.'s 1958-59 review. AIA also said:

• **Average hourly earnings** of $2.55 in September were 12 cents higher than in January. Weekly hours worked declined slightly from 40.8 in August to 40.7 in September.

• **Backlog of orders** for complete aircraft, engines and propellers of $13.1 billion in September was $9 billion below September, 1957.

• **Deliveries of civil aircraft** of 5,717 during January-October, 1958, were above the 5,685 for the same period of the previous year.

New officers elected to two AIA committees were:

• **Space Parts Committee:** chairman, J. M. Bird, of Boeing Airplane Co.; vice chairman, E. P. Fechtman of the Allison Division of General Motors Corp.; western vice-chairman, R. W. Shaffer of General Dynamics; eastern vice-chairman, D. L. Lee of Minneapolis-Honeywell.

• **Aircraft Research and Testing** Committee: chairman, Dr. Robert S. Ross of Goodyear Aircraft Corp.; vice chairman, Royal B. Jackman, Northrop Corp.

Aircraft Exchange Closes First Market

New York—Aircraft Exchange closed its first market last week with 37 quotations involving about 100 aircraft, mostly offers to sell.

Though these early indications were of a predominantly buyers' market in used aircraft, Robert I. Helliesen, president, said that the Exchange (AW Dec. 8, p. 29) hasn't been organized long enough to exploit foreign contacts which might include larger numbers of buyers.

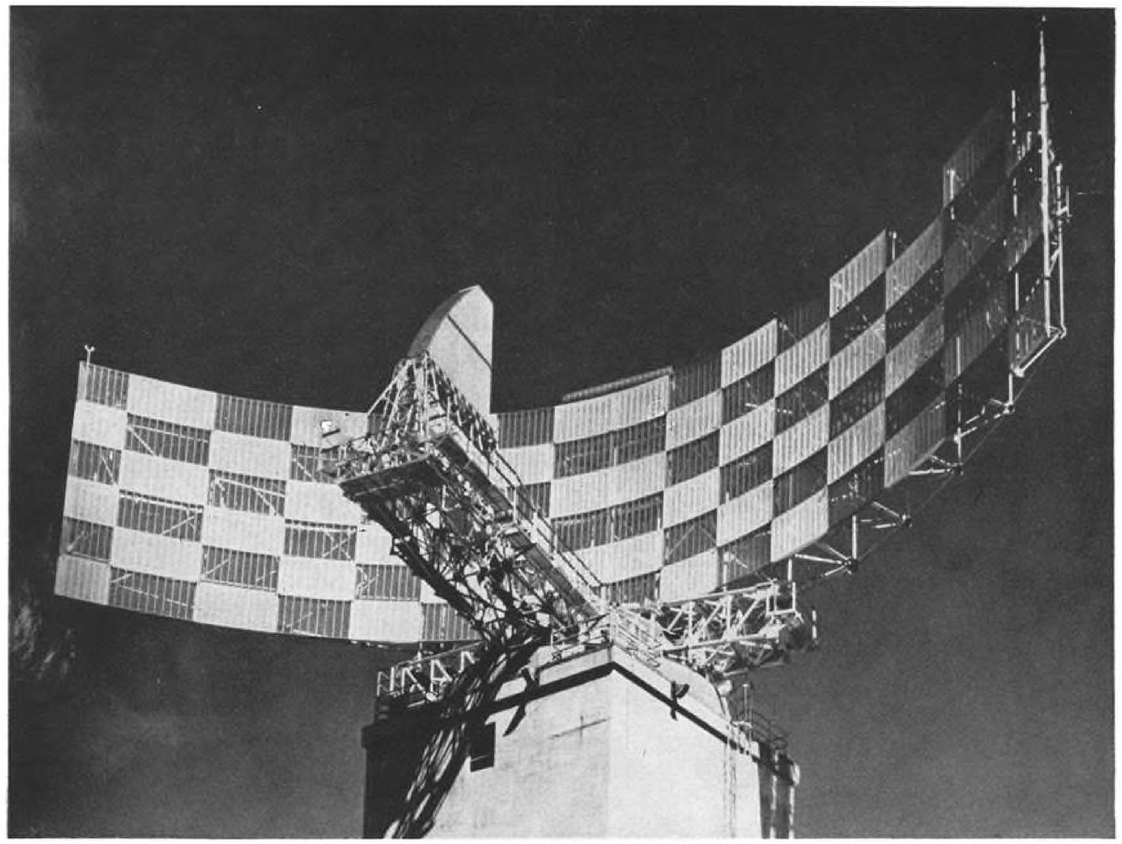
Aircraft offered included two Fairchild F-27s at the manufacturer's original price, and Douglas DC-6As and DC-6Bs, DC-4s and DC-3s or C-47s. There were no DC-7s in the initial offerings.

RAT Canceled

Washington—Navy last week terminated the development of the RAT (Rocket Assisted Torpedo) because of "superior anti-submarine warfare weapons are now under development." The RAT program, began in 1953 by the Bureau of Ordnance, consisted of a rocket motor secured to a torpedo. The complete unit was fired from a special adapter on a five-inch gun.

The rocket propelled the torpedo to the general target area where it separated and the torpedo dropped into the water by parachute. Various homing devices then guided the torpedo to its target.

The RAT system was managed by Librascope Inc.; the primary Navy development agency was the Naval Ordnance Test Station at China Lake, Calif. The torpedo was developed by the Clevite Ordnance Division of the Clevite Corp., Cleveland, Ohio; the launcher by the Puget Sound Naval Shipyard, Bremerton, Wash.



RADAR REFLECTOR and feed system of Lincoln Laboratories' CCM-1 experimental installation at Boston Hill, near North Andover, Mass., is shown in place on its 82 ft. high, reinforced concrete tower. Antenna and pedestal weigh about 110,000 lb. Reflector measures 120 x 30 ft.

MIT Studies Jam-Proof Defense Radar

By James A. Fusca

North Andover, Mass.— Program to investigate some of the most complex problems of defense against manned aircraft, air-breathing and ballistic missiles is under way at Massachusetts Institute of Technology's Lincoln Laboratories under Air Force sponsorship.

These problems include the development of techniques to limit the effectiveness of enemy countermeasures, highly sensitive radar receivers capable of sophisticated analysis of target echoes, and studies of interference from such natural sources as the Aurora Borealis.

Rotatable Antenna

The radar being used in this program is an installation called the CCM-1 (counter-countermeasures) located at Boston Hill near here. The system became operational last November. The antenna reflector for this radar measures 120 ft. in diameter by 30 ft. in height which makes it one of the largest rotatable radar antennas known to exist.

Primary effort of the program will be to explore defensive techniques to prevent jamming or deception of air defense radars such as the AN/FPS-24 being developed by General Electric and the AN/FPS-35 under development at Sperry Rand Corp. by active or passive countermeasures of non-ballistic enemy weapons.

The Boston Hill radar, however, is capable of acting as an adjunct to the Millstone Hill radar in studying the problems of ballistic missile defense by analyzing the effects of reflection, refraction and Doppler shift caused by the aurora as well as by tracking missiles launched from Cape Canaveral, Fla.

The large size of the Boston Hill antenna installation is significant because it is indicative of the approach being taken to the threat of enemy countermeasures. Antennas the size of the CCM-1 reflector are being considered for both the AN/FPS-24 and AN/FPS-35, although the reflectors for these may be more difficult to construct.

The reflector for the CCM-1 installation is a singly curved cylindrical section, fed by a half-pillbox feed, which forms a beam 1.5 deg. in azimuth and approximately 5.0 deg. in elevation. Doubly curved, or parabolic, sections are under consideration for the two other systems.

One reason for requiring doubly curved reflectors is that present plans call for installing the AN/FPS-24 and AN/FPS-35 together in certain locations where they will use a common reflector and feed system. Because they operate at different although harmonically related frequencies, both radars can operate through a bipolarized feed system which minimizes coupling but the reflector must be doubly curved to function effectively.

Site Details

The Boston Hill installation is located off of Route 114 southeast of North Andover, Mass., 15.6 airline miles to the northeast of Lincoln Laboratories at Lexington, Mass.

The radar reflector and feed system are mounted on a reinforced concrete tower 82 ft. high at a location 380 ft. above sea level.

The radar for the system was designed by the laboratories. It operates at a frequency of 400 mc. with a peak power of five megawatts and a variable duty cycle (percentage of the time it transmits) to a maximum of 8%.

The half-pillbox feed has an aperture 19 ft. high and 17.5 in. wide, with a

parabolically curved rear surface for beam shaping. To protect the feed against weather, the aperture is covered with a silicon glass laminate window.

Focal length is approximately 30 ft. The reflector and feed can be rotated continuously in either direction at speeds up to 60 mph. The antenna system is capable of surviving a 130 mph. wind when covered with ice.

Combined weight of the antenna system and its pedestal is about 110,000 lb. The antenna is driven by four 100 hp. motors. Reflector and feed system were built by General Bronze Corp., the pedestal by Avery and Saul Co. and Watertown Arsenal.

The only rotatable radar reflector of comparable size known to be in use is the AN/FPS-31 air surveillance radar on Jughandle Hill, near Bath, Maine. This system was designed by Lincoln Laboratories and operated as part of its experimental SAGE sector from July, 1955, until early this month when the installation was transferred to the newly organized MITRE Corp.

The Jughandle Hill reflector measures 120 ft. in diameter by 18 ft. in height, with a focal length of 30 ft. It differs from the Boston Hill antenna system, however, in that it is a much lighter structure mounted on an unguyed openwork steel tower. The reflector was manufactured by D. S. Kennedy and Co.

J83 Canceled

Washington—Cancellation of approximately $56 million in contracts for the development of the Fairchild J83 turbojet engine was announced last week by the Air Force. The lightweight J83 had a very high thrust-to-weight ratio and was intended for use in the Fairchild Goose intercontinental diversionary missile which also has been canceled (AW Dec. 22, p. 27).

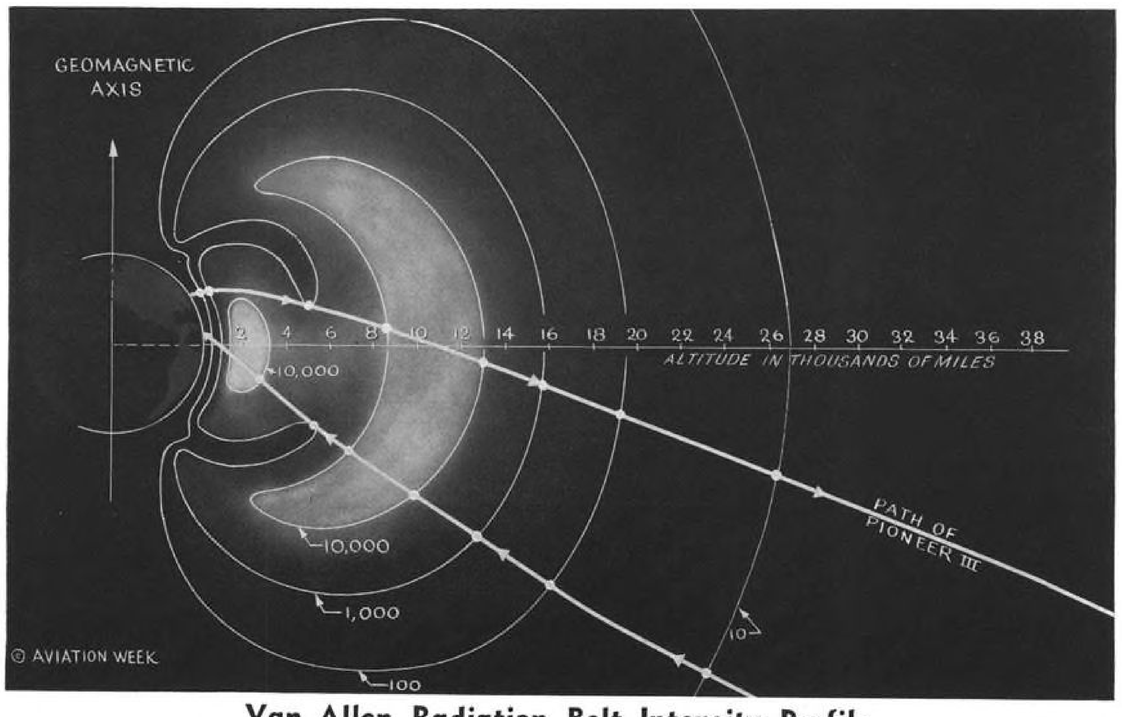
Fairchild will close its $12 million production plant at Deer Park, Long Island, N. Y., and lay off about 2,000 employes as a result of the loss of the J83 contract. J. H. Carmichael, Fairchild president indicated that none of the other Fairchild facilities on Long Island will be affected.

Aircraft Companies Form Space Group

New York—Three Long Island aircraft companies have announced that they will work together on future space programs.

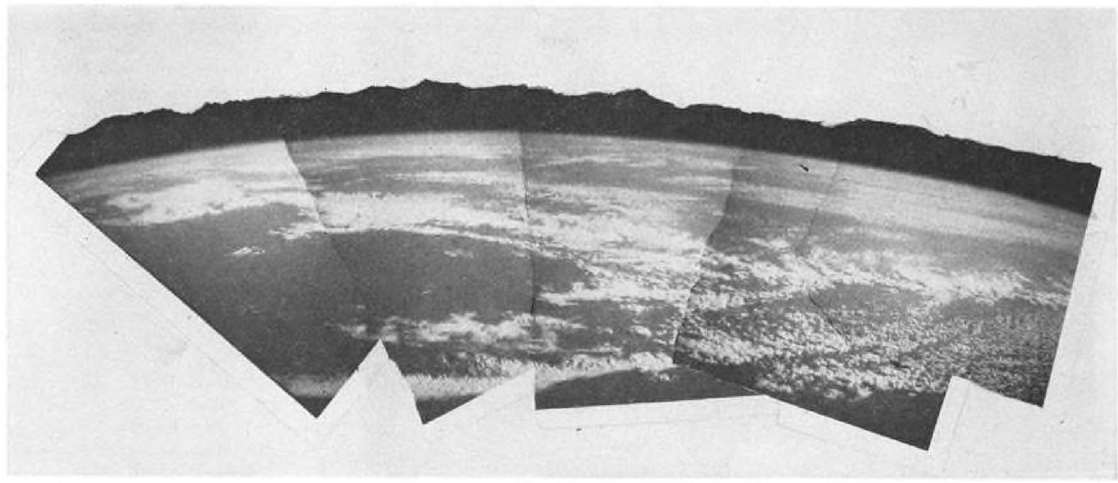
Grumman Aircraft Engineering Corp., Republic Aviation Corp. and Fairchild Engine & Airplane Corp. intend to combine their appropriate Long Island facilities and staffs "whenever advisable on new astronautics projects." Joint effort programs will be directed by a Space Projects Coordinating Committee made up of two representatives from each of the member firms. In addition, there will be an advisory team of top corporate and consulting scientists.

Each company will prepare its own proposals on missile and space projects it originates. But when it appears that one of these projects can be better handled in a combined effort with the other companies, the firms will get together and collaborate on proposals. The first joint effort on space projects, in fact, is now under way.



Van Allen Radiation Belt Intensity Profile

Intensity profile of radiation surrounding the earth, constructed from data obtained by Army Pioneer III space probe (AW Jan. 5, p. 19), shows two "Van Allen" belts of intense radiation centered at altitudes of approximately 2,400 and 10,000 mi. with low radiation buffer zone between, centered at approximately 6,000 mi. Outer radiation belt extends from approximately 8,000 to 12,000 mi. in altitude, with center at some 10,000 mi. Number of counts per second registered by Pioneer Geiger counters are shown. Relatively low-intensity "horns" which project outward at higher geomagnetic latitudes may result from atmospheric heating, produced by radiation that leaks in along converging magnetic lines of force, which pushes radiation outward. Peak radiation measured is about 10 roentgens per hour, if radiation consists of electrons, or 10 roentgens per hour if protons. Minimum radiation level at 6,000 mi. is 0.3 roentgen per hour if radiation consists of electrons, 3 roentgens per hour if protons.



FRONTAL cloud formations were photographed over the Atlantic Ocean by a camera carried to an altitude of 86.25 mi. in the nose cone of a rocket launched Dec. 5 from the National Aeronautics and Space Administration's Pilotless Aircraft Research Station, Wallops Island, Va. (AW Sept. 22, p. 33). The rocket-camera unit was designed specifically to photograph cloud formations associated with hurricanes and weather frontal systems from extremely high altitudes over ocean areas where there are no permanent weather stations. The film shows frontal cloud formations starting about 200 mi. offshore and extending about 700 mi. farther seaward. Mosaic strip covers about 1,000 mi. in length. The film was recovered at sea.

ONR Designs Weather Research Rocket

Washington—Low cost weather research rocket designed to provide the most complete photographic information to date on weather frontal systems and storms has been developed and successfully fired by the Office of Naval Research.

Designation of the program is Project Hugo.

Photographs of cloud cover over an area of about 500,000 sq. mi. along the east coast of the U.S. from Maine to Florida were taken at from an altitude of 86.25 mi. during the first flight of a Nike-Cajun rocket which ONR had equipped with a modified World War II gunsight camera.

Weather Forecast

U.S. Weather Bureau and Navy scientists believe that such large area photographs will allow complete storm systems, including hurricanes, to be seen instantaneously. This could possibly provide a means of tieing together all of the variables affecting storms and weather frontal systems into a single theory or method to improve weather forecasting.

At present, long-range forecasting is accomplished primarily by using the Norwegian weather front theory, but the relatively imprecise and incomplete measurements taken by many surface weather stations and balloons leave room for improvement in forecasting accuracy.

Present budget requests for this basic research project include funds for eight or 10 more shots during the coming year. Weather scientists, however, would like to have enough rocket equipment to fire a number simultaneously so that a three-dimensional picture of cloud cover over a particular area could be obtained or a very great portion of the earth's surface could be viewed at once.

Photographs similar to those just obtained by the Navy were made about 10 years ago from a Viking rocket, but the cost involved made the use of such equipment for weather research prohibitive. Present equipment and recovery techniques were evolved to overcome this cost objection.

Rocket and camera payload that have been developed cost less than $15,000 and a team of only one aircraft and one destroyer is needed to recover the camera capsule.

No special equipment is needed to stabilize the camera section after it has been boosted to altitude and separated from the rocket. This feature was a major factor in reducing cost.

The Nike-Cajun solid propellant rocket has been used successfully for a number of years and has shown a high degree of reliability. It can be fired at sea from missile launchers for the Convair Terrier now installed aboard a number of Navy ships.

The first firing of the ONR rocket demonstrated its ability to be used in rough weather which will make it valuable for studying storms. The rocket was fired when ground winds were 20 to 30 mph. It weather-cocked somewhat, was thrown off course and landed some 30 mi. away from the recovery ship. A small radio transmitter in the buoyant camera capsule enabled the ship to recover it within two hours with the aid of one aircraft, although the sea was rough with eight to 10 ft. waves. Battery life is 30 hr. which would allow a long search in very bad weather.

Camera Installation

Camera used in the rocket was a gunsight camera modified to withstand accelerations of 100Gs. Plus-X film was used with a red filter. A high-grade Swiss lens was installed in the camera, and its stop was f/2.

The camera package assumes an unpredicted motion after it is separated from the booster. Generally, however, it will roll slowly and precess slowly so that it will cover the whole horizon even though it takes many shots of the sun as well. The camera runs for 220 sec. and allows pictures to be made from about 300,000 ft. to 450,000 ft. and back down to 300,000 ft.

Montages pieced together from this movie film normally would allow cloud cover in all directions to be recorded. Two cameras are used in the capsule and one will have a 90 deg. prism in the future so that they will not duplicate pictures, provide a wide coverage and lessen the chances of erratic capsule motion from keeping the cameras pointed at the sky.

UF-2 Being Produced for West German Navy

Grumman UF-2 Albatross, first of five in production for the Federal (West) German Navy, makes test flight. The amphibians will be used for air-sea rescue and utility operations.

Chance Vought Joins B-70 Team; Prepares for Army Missile Trial

Dallas—Chance Vought Aircraft won a place on the North American B-70 Valkyrie bomber development team last week, taking some of the sting out of recent cancellations of Regulus II missile and F8U-3 jet fighter programs.

The company is moving ahead this week with its efforts to sell a battlefield missile to the Army.

Chance Vought was chosen by North American Aviation to build the horizontal and vertical stabilizer sections for the Mach 3 bomber. At the same time, Lockheed Aircraft Corp.'s Georgia Division was named to design and build the B-70 aft fuselage section. Convair's San Diego Division will build the wing for the F-108 Mach 3 interceptor.

At Redstone Arsenal, Chance Vought is scheduled to start demonstrating a battlefield missile Thursday on an Army rocket and guided missile agency range. Further test firings are scheduled for mid-February and mid-March. The company is offering the missile to the Army under the Project FIRE program.

Missile is a weapon designed for use at battlefield ranges as part of a projected family of Army short range missiles. It is about 12 ft. long, and is powered by a liquid rocket motor built by Rocketdyne Division of North American Aviation.

Test vehicles which Vought will show the Army were designed and built on company funds at a cost of about half a million dollars. Missiles were developed purely as a speculative venture in an effort to break into the Army market. Convair will demonstrate its Lobber missile at Redstone this month in a similar company-financed effort.

Contract for the B-70 work won't mean a rehiring program at Chance Vought, according to Fred O. Detweiler, president, although it will make work for several hundred employes, mostly engineers and other technical personnel, over the coming months. Main effect probably will be to mitigate further layoffs in the wake of the Regulus II and F8U-3 cancellations, rather than to recall dismissed workers. The company has laid off more than 3,500 persons since the December cancellations (AW Dec. 29, p. 27).

Detweiler said the B-70 business involved a "multi-million dollar contract," but no exact amount or specific contract terms were available. Chance Vought and North American have not completed negotiations.

Announcing the B-70 contract awards, Raymond H. Rice, North American president and general manager of the Los Angeles Division, described the advanced metals work necessary in Mach 3 aircraft work and said that great strides have been made in solving problems.

"All of this know-how will be made available to the companies working with us on these new projects under the weapon system manager concept," he said.

Chance Vought also has made some management changes in the wake of the Navy's missile and fighter cancellations. Raymond C. Blaylock was named vice president and general manager of the company, putting him in charge of operations here, and Gifford K. Johnson has become vice president in charge of business planning and president of Genesys Corp., Chance Vought's Los Angeles electronic subsidiary. Blaylock was vice president-engineering and Johnson was vice president-production.

Detweiler remains president and chief executive officer. Blaylock will run the Dallas operation, leaving Detweiler free for broader corporate matters. The move also injects an engineering emphasis into the entire Chance Vought operation here, since Blaylock's background lies in that area.

Johnson's appointment strengthens the company's effort to diversify. He will not only be looking for new business, but for new types of business for Chance Vought to move into.

Sud Liaison Award

Paris—Sud Aviation reportedly has won a development contract for a combined military and civil version of its twin turboprop liaison aircraft. Budget for 1959 includes appropriation for about $6 million dollars for development of the SE. 117 Voltigeur (AW June 30, p. 65), and SE. 118 Diplomate. Both aircraft are powered by two Turbomeca Bastan turboprops, developing about 750 eshp. each. About 65% of the elements of both aircraft are identical; the Voltigeur is the military version and the Diplomate is an eight to 10 passenger civil liaison aircraft. The Sud Aviation aircraft were competing with a Dassault 415 liaison aircraft, also powered by two Bastans.

Avco, Bendix Sales, Earnings Decline

New York—Declines in sales and earnings were reported last week by Bendix Aviation Corp. and the Avco Mfg. Co., both major contractors in aviation and missile systems.

- **Bendix** reported a drop in earnings from $27,499,034 in 1957 to $21,171,902 in 1958 or from $5.44 to $4.18 a share. Sales declined from $706,984,631 in 1957 to $619,138,095.
- **Avco** earnings fell from $12,833,-

000 or $1.38 a share in 1957 to $11,597,000 or $1.24 a share last year. Sales declined to $282,930,000 last year from $314,883,000 in 1957. The company discontinued various commercial lines last year to concentrate on military business.

Bendix divided its business for the year as 73% military and 27% commercial and of the total 40% was in electronics. Sales in the missile and satellite field were $78,800,000 or 13% of the total. Missile backlog was $107 million, or 23% of the corporation's total backlog of $465 million.

Avco last week joined the ranks of aviation companies entering the public market to borrow funds. It filed with the Securities and Exchange Commission a $15 million convertible debenture offering in part to repay bank loans and to finance the company's research center at Wilmington, Mass.

AFOSR Transfers Advanced Study Office

Washington—The Directorate of Advanced Studies of the Air Force Office of Scientific Research, Pasadena, Calif., will be moved to AFOSR headquarters here by the end of March. Liaison between AFOSR and its West Coast contractors will continue to be provided by Air Research and Development Command's regional office in Los Angeles headed by Col. Paul F. Nay.

Dr. Morton Alperin, director of AFOSR's Directorate of Advanced Studies, is terminating his association with the activity this month and will establish an independent consulting practice on the West Coast offering advisory services in the field of space technology and related sciences.

Dr. Alperin has been associated with the Air Force for 15 years in various scientific capacities. He has been affiliated with the Directorate of Advanced Studies since its inception in 1951, when it was known as the Western Division of AFOSR. Under his direction, the Directorate of Advanced Studies pioneered in the U. S. program in the space technology field, initiating and supporting space research with industry and universities in such categories as actual and simulated space environment, mechanics of orbits, detection, chemical, free-radical and electrical propulsion.

Fiat G.91 Production Assured

Turin, Italy—Year end status of orders booked for the Fiat G.91 lightweight strike fighter shows a total of 180 airframes either built or on order plus 87 more in various stages of negotiation. In addition, license rights are being worked out for production of 150 in Germany.

The revenue-producing total of 330 airframes assures the Italian firm continuing G.91 production for months to come. Developments of the airplane now in design and test stages give Fiat engineers the feeling they finally have a long term project under way.

One possible major effect on future orders could be choice of a VTOL strike fighter as second generation for NATO, bypassing the French Breguet Taon development once assured of that place in an attempt to sweeten the bitter pill of losing the NATO first generation order to Fiat.

The British talk as if they had a VTOL order in the bag, but, as Fiat learned the hard way, there is many a slip between winning a competition and getting the orders.

First order for the Fiat fighter was placed by NATO after the plane had been selected as winner of the 1955 paper competition. Three prototype and 27 preproduction planes were ordered to standard fighter configuration.

There followed a long time lapse while political footwork went on behind NATO scenes. Finally, the Italian government placed an order for 25 fighters and 25 two-seater trainer versions. But the French, who had originally gone along with the idea of ordering the winner of the NATO strike fighter competition, dragged their feet when the winner turned out not to be of French design.

Third order for the G.91 came in a German announcement of future equipment for the fledgling Luftwaffe (AW Nov. 10, p. 33). German order was for 50 airframes from Fiat production lines and built under license in Germany. Most recently, the United States has financed purchase of 50 more production fighters expected to be turned over to Turkish and Greek air forces in units of 25 each (AW Dec. 29, p. 26).

Follow-on order is expected soon from the Italian government for additional 25 fighters. Negotiations are proceeding with Austrians now, with the prospect of the purchase of 12 fighters and two trainers. In addition, U. S. Army in Europe is reported considering purchase of some reconnaisance versions of the G.91.

Fiat salesmen have been active in Belgium and The Netherlands where fighter and fighter bomber replacements are badly needed for some of the castoff and obsolescing U. S. and British equipment now operating. Company has also "not given up hope" of selling 48 units to the French, as originally planned.

News Digest

Record sales of $86,160,000 and earnings of $4,755,000 after taxes are reported by Cessna Aircraft Co., Wichita, Kans., for fiscal year ended Sept. 30. Sales in Fiscal 1957 totaled $70,049,000 and earnings after taxes $3,866,000. Increases of 17% in business plane volume, 29% in military business and 22% in industrial products over Fiscal 1957 were responsible for Cessna gains. Business plane sales by company in Fiscal 1958 totaled 2,725 units valued at $38,230,563, highest in company's history. Company expects Fiscal 1959 business to at least equal year past despite expected declines in military volumes.

British government has ordered a military version of the Armstrong Whitworth AW 650 Argosy for the Royal Air Force Transport Command. The aircraft (AW Jan. 5 p. 29) is awaiting favorable weather conditions for its first flight. RAF order quantity was not disclosed.

Navy has successfully flight-tested its first missile using a prepackaged liquid rocket engine. The test took place at Naval Missile Test Center, Point Mugu, Calif., and involved the small, bipropellant Guardian engine developed for the Navy by Reaction Motors Division of Thiokol Chemical Corp. The flight vehicle was the Sparrow III air-to-air missile.

Saunders-Roe Ltd. is going into production with its Mark II P. 531 helicopter (AW Sept. 8, p. 59). The P. 531, of which there are presently two prototype models, is a five-seater powered with a 425 hp. Blackburn Turmo free turbine engine. It made its first public appearance at the Farnborough Air Show last year.

Bristol Aero-Engines, Ltd., and Armstrong Siddeley Motors, collaborators in Bristol-Siddeley Engines, Ltd., will merge into a single company.

Fourth production Douglas DC-8 jet transport has rolled off Long Beach, Calif., line to enter flight test programs with three predecessors. Certification program will begin this month.

U. S. Army has awarded a $54 million contract to the Martin Co. for research and development on Pershing ballistic missile weapon system at Orlando, Fla.

Industry May Accept Fourth Crewman

Eastern shutdown ends with assent on third pilot plus engineer; American settlement seems 'remote.'

By Glenn Garrison

New York—Industry acceptance of a fourth crewman as the way out of the jet cockpit controversy seemed likely last week in the wake of Eastern Air Lines' agreement to carry a third pilot-qualified crewman in addition to a flight engineer.

Eastern's 38-day shutdown ended New Year's night after the carrier signed a new contract with striking flight engineers which does not require that they train as pilots, and also signed a memorandum of agreement with Air Line Pilots Assn. to carry the third pilot. American Airlines, still grounded late last week by a pilot's strike, has offered a similar fourth man solution.

American Settlement 'Remote'

Settlement of the American strike "appears remote," the airline's president C. R. Smith reported last Wednesday in a letter to his employes. He said ALPA apparently had no intention of accepting any reasonable terms and refused to follow the agenda of negotiations. Main stumbling block reportedly concerned working time and off-duty time and allowances.

Flight Engineers International Assn. calls its new contract with Eastern the second best in the industry from a wage standpoint, with National Airlines running first. A top seniority Douglas DC-8 engineer on Eastern will get $1,377 monthly and other increased benefits, an agency shop, dues checkoff and—relevant to the bitter crew dispute—assurance in a scope clause that FEIA senior engineers will be carried on all aircraft requiring more than two crewmen and that they will be used as flight engineers.

Flight Engineers International Assn. agreement runs until April 1, 1960, as does the Eastern-ALPA agreement. By that time Eastern's DC-8 operations will have begun, and should the crew issue arise again, Railway Labor Act procedures would undoubtedly assure that the status quo lasted at least through 1960.

But apparently Eastern, like American, has decided to accept the fourth crewman solution at least for the time being. Once in the cockpit, it seems he would be difficult to dislodge.

Eastern said that the agreements were subject to any new federal regulations which might be issued in the meantime, but this is at present unlikely. Federal Aviation Agency told AVIATION WEEK it is satisfied with present safety regulations covering airline crews. These regulations do not call for more than two pilot-trained crewmen. If any carrier feels present rules are threatening jet operational safety, an FAA spokesman said, such carrier must request a review of the regulation and the agency will act accordingly. So far, no such request has been submitted by an airline. FAA said it had no intention of reviewing a rule to "resolve a labor dispute."

Eastern also said that "an entirely new concept of crew complement and qualifications may well be required" when actual jet operations by the first two carriers are appraised. Pan American World Airways has been operating its Boeing 707-120s since last October, and American had hoped to begin 707-120 service late this month.

Crew Future Uncertain

American, too—though not officially talking about the fourth crewman proposal—has suggested that operational experience may change its views on crew needs. Last July, American president Smith said "The facts of the situation are that there is a need for the services of a flight engineer, and there is no need for the services of a third pilot. There are two qualified pilots on each of the airline planes, and that number has been found to be sufficient by the Civil Aeronautics Board."

Smith noted at the time that requiring flight engineers to be pilots would decrease job opportunities for non-pilot engineers and increase pilot jobs.

One industry source estimated that it would cost a major airline about $2.5 million annually to carry an additional pilot. Figure was based on a $5,000 yearly salary plus fringe benefits, assuming four crews per jet aircraft, and a total of 120 jets in the fleet.

Eastern advised ALPA that the company would afford the third pilot the opportunity to train as a flight engineer in order to provide relief for the engineer in flight. The engineer's union, however, could—and undoubtedly would—refuse to accept such relief.

The ALPA-Eastern agreement provides for appointment, within 30 days of the signing, of a committee to determine the specific allocation and duties of the third pilots. The committee will comprise two Eastern representatives and two ALPA members.

It is to complete its assignment not later than 60 days prior to the introduction of the jets.

Eastern expected to be back in 100% operation today and to inaugurate Lockheed Electra service today. Airline was scheduled to have received 12 of the turboprops by the inaugural date. Original plans called for introduction of Electra service Dec. 1, and December timetables were set up accordingly. The timetables had not been distributed at the time of the strike, and after service was resumed Jan. 2, had to be rushed to stations over the system.

The strike break came suddenly, with the engineer-Eastern agreement finally signed at 11 p.m. New Year's eve. Reports then went out that Eastern was flying again, but actually there was still a mediation session New Year's day to be gone through with the pilots. This ended about 9 p.m. Jan. 1, and meantime a hold had been sent out to reservations personnel until the agreement was reached. First flights next morning out of New York ran practically empty but loads began building up that afternoon. Eastern estimated it lost $28,842,579 in anticipated operating revenues during the strike period Nov. 24-Dec. 30. This does not allow for payments from non-struck carriers under the six-airline strike compact (see below).

American puts its strike losses, in terms of employes' salaries, at $295,000 daily for the 18,500 non-striking employes who had been furloughed by last mid-week. Another 1,000 people were due to be furloughed over the weekend, most of whom were retained to handle year-end tax accounting. Airline retained all its employes until Jan. 4. The strike began Dec. 19.

American has received a second Boeing 707-120, but it, along with three new Electras and 195 piston aircraft, were sitting idle last week dispersed among 24 cities across the country.

Pan American, with actual revenue jet operating experience since Oct. 26, continues to fly its transatlantic runs with supervisory pilots pending negotiations with ALPA.

The airline and the union expect to resume mediation sessions shortly after a holiday break.

PanAm says that on the basis of its operation so far it sees no reason to change its views on what jet crew complements should be. On the Atlantic run, the 707-120s carry two duty pilots and a pilot-qualified navigator in addition to a mechanic-qualified flight engineer.

On shorter hauls not requiring a navigator, PanAm sees two pilots as all that are needed.

Bitterness between some Eastern pilots and flight engineers led to several incidents as the airline resumed schedules. One captain reportedly let his engineer know that he was unwelcome on a flight and would be permitted few duties. The engineer walked off the plane until matters were straightened out.

Some of the bitterness arose from engineers' acceptance of help from teamster boss James Hoffa, who underwrote a $200,000 loan to the engineers from a Washington bank. Two payments on this loan had been made by last week.

Unless a break appears in the American strike, plans to inaugurate jet and turboprop service this month will be forestalled. The airline had scheduled New York-Chicago Electra service Jan. 23 and New York-Los Angeles 707-120 service two days later. The shutdown also played havoc with American's expansive promotional plans, causing cancellation of promotion tours with each aircraft during January.

Boeing 707 Idled With American Fleet

Idled fleet of strike-bound American Airlines includes Boeing 707-120 seen in background above. Also shown in new $12 million American hangar at New York International Airport are six of the carrier's Douglas DC-7s and one DC-6.

Airline Mutual Aid Proposal Goes to CAB

By Robert H. Cook

Washington—Member airlines of the controversial mutual aid pact and opposing unions last week filed final briefs with the Civil Aeronautics Board prior to oral arguments this week before the full five-member Board. The Board is expected to settle the legality of payments of excess revenues realized by non-striking airlines to strikebound members of the agreement.

Regarded as a showdown between airline management and organized labor, the pact was signed by American, Eastern, Capital, Trans World, Pan American and United Air Lines as a defensive measure against strikes which have cost four of the six members an estimated $62 million in lost operating revenues since October. The agreement brought immediate repercussions from the International Assn. of Machinists, the Air Line Pilots Assn., Flight Engineers International Assn. and the Brotherhood of Railway and Steamship Clerks.

Union spokesmen view the mutual aid pact as a strikebreaking weapon and have threatened industry-wide strikes if not disapproved by the CAB (AW Nov. 10, p. 40).

Indicative of the far-reaching importance of the issue and CAB's desire to relieve the current high tension between the airlines and unions, was the Board's alacrity in calling for briefs and an oral argument before its members as the expected sole basis for a final CAB decision instead of the usual formal hearing procedures which take several months.

What Board Must Decide

In arriving at a decision the Board must make the following determinations:

- **Does the agreement violate** any applicable provisions of the Railway Labor Act?
- **Will the agreement improve** or impair labor-management relations in the industry?
- **Will the agreement cause a restraint** of trade against non-pact members?
- **What effect will the pact** have upon the administration of the mail pay program?
- **What effect will the agreement** have on government participation in labor-management disputes?

The pact has been in effect since Oct. 20. An estimated $3.5 million in mutual aid payments have been made to strike-bound members. While the sums exchanged have been negligible in comparison to the lost revenues suffered by the carriers, the payments have helped. Capital Airlines, for example, received $2,247,972 from other pact signers. The carrier had a projected $1.5 million operating profit for October and November, but the Oct. 11-Nov. 22 strike by the International Assn. of Machinists resulted in an actual operating loss of $2 million for the two-month period. Mutual aid dropped the company's net loss of $2.6 million to an estimated $398,028, although the true net loss is nearly $500,000, reflecting payments made by Capital to TWA and Eastern.

In a supplemental filing with the Board, Capital pointed out that, while the funds helped alleviate its "critical" financial position, the company expects to suffer substantial long-term losses resulting from permanent traffic diversion to competing carriers and other costs.

Hard Core of Dispute

Hard core of dispute between pact members and opposing unions centers around the proper interpretation of recommendations made by presidential emergency fact finding boards as a last measure to avert strikes under the Railway Labor Act.

Pact members have conditioned en-

actment of the aid agreement to cases where union demands may "exceed or conflict with presidential emergency board recommendations or where strikes are in violation of the Railway Labor Act. While the joint brief filed by the six airlines specifically points out that such recommendations are not compulsory under law, it further observes that Congress had intended the findings to be a "persuasive" measure commanding "respect" in collective bargaining. They also charge that unions have used emergency board recommendations as a "point of departure" for bargaining.

On the other hand, unions remain adamant in their stand that pact members are attempting to make such findings compulsory and binding on all employes and say that the agreement, by the nature of its wording, is predicated on the assumption that labor demands will be "extreme and unreasonable."

Attorneys for the International Assn. of Machinists charge that any such reasoning is a "fallacy" in light of labor-management disputes with the six pact airlines between 1946 and 1957 when union members accepted presidential emergency board recommendations in 18 instances as against 32 arbitration decisions.

Formation of the pact plan, the carriers say, was necessary to correct the "imbalance" of power at the bargaining table since unions have become so powerful and unified in their demands that individually airlines have been losing the economic capacity to deal with labor on any terms approaching equality.

Airline attorneys called attention to the variety of mutual assistance arrangements between unions in the airline industry in answer to labor attempts to brand the six member pact as illegal. Listing 52 instances of such inter- and intra-union aid, including the recent offer of a $200,000 loan from the International Brotherhood of Teamsters to the Flight Engineers International Assn. during the Eastern strike, they also pointed to the ability of airline unions to exert powerful economic pressure through the merged AFL-CIO which covers the majority of airline workers.

Pact signers are firm in the belief that their agreement will deter the possibility of strikes instead of fomenting industry-wide disputes as suggested by opposing unions.

The carriers also cited an IAM publication in its answer to a reader who feared that the union's $2 million strike defense fund might mean more strikes.

Quoting from "The Machinist," the joint airline brief said the magazine reported: "On the contrary, the executive counsel believes that the defense fund will mean fewer strikes because management knows now that IAM proposals at the bargaining table are backed by $2 million. Convincing management that we are able to finance a strike will result in management taking our proposals more seriously."

Since the pact plan deals only with the two points of either "excess" demands beyond emergency board findings or unlawful strikes, airline attorneys contend that it is not in violation, but rather supports, the purpose of the Railway Labor Act. IAM had objected that the agreement did constitute a violation since American, Pan American and United were not involved in labor disputes with the union at the time the carriers joined the pact.

On the question of possible further government participation in labor-management disputes if the CAB approves the agreement, the unions emphasized the possibility of industry-wide strikes which they say might result in government seizure of airline operations as it has with railroads in the past.

CAB, however, has often voiced its intention to adhere to a "hands off" policy in any matter it considers a labor-management dispute, and airline attorneys contend that while the agreement would give the intended effect of government participation in such disputes by inducing greater respect to emergency board recommendations, both the administration of the pact and the conditions of payments would involve only the carriers themselves. They also said they regarded union arguments of industry-wide strikes as a "threat" and a "flagrant effort" to coerce a government agency.

Union arguments that the agreement is a restraint of trade against non-pact members were discounted by the airline filing which pointed out that the carriers were free to join or not. "If they remain outside the agreement, they do so solely by their own act and decision on the basis of a calculation that they will make more money by not joining than by joining," the brief said.

Aeroflot Starts Helicopter Service

Aeroflot, Soviet state-owned airline, has inaugurated its first regular intercity passenger helicopter service between Simferopol and Yalta in the Crimea, using Mil Mi-4P aircraft. Helicopter is 10-place, single rotor craft and can make the run in 25 min.

Hughes-TWA Pact Approved by CAB

Washington—Civil Aeronautics Board last week modified its order restraining business transactions between Hughes Tool Co. and Trans World Airlines to permit a four-part lease and sales transaction for aircraft and spare parts between the two companies.

Modification of CAB's original order issued in 1944 will permit TWA to sublease five Lockheed L-1049H Constellations from Hughes and later sell to Hughes four L-1049Hs which the airline has contracted to purchase from Lockheed.

In addition, the airline will be allowed to purchase at cost $1,155,143 worth of spare parts for L-1649A aircraft from Hughes, with Hughes also guaranteeing an undisclosed TWA obligation under a bank loan and conditional sales contracts.

TWA told the Board that, while it believed Hughes actions as a guarantor were not restricted by the 1944 order, the carrier wanted CAB to clarify the order.

TWA told the Board that terms covering the sale and lease of aircraft and spare parts involve only the payment of rent to Hughes on leased planes and reimbursement to cover the actual cost of spare parts. Guarantees to be supplied by Hughes will not involve any cost on the part of TWA, the carrier said.

Cuban Service Restored After Revolution

By L. L. Doty

Washington—Airline service to Havana, brought to a virtual standstill by the collapse of the Batista regime, was restored last week with the end of a strike that paralyzed Cuban industry and communications for five days.

Only Cubana Airlines operated flights to and from Havana's international airport over the five-day period during which followers of rebel leader Fidel Castro moved cross-country from easternmost Oriente Province to occupy the Cuban capital. All other carriers serving Havana on a scheduled basis promptly suspended operations on Jan. 1 following the abdication of President Fulgencio Batista and his supporters.

First attempts by Pan American World Airways to resume service Monday, following authorization by the provisional Urrutia government to start flights, were abruptly frustrated by a closing of the airport due to "technical difficulties." First flights were completed without incident, but the carrier cancelled the balance of its trips pending clarification of the situation.

No explanation as to the source of the "technical difficulties" was given the carrier by the new airport management. However, by Tuesday, National Airlines, Delta Air Lines and PanAm had restored scheduled operations.

Cubana Airlines cancelled all its scheduled service during the revolt but conducted daily charter service between the U.S. and Cuba with a Lockheed Constellation 1049G. The carrier's fleet consists of three 1049Gs, one Lockheed L-049, two Viscounts and one new Bristol Britannia.

The first flight was operated from Havana to Idlewild on Jan. 1 after the pilot, Miguel Rual Cabeza, was reportedly forced into the cockpit at gunpoint by two civilians. Although he had originally decided against running the risk of a takeoff from the beleaguered airport, Cabeza completed the flight with 92 passengers aboard.

The carrier operated one flight a day for the next four days under charter to exiled Castro supporters in New York. Through arrangement with the American Embassy in Havana, the carrier flew U.S. evacuees from Havana to New York on the deadhead return flights. Most U.S. citizens seeking evacuation were transported by steamship to Miami or Key West.

Cubana also flew Castro supporters from Mexico City to Cuba on one flight with its new Bristol Britannia turboprop transport. One of the carrier's Vickers Viscounts was held in readiness to pick up Fidel Castro at his temporary headquarters in Santiago.

Castro, however, elected to drive across the island at a slow pace, making speeches and mopping-up diehard resistance groups en route so that the Viscounts were not put into service.

Delta Air Lines suspended Havana operations Dec. 31 and resumed normal schedules on Jan. 6. However, Delta maintained its Caribbean schedules without interruption by bypassing the Havana stop on all its flights.

A Delta official told AVIATION WEEK that it is being required to train an entirely new crew of cargo and baggage handlers at its Havana station because the original crew, all Batista supporters, were forced to evacuate Havana. The company is now hiring Castro men to handle ground operations.

Delta, National, Braniff and Pan American reported no damage to property either at the airport or in the downtown sales offices. The airport itself was reported to be undamaged.

However, downtown ticket offices of Iberia Air Lines of Spain, KLM, Linea Aeropostal Venezolana and Aerolineas Argentinas were reported to have been sacked by street mobs during the early stages of the rebellion. Windows were broken, tickets burned, papers destroyed and office furniture and equipment were left in shambles.

Iberia cancelled all its flights in and out of Havana and had not restored service by late last week. Normally, the carrier experiences an approximate 80% load factor on its service between Madrid and the Caribbean area. However, the gradual buildup of revolutionary activities in Cuba has seriously undermined its volume on the route.

Braniff Airways resumed its twice weekly DC-6B service to Havana Wednesday on its Dallas-Houston-South American route. The airline's Miami service to Bogota, Rio de Janeiro and Buenos Aires operates nonstop to Panama City en route to South America.

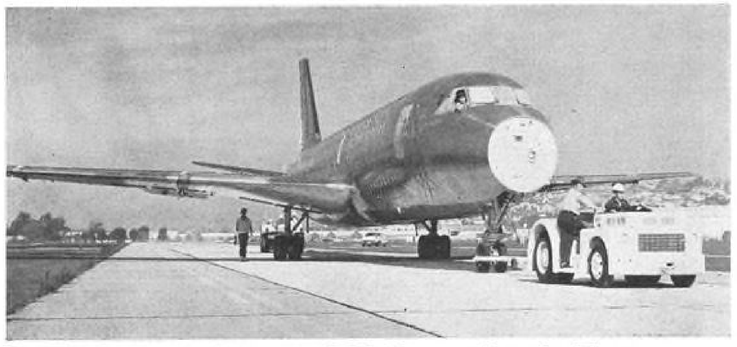
Clouded in mystery is the fate of the Cuban airline, Aerovias "Q," which operates DC-4s and C-46s from Havana to Key West, Palm Beach, and Gerona and Veracruz, Mexico. The company's president and general manager, Manuel Quevado, is reported to be a staunch Batista supporter and probably was forced to flee the country with others loyal to the ex-president. Observers close to the aviation industry in Cuba feel the airline's equipment will be confiscated by the Urrutia government.

Loss of revenues to the scheduled airlines operating into Havana has been substantial. However, most U.S. carriers are confident that tourist traffic will rebuild quickly once the political situation has become fully stabilized.

In some instances, traffic throughout the entire Caribbean area was affected by the Cuban revolt. In addition to the marked dip in Iberia's traffic, Delta reports an estimated 50% decline in the number of passengers it normally carries on its route to Caracas. Load factors are at an estimated low of 45%.

Tourism is ranked second to sugar as Cuba's largest industry. Recently, it was reported that an estimated $100 million would be invested in Cuban hotels by American businessmen during the next five years.

Most carriers report that traffic was "fairly" good until the New Year's Day rebellion. They admit, however, that a large part of this traffic consisted of business and government travel and that the threat of an open revolt had forced a majority of potential American tourists "to shy away from Havana and to seek recreation elsewhere."



Second Convair 880 Starts Static Tests

Second Convair 880 jet transport has been equipped with tension pads for start of nine-month structural test program at San Diego, Calif. Aircraft also is fitted with metal fuselage straps; simulated flight loads will be applied by attaching whiffletrees to pads and straps to flex wings and fuselage. Seven more 880s now are in major assembly.

Probe of International Operations Planned

By Katherine Johnsen

Washington—The House Commerce Committee plans a comprehensive investigation of international airline transportation during the new session of Congress which opened last week.

A report by the committee's Legislative Oversight Subcommittee specified these aspects for study: international rates and routes, including route negotiations; comparative safety of U.S. and foreign air carriers; the keeping of statistics by international organizations and their adequacy for ratemaking, safety and other regulatory purposes; reasons for the declining percentage of participation by U.S. carriers in international air traffic.

The subcommittee headed by Rep. Oren Harris (D.-Ark.), who is also chairman of the full Commerce Committee, also proposed:

• **That the President be banned** by law from selecting the carrier to operate an international route. The President could, within 90 days, veto a decision by the Civil Aeronautics Board only for "overriding reasons of foreign policy or national security." The Board would then reopen the proceeding. (The White House threatened to veto similar legislation passed by the Senate several years ago.)

• **That CAB have the same authority** to regulate property and passengers in foreign transportation that it has in the domestic field.

• **That CAB use its present authority** to audit the records and use its subpoena powers, if necessary, to obtain "all information possible" on the management and operations of U.S. international airlines.

• **That, so far as possible, details** on international negotiations be made public. "Requests by foreign countries for limitations on the frequency of our foreign flights and other efforts to restrict operations of our air carriers are matters that the public should know about," the subcommittee declared.

Recommended Legislation

Legislation recommended by the subcommittee to eliminate "influence peddling" and promote fair and efficient administration by CAB—and all other regulatory agencies—would include these provisions:

• **Prohibit "ex parte" or "extra record"** presentations to CAB members or personnel aimed at influencing a decision, with civil and criminal penalties for participants in violations, including any person who might "aid or abet" the unauthorized presentation.

• **Make public any presentation** by a member of Congress or the executive branch on a CAB proceeding. If the presentation is by telephone or in conversation, a memorandum summarizing the content would be made part of the public record.

• **Make public any communications** between CAB members and personnel concerning a case which is being decided upon the record established during open hearings.

• **Any communication between CAB** members or employes on any matter pending before the Board would be made part of the Board's permanent official file.

• **Provide civil and criminal penalties** for an unauthorized "leak" of any CAB action.

• **Require the Board to grant** or deny any motion in a proceeding within 60 days after its conclusion. Harris commented that current delays in decision-making invite parties to use pressure and influence tactics.

BEA Orders Rotodynes

London—British European Airways plans to place an initial order for six improved versions of the Fairey Rotodyne VTOL airliner with Fairey Aviation Co. Firm contract is subject to government financial approval, and to development of the Rotodyne to meet BEA operational requirements.

In making the announcement, BEA chairman Lord Douglas of Kirk Ide did not detail the requirements. He specified only two of the "many technical problems still to be solved"—silencing the aircraft sufficiently to fly into city centers and an adequate background of flying experience to ensure its reliability for city center operations.

BEA would require a larger aircraft than the present 48-passenger Rotodyne prototype—probably on the order of about 60 passengers. That would mean more powerful engines than the present Napier Eland turboprops. Fairey is known to be considering substitution of the Rolls-Royce Tyne.

Lord Douglas said BEA foresaw an eventual requirement of up to 20 Rotodynes for shorter cross-channel and domestic routes.

The BEA move is expected to strengthen Fairey's hands in its sales efforts abroad. So far only one airline—Okanagan Helicopters of Canada—has placed a firm order, and that for just one aircraft. Kaman Aircraft Corp., Bloomfield, Conn., is the U.S. licensee.

The BEA order may also speed decision on extent of future government aid to Rotodyne development.

• **Provide for election of the CAB** chairman by Board members—rather than by appointment by the President—for a maximum period of three years.

• **Permit the President** to remove a Board member only for "neglect of duty" or "malfeasance in office." At present, the President also may remove a member for "inefficiency".

• **Require that each decision** or opinion be prepared by a Board member or under his personal direction. "Care should be taken . . . to rotate this responsibility . . . so that every member is designated to prepare opinions in all types of cases and to avoid specialization by individual members," the subcommittee said.

Administrative and civil sanctions, as well as criminal penalties, should be provided for violations of the recommended laws, as well as other Board rules and regulations, the subcommittee said, commenting: "Violators presently know that they can keep the fruits of their violations and go scot free because the drastic nature of existing sanctions prevents their effective application or because the cumbersome procedure for enforcing existing penalties makes them of no practical effect."

Congressional Inquiry

In addition to the international airline investigation, the Commerce subcommittee also marked down these aspects of CAB operations for congressional inquiry:

• **Whether investigations** have been sufficiently thorough or whether the Board has relied too heavily upon information from applicants and competing interests.

• **Whether there are variations** in the application of standards or criteria in licensing, certificating, adjudicatory and policing functions, or whether there is discriminatory enforcement of statutes or regulations.

• **Whether further measures are** necessary to strengthen the independence of CAB, its chairman and members.

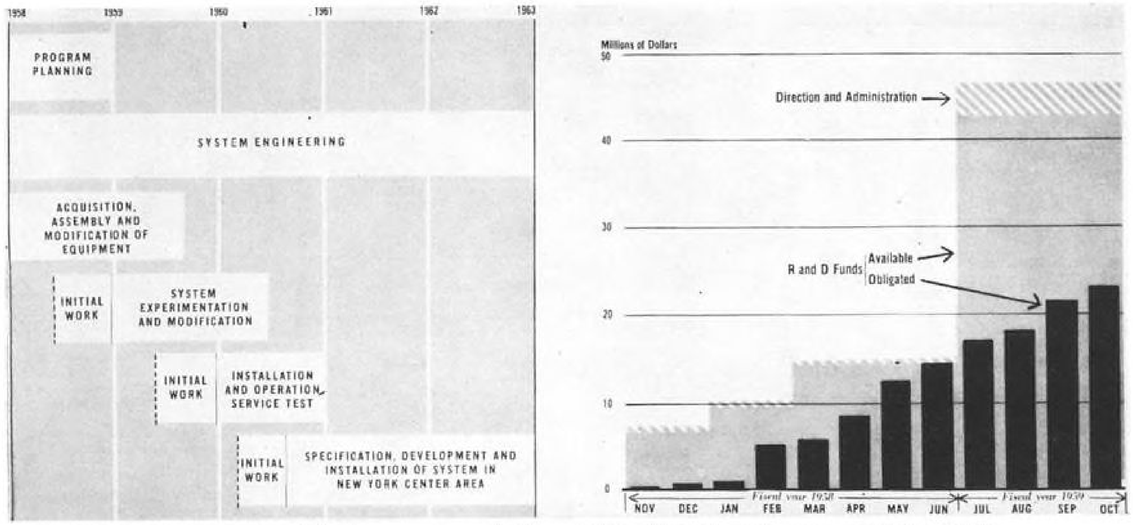
• **Whether CAB budget requests** and legislative requests should be exempted from review by the Budget Bureau.

• **Whether steps are needed** to improve the quality of examiners, their opinions and recommended decisions and the quality of Board decisions and opinions.

• **Whether excessive paperwork,** expense and delay in proceedings can be eliminated.

• **Whether reprisals are ever taken** against persons or companies who challenge CAB actions.

• **Whether examiner assignments** are made "with view to ensuring a predetermined result".



TIMETABLE for FAA's research and development program is shown at left, with funding and procurement status at right.

FAA Issues Report On AMB Projects

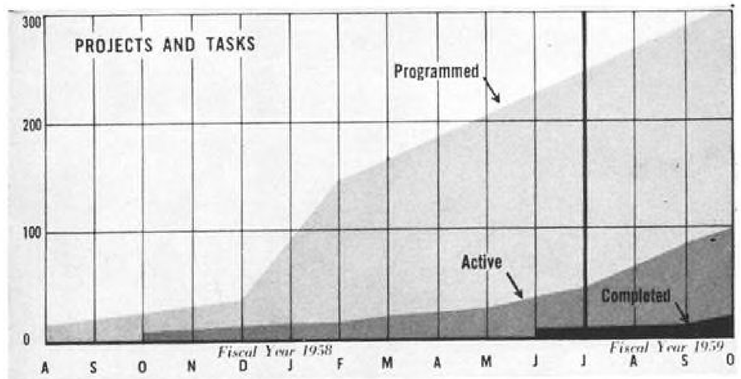
Washington—Progress report on the 306 projects and tasks established by Airways Modernization Board during its 14 months of existence and prior to Nov. 1 when AMB was designated to become the Research and Development Bureau of the new Federal Aviation Agency, has been issued by FAA.

The report discloses that more than 100 projects and tasks are already under way with private industry and government agencies under contracts totaling more than $21 million. Sixteen of the projects have been completed. The Research and Development Bureau plans to obligate another $21 million during the current fiscal year.

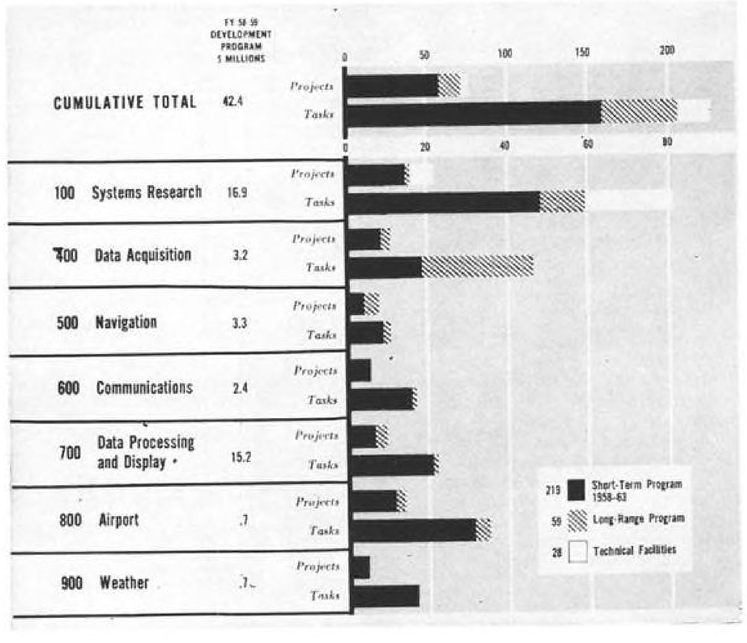
As of Oct. 31, AMB had a total of 361 civilian and military personnel, 175 of them located at the National Aviation Facilities Experimental Center (NAFEC) in Atlantic City, N. J. Approximately half of the staff has scientific or engineering background, the other 50% had air traffic control operational experience, the report says.

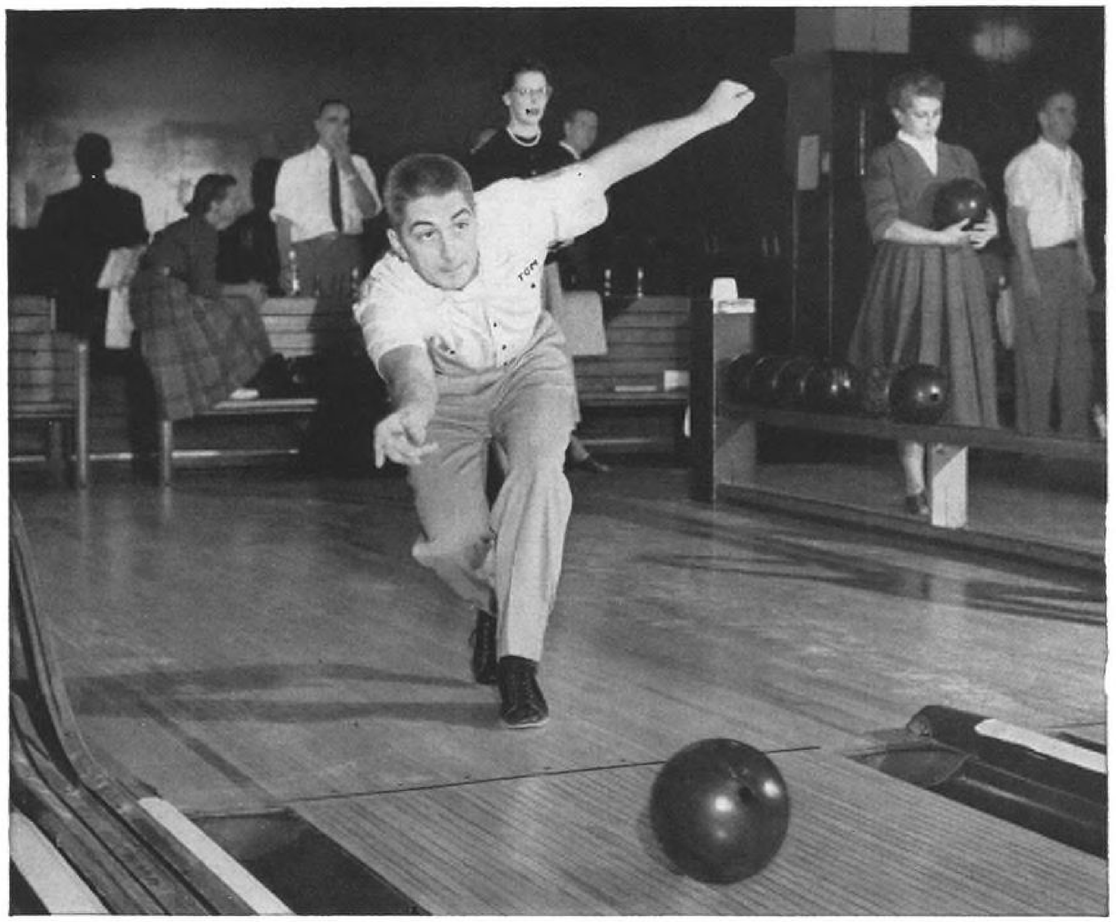
Projects and tasks the Research & Development Bureau plans to launch in the near future include:

- **Ground-based takeoff monitor** to determine whether takeoff will be successful and provide a warning if an abort is necessary will be investigated as well as airborne type monitors which can be carried by individual aircraft (AW June 23, p. 65; July 28, p. 77).
- **Ground-based direction finder** that will permit almost instantaneous determination of airplane azimuth (bearing) and possibly altitude from pilot voice transmissions will be procured during the current fiscal year with delivery planned for June, 1960.



STATUS report on all Federal Aviation Agency research and development projects is summarized above, while status by individual project category is shown below.





In Precision Machining—meet a man who gets results

Tom operates a precision jig borer in this picture, but he is an expert at every machine in the plant. Earlier in his career with us, he won the Minnesota Employer's Association award as the state's Outstanding Apprentice of the Year. He is active in community affairs, participates in many company activities. Tom Nelson—another of the many good reasons our customers say, "At General Mills, we get results."

Picking up a spare or machining a part... accuracy typifies this General Mills craftsman

Meet Tom Nelson, bowling enthusiast and General Mills' machinist with 12 years experience. At the bowling alley or at the plant, Tom's physical and mental capabilities make him an outstanding performer.

Like our other precision craftsmen, Tom works to extremely close tolerances. We've equipped him with the tools—lathes, mills, drills, grinders and many special purpose machines built to our specifications—to make close tolerance manufacturing a routine procedure. And we back his output with strict quality control to make doubly sure only perfect parts go into assembly.

Complementing our precision manufacturing facility are well staffed research and engineering laboratories. Together, Research, Engineering and Manufacturing work as a team to provide complete military systems and subsystems services.

WORTH SENDING FOR—new fact-packed booklet tells about the many ways we serve industry and the military. Send for your copy today. Address Dept. AF-12.

MECHANICAL DIVISION
1620 Central Avenue, Minneapolis 13, Minnesota

General Mills

To wider worlds—through intensive research • creative engineering • precision manufacturing

SHORTLINES

► **Amsterdam's Schiphol Airport** is accelerating construction of its 11,000 ft. runway to meet a completion date of early 1960 when KLM Royal Dutch Airlines will receive its first Douglas DC-8 jet transports. The new runway will be 150 ft. wide with an additional 50 ft. surfaced shoulder on either side of the runway. Schiphol's parking apron also is being enlarged and strengthened to accommodate the heavier jet aircraft, with the present 150,000 sq. ft. area capable of accommodating 24 aircraft being enlarged to accommodate 32 aircraft, including six jet airliners.

► **Australian government** is expected to formulate a new aviation policy for the territory of New Guinea. Main feature expected is a permit for Ansett-ANA to compete with Qantas and provide service from Australia to Port Moresby and Lae on New Guinea. The government also has been asked to study the question of subsidies for some of the New Guinea service.

► **British Overseas Airways Corp.** hopes to be first with round-the-world turbojet and turboprop service. BOAC hopes to initiate new schedules in the spring, subject to approval from various governments. Proposals include twice-weekly westward Bristol Britannia service from London to Tokyo and Hong Kong, via New York, San Francisco, Honolulu and Wake Island, and de Havilland Comet 4 service on a five flights per week basis eastbound from London to Hong Kong and Tokyo. During the summer, BOAC hopes to add two flights by Comet 4s to Bahrein, Bombay, Colombo, Singapore, Hong Kong and Tokyo, making daily service. Towards the end of 1959, Comet 4s will take over London-Sydney and London-Johannesburg routes.

► **Icelandic Airlines** reports a 28.2% increase in 1958 for passengers carried over 1957. The transatlantic carrier says it had a 92.8% booking on all its flights in December, a 15.5% rise over the same month in 1957. The company reported 69,314,000 passenger miles flown during 1958.

► **Southeast Airlines,** of Kingsport, Tenn., has purchased two Convair 240 aircraft from Frederick B. Ayer & Associates, Inc., of New York. Southeast paid some $500,000 for the two craft and took an option to purchase two more at the same price. Southeast operates on an intra-Tennessee route, flying six 21-passenger Douglas DC-3s. It plans to sell two DC-3s, replacing them with the Convairs.

AIRLINE OBSERVER

► Air traffic tieups over the holiday period were held to a minimum. Air Transport Assn. this year received no complaints from member airlines—a marked contrast to previous years when a large volume of protests against the air traffic control system flooded the ATA. Reduced traffic as a result of Eastern and American strikes eased the situation, but most airline officials concede the over-all air traffic control system is operating more efficiently than ever before. Long-range radar has increased system capacity and air traffic controller complements are up to full strength although the experience level still hovers in the 40% area.

► **Watch for legal interpretation within 30 days by the Civil Aeronautics Board's general counsel on Qantas Empire Airways' bid to carry local international traffic between San Francisco and New York. Decision as to whether the Qantas petition constitutes cabotage or Fifth Freedom traffic (AW Oct. 20, p. 46) has been delayed as result of the heavy workload in the general counsel's office.**

► Civil Aeronautics Board has adopted a regulation requiring an electrocardiographic examination of the heart for first-class medical certificates for pilots over 35 years of age. Pilots over 40 will be required to take the examination annually. In adopting the rule, which will become effective July 1, the Board anticipated an increase in the number of deaths in the cockpit due to heart attacks as the "mean age of the pilot population increases."

► **First flight of the Vickers Vanguard, scheduled a few days before Christmas, was postponed when one of its four Rolls-Royce Tyne engines began running rough. All four engines were removed and torn down at the factory where the trouble was found to be only a small piece of brazing metal in the oil system of the rough running engine. No modifications are necessary but engines will need at least a week for reassembly to bring the airplane back to preflight status.**

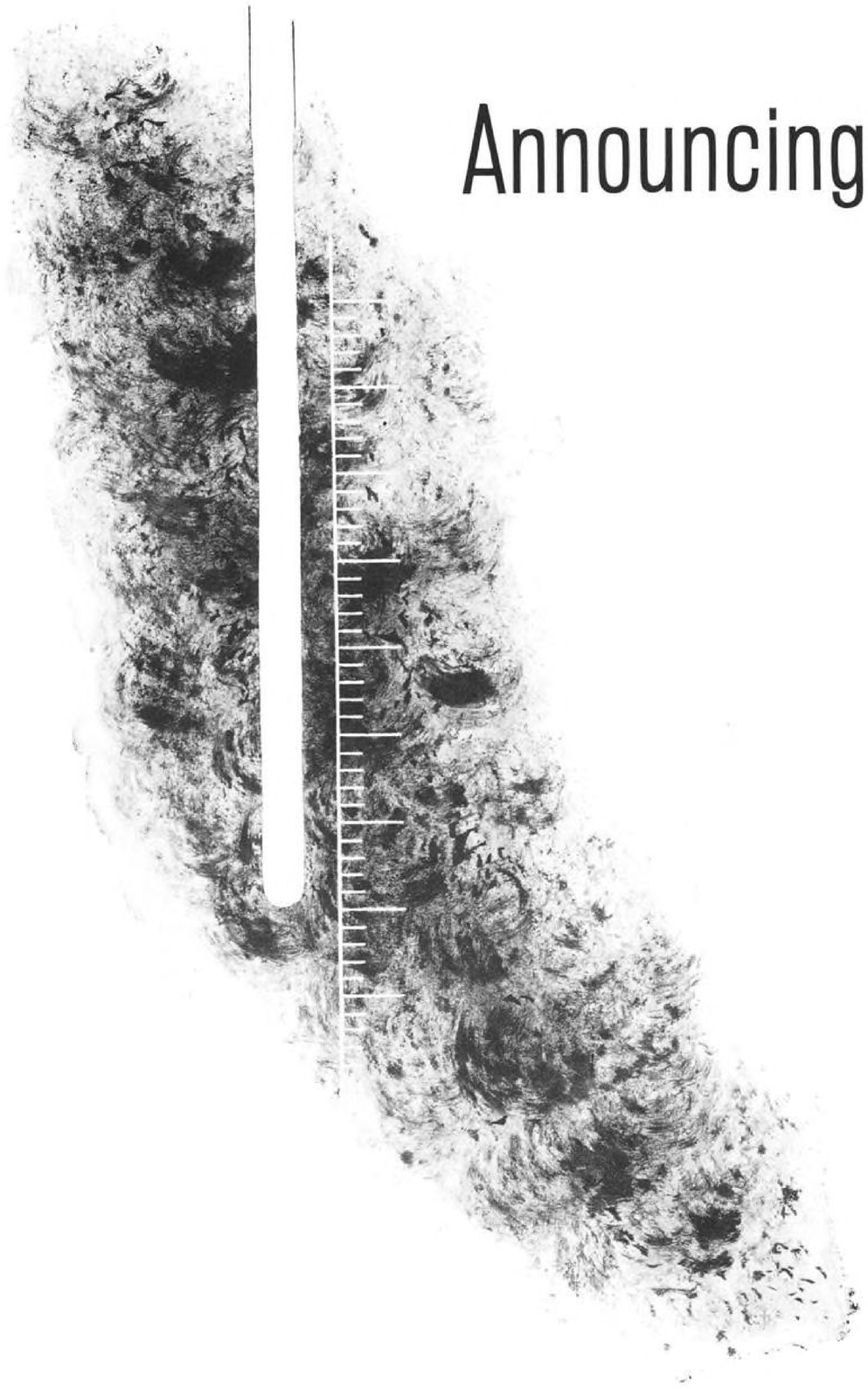
► CSA, Czechoslovakian airlines, reports it transported 1,500 passengers daily on its domestic routes during 1958. The Czech carrier also says it will introduce the Russian-built I1-18 is on its routes during 1959. Airport improvements planned for this year include a new airport at Ostrava and a two and one-half mile runway at the airport in Brno. Prague's airport which now has a one and one-half mile strip will have a second runway two miles long before the end of the year.

► **Authorization for local service and Hawaiian territorial carriers to exchange advertising for air transportation has been extended to Jan. 1, 1960, by the Civil Aeronautics Board. During 1958, carriers signed 1,200 advertising-exchange agreements with a value in excess of $1 million.**

► Air Transport Command reunion is scheduled for March 6 at the Waldorf-Astoria Hotel in New York. Reunion committee consists of American Airlines president C. R. Smith, Northeast Airlines president James Austin and General Dynamics executive vice president Earl Johnson. Arrangements are being handled by R. Caverly who can be contacted at the Waldorf-Astoria.

► **Weather division has been created by the Federal Aviation Agency in a move to modernize the national aviation weather system. The new division, to be a part of the Research and Development Bureau of the FAA, will be headed by Newton A. Lieurance, former director of the Weather Bureau's Aviation Weather Services.**

► International Air Transport Assn. Traffic Conference in Paris has been postponed from Jan. 20 to Feb. 16. Reason for the postponement is the desire of some carriers for more time to prepare material for the meeting which now represents a last ditch attempt to resolve the jet surcharge issue and prevent an open rate situation on the North Atlantic routes.



Announcing... USS 9% Nickel Alloy Steel

for the world's coldest applications down to -320°F

Nothing gets much colder than liquid nitrogen, which exists at temperatures of minus 320° F and below. At such temperatures, most container materials get brittle —lose their toughness.

To meet the need for an economical material that can be used for low-temperature pressure vessels, U. S. Steel is making an alloy steel containing 9% nickel. This steel is stronger, tougher and less expensive than other metals used for handling liquefied gases such as methane, oxygen, and nitrogen. For test purposes, plates in thicknesses of ¼ and ½ inch are ready for immediate delivery. Sheet sizes and heavier plates, as well as structural shapes, bars, and semi-finished products, are also available upon inquiry.

Higher Strength. USS 9% Nickel Steel can be furnished to meet all requirements of ASTM Specification A-353, Grades A or B. The ASME Boiler and Pressure Vessel Code allows a maximum working stress of 22,500 psi for 9% Nickel Steel. This is about 17% higher than allowed for other metals used for this purpose.

Greater Toughness. The toughness of 9% Nickel Steel has been well established in drop tests of actual vessels containing liquid nitrogen at minus 320° F. Charpy keyhole-notch impact values have been observed to be as high as from 31 to 38 ft.-lbs. at minus 320° F, from 73 to 84 ft.-lbs. at room temperature.

Weldability. Joints of 100% efficiency are possible with either manual or automatic welding in the inert gas metal-arc process. Suitable welding rods are available.

Weight Reduction. Greater strength permits USS 9% Nickel Steel to be used in thinner sections with substantial weight reduction. This is important for stationary storage and shipboard storage tanks for methane—and for other severe low-temperature storage applications.

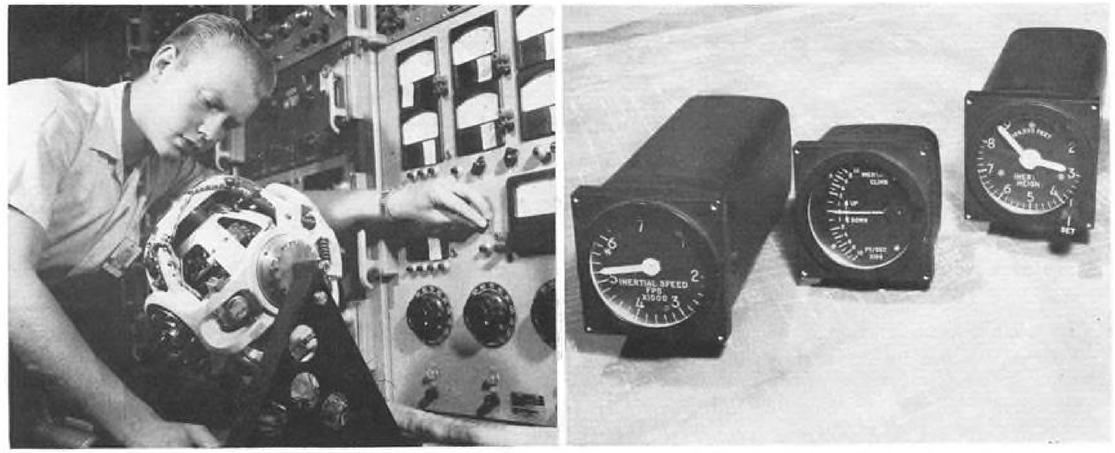
Lower Costs. The steel itself costs less than competing materials by about 40%—and products such as tanks and heads can be made stronger with less material.

We urge you to consider USS 9% Nickel Steel for better, less expensive low-temperature vessels.

USS is a registered trademark

United States Steel Corporation – Pittsburgh
Columbia-Geneva Steel – San Francisco
Tennessee Coal & Iron – Fairfield, Alabama
United States Steel Supply – Steel Service Centers
United States Steel Export Company

United States Steel



HEART of the X-15 inertial flight data/instrument system is a four-gimbal gyro stabilized platform made by Sperry Gyroscope (left). Cockpit instruments for the X-15 (right) show, left to right, velocity, rate of climb, and altitude—all obtained from inertial data.

X-15 Flight System Shows All Attitudes

By Philip J. Klass

Great Neck, N. Y.—First all-attitude inertial flight data/instrument system, which will guide the North American X-15 pilot during his fringe-of-space probes, has been delivered by Sperry Gyroscope Co.

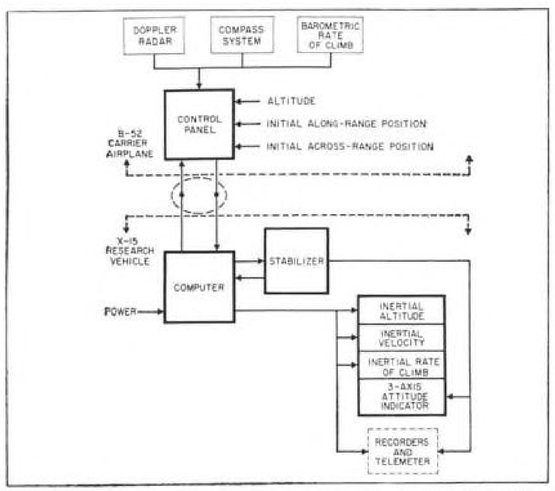
The X-15 system is a forerunner of the inertial type instrumentation that will be required for space probes at altitudes where pressure-type instruments cannot be used to indicate vehicle altitude and speed, and where high-G maneuvers make conventional gyroscopic attitude indicators inadequate.

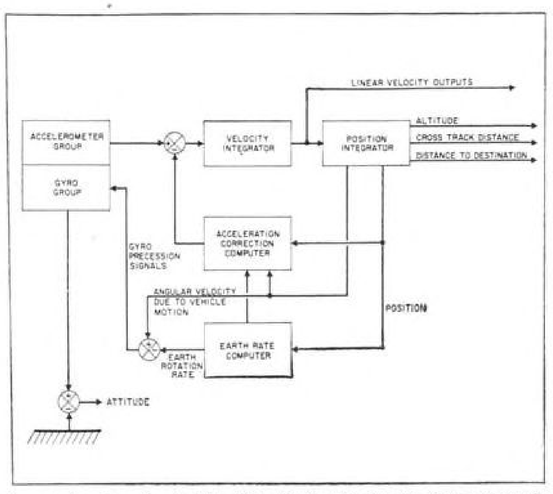
Heart of the new X-15 system is what amounts to an inertial guidance system, although present plans do not call for its use to indicate the X-15's position to the pilot. This will be done by means of ground-based tracking radars. The Sperry system will measure accelerations of the X-15 about three orthogonal axes, compute and convert these into airplane altitude, velocity and rate-of-climb.

Gyro-stabilized platform upon which the three accelerometers are mounted also serves to provide pilot with heading, pitch and roll attitude information. Latter is displayed on an integrated all-attitude indicator being developed by Lear, Inc.

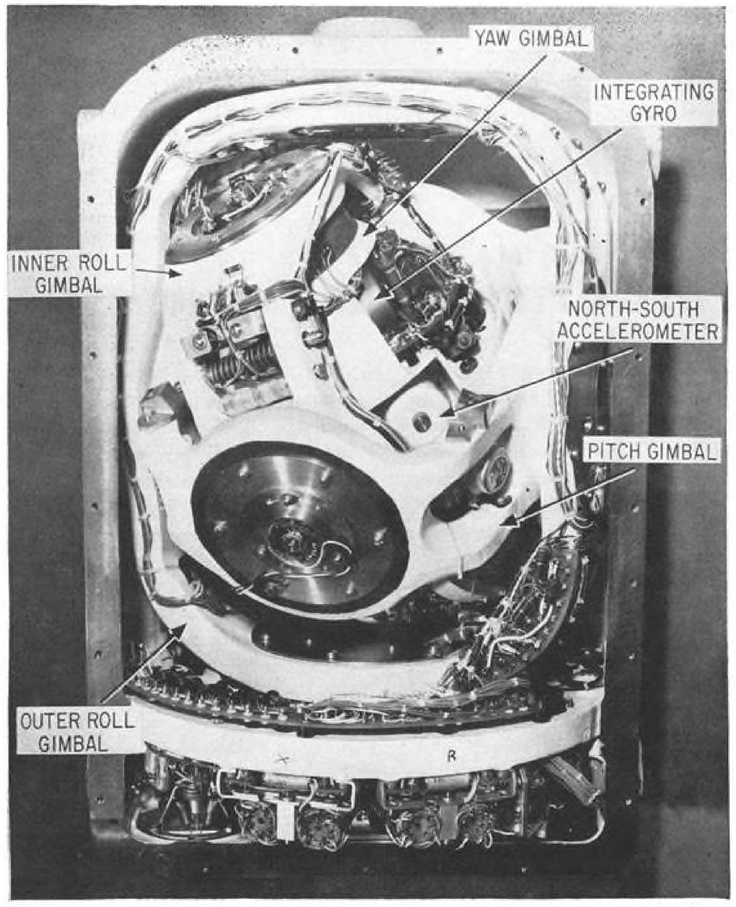
Sperry X-15 system weighs approximately 150 lb., including gyro-stabilized platform, associated computers, amplifiers, and three cockpit indicators, according to Robert Garbarini, engineering manager at Sperry's nearby Carle Place (N. Y.) facility. The figure does not include weight of the control panel carried in the Boeing B-52 from which the X-15 will be launched. A control panel is used to calibrate X-15 instrumentation and monitor its performance prior to release.

The three accelerometers each meas-





FUNCTIONAL schematic diagram of the X-15 inertial flight data/instrument system is at left. The block diagram at right shows the inertial operating principles of the X-15 system. The Sperry system will measure accelerations of the X-15 about three orthogonal axes.



ALL-ATTITUDE stabilizer for the X-15 inertial system is fully assembled in its 12 x 18 in. case. Unit weighs 55 lb., contains its own amplifiers, power supplies and heat exchanger.

ure acceleration of the X-15 in one of three directions, i.e. north-south, east-west and up-down. Accelerometer signals are integrated once to give corresponding X-15 velocity signals. These are then combined (square root of the sum of the squares) to give total vehicle velocity along its flight path which is shown on pilot's cockpit instrument.

Rate-of-climb signal for cockpit indicator comes directly from integrator for the up-down axis accelerometer, whose output is proportional to vehicle vertical velocity.

Altitude is obtained by a double integration of up-down axis accelerometer signal which gives total vehicle displacement in an up-down direction. This is measured from the instant of launch, then automatically and continuously added to altitude of X-15 at instant of launch from the B-52. The latter is accurately determined by means of ground-based radar and airborne barometric sensors in the B-52 and preset into Sperry's X-15 system prior to launch.

In computing X-15 flight data, Sperry automatically introduces necessary corrections to compensate for Coriolis Effect, vehicle motion relative to the earth and for change in value of "G" as X-15 changes altitude.

Stabilized Platform

The gyro-stabilized platform is Schuler-tuned (84-min. pendulum) so that it continuously maintains itself aligned to the local vertical. The platform itself has four independent gimbals which permit unlimited maneuvering of vehicle about all three axes. Platform uses three integrating HIG-5 gyros and can maintain its attitude under aircraft maneuvering rates up to 4,000 deg./sec. in yaw, or up to 2,500 deg./sec. in pitch and roll, according to Nathan White, section engineer in charge of the X-15 project.

Stabilized platform weighs 55 lb., including 10 amplifiers required for stabilization, torqueing of three integrating gyros, and for amplification of signals from three linear accelerometers. All amplifiers are completely transistorized, except for three tubes in the am-

ONE of 10 transistorized amplifiers which mount directly onto gimbals of the Sperry gyro stabilized platform.

plifiers which demodulate signals from capacitance-type signal pick-offs used in the accelerometers. (These could be completely transistorized today, but at the time program was launched it was decided to stick with tubes to avoid program delay.)

All the platform amplifiers are mounted on gimbals within the device. This makes the stabilized platform a complete operating entity without need for external black boxes, and greatly reduces the number of slip rings required to bring signals in and out of the platform, White points out.

To achieve the high stabilization performance required for the X-15, Sperry uses d.c. torque motors to maintain platform gimbals in proper alignment, rather than using conventional servo motors and associated gearing, with their higher inertia, White says.

Structural Rigidity

Considerable effort has gone into assuring structural rigidity of the platform gimbals to enable system to withstand anticipated high-G vibration and shock. Gimbal bearings are preloaded to 150 lb. to prevent mass shift under high Gs.

Sensitivity of the accelerometers used to measure X-15 accelerations is better than 0.0001Gs, and their accuracy is of the order of 0.001G without recalibration, the company says.

Cooling of the platform and its internal amplifiers is accomplished by means of an external case, consisting of two concentric shells through which cooling air and nitrogen are passed. Internal blower circulates air inside the inner shell to transfer heat to the case.

X-15 system calculations are made by d.c. analog computers. Integration is accomplished by means of motor-driven tachometer generators whose output is

balanced against the accelerometer signals. In this way, tachometer generator velocity is proportional to acceleration signal, and its total rotation angle (as measured by multi-turn potentiometer and synchro) is the integral of vehicle acceleration, or velocity. Ultra-precision tachometer generators used have accuracy of 0.01%, Garbarini says.

Because the X-15 platform is Schuler-tuned, two sets of integrators are required for each of the three axes. Three velocity integrators with associated circuitry are packaged together, while the three position integrators and circuitry are also packaged as a group, to simplify check-out and maintenance.

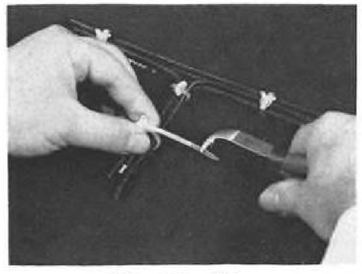
Acceleration corrections and earth rate computations are accomplished passively by means of resistor networks and potentiometers. All a.c. to d.c. power supplies for the computer are packaged within the device. Computer weighs approximately 76 lb.

In use, an AN/APN-81 Doppler radar carried aboard the launching B-52 will provide accurate ground-speed data which is used to calibrate and monitor performance of the inertial system's velocity integrators prior to X-15 launch. Doppler radar signals also provide damping for Schuler tuning of the stabilized platform during this period.

Sperry expects the platform to maintain alignment to local vertical to an accuracy of within one minute of arc.

A control panel in the B-52 enables the operator to continuously monitor performance of the inertial system prior to X-15 launch and to preset required calibration through umbilical cord.

Sperry system was developed under sponsorship of Wright Air Development Center's Flight Control Laboratory.



Plastic Tie

Low-cost plastic tie to bind wiring harnesses, made of nylon base Moldarta material, reportedly reduces time required to tie bundle of wires by 30%. Ratchet-arrangement makes tie self-adjusting for wide range of bundle diameters. Material is said to be fungus and moisture resistant. Special plier also has been developed for installing, tightening and clipping excess strap. Westinghouse Electric Corp., Component Products Dept., 4-S-18, East Pittsburgh, Pa.

Army to Evaluate Bell Helicopter ILS

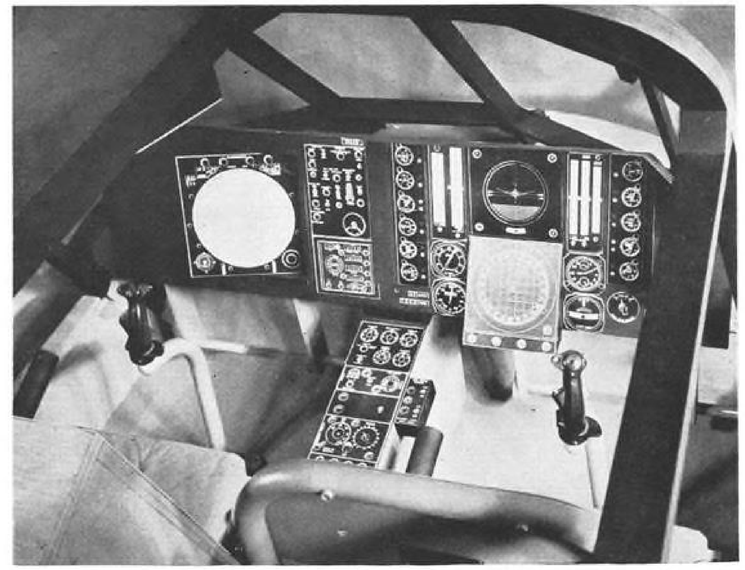
By Craig Lewis

Ft. Worth—Helicopter instrument landing system designed by Bell Helicopter Corp. for use in remote areas will be evaluated by the U. S. Army as a means of giving its helicopters instrument flight capability in all visibility conditions.

Using a portable ground beacon for remote area landings, the Bell system could provide interim instrument flight capability for helicopters until the Army-Navy Instrument Program comes up with a completely self-contained system, perhaps by 1965, company officials said.

Helicopters are currently short on blind flying capability. They have the flight capability to do it, but not the instrumentation. The few machines equipped with ILS must use fixed facilities, and although hyperbolic navigation systems like Decca can be set up in remote areas, they still involve fixed towers. ANIP will solve the problem eventually with its ultimate system, but something is needed to fill the gap.

Bell Remote Area Instrument Landing System (RAILS) is designed to use hardware and techniques now available to fill that gap. Microwave RAILS was the center of discussion at a symposium sponsored here recently by Army Electronic Proving Ground, and the system is scheduled for its first flight next July.



COCKPIT MOCKUP shows how central displays provide attitude, flight path and terminal navigation information. Vertical rows of engine instruments outside the tape displays are covered to reduce clutter. At far left is dead reckoning position indicator display board; instrument at right provides range and distance information.

Simplified Display

Under Army contract, Bell is integrating its RAILS system with a new, simplified pilot information display and instrument panel and with other flight and navigation gear that comes with a government furnished Sikorsky H-34 helicopter. The goal is complete "black bubble" operation in which a pilot can take off, climb, fly to his destination, hover and land on instruments. The system can also probably be used by the smaller fixed wing aircraft in remote areas.

Bell has tried to use familiar instrument symbols and standard flight techniques wherever possible, according to chief electronic development engineer Harry Mitchell, but some new symbols and techniques will be used where they are demonstrably better than familiar types. Capability of the system will be all-visibility rather than all-weather because such problems as icing and turbulence are not yet solved. System is planned for operation without a copilot.

Starting point of the system design was the RAILS component, since landing a helicopter on instruments in a remote area is the most difficult part of the job. Bell does the job by packaging all equipment but a small beacon in the machine to make the system as easy to use as possible. Complete system will add 80 lb. to the weight of the helicopter.

Beacon is a battery-operated microwave transponder that is dormant until queried by a pilot. It then provides the airborne equipment with the signal it needs to make an instrument approach and touch down. The beacon can be spotted in a remote area in a number of ways, including positioning by ground troops. A man on the ground can talk to a helicopter through the beacon once the machine flies within its 10 mi. range, and the ground observer can describe terrain features to the pilot coming into the area blind.

Traffic Control

Right now, the beacon can handle two helicopters at once, and ultimately it will handle up to 10. Capability for controlling traffic in the beacon area is a refinement that will come later. Standard beacon is designed for two days of steady use and weighs about 15 lb. A lighter rescue version with a life of about six hours is planned as is another model that can be hooked into an auxiliary power unit.

After the ground beacon has been queried by a pilot, it shuts off in a set length of time if the helicopter leaves the area. Bell conceived and designed the beacon, but W. L. Maxson Corp. will do detail design and build it. W. L. Maxson will also build the airborne transmitting and receiving equipment that, using standard DME techniques, works with the beacon as well as the radar system that determines position of the beacon.

Obstacle Sensing

Microwave transponder on the ground provides the airborne equipment with the information it needs to make an instrument approach and landing, including azimuth and elevation of the beacon in relation to the helicopter, distance and ground speed. Altitude information must be accurate within the area of plus or minus one foot, and precise landing spot data has a tolerance of plus or minus 20 ft. RAILS also provides a crude sort of obstacle sensing because it broadcasts only in line of sight, and the pilot knows there are no large solid obstacles between him and the beacon as long as he continues to get its signal and maintains altitude.

Signals from the DME and radar systems go to an air data computer where they are mixed with other sensed signals and computed values; then the necessary information is sent to the pilot display. Bell is designing and building the computer, display and new instrument panel layout.

Bell equipment will be installed and integrated with the systems in an H-34

helicopter furnished by the Army. First flight is scheduled for July 6, 1959, and Bell expects to deliver test hardware in October. It will go to Ft. Huachuca for electronic evaluation, then to Ft. Rucker for pilot evaluation.

The H-34 furnished to Bell will have Automatic Stabilization Equipment with throttle control, APN-100 absolute altimeter and ARC Type 12 VHF equipment. It will also have SCAN equipment, which includes the Ryan Model 120 Doppler radar, MA-1 compass system, Waldorf attitude indicator, Clifton precision computer and a dead reckoning position indicator display board.

In the H-34 Bell will equip with this Interim Integrated Aircraft Instrumentation and Letdown System, the pilot will fly by monitoring two displays mounted vertically on the panel. Top display will give the pilot attitude and flight path information, and the lower display will be used for terminal navigation in the beacon area.

Top display has an attitude symbol for attitude orientation. It also has a flight path circle which moves around the display as the helicopter varies from the programed flight path, and which moves to dead center when the machine is flying the desired track.

Altitude Scale

At the bottom of the top display is an absolute altitude reference scale in the form of a dark area under a horizontal line that moves up in the display as the helicopter approaches the ground. It switches between scales of 1,000 and 300 ft., and when the dark area moves up to a set mark on the display, the pilot knows he has reached his hovering altitude.

In the bottom display, the helicopter is represented by a fixed point in the middle, and it is always flying straight up the display. Around the perimeter is a revolving heading ring that indicates compass direction of flight at the top of the display. A moving dot represents the ground beacon position in relation to the fixed helicopter position marker, and a reference line runs directly from the center dot through the beacon dot to the display perimeter where it indicates heading of the beacon.

Markers on the display show distance from the beacon, and they switch among scales of 60,000, 3,000, 300 and 30 ft.

A grid is used for velocity information. When the programed velocity is held, the grid stands still. When the helicopter varies from the desired velocity, the grid begins to move, giving the pilot the same picture he would have of the ground if he were drifting in a hover.

Between the top and bottom displays

is a self-contained slip skid instrument. Panel also has a fuel management instrument which shows range to destination and fuel range under existing flight conditions. This gives the pilot a constant reading on whether he can reach his destination.

Bell is using cathode ray tubes for test purposes, largely because they are flexible and can be changed to suit Army wishes on sensitivity and other features. Once the display configurations are fixed, they may be converted to mechanical types, although the Army could decide that cathode ray tubes have reached the point where they are rugged and reliable enough to use. Bell has been flying one bolted into a helicopter for three years without a failure.

With the Bell RAILS equipment, plus the other sensors which feed information to the displays, a helicopter pilot should be able to fly completely blind from takeoff to touchdown. Ordinarily, most flight path information will be set into the computer before takeoff, and with a simple flight path, all of it can be fed in on the ground.

Ground Beacons

Reversing the landing process, a beacon can be used for takeoff where necessary. Ground beacons can also be used for en route navigation if they are placed along the flight paths with their 10 mi. radii overlapping. An off-course computer eliminates the need for flying directly over the beacons, and it also allows the helicopter to land to one side of the transponder.

Alternately, the Ryan radar and barometric altimeter can furnish en route navigation information to the display so the pilot can simply keep his flight path circle centered in the top display to stay on a preset flight path. Or the compass system can supply information to keep the helicopter on a preset heading.

When the helicopter gets into the terminal beacon zone, the RAILS system takes over with the aid of the APN-100 altimeter, MA-1 compass system and the vertical gyro for the attitude symbol, instruments which supply both en route and terminal information. The pilot can line up the beacon dot and reference line so the line runs directly up the navigation display or, with the off-course computer, he can land to one side of the beacon. In the latter case, the reference line wouldn't run straight up from the center of the display, but it would still provide beacon location information. Display will automatically switch to smaller distance scales as the helicopter nears the beacon.

With heading to beacon established, the pilot keeps the grid which indicates ground speed variations steady, the attitude symbol aligned and flight path

circle centered. He watches the dark area move up as altitude decreases, and the display automatically switches to the 300 ft. scale as he nears the ground. When the line on top of the dark area reaches the hover mark, he can hover, then touch down. All this work is done by monitoring two displays.

Along with the cathode ray tube displays, Bell will include tape presentations for evaluation as backup information. These vertical tape instruments will show ground speed, absolute altitude, barometric altitude, rate of climb and airspeed information, and the Army will decide whether to use the moving tape displays for backup or to supply the information with conventional needle and dial instruments. Bell will also supply conventional instruments, including rpm. indicator, manifold pressure indicator, turn and slip indicator, clock and stop clock.

A number of engine function instruments will be included in the new panel, and a new approach will be tried to eliminate clutter and confusion. Engine instruments will be covered when operation is normal. When an unusual trend develops, a light will signal the pilot, and he can uncover the instruments for a precise reading on the situation.

Since the new Bell system is currently in the development stage, some details may be changed before the final configuration is fixed. Bell is now experimenting with information mixes for the computer and evaluating the display, using a Model 47 helicopter without ASE gear. More than two dozen blind flights have been made involving takeoff, hover, hovering maneuver around the beacon and landing without looking outside.

FILTER CENTER

►**Micro-miniature Lamp**—Tiny light bulbs, suitable for use as indicators in flip-flop circuits, which measure only 0.035 in. dia. by 0.1 in. long have been developed by the Army's Diamond Ordnance Fuze Laboratory, Washington, D. C. Lamps can be lit by as little as 40 ma. at 1½ v., making them suitable for operation directly from flip-flop circuit transistors.

►**Portable "Little SAGE"**—Air transportable version of the Navy's Air Tactical Data System (ATDS), designed to provide air defense capability for Marine Corps amphibious landings, will be announced soon by Litton Industries. System provides automatic analysis of radar data, automatic guidance for defending interceptors, similar to ATDS

military electronics experience/on file at Motorola

ASW AND UNDERSEA WARFARE

SE Submarine communications and detection.
SE ASW data processing and display aids.
PP ASW listening and retransmitting devices.

SPECIAL DEVICES

SE Proximity warning.
SE Long range electronic surveying equipment with airborne repeater.
DS Electronic fusing.
DS Electronic surveying equipment.
DS Pulsed light range measurement equipments.
PP Radiosonde transmitter and preamplifier.

MISSILE AND DRONE CONTROL

SE Precision inertial-guidance system for short range air-to-surface missile.
SE Bomber defense missile system.
DS Homing guidance system for attack and reconnaissance drones.
DS Air-to-air radar guidance system.
DS Surface-to-surface radio inertial guidance system.
DS Drone command guidance system.
PP Data transmission and processing for surface-to-air missile guidance.
PP Surface-to-air radar guidance system.

SENSORS

SE Precision location of radars.
SE High precision and high resolution forward-looking radar.
DS VHF homing beacon for supply-drop aircraft.
DS Anti-jam radar transmitter and receiver.
DS Radar anti-clutter receiver.
PP Beacons, C-band and X-band.
PP Strategic bombing radars.

COMMUNICATIONS AND DATA TRANSFER

SE Obstacle-gain data transmission.
SE 18-Channel teletype.
SE Noise-modulated data links.
DS Integrated battlefield air mobile radio communication system.
PP High-density FM voice multiplex.
PP Integrated battlefield ground mobile radio communications system.
PP High density UHF communication system for air defense.
PP Coded secure communications.
PP Pulse code modulated communication equipment.
PP Multitone and digital selective calling equipment.
PP Transportable and fixed-station microwave wide-band relay equipment.
PP AM, FM and SSB voice and data communications equipment.
PP I.F.F. equipment.
PP Data link and logic for ground-to-air command guidance of aircraft and missiles.
PP Miniaturized Transceivers.

Here is an unclassified look at representative Motorola military electronics programs...past and current. Necessarily incomplete, the listing includes only enough projects to demonstrate the breadth of experience at Motorola's Military Electronics Division. For detailed information on how Motorola's capabilities can be applied to your problem...or for data on engineering career opportunities...please write: Motorola, Inc., Military Electronics Division, 8201 East McDowell Road, Phoenix, Arizona.

A-811-1

KEY:

Program Status Coding (Reference MIL-E-5400B)

- SE *Study programs or programs resulting in experimental models.*
- DS *Programs resulting in developmental and/or service test models.*
- PP *Programs resulting in pre-production prototypes and/or production models.*

COMPONENTS

PP Quartz crystal resonators and filters.
PP Electrical wave filters.
PP Electromechanical filters.
PP Precision V.F.O.'s and B.F.O.'s
PP Electromechanical reed filters and tone generators.
PP Transistorized power converters.
PP Transistorized voltage and current regulators.

NAVIGATION

SE Doppler personnel navigator.
SE Inertial sensors.
SE Supersonic intercontinental bombing-navigation system.
SE Hyperbolic battlefield navigation system for aircraft, land vehicles and man pack.
DS Hyperbolic amphibious navigation system.
PP Aircraft rendezvous and station-keeping systems.

DATA PROCESSING AND DISPLAY

SE Automatic data processing for electronic countermeasures.
SE Data processor for electromagnetic intercept.
SE Threat evaluator for air defense.
PP Shipborne electronic data system for air defense.
PP Large-scope bombing radar indicator.

ELECTRONIC WARFARE

DS Battlefield electronic warfare.
DS False target generation system.
DS Tracking jammer.
PP Subminiature passive radar illumination detector.

GROUND SUPPORT AND TEST EQUIPMENT

PP Phase-lock telemetry.
PP Command destruct receivers.
PP Guided missile test equipment.
PP Programmed automatic test system.
PP Aircraft test equipment.
PP Militarized precision pulse circuit testers.

SOLID STATE MATERIALS AND DEVICES

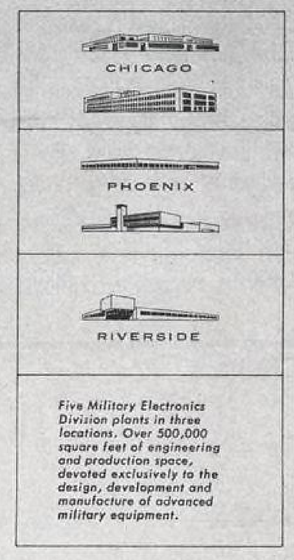
SE Ferro-electrics.
SE Ceramics.
SE Solid state devices.
PP Ferrites.

COMBAT SURVEILLANCE

SE Drone guidance, data sensor, and data transmission integrated reconnaissance system.
SE Aircraft data sensor, and data transmission reconnaissance system.
PP High resolution side-looking radars for aircraft and drones.

MOTOROLA

Military Electronics Division / CHICAGO • PHOENIX • RIVERSIDE



Five Military Electronics Division plants in three locations. Over 500,000 square feet of engineering and production space, devoted exclusively to the design, development and manufacture of advanced military equipment.

developed for use in Navy airborne early warning and control aircraft (AW Dec. 22, p. 30.)

► **Traffic Control For Carrier Aircraft**—System designed to bring aircraft onto Navy carriers at precisely controlled intervals is being developed by Cornell Aeronautical Laboratory under Bureau of Ships sponsorship. Cornell carrier traffic control system operates somewhat like USAF's old Volscan, but uses digital computer instead of analog computation. System will transmit desired commands for speed, heading and altitude to individual airplane cockpits via data link every few seconds.

► **Two Loran Patents Granted**—International Telephone & Telegraph Corp. (ITT) has been awarded two U. S. patents covering basic Loran navigation system. One covers invention in 1941 by F. G. Bac in France of the principle of using pulses transmitted by a pair of radio stations to provide family of hyperbolic lines of constant time difference. Second patent, covering 1942 invention by Andrew Alford of U. S., provides for complete Loran system in which two pairs of stations are employed.

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

• **Burroughs Corp.**, two contracts totaling $22.4 million for ground-based computers used in Atlas command guidance system, bringing company total to date for Atlas guidance to $68 million.

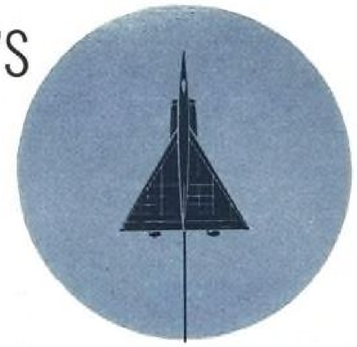
• **Telecomputing Corp.**, Los Angeles, $2.8 million from Army Ordnance for data processing services at Holloman AFB and White Sands Missile Range, N.M.

• **Hoffman Electronics Corp.**, Semiconductor Division, Evanston, Ill., two production contracts totaling $791,000 for solar energy converters, from Army Signal Corps and Space Technology Laboratories.

• **Collins Radio Co.**, Cedar Rapids, Iowa, $2 million for high density microwave system to be used at new Pacific Missile Range. System will relay voice teletype radar and other data between main control center at Pt. Mugu, Calif. and subsidiary centers at San Nicholas Island and Point Arguello. Company also received $3 million contract from Civil Aeronautics Administration for microwave link installations to tie civil and military long-range radars into air route traffic control centers.

• **Sperry Gyroscope Co.**, Great Neck, N. Y., $2.9 million from Air Material Command for AN/APN-59 airborne radar sets, spare parts and ground support equipment.

NEW WAYS TO TRAIN TOMORROW'S ANTI-MISSILE CREWS are taking shape at



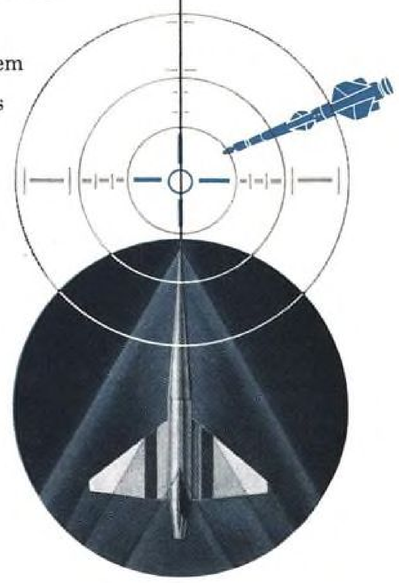
DEL MAR ENGINEERING LABORATORIES

Tomorrow's ground-to-air and air-to-air anti-missile systems will not be effective until crews are trained to use them. For this reason, Del Mar Engineering Laboratories privately supports a dynamic R & D program that will provide realistic training systems concurrently with the delivery of weapons systems that are still under development. By not waiting for an "invitation to bid" on established training system requirements, Del Mar helps to "plug the gap" in America's defense and drastically reduce dangerous lead-time periods.

A product of this farsighted policy is the RADOP® Weapons Training System presently in universal use by the military air services of the United States, Canada, and other NATO countries. This system uses a wood-fiber tow target that costs less than a hundred dollars and is launched and recovered in flight. The remarkable ability of the RADOP® target to "stand in" for high-performance aircraft introduces a higher degree of realism into training than is available with other more costly systems.

Del Mar invites Training Commands and weapons systems developers to write for particulars about company capability in the development of advanced aircraft or missile training systems and the production of associated hardware.
Write Dept. AW-540-2.

ENGINEERS: *Investigate employment opportunities with this steadily growing organization.*



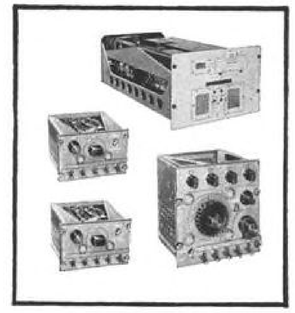
Del Mar *ENGINEERING LABORATORIES*
international airport • los angeles 45 • california

COMMUNICATIONS...

Radio Set AN/ARC-57 . . . designed and developed by *The Magnavox Company*, in conjunction with the Air Force, is an essential UHF communications system, providing the utmost in performance and reliability for the CONVAIR B-58.

It clearly demonstrates *The Magnavox Company's* ability to produce and work as a prime contractor on a complex weapons system.

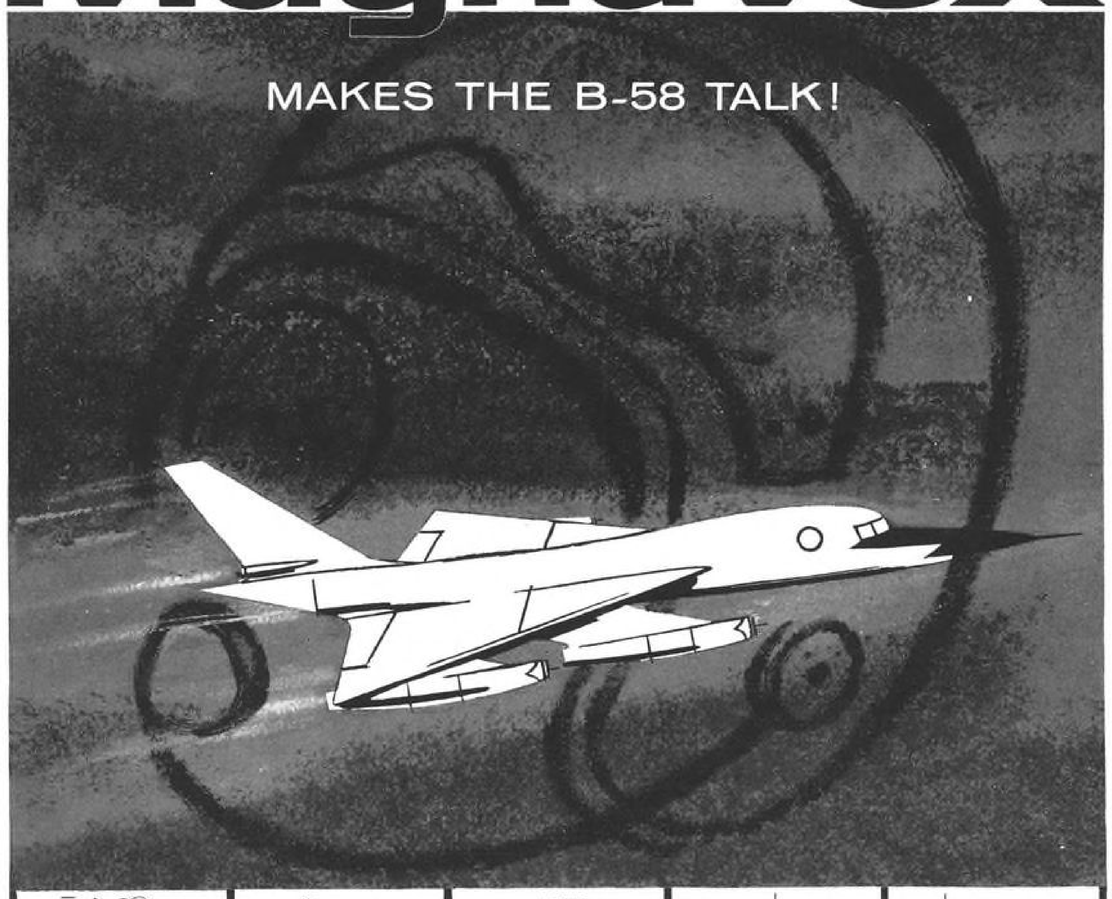
MAGNAVOX capabilities are in The Fields Of Airborne Radar, ASW, Communications, Navigation Equipments, Fusing and Data Handling . . . your inquiries are invited.



PRODUCTS THAT SPEAK FOR THEMSELVES

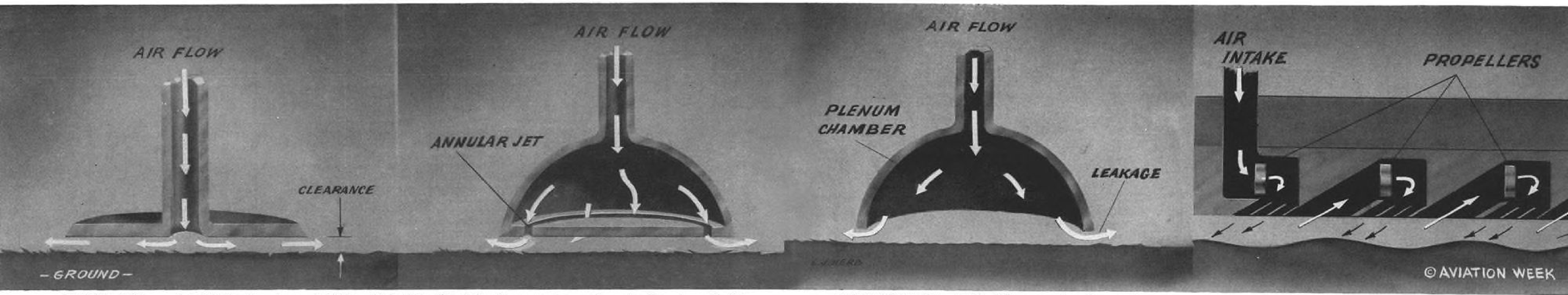
Magnavox

MAKES THE B-58 TALK!



COMMUNICATIONS | RADAR | DATA HANDLING | ASW | MISSILES

THE MAGNAVOX CO. • DEPT. 36 • *Government and Industrial Division* • FORT WAYNE, IND.



LEVAPAD (left) uses air lubrication to cut ground friction. Ford Motor Co. designed man-carrying scooter using three Levapads that can be propelled by less than 1 hp. Annular jet (right) when close to ground is more efficient lifting machine than helicopter or airplane.

PLENUM CHAMBER principle (left) was used on Spacetronics machine (bottom p. 74). Labyrinth seal (right) was proposed for ocean vehicle several hundred feet in diameter. Seal would be designed to prevent leakage and maintain a strong air cushion under the machine.

Designers Study Air Cushion Principles for Vehicles

By J. S. Butz, Jr.

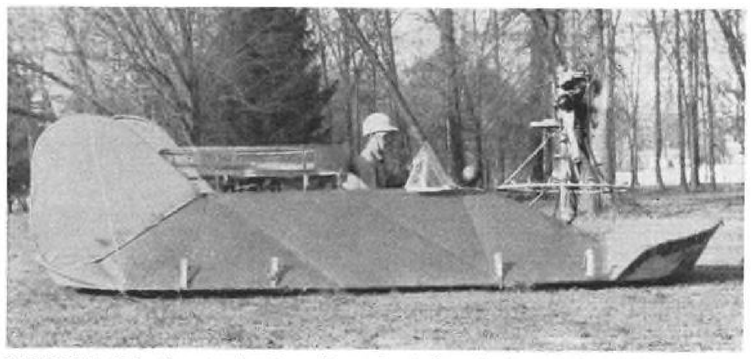
Washington—Large machines capable of traveling on a cushion of air over land and water without the use of wheels, tracks, hulls or hydrofoils are in the preliminary design and basic research stage by several U.S. military groups and industrial companies.

Enough coarse data has been obtained to indicate that the lifting capacity of certain machines can be increased several hundred times when they stay near the earth and operate continuously within the ground effect. This represents a major improvement over conventional helicopters and airplanes which experience a lift increase of only 10 to 20% when they enter the ground effect.

Study work on these machines is in progress at the Department of Defense level, where it was begun for the now non-existent Office of the Assistant Secretary of Defense for Research and Engineering by the Weapon System Evaluation Group, in the Navy at the Office of Naval Research at the Bureau of Aeronautics and at the Bureau of Ships. Several offices of the Air Force and the Army have also been active in this area.

Ford Motor Co., the Martin Co., Convair, Ryan and Hiller are among the U.S. companies studying this development. In England, work is being conducted by Saunders-Roe and in Switzerland one of the pioneers in the field, Carl Weiland, is still working.

Anticipation of a large commercial, as well as military, market has resulted in a large shield of proprietary secrecy around this work, and patent litigation already is in progress.



VEHICLE built by Spacetronics, Inc., rides a few inches off the ground and is designed to replace the truck as a vehicle for traversing swampy ground, snow or ice. A flexible skirt would enable it to cross many obstructions. Company plans to market a model for sportsmen at less than $2,000. Horizontal propeller behind driver maintains pressure in hollow body.

Basic research on these ground effect and air lubrication machines has reached the point that most experts in the field believe that a coordinated applied research program to gather detailed, quantitative engineering data is the next logical step.

Spacetronics Demonstrator

One man-carrying demonstration machine has been shown publicly in recent weeks. This vehicle, built by Spacetronics, Inc., normally rides about four or five inches off the ground. Its undersurface is a large cavity or plenum chamber, and its lifting force is obtained by keeping a pressure of less than 1 lb. per sq. in. in this chamber. A propeller of about four feet diameter driven by a drone motor of around 12 hp. is used to maintain chamber pressure.

A general review of the state-of-the-art of ground effect and air lubrication machines was presented in a recent paper for the American Helicopter Society by Gabriel D. Boehler of Catholic University and the Aerophysics Co., of Washington, D. C. Dr. Boehler discussed three machines using the strong ground effect principle typical of present thinking but by no means all inclusive:

• **Small size STOL vehicle** which discharges air around the periphery of its wing in an annular jet. This annular jet increases the strength of the ground cushion, reduces ground friction and allows shorter ground roll for a given power available.

• **Ground limited,** very close to the ground, very large size (several hundred feet in diameter) vehicles using a labyrinth seal to maintain a high pressure cushion of supporting air under the machine. This vehicle has been proposed in England and Switzerland as a 100-mph.-plus replacement for the oceanliner. It is under active study in the U.S.

• **Ground limited,** rather far from the ground, small size machine comparable to an Army truck. It would use annual jets and ride four feet or more above the ground. The power-to-weight ratio would have to be much higher for this small machine than in the large type described above because of its relatively high distance above the ground for its bottom area.

Ford 'Levapads'

A somewhat different machine has been built and demonstrated by the Ford Motor Co. It is supported by "Levapads," flat circular plates that have compressed air forced out of their center.

This high-pressure air forms an air-bearing which raises the "Levapad" a few thousandths of an inch. Vehicles supported by this device must travel upon a completely smooth surface and are probably best suited for rail transportation (see figure at right).

The ground effect machines now under study generally use an annular jet of high speed air or a labyrinth seal to trap air under the machine. These seals increase the lifting effect of the ground cushion several hundred times. Exact benefits of the annular jets and labyrinth seals are not yet known because of a lack of systematic quantitative data that could not be made available except at considerable expense through a coordinated research program.

Until such a research program has been completed it would be impossible to say exactly what type of ground effect machine would be most economical and practical. Without definite information as to lifting power available it is not possible to tie down payloads, structural weights, powerplant requirements, etc.

A number of small models of ground effect machines using annular jets are being flown at various places in the U.S. Most of this work is proprietary, but some of it is being done in government laboratories such as the Navy's David Taylor Model Basin. Most of these tests are concerned with stability problems for the performance of annular jets has proven more complicated than originally predicted. Many arrangements are being tried on the models in an effort to produce an inherently stable configuration.

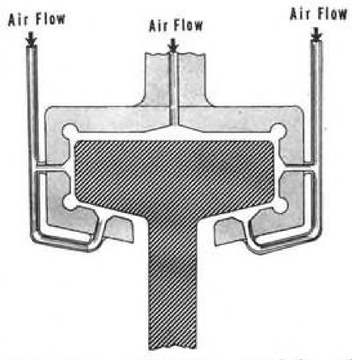
Basic purpose of the very large ground effect machine is to materially increase the surface speed of ships. Dr. Boehler, who believes that this type of machine is feasible, estimates its speed conservatively at 100 kt. Major problems connected with the machine at present are the lack of complete engineering data on the labyrinth seal proposed by Weiland and insufficient loads data for large circular structures which might be forced down in a heavy sea.

Saunders-Roe in England is reportedly studying this type of vehicle as is the U. S. Navy. Land versions of this vehicle are visualized by some as revolutionizing ground transportation in arctic regions.

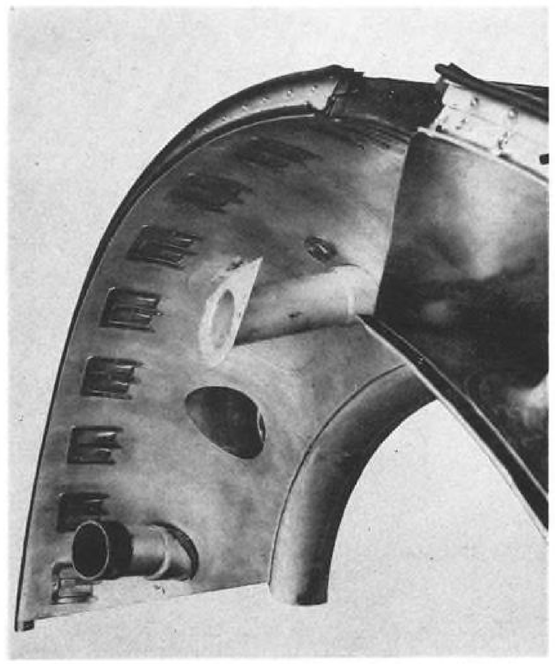
The very large amplification factors that were predicted for the annular jet in 1956 and 1957 in separate studies by Boehler and H. R. Chaplin were met with much skepticism by some scientists. Principle reason for this doubt was the fact that a large negative pressure exists around the base of a high-speed jet. It was thought that a circular jet would have a negative rather than positive pressure in its center and be useless for supporting a vehicle near the ground.

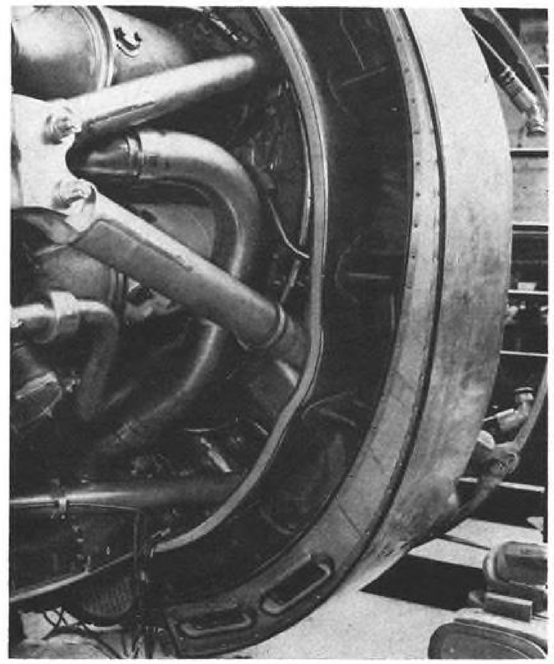
Boehler and Chaplin, however, reasoned that when the jet was close to the ground it would be turned outward in much the same manner that a paper cup spreads when it is pressed down on a flat surface. Since the pressure acts uniformly in all directions the spread-out jet would exert a pressure against the ground over a wide area, increasing the lifting power many times.

While no exact mathematical proof of this phenomena has been produced, it was verified experimentally in 1957 by a group at the NACA.



LEVAPAD is probably best suited for rail transportation because it must operate over a very smooth surface if its air lubrication or air bearing is to be maintained.





JETS upstream of elbow in Proteus 705 turboprop engine plenum chamber (left) are fed from serate tappings. Plumbing is located between inner and outer skins. At right, multi-duct plenum chamber divides flow around intake elbow. Auxiliary intakes are at bottom.

Proteus 705 Overhaul Life Extended

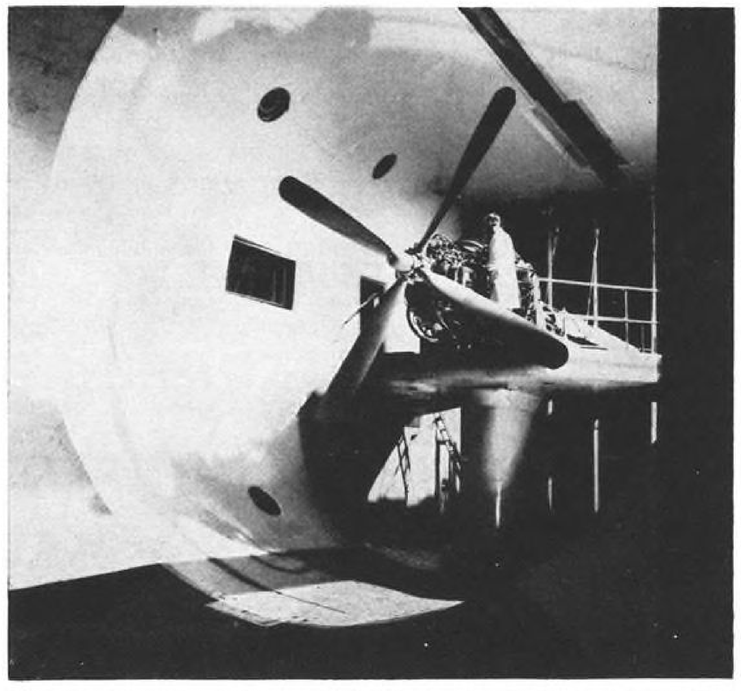
By John Tunstall

London—Overhaul life of Bristol-Aero Engines' Proteus 705 turboprop engine has been extended to 2,000 hr. life by the Air Registration Board, after 22 months of service on Bristol Britannia transports.

Reliability of the 3,900 eshp. engine is reported in a company analysis of 172 unscheduled engine changes, which put average flying hours per unscheduled engine change at 3,000 hr. and the feathering rate at one engine per 4,850 hr. of service. This record has been achieved, the company said, despite frustrating encounters with new types of icing conditions. Engine entered service with overhaul life of 800 hr.

More than 50% of the unscheduled engine changes were due to two non-mechanical features, which point up the outstanding over-all engineering integrity of the engine design. Both defect causes have been largely eliminated. A faulty batch of Nimonic first stage blading was responsible for 37.8% of the removals and 14.5% were due to ice damage to the compressor.

The record of the later Proteus 755, engine which is only slightly modified, is accordingly more impressive. By last September, engine hours per un-



PROTEUS turboprop engine is prepared for test in new British Overseas Airways Corp. installation at Nantgarw, Treforest, South Wales. Facility tests engines to 10,000 eshp.

scheduled engine change had reached 4,380 hr. and the feathering rate was 6,360 hr. This engine entered service 12 months ago and its record, say Bristol engineers, compares with the best piston engines after many years in service.

Currently, the Proteus 705 has an approved life of 1,600 hr. with all British Overseas Airways Corp. Britannia 102 aircraft flying one engine to 2,000 hours. The 755 engine has an approved life of 850 hr. and is on trials to 1,050 hr.

Annual Utilization

Altogether Proteus engines logged 356,000 service hours up to Oct. 31 and Britannia annual utilization rose during this period from 2,500 hr. to 3,800 hr., a figure which Bristol maintains has never before been achieved so quickly by any other airplane.

Fault in Nimonic 90 first stage turbine blade material resulted from blade makers using extruded stock which had necessitated the introduction of an additional annealing operation. This had increased the grain size and had correspondingly lowered the fatigue life. In all Proteus 705 engines the blade material was replaced by Nimonic 100 at overhaul, according to Hugh Green, Bristol's chief production designer.

The icing damage was caused by lumps trapped between the stators and the first stage compressor blades, causing the blade tips to advance on the stators and rub. Modification was to increase the axial blade/stator clearance but the primary cure was the elimination of the icing itself.

Main bearing failures accounted for nine out of 172 engines removed, and have been the subject of detail modifications.

The most significant change was the elimination of the rear compressor roller bearing.

Originally the shaft was located laterally by the roller bearing and axial thrust was taken by the ball bearing. Trouble developed because the ball bearing imposed a lateral restraint and accordingly the roller bearing was eliminated and both lateral and axial location was achieved by the ball bearing.

New high tungsten alloy races were introduced on this compressor bearing and on the propellor turbine bearing as a result of two failures of the latter. The remainder of the nine bearing failures occurred in the propellor shaft coupling front bearing and were eliminated by increasing the fatigue strength of the cage.

Steel bearing cages had previously been given a phosphate treatment for lubrication purposes. This reduced the fatigue properties and a change was

made to a sulphate treatment which restored the fatigue properties.

The reduced chromium content of the Nimonic 100 material lowers its resistance to surface corrosion. This material, which replaced the Nimonic 90 used in the Proteus 705, was used as a design requirement in the later 750 series. Subjecting this material to sodium dichromate treatment produces a surface layer which restores the blade's resistance.

The most protracted development phase for the Proteus design team started late during proving trials when it was revealed that the intake configuration would not process dry ice particles. These crystals led to two unsuspected icing hazards which had not previously affected aircraft or piston engines. A baffling feature of both icing conditions was the fact that they were aggravated by the application of cowl heating.

In one condition, the ice crystals were dry, visibility was good, the ambient air temperature was below —15C and heights were in excess of 20,000 ft. The other condition occurred at ambient freezing levels and the ice crystals were mixed with free water.

Dry Icing

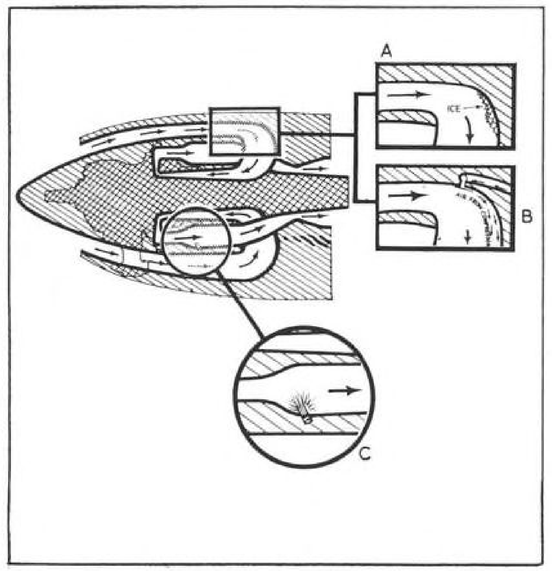
Dry icing was first experienced in April, 1956, and an investigation program led to relatively simple modifications which were easily incorporated. But these proved inadequate against the extremely severe mixed icing condition which was not first encountered until after the aircraft had entered service in February, 1957.

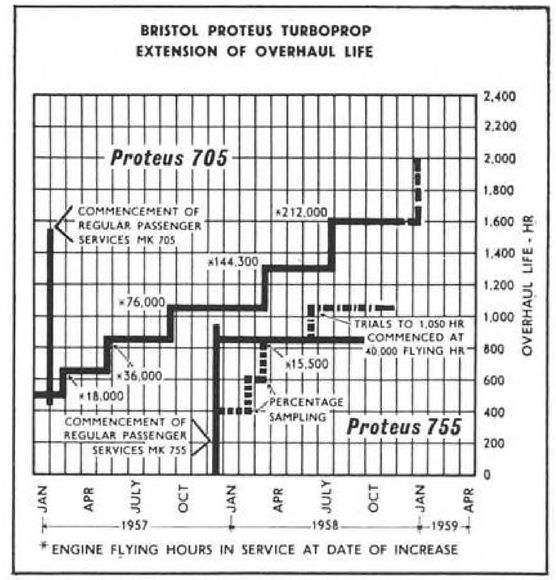
The effects were confined to tropical fronts with very high water content and resulted in total flameouts and compressor damage.

Cause lay in the intake geometry of the Proteus, but dry ice particles can affect all large air-breathing engines. Against the classical supercooled droplet icing hazard, the reverse low configuration of Proteus possessed inherent anti-icing properties, and the engine with conventional cowl heating had demonstrated outstanding performance throughout natural and simulated icing trials.

In one severe test under Civil Aeronautics Administration conditions, after the engine had run for 43 min. at —4C with anti-icing services switched off, the output only dropped 3%. Contributing reasons, although these are entirely incidental to the design, are the large plenum chamber which has a marked volumetric icing tolerance and the presence of the combustion chamber tunnels which traverse the inlet annulus on the way to the turbines, and provide local surface heating.

Dry ice particles do not stick to cold





ICE particles in presence of free water, stick in elbow of plenum chamber intake (left—A) and are cleaned by jets supplied from compressor tapping (B). Glow plugs ensure automatic relight (C), as a safeguard. Graph at right shows extension of Proteus overhaul life.

surfaces. Because of their physical stability, relatively large size and inertia, they bounce their way through engine breathing systems, and pass over wings and external surfaces. Ice crystals were thought to occur only in upper cloud formations and then in very slight concentrations. There had been little need to collect data, particularly of a quantative nature, and little existed.

First signs of trouble occurred during BOAC Britannia route proving trials in the area of Entebbe. Manifestations were momentary drops of engine rpm. of about 2% and in some cases total flameout occurred. Response to manual relighting measures was immediate.

Because of the absence of external icing and the fine weather conditions, these fluctuations were first attributed to water in the fuel system. Eventually a Britannia, fully-instrumented and equipped with closed-circuit television to view the intakes, revisited Entebbe.

The cameras immediately revealed a new icing technique. Ice particles trapped in crevices and pockets in the plenum chamber built up, compacted, then broke away and crashed against the inlet guide vanes causing temporary partial blockage which disturbed the flow.

In most cases at Entebbe, the disturbance was only sufficient to douse one or two combustion cans and cause slight fluctuations in engine speed. But larger formations produced complete flameout, the water content itself contributing to the dousing effect of the flow disturbance.

These larger formations were associated principally with the heated surfaces which caused partial melting. In this condition the particles became sticky and compacted more readily. The same process explained the adverse effects produced by using the anti-icing services.

Remedial action proved simple and effective and was readily applied to existing aircraft. The intake was cleared of auxiliary intakes which trapped the ice particles and was generally cleaned up.

Local heating was minimized by shielding the combustion chamber elbows. Platinum alloy glow plugs were inserted into half the combustion cans to ensure automatic relight.

Engine Speeds

Although no further flameouts were experienced, some slight fluctuations in engine speed persisted. These were of such short duration that they would not have been detected on an ordinary revolution counter. Bristol's engineering ice specialist added: "It was still infinitely smoother than a piston engine."

The second and more vicious mixed icing condition was not experienced until May, 1957, several months after the Britannia had entered service.

Turbulence at the ambient freezing level produced a mixture of dry ice particles and free water. The large surfaces presented by the plenum chamber intake elbow due to the reverse flow layout were made wet by the free water and induced large quantities of particles to stick and accumulate in the bend.

The cure was to accelerate the boundary layer in this area by a system of jets bled from the compressor. The rig testing was carried out at the Royal Aircraft Establishment. The method prevents the formation of ice at this area for a bleed flow of 2%. Again the modifications were incorporated in the original hardware, and as a result flameouts were eliminated and Proteus was cleared for all forms of icing conditions.

A particularly glum day was registered between these two icing periods, when a BOAC Britannia seeking dry icing conditions in the Carribbean area flew into the core of an isolated cumulo nimbus. The sudden temperature change caused a differential contraction of the compressor casing which closed up at the center line.

Severe rubbing and welding of the stator blades in this region with the compressor drum spacing rings ruined two compressors. This type of contraction is inherent with a double-walled casing divided horizontally. The modification included relieving the tips of the stator blades in the region of the casing joint and by giving the drum spacer rings a hard anodized abrasive surface, readily able to remove blade material by grinding.

The 750 Proteus series is physically similar to the 700 series engines but has been uprated to meet the long range Britannia requirement. The power turbine assembly is redesigned and gas temperature raised. Principle derivative is the 758 which has additional burners to provide a 4% boost in takeoff power at elevated airfields. The cruising rating remains unaltered.

This series is to be superceded by the 760 series which introduced re-staggered compressor entry guide vanes and

electro-polished compressor blades. These two features contribute to a reduction in specific fuel consumption of 3%. All current production and overhauled engines are being delivered to this standard.

The 765 derivative of 4,445 eshp. achieves a 6% power increase at cruise and takeoff for small increases in compressor speed and turbine temperature which the company says will not materially shorten the engine life. Derivatives in all three series have been fully certified. The military 255 is a 765 engine with a one-shot water injection system for takeoff.

The company disclosed that development work on another series is well under way. The main difference of this series will be the incorporation of labyrinth seals at the tips of the turbine blades, which substantially improve turbine efficiency.

The company has temporarily dropped development of a Proteus type engine which was to have had air-cooled first stage turbine blades.

WHAT'S NEW

Reports Available

The following reports were sponsored by the Office of Technical Services, U. S. Dept. of Commerce, Washington 25, D. C.:

A Study Of A Controlled Acoustical Experiment In A Water Tank At 213kc. –by W. G. Neubauer, Naval Research Laboratory. Jan., 1958. $.50; 11pp.; (PB 131474).

Development of Niobium-Base Alloys –by R. T. Begley, Westinghouse Electric Corp., for Wright Air Development Center, U. S. Air Force. May, 1958. $2.50; 113pp.; (PB 151004).

Determination of Hydrogen in Zirconium Hydride–by W. H. Jones, Wright Air Development Center. Dec., 1957. $.50; 10pp.; (PB 131972).

Development and Evaluation Services on Ceramic Materials and Wall Composits For High-Temperature Radome Shapes–by J. J. Dorsey. P. R. Mallory & Co., Inc., for Wright Air Development Center, U. S. Air Force. Feb., 1958. $.75; 20pp.; (PB 131987).

Bibliography On Photographic Film Dosimetry–by G. H. Griffith, Wright Air Development Center. May, 1958. $.75; 19pp.; (PB 151026).

An Extraction Procedure For The Determination Of The Metallic Constituents In Greases–by L. A. Harrah, Wright Air Development Center, U.S. Air Force. May 1958. $.50; 15pp.; (PB 151027).

CAB Accident Investigation Report:

Mechanic Blamed in Western Crash

At 1344,[1] Feb. 13, 1958, just after takeoff, Western Air Lines Flight 19 experienced severe control difficulty and made an emergency geardown landing in the desert 4 mi. north-northwest of the Palm Springs, Calif., Airport. During the ground roll the aircraft, a Convair 240, N 8405H, struck large boulders in its path and fire occurred which consumed the major portion of the aircraft. There were no fatalities but serious injuries resulted to 5 of the 18 passengers and minor injuries to most of the others. The crew of three received minor or slight injuries.

HISTORY OF THE FLIGHT

Western Air Lines Flight 19 is a scheduled passenger service between Las Vegas, Nev., and San Diego, Calif., with an intermediate stop at Palm Springs, Calif. On Feb. 13, according to normal scheduling, the aircraft, N 8405H, used on Flight 19 was flown from Los Angeles to Las Vegas as Flight 12. This was the first flight for the airplane following a No. 3, areas 1 and 3, heavy maintenance, check performed by the company at its overhaul base located on the Los Angeles International Airport. The flight crew of Trip 19, who also operated Trip 12, consisted of Capt. Richard E. Schumacher, First Officer James R. LeBel, and stewardess Barbara F. Grimes.

Following crew preparation for both flights, Trip 12 was completed in a routine manner. At Las Vegas 330 gal. of fuel were added to the existing fuel on board, making a total of 700 gal. No maintenance and no other pertinent services were performed or requested. Departure from Las Vegas was at 1230, about 15 min. behind schedule, the result of minor unrelated delays. First Officer LeBel, seated in the captain's seat, flew the aircraft to Palm Springs while Capt. Schumacher, in the right seat, supervised the flight and performed the duties of first officer. The flight was planned according to a DVFR (Defense Visual Flight Rules) flight plan. Upon reaching the intended cruising altitude of 10,000 ft. mild turbulence was encountered and for passenger comfort the altitude was changed to 12,000 ft. Otherwise, in clear weather conditions the segment to Palm Springs was uneventful and arrived at 1330.

The Palm Springs stop was for passenger changes only; therefore, the crew remained on board and the aircraft did not receive attention. After about 6 min. at the terminal the engines were restarted and First Officer LeBel taxied the airplane to runway 31 for takeoff. Pretakeoff checks were completed during which the engines, propellers, and instruments gave normal indications. The gross weight of the Convair was 35,655 lb., which was 4,742 lb. less than the maximum allowable for takeoff. According to the load manifest the load was distributed within the center of gravity limitations.

About 1342 Flight 19 took off from runway 31. The takeoff appeared normal, and the aircraft climbed to approximately 500 ft. above the ground. At this time several ground witnesses saw two or more silvery pieces separate from the aircraft. Most witnesses said the pieces seemingly separated from the area of the right wing. Almost simultaneously the aircraft was observed to nose down sharply and descend at a steep angle. As it neared the ground it leveled off considerably but continued to descend. It contacted the ground raising a large cloud of dust and then disappeared from the view of the observers behind intervening higher terrain. Seconds later large columns of smoke were seen rising from the accident site.

Weather conditions were no factor in the accident.

INVESTIGATION

Prior to the origination of Flight 12 the pilots performed a preflight walk-around inspection of the aircraft. The description of this inspection by the pilots indicated it was in accordance with company procedures. It also showed that the inspection would have revealed discrepancies of a nature which would normally be detected during the pilot walk-around. However, none were noted.

Both pilots stated that except for about 4 deg. left aileron trim required during climb and about 3½ deg. in cruise, N 8405H, its powerplants, and all equipment functioned perfectly. The amount of trim necessary, they stated, was within allowable tolerance for continuation of the operation but would have been written up after the completion of Flight 19.

The pilots stated that the takeoff roll was entirely normal and when the aircraft was approximately 30 ft. above the runway the landing gear was retracted. Thereafter, takeoff flap was raised and power was reduced to METO (maximum except takeoff). When it was determined that no appreciable turbulence existed and about 1,000 ft. (550 ft. above the ground) was reached the first officer called for climbing power. The pilots stated the climb angle was normal and the airspeed was 155 kt. The first officer made a slight right bank to keep another aircraft in sight and then rolled out. At this instant there was a noise which impressed the pilots as being a structural failure. First Officer LeBel, who continued to fly the airplane, said the elevator control became "sloppy" and the aircraft began "bucking" and "buffeting" in a manner "as bad or worse than a secondary stall." The nose of the aircraft dropped, and elevator control would not raise it.

First Officer LeBel said that at this time he doubted if he would be able to control the aircraft and told Capt. Schumacher he thought they must have a "broken elevator." Both pilots stated that they agreed a crash landing was inevitable and that the nose would have to be raised to accomplish it. First Officer LeBel stated that he then pushed the nose down to a 30-40 deg. angle and added nearly full power. When the airspeed increased to 240-260 kt. the first officer sensed a partial regaining of elevator control.

He then added full power and when about 300 ft. above the desert began decreasing the angle of descent. The first officer said that when the aircraft was about 50 ft. above the ground, Capt. Schumacher asked if he wanted the landing gear down. The reply was affirmative. When the landing gear extended, the first officer said that he noted somewhat more positive elevator control. He said that he was able to raise the nose of the aircraft so that ground contact occurred main gear first, the nose slightly raised. The specific touchdown speed was unknown but the first officer thought it was in excess of 200 kt.

A passenger seated on the right side of the aircraft in the window seat of the first row stated that at the outset of the vibration he saw a large piece of the right wing break loose and "flop back and forth" on the wing. He said this lasted three to four seconds, then the piece separated from the wing. He said when the piece was gone a mass of tubing and pipes was exposed along the front of the wing. At least one other passenger saw a piece flash past his window at approximately the time the buffeting started.

Severe Buffeting

The buffeting in the cabin was described by several passengers and the stewardess. One passenger said the aircraft "bobbed like a cork on a stream," and another said the buffeting made it difficult to get hold of her safety belt clasp to pull the belt tighter. The stewardess stated the buffeting spilled galley equipment onto the floor, hurled her equipment kit down the aisle, and even shook her stewardess cap from her head. She doubted that she could have stayed in her seat if her seat belt had not been fastened. She said there was no pattern to the buffeting and it was equally severe up and down and from side to side.

The crew said the aircraft rolled fairly well over the rough terrain until it struck boulders which were scattered over the desert surface. They stated the landing gear failed when it struck the boulders and mounds of drifted sand. The aircraft then slid to a stop and fire broke out in the left wing. Almost at once the fire spread and became uncontrollable.

Because of the fire on the left side of the aircraft the evacuation was accomplished through exits on the right side. The front

[1] All times herein are Pacific Standard based on the 24-hr. clock. Altitudes are mean sea level unless indicated otherwise.

divisions and subsidiaries of TELECOMPUTING CORPORATION

WHITTAKER GYRO
Leaders in electrically driven and spring-wound free gyros, rate and floated rate gyros for missile systems—rate of roll, pitch, and yaw indicators for manned aircraft—bank and turn indicators.

BRUBAKER ELECTRONICS
An R&D leader in the field of ground and airborne IFF components, test & checkout equipments—IFF systems analysis—Air Traffic control systems—radar beacon ry—detection equipments.

DATA INSTRUMENTS
Pioneers in equipments for fast and accurate analysis of test data, with automatic recording on punched cards, tapes, or printed lists—for aircraft, missile, industrial and scientific uses.

ENGINEERING SERVICES
Currently engaged in reduction and analysis of flight test data generated by daily missile firings at Hollman Air Force Base, White Sands Proving Grounds Integrated Range.

WHITTAKER CONTROLS
The largest developer and builder of custom-built high-performance hydraulic, pneumatic, and fuel valves, controls, and regulators for advanced missile, aircraft, and industrial applications.

NUCLEAR INSTRUMENTS
Designers and builders of high quality, reliable equipments for prelaunch checkout and testing of nuclear special weapons.

BRUBAKER ELECTRONICS, INC.
subsidiary of
TELECOMPUTING CORPORATION

expanding the frontiers of technology... over the full spectrum of advanced electronics

Brubaker scientists and engineers are dynamically attacking and overcoming the highly specialized electronic barriers associated with space-age technology. A skillful blending of technical ability, competitive production capabilities, and extensive testing facilities has established Brubaker Electronics as top-flight experts in the research, design, and development of complex electronic systems and components for both military and industrial applications. Brubaker's experience, personnel, and capabilities, together with a well-integrated research program, are the reasons why Brubaker equipment is operational on so many of the nation's vital weapons systems.

Past achievements show why Brubaker is superior in the area in which it operates: coding and decoding systems, radar, radar beacons, IFF, telemetering, communications and custom test equipment, highly classified military electronic systems—and such components as networks, delay lines, pulse transformers, switches and relays.

If you have a problem in advanced electronics, Brubaker engineers have a solution! Wire, write or phone:

BRUBAKER ELECTRONICS, INC.
subsidiary of
TELECOMPUTING CORPORATION
3652 Eastham Drive
Culver City, California
Telephone: TExas 0-6441
TWX Culver City, Calif. 7239

loading door was opened by Capt. Schumacher and the first and second window exits on the right side by passengers. A third passenger, with stewardess Grimes at his side, attempted to open the rear emergency door but found it was jammed.

According to the crew and passengers, the evacuation was fairly well distributed through the three openings. It was done in an orderly and rapid manner with most agreeing it required less than a minute. It was also agreed that seat belts remained intact and the seats anchored to the floor. The leg of one passenger was broken when it was caught in a seat or became entangled in a safety belt as he was stepping through the second window exit. There was no panic and passengers moved well away from the fire fully cognizant of the possibility of an explosion. The captain and first officer then checked the cabin to be sure all were out. Many passengers were highly complimentary of the efficient manner in which the pilots and stewardess handled their duties.

Investigation at the accident scene revealed that the aircraft initially contacted the ground four miles from the far end of runway 31. This area is desert land which, although relatively flat, has many sharp rises, depressions, and mounds of drifted sand. It is also strewn with thousands of large and small boulders buried or partially buried in the desert floor. The initial contact was evidenced by intermittent tire tracks on a magnetic heading of 320 deg. The tracks were apparent over a distance of about 600 ft., at the end of which the left main gear struck and was torn off by a huge boulder. This gear was located about 100 ft. past the boulder and about 45 deg. to the right. The absence of marks in the sand showed the gear was lofted to the final resting place.

The aircraft continued straight ahead through many boulders, over dunes, and uneven terrain which subjected it to severe impact forces. With the left gear off, the impacts caused major components of the aircraft to separate along the wreckage path. The left propeller dome was found 700 ft. from the initial ground contact and at 1,100 ft. the left engine nose case and propeller came to rest. A few feet farther and slightly to the right the right engine nose case and propeller were located. Numerous smaller pieces of aircraft structure were strewn along the path at various distances. The right wing was sheared off and it came to rest inverted 1,185 ft. past the initial contact point.

Just beyond this wing the right engine power section and right main landing gear were found.

The remaining portion of the aircraft stopped upright a few feet past the right wing and engine. This portion consisted in the main of the fuselage, left wing and engine, and portions of the empennage. Although completely gutted by fire, the fuselage, according to testimony of the crew and passengers and some physical evidence, apparently withstood the severe ground impacts and came to a stop in relatively good condition. Because of the destruction by fire it was impossible to determine why the rear emergency exit was jammed.

The major portion of the right wing

leading edge between the fuselage and right engine nacelle was found about one-half mile past the far end of runway 31. This location relative to the aircraft wreckage site confirmed ground observations that this component had separated in flight.

This portion of the right wing leading edge is installed as an individual section of leading edge. Its size is 52 in. long and 25 in. deep, and it serves as part of the airfoil design by forming the leading edge of the wing inboard of the right engine nacelle to the fuselage. Its construction is a series of six former ribs over which the wing skin is attached. The component is hinged on the top side with a "piano hinge" enabling it to be raised for inspection and/or repair purposes. In its down position the leading edge is secured by a series of 27, 10-32 x 11/16, stress screws installed from the bottom edge of the leading edge into an equal number of 10-32 self-locking nuts mounted on the lower spar cap of the wing.

Gap straps are used to cover the small spaces on each side of the leading edge when it is in the down position. The gap straps are flexible metal strips retained by screws at the top. At the other ends, or bottom ends of the straps, are cross pins which serve to connect the straps into a turnbuckle overcenter latch assembly which is for the purpose of adjusting and drawing up the straps. The turnbuckle overcenter latch unit is screwed to the lower spar cap. Over the gap strap length a series of 12 fasteners is incorporated to hold the strap and prevent it from "ballooning" in flight. Although the straps do hold the leading edge down to some extent they are not intended to serve this function.

As noted, the leading edge component was recovered about one-half mile from the far end of runway 31. It was relatively intact except that the skin covering, about one-half of the heater duct, and the piano hinge were missing. A major portion of the skin and the heater duct were located about 200 yards beyond the leading edge. The hinge was recovered with the right wing and although badly impact-damaged it was still attached to the wing. The missing balance of leading edge skin, a piece about 18 x 18 in., was attached to the hinge.

The self-locking nuts which were previously mentioned as serving to retain the 27 stress screws are normally held in position by a "gang channel" riveted to the lower spar cap. The gang channel was recovered in several sections with 21 of the 27 self-locking nuts still in place. The channel was recovered in the main wreckage separated from the wing spar cap by impact forces which sheared the retaining rivets.

Each of the self-locking nuts was meticulously examined under a magnifying glass for any evidence of pulled threads, sheared screws, or other evidence which would indicate that the stress screws were in the nuts at the time of the accident. The nuts were examined in their recovered condition and again after they were cleaned. There was no evidence which indicated the screws were in the nuts. In fact, the threads of each nut were found to be in good condition; none was pulled and there were no screw portions in any of the nuts. Also, a search in the wreckage and along the ground and flight path failed to recover any of the screws normally used to secure the leading edge.

The countersunk screw holes in the leading edge showed no evidence of abnormal elongation, marks, or tearing which would be present if screws had worked loose allowing the middle portion of the bottom of the leading edge to "work" or "balloon."

Both gap straps were recovered. One was found just beyond the airport boundary and the other was with the main wreckage. Their examination revealed that both had failed from loads beyond their design strength. Failure occurred when the cross pins pulled out of the turnbuckle assembly. The turnbuckle and overlatch assembly remained in place.

Except in areas noted, the continued examination of the aircraft, its engines and propellers, and other major components revealed no discrepancies. They were determined as not having been factors in the accident. This was substantiated by the pilots who said that there was no other difficulty other than the one involving controllability of the aircraft after the leading edge separated.

As indicated, N 8405H received a No. 3, areas 1 and 3, (heavy) maintenance check just before the aircraft left Los Angeles as Flight 12. The flying time involved since the inspection was 2 hr., 9 min.

Maintenance Check

With regard to the maintenance check the investigation revealed that the aircraft entered the maintenance hangar at approximately 1600 on Feb. 12, the afternoon before the accident. The lead mechanic on duty instructed some of his crew to open all inspection doors which included the right and left wing leading edges. The work was done by several mechanics. The aircraft inspector then went over the aircraft, noted and wrote up items for correction. Two discrepancies were located in the area exposed when the right leading edge was raised. Investigation disclosed these items were corrected and signed off before 0030 Wednesday morning when there was a shift change. Because the closing of all inspection plates is one of the final actions during a maintenance check the right leading edge and all other inspection plates remained open.

The check continued and about 0330 it was time to close the many access panels, inspection plates, and covers. The lead mechanic assigned personnel to this job, one of whom was borrowed from the engine crew. This mechanic, a certificated airframe and powerplant mechanic, was assigned to close the right leading edge and other openings on the right side of the aircraft, a job requiring considerable time.

The mechanic recalled that he first checked the self-locking nuts for security in the gang channel. He then determined the proper screw length, unhooked the right leading edge from its raised position, and lowered it into place. Although other mechanics said it was customary to put the stress screws in along the bottom of the leading edge before installing the gap straps the mechanic in this instance initially stated that he installed the straps first and experienced no difficulty.

Later, at the public hearing, the mechanic

testified that he believed after lowering the leading edge he then put in a few screws along the bottom edge of the leading edge to align and hold the component. He said he partially tightened these screws. He said that the screws used were obtained from his tool box because, although he looked, he did not see the screws originally taken out. At least two mechanics, however, stated they had seen them hanging in a rag at the leading edge opening. He stated that he then installed the gap strap overcenter latch assembly with screws and pulled up the straps as required. The witness said he had obtained an air-driven screw driver at this time and to his best recollection had installed the remaining screws and fully tightened the few which had been initially put in and partially tightened.

An engine lead mechanic stated he had seen two screws being tightened by the mechanic using the air-driven screw driver. He, however, did not recall the precise area (gap strap or bottom leading edge) where the screws were being tightened.

An examination of the mechanic's tool box disclosed a supply of various type screws. The supply included 10-32 screws of both 11/16 and 9/16 lengths. These, and the others, were separated in individual small containers.

During the public hearing the mechanic was asked directly, if, in view of the evidence indicating that there were no screws installed along the bottom edge of the leading edge, he might have forgotten to install them. In response the witness stated, ". . . it just doesn't seem like they were in it." When asked, the mechanic revealed factors of a personal nature which could have contributed to forgetting the screws. These reasons were verified by Board investigators.

The mechanic said that he believed the work on the leading edge required about 30 min. and he completed the task at approximately 0400. He then continued to close other openings for most of the remaining shift.

Maintenance Responsibility

According to Western Air Lines maintenance procedures at the time of the accident, the responsibility for ascertaining that all inspection openings are properly closed and secured was that of the lead aircraft mechanic. This is expressed in the company's maintenance manual (2.2.3(d)) as follows: "The lead mechanic will make a walkaround inspection of the aircraft to ascertain that ALL ACCESS DOORS, PLATES, OPENINGS AND CARGO PIT LINING IS IN PLACE AND SECURED and sign off the applicable line on the Master Card." The replacement and security of all access doors, plates, and covers is one of five items to be individually certified on the bottom of the master work record form. This item is to be signed for by the lead mechanic indicating satisfactory completion prior to returning the aircraft to service.

The lead mechanic who was charged with this responsibility stated that he made the inspection in his usual manner. This, he said, was to determine that no plates were open and/or hanging down. In response to questions he said that he did not check each plate "screw by screw" but that he went over the airplane looking into various areas and sighting over its exterior surfaces and then

checked the cargo pit lining. He said that he could not, from his inspection, state whether or not the leading edge screws were in place but that his inspection would normally reveal any screws sticking out or plates which were not flush with the aircraft surface.

He said that he expected a mechanic with airframe and powerplant ratings to do the job of "putting up plates" properly. The witness indicated that he believed there was a certain amount of work which those mechanics do which need not be checked on. He said, "I shouldn't have to check everything." The lead mechanic estimated that detailed inspection of each and every plate on the Convair would require about 45 min. He said that such an inspection, in consideration of his other duties of directing, coordinating, and assigning the work to be done by up to 12 men, would be very difficult. He added that in his view the inspection in issue was more properly the function of an inspector rather than that of the lead mechanic. The witness stated that after completing the inspection he had signed for the work on the master work record form and when he was relieved he reported to the incoming lead mechanic that the plates were closed.

Instruction Clear

Another lead mechanic was questioned during the hearing concerning the manner in which he performed the walk-around inspection and his understanding of the company instructions delineating the responsibility to the lead mechanic. He said that the instruction was quite clear to him and that it meant "just what it said" to inspect the plates, see that they were in place and secured. He indicated that his method of accomplishing the inspection was to view the plates from close proximity, looking for proper placement, looseness, and/or missing or partially tightened screws. He said that this was the only way he knew how to do the job. He indicated the responsibility was part of his work and he did it taking the time which the task required. He considered the responsibility very important and said when he "bought off" an item he ascertained personally that it was done to his own satisfaction. He also considered his responsibility as a necessary check on the work of another mechanic. Other maintenance personnel testified in substantial agreement with this lead mechanic.

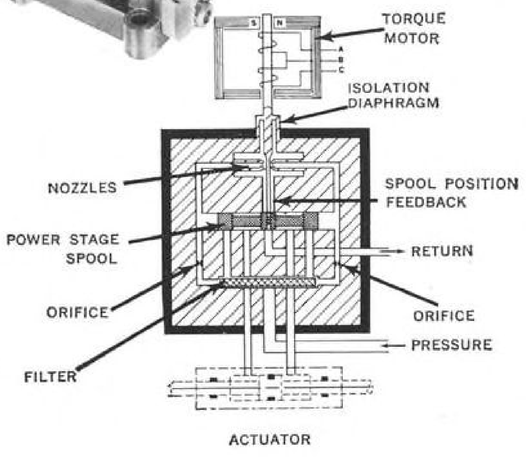
During the investigation and public hearing an over-all review of the company's maintenance practices, procedures, and policies was included. This was done believing firmly that these areas, particularly those relating to the heavy check phase, were properly part of the Board's responsibility in accident investigation.

The maintenance structure, in most respects, is comparable to other air carriers. Maintenance planning and instructions originate with the Director of Maintenance and are passed to a shift foreman who in turn passes them through lead mechanics to the individual mechanic. The company utilizes a progressive maintenance and card system. In general, the cards show work to be done according to the check being performed and a master work record form designates the cards appropriate for the check. Items completed are initialed by the mechanic com-

IMMEDIATE AVAILABILITY...*Hydraulic Research's new FLOW CONTROL TRANSDUCER for 2nd generation missiles...featuring*

ULTRA-HIGH STABILITY AT EXTREME ENVIRONMENTS

MAXIMUM PERFORMANCE FROM -65° TO +450° F, AND TO 100 G's



Here is a completely integrated electro-hydraulic flow transducer developed exclusively for advanced, high performance control requirements. It is essentially unaffected by acceleration, vibration and temperature extremes.

TYPICAL PERFORMANCE DATA

Control Flow Range	0.15 to 15 GPM
Typical Electrical Input	80 milliwatts
Operating Pressure Range	150 to 4000 psi
Hysteresis	3% max.
Threshold	½% max.
Null Shift Due to Temperature Changes	5% max. —65 to +450°F.
Null Shift Due to Acceleration, Vibration, Shock	5% max. up to 100G
Operating Temperatures	—65 to +450°F.
Weight	1.0 lb. nominal
Flow Gain Linearity	±5%

Compatible with all hydraulic system fluids and most fuels.

no external null adjustment necessary

write for complete details

HYDRAULIC RESEARCH AND MANUFACTURING COMPANY
Subsidiary of Bell Aircraft Corp.
2835 N. Naomi Street • Burbank, Calif. • Victoria 9-2227

REPRESENTATIVES:

WASHINGTON
C & H SUPPLY COMPANY
King County Airport, Boeing Field
Seattle 8, Washington

KANSAS
C & H SUPPLY COMPANY
1725 East 2nd Street
Wichita, Kansas

TEXAS
E. S. BETTS
Post Office Box 1107
Grand Prairie, Texas

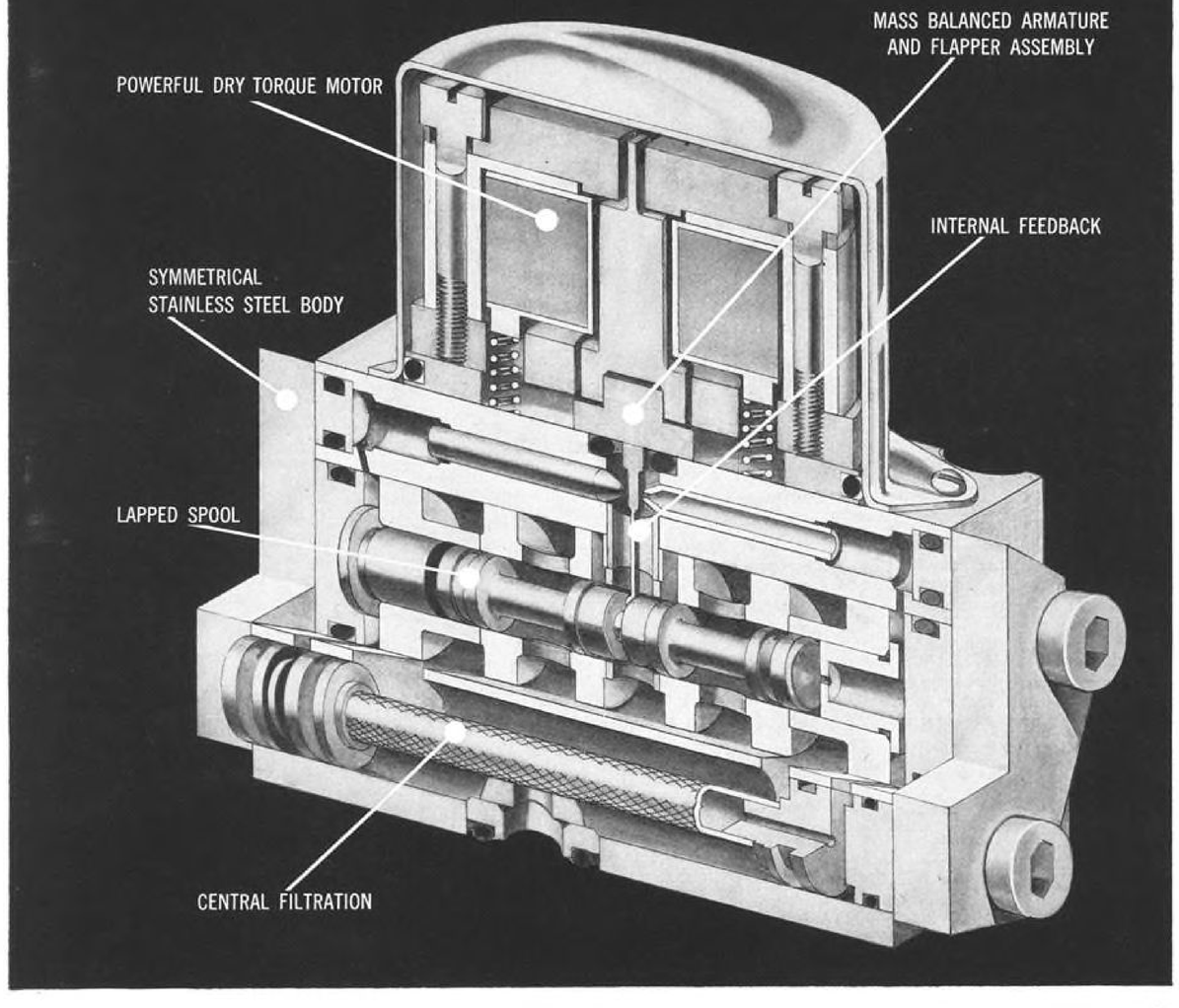
MISSOURI
R. F. CARLSON, JR.
#1 Spoede Acres
Creve Coeur, Missouri

NEW ENGLAND STATES
NORTHEAST SALES ENGINEERING
3013 Dixwell
Hamden, Connecticut

SOUTHEASTERN STATES
SOUTHERN DYNAMICS
7257 Lake Drive
Orlando, Florida

CANADA
AIRCRAFT APPLIANCE
& EQUIPMENT LIMITED
585 Dixon Road, Post Office Box 177
Toronto 15, Ontario, Canada

HYDRAULIC RESEARCH FLOW CONTROL TRANSDUCER/MODEL 26



pleting the work and when the card is finished the lead mechanic, or foreman, ascertains that the work has been signed off. The mechanic's work of closing the panels and plates, however, did not require his initials as indicating work having been done.

Items considered by the company to require inspection and sign off by an inspector are indicated by an asterisk beside that item on the card. Other items requiring the reinspection by an inspector are designated as "red and black' line items. These are designated in the maintenance manual or are so determined by the inspector working the aircraft. In addition, other items requiring reinspection are those defined in the company maintenance manual "CV-240 2.2.4(b)."[2] Accordingly, of 84 items written up by the inspectors on N 8405H, 64 were reinspected by an inspector.

During the public hearing company policies, procedures, and their basis surrounding the inspection of all access panels and plates were fully explored. As already indicated, these items included the leading edges of the Convair and it was learned that ascertaining that these items were "in place and secure" was not an inspectors responsibility. It was, however, considered an inspection function delegated to the lead mechanic.

Company Tests

Several reasons were given for delegation of the responsibility to the lead mechanic. The reasons dated back several years to an incident following which this responsibility was re-evaluated. It was learned that before assigning the responsibility a test was made in the nature of a time and workload study. The test consisted of having lead mechanics perform the subject inspection. It was determined at that time the function could be done quickly and adequately by the lead mechanic. It was also felt by supervisory personnel that it fitted into the lead mechanic's workload without apparent difficulties and that both the inspector and lead mechanic were equally qualified to do the task.

The delegation was then disseminated through shift foremen to all lead mechanics and incorporated in written procedures. Company personnel stated that this assignment had worked well for the intervening years prior to the accident and no complaints had been registered through supervisory personnel concerning the delegation. Company supervisory personnel said, in summary, that it was felt the job was by no means downgraded in importance but it was simply a matter of selecting in their minds the proper person for the job, considering all factors. The CAA air carrier maintenance inspector assigned to the carrier stated he was aware of the procedure and was in concurrence with it.

Reviewing the work records of the maintenance performed on N 8405H during Feb. 12 and 13 it was noted that one work

[2] 2.2.4 Numbered Check Work Record Form OM-25. Recording Procedure. (b) Whenever it is necessary to disconnect lines, cables, electrical connections, etc., or remove components, etc., to make repairs and/or adjustments during the course of accomplishing any numbered check on the engines or aircraft, the Mechanic will enter such item/s on the Work Record Form and sign off the item on completion. The purpose of such recording is to provide a complete history of all work operations. All such items are to be re-inspected and signed off by an Inspector.

record form used was not the latest card. The card had been revised and, according to the company, the older card should not have been used. In another instance the Master Work Record Form used was for the DC-6B. This form, however, had been made suitable for the Convair by striking the inapplicable items and by adding applicable ones. One applicable item, although it had no bearing on this accident, was nevertheless omitted. A company witness stated this form was used probably because the Convair form was in reprint and temporarily out of supply. Other than the above discrepancies the paper work covering the No. 3 heavy check was in good order.

Experience Standards

Western Air Lines' standards of experience and qualifications for maintenance personnel are high. An applicant for employment in the maintenance section must possess a CAA mechanic certificate with a current airframe or powerplant rating. If his duties are to be in line maintenance or as a member of a heavy check crew and the employe has only one of the ratings he must obtain the other within a reasonable period. Company policy establishes the same experience and qualification requirements for the inspector and lead mechanic positions and the positions are of equal status in the personnel structure.

All heavy maintenance inspections are scheduled and performed at the carrier's Los Angeles facilities. All airframe, engine, propeller, and instrument overhauls are accomplished there. At Seattle the company performs turnaround and No. 1 checks on its DC-6 equipment and the same checks are accomplished on the Convair at Denver. In the event an unscheduled engine change or other major work is required at an outlying station, personnel from Los Angeles are sent to do the work.

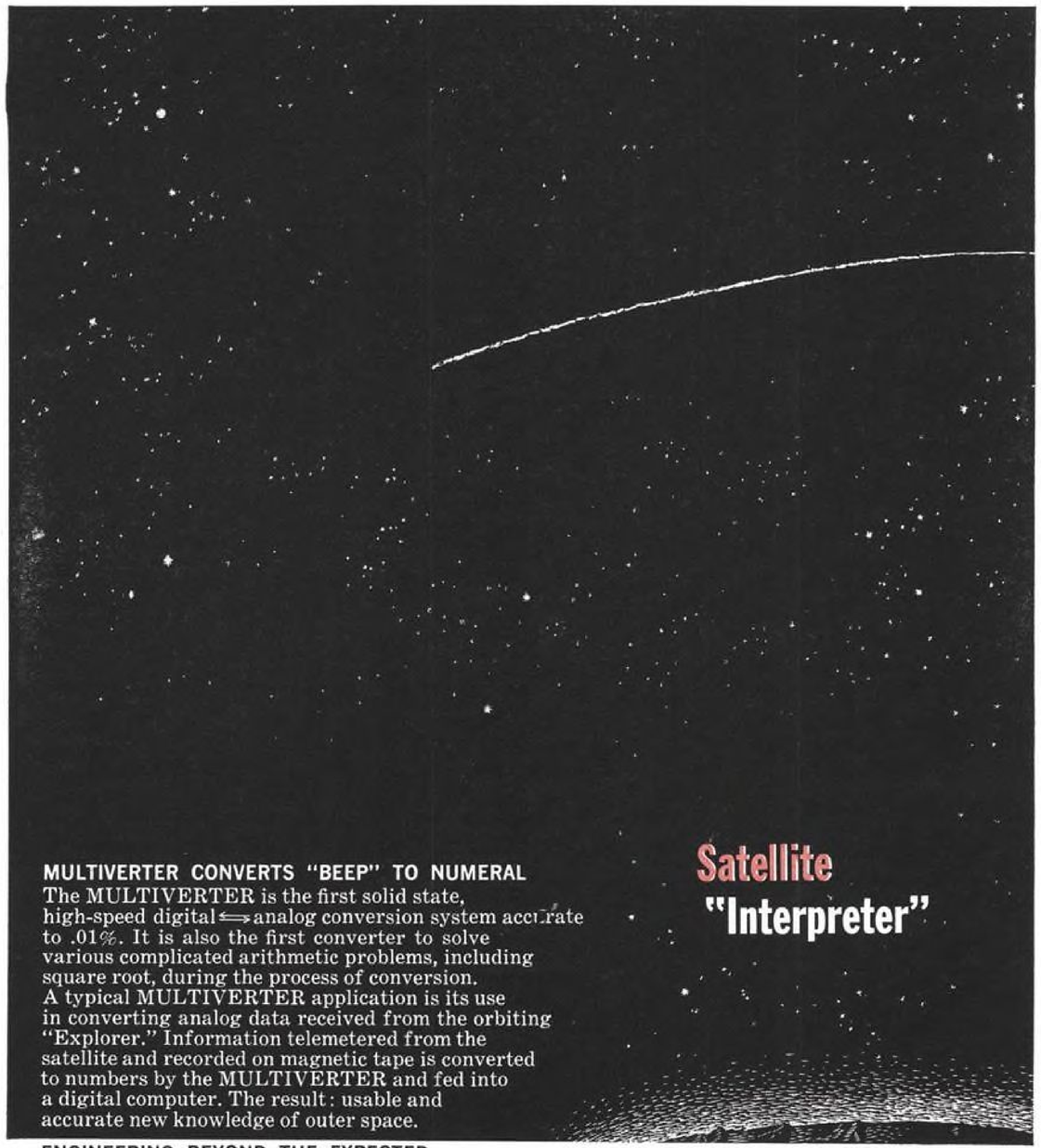
The maintenance hangar and shops of Western at Los Angeles are maintained in a clean and orderly condition. They are well lighted, both day and night, with extension lights and floodlights available. The maintenance docks are permanently mounted in the hangars, with sufficient ladders and work stands provided. The various shops have necessary test stands and special tools, and both these tools and those belonging to the individual mechanics are adequate in quantity and quality to ensure good work.

ANALYSIS

Prior to the origination of Flight 12 the pilots performed a preflight inspection of the aircraft. The description of this function by the pilots was, in the Board's view, in accordance with the company procedures and would have revealed such discrepancies as normally expected from the pilots' walk-around. The Board is well aware that the pilot preflight is not a maintenance function nor is it by nature and purpose a "screw by screw" check of an aircraft.

When Flight 19 reached about 500 ft. above the ground immediately following takeoff the pilots heard a sharp report which was immediately followed by severe control difficulty. The problem manifested itself as severe vibration, buffeting, and difficulty in raising the nose of the airplane.

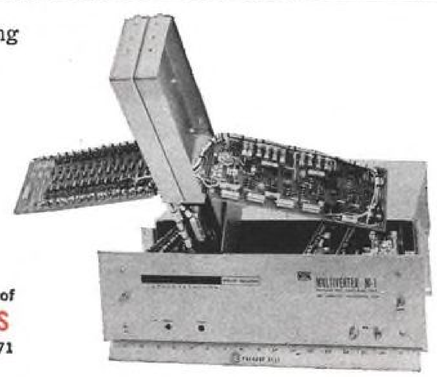
As shown by a preponderance of clear evidence, the difficulty was caused by an



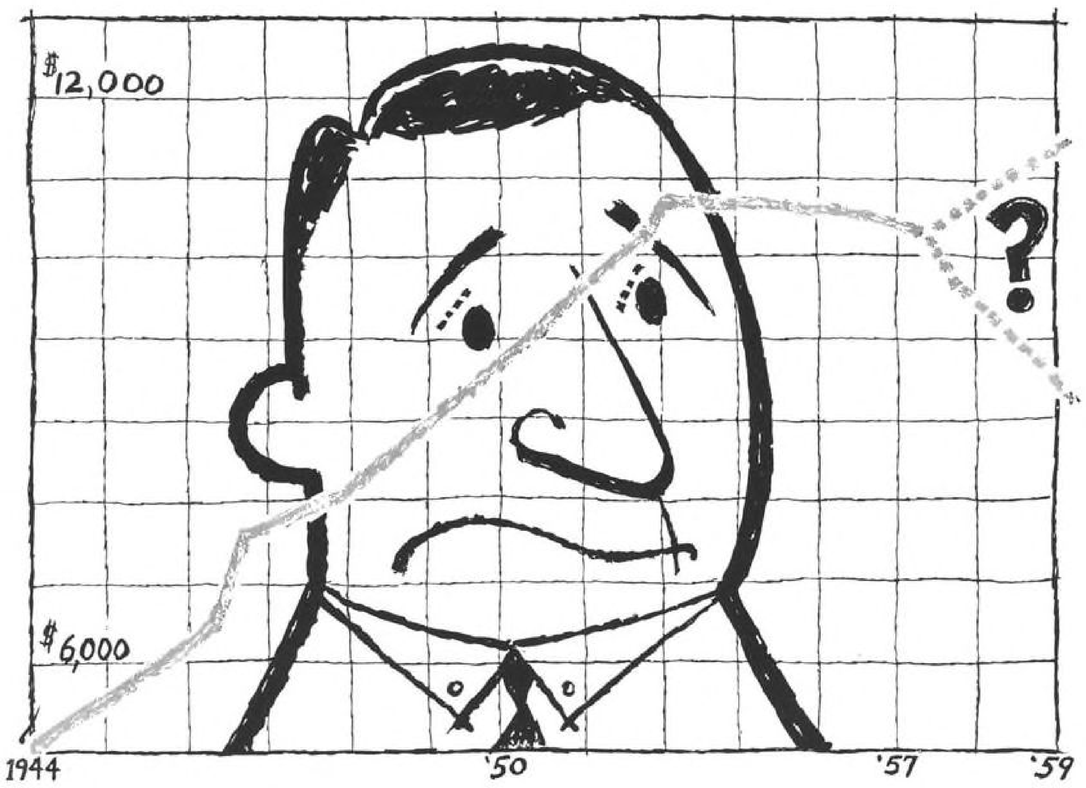
Satellite "Interpreter"

MULTIVERTER CONVERTS "BEEP" TO NUMERAL
The MULTIVERTER is the first solid state, high-speed digital⟺analog conversion system accurate to .01%. It is also the first converter to solve various complicated arithmetic problems, including square root, during the process of conversion. A typical MULTIVERTER application is its use in converting analog data received from the orbiting "Explorer." Information telemetered from the satellite and recorded on magnetic tape is converted to numbers by the MULTIVERTER and fed into a digital computer. The result: usable and accurate new knowledge of outer space.

ENGINEERING BEYOND THE EXPECTED
The need for highly accurate measurement in an accelerating technology called for a solid state converter with an accuracy of .01% and a speed of four microseconds per bit. The MULTIVERTER and related accessories resulted. One immediate application has been the interconnection of Packard Bell's TRICE, the first incremental differential analyzer to operate in real time, with various analog systems. Other applications include Missile Impact Prediction, Coordinate Conversion, Orbit Prediction and Solid State Automatic Checkout Systems.



Packard Bell Computer Corp., a subsidiary of
PACKARD BELL ELECTRONICS
12333 W. Olympic Blvd., Los Angeles 64, Calif., BR 2-2171



The "career-curve" of a man named Carter

Charlie Carter started out like a ball of fire. First ten years — terrific! Then he seemed to slow down. Other men — younger newcomers — passed him by. Why?

What happened to Charlie? Nothing. It's what has been happening to industry. Business has become so big and busy, it moves too fast for men who seem satisfied with the status quo. Never have management ranks been so wide open for "get-up-and-go" men.

Look ahead, read ahead, get ahead. Know your job inside out. Be an "authority". But don't stop here. Be a growing man . . . equally knowing on the cross-currents of other job functions within your company — well-informed on the working inter-relationship of all operations — the big picture.

How can you do this comfortably? With the business publication you have in your hand right now. Its editors know your field. They work in it — right at your side. They are your eyes and ears. They go to the places you would go if you had the time. They look, listen, question for you. They review, analyze, edit . . . deliver all that is important to you. They eliminate the non-essential and the time-wasting. They do this fast and accurately. And because they write about that which is as close to you as your own family — your future . . . you will find your favorite McGraw-Hill publication more and more a pleasure as well as a profit to read.

The big benefit to you is simply this: The greater time you put into reading this magazine, the greater your gain in "time saved". You handle your present job faster and with far greater effectiveness. And you reward yourself with bonus hours of new opportunity to look up and do something about that bigger job ahead.

McGRAW-HILL SPECIALIZED PUBLICATIONS

The most interesting reading for the man most interested in moving ahead

inflight separation of the right wing leading edge section, normally installed between the right engine nacelle and fuselage. The control difficulty is compatible with the disruption of normal airflow over the right airfoil after the leading edge section separated. Undoubtedly normal lift was affected and a turbulent abnormal slipstream was introduced to the horizontal stabilizer and elevator control surface. It is also apparent that the section of leading edge skin which remained attached to the hinge blew back and forth in the slipstream. This most likely aggravated the disruption of airflow and produced a spoiler effect on the right wing. In the judgment of the pilots, which seems entirely reasonable to the Board, the severity of the control problem necessitated an immediate emergency landing.

Examination of the leading edge disclosed no evidence which would indicate that the screws used to retain the leading edge were in place at the time of the accident. There were no stripped threads in the self-locking nuts, there were no sheared screws in the nuts, and there was no other evidence which would show the screws had pulled out.

Examination of the leading edge screw holes exhibited no indication of abnormal elongation, scratches, and marks which would be expected if some of the screws had vibrated loose allowing the leading edge to "work" or "balloon" against remaining screws. If the proper screws had been installed they would not have worked out and if shorter screws had been used it is extremely improbable that all 27 screws would work out evenly at the same time. Even in this situation evidence would have been present on the edges of the screw holes or on the self-locking nuts. On the contrary, the screw holes and the 21 nuts recovered were in good condition. Therefore, after careful consideration, it is the opinion of the Board that the mechanic assigned to close the leading edge opening forgot to install the screws. It is obvious that he did install the gap straps which held the leading edge in place for about two hours of flight time before they failed under loads which exceeded their design limits.

The Board can neither justify nor excuse the manner in which the lead mechanic carried out his responsibility of inspecting the access panels for being "in place and secured." Considering that he was an expert in aviation maintenance, and the responsibility was clearly expressed in company material, its importance should have been evident to him. The Board is of the opinion that only a close and detailed inspection of each panel could satisfy the responsibility as it was expressed. The method of inspection of the aircraft, according to the lead mechanic's description, could not have assured him that screws were installed in the leading edge. From all the evidence, the Board is convinced that the lead mechanic treated the inspection in a cursory manner and as if there was an inadequate appreciation for its importance.

It is obvious that the inspection for proper closing and security of the access panels is an important airworthiness function and the responsibility for it must be placed in the proper person. That individual must be selected considering such tangible factors as qualification and experience as well as his other duties and over-all workload. From the evidence presented it is apparent that

all these factors were considered before the inspection assignment was made.

Nevertheless, there are other factors which the Board believes are worthy of consideration or reconsideration. In order to provide an efficient and smooth working maintenance organization a definite distinction is normally made between the responsibilities and duties of the production and inspection phases of air carrier maintenance. One of the primary concerns of the production group is the expeditious completion of all maintenance on each aircraft involved and its return to service. In this operation quality is expected; however, the early completion of the work scheduled is paramount. On the other hand, the primary concern of the inspection group is quality control relative to workmanship of the maintenance group and the airworthiness of the aircraft before its return to service.

In general, Western Air Lines has followed this concept; however, the division of responsibilities is not sharply drawn within the structure of the maintenance organization. According to WAL maintenance manual, all airworthiness items must be "Red Lined" which requires reinspection by an inspector.

Obviously, the portion of the wing leading edge which separated in flight is critically related to the airworthiness of the aircraft. Despite this, the inspection responsibility was delegated to the production group.

The importance of maintaining a distinct separation between production and inspection is well illustrated by the testimony of the lead mechanic who performed the inspection in this instance. In essence, he said that reliance should be placed on the working mechanic to do uncomplicated work without the necessity of his inspection. While many may consider this view to be an individual's viewpoint, the Board believes it may be a consideration which should be reviewed by the company before delegating any inspection responsibility to production personnel.

Civil Air Regulations, Parts 18 and 40, state the requirements to be met in air carrier maintenance. These regulations require that an inspection department be maintained within the maintenance structure; however, considerable latitude is allowed so that each carrier may have flexibility in its specific maintenance structure according to the many variable needs and considerations in air carrier operations.

FINDINGS

On the basis of all available evidence the Board finds that:

1. The carrier, crew, and aircraft were currently certificated.
2. At Los Angeles, prior to Flight 12, the pilots made a walk-around inspection in accordance with company procedures.
3. Flight 12 and Flight 19, until the Palm Springs departure, were uneventful and except for a lateral "out of trim" condition the aircraft operated normally.
4. During the departure from Palm Springs the right wing leading edge separated in flight.
5. Separation of the component resulted in severe control difficulty and buffeting of the aircraft.
6. A gear-down emergency landing was

made in the boulder-strewn desert about ¾ mi. north-northwest of the airport.

7. During the ground roll, impacts with the boulders caused severe damage and breakup of the aircraft, and a fire in the left wing spread rapidly and destroyed the aircraft.

8. N 8405H received a No. 3, areas 1 and 3, heavy maintenance check about two hours of flying time before the accident.

9. During the maintenance a mechanic assigned to close and secure the right leading edge forgot to install the retaining screws.

10. The gap straps were properly installed.

11. An inadequate inspection of the aircraft by the lead mechanic resulted in the failure to detect the omission.

12. The gap straps held the leading edge in place until the Palm Springs departure when they failed from loads beyond their design strength.

PROBABLE CAUSE

The Board determines that the probable cause of this accident was the failure of a mechanic to secure properly the right wing leading edge section as a result of which the unit separated in flight. This improper installation was undetected because of inadequate inspection.

By the Civil Aeronautics Board:

James R. Durfee
Chan Gurney
Harmar D. Denny
G. Joseph Minetti
Louis J. Hector

SUPPLEMENTAL DATA

The Civil Aeronautics Board was notified of the accident at 1440 Feb. 13, 1958, approximately an hour following the occurrence. An investigation was immediately initiated in accordance with the provisions of Section 702 (a) (2) of the Civil Aeronautics Act of 1938, as amended. A public hearing was ordered by the Board and held in the Hollywood Roosevelt Hotel, Hollywood, Calif., Mar. 28, 1958.

Western Air Lines, Inc., is a scheduled air carrier incorporated under the laws of the state of Delaware. Its principal offices are located in Los Angeles, Calif. The carrier operates under a currently effective certificate of public convenience and necessity issued by the Civil Aeronautics Board and an air carrier operating certificate issued by the Civil Aeronautics Administration. These authorize the company to transport by air persons, property, and mail between various points in the United States including the route over which the accident occurred.

Capt. Richard E. Schumacher, age 40, held a currently effective airman certificate with an airline transport rating and rating for the subject aircraft. He was employed by the company on Feb. 23, 1945. At the time of the accident he had a total of 9,845 flying hours, of which 3,547 were in the Convair 240.

His latest medical examination was satisfactorily completed, without waiver, on Dec. 18, 1957.

First Officer James R. LeBel, age 31, was employed Sept. 7, 1954. He held a currently effective airman certificate with airline transport rating. First Officer LeBel, at the time of the accident, had accumulated

5,240 flying hours, with 785 in the Convair 240. His latest medical certificate was dated Mar. 5, 1957.

Stewardess Barbara F. Grimes, age 24, was employed as a stewardess on July 8, 1957, following the satisfactory completion of training. This training included emergency procedures on the aircraft utilized by the carrier.

N 8405H, a Convair 240, was manufactured Dec. 23, 1948, bearing serial number 22, and delivered to Western Air lines in 1948.

From date of manufacture until the accident the aircraft had accumulated a total of 22,516 hr. It was currently certificated by the Civil Aeronautics Administration. At the time of the accident the aircraft was equipped with nearly new Pratt & Whitney model R-2800-CB-16 engines. The propellers were Hamilton Standard 43E60-7 with model 6895A-12 blades.

Navy Contracts

Following is a list of unclassified contracts for $25,000 and over as released by Navy Contracting Offices:

AVIATION SUPPLY OFFICE, 700 Robbins Ave., Philadelphia, Pa.

The Cleveland Pneumatic Tool Co. Division, Cleveland Pneumatic Industries, Inc., Cleveland, Ohio, cylinders: used on strut assemblies for various aircraft, N383-56869A(383/7112-208011/57, 383/217004/59), various, $117,549.

Joseph Pollak Corp., Boston, Mass., control assemblies: ignition switch for P5M-1, -2 aircraft, N383-56788-A(JD 383/214131/-59), various, $46,575.

Western Gear Corp., Lynwood, Calif., gear boxes for various aircraft, N383-56551-A(383/211118/59), various, $105,335.

Melstrom Manufacturing Corp., Perth Amboy, N. J., antenna for airborne electronic equipment, N383-56736A(383/233161/59) 70 ea., $26,390.

Collins Radio Co., Cedar Rapids, Iowa, coil assemblies: airborne radar receiver, N83-56749A(383/231019), various, $33,599.

General Electric Co., Philadelphia, Pa., transmitters: fuel tanks for various aircraft, N383-56909A(383/216020/59), 42 ea., $29,-024.

Thompson Products, Inc., Cleveland, Ohio, repair kits: used on pumps for various aircraft, N383-56637A(383/213073/59), various, $29,248.

Westinghouse Electric Corp., Philadelphia, Pa., brush kits used on generators for P5M-1-2, aircraft, N383-55806A(383/-212015/59), various, $35,257.

Lisle Corp., Clarinda, Iowa, chip director to support engines, N383-56910A(383/-251100/59), 18,000 ea., $61,740.

United States Gauge Division, American Machine & Metals, Inc., Sellersville, Pa., torquemeters: press: for various aircraft, N383-56785A(383/211129/59), 696 ea., $46,-354.

Acco Equipment Division, American Chain and Cable Co., Inc., hoists: portable, bomb, N383-56397A(383/261115/59), 286 ea., $97,-235.

Eclipse-Pioneer Division, Bendix Aviation Corp., Teterboro, N. J., indicators: range for A4D-1, 2 aircraft, N383-56902A-(383/216150/59), various, $49,876.

The Goodyear Tire and Rubber Co., Akron, Ohio, linings: used on brake assemblies for various aircraft, N383-56884A-(383/211069/59), various, $119,933.

Bill Jack Scientific Equipment Corp., Solana Beach, Calif., shell assemblies, for aircraft pilots helmets, N383-56810A (JD 383/27113/59), various, $246,996.

The Goodyear Tire and Rubber Co., Akron, Ohio, brake and wheel assemblies for various aircraft, N383-56342A (383/-211012/59), various, $273,537.

The Goodyear Tire and Rubber Co., Akron, Ohio, brake and wheel assemblies for various aircraft, N383-56875A (383/-211013/59), various, $108,143.

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:

Boeing Airplane Co., Wichita, Kan., B-52 MTU, (PR XE-9-6936-7095), $385,000.

Boeing Airplane Co., Wichita, Kan., B-52 airplanes and associated support items, (PR XE-9-1510-7012 and amendment no. 1), $15,000,000.

Northrop Division, Northrop Aircraft, Inc., Hawthorne, Calif., T-38 static test program, (PR TR-9-1510-7217), $100,000.

Cessna Aircraft Co., Wichita, Kan., T-37A aircraft (jet trainers), PR XR-9-1510-7028), $12,345,000.

Link Aviation, Inc., Binghampton, N. Y., T-37 flight simulator trainers, type AF/F-37A-T4 and spare parts, (PR XR-8-28-7256), $1,952,137.

Northrop Aircraft, Inc., Hawthorne, Calif., spare parts and ground equipment for T-38 airplanes, (PR XR-9-1510-7008), $16,926.

Cessna Aircraft Co., Wichita, Kan., engine noise reduction and engine boundry surge increase program for T-37A aircraft, (PR XR-8-1510-7292), $48,335.

Northrop Division, Northrop Aircraft, Inc., Hawthorne, Calif., planning, engineering, tooling, fabrication, assembly and other work incidental to the development of the N-156F fighter aircraft, (PR XR-9-1510-7100), $997,884.

General Electric Co., West Lynn, Mass., indicators, tachometer, type MU-1 for F-100F, KC-135A, B-58A, F-101B, C-130B, T-37A, H-43B and Army requirements, (RFP PE-8-05D-3800), (PR PE-8-05D-3800), $273,480.

Aerial Machine & Tool Corp., Long Island City, N. Y., harness, aircraft safety, personnel retaining type MA-1 for aircraft, (IFB 33-600-59-8), (PR OC-8-03F-5444), $29,278.

AiResearch Manufacturing Co. of Arizona Division, The Garrett Corp., Phoenix, Ariz., constant speed drive assemblies, pneumatic, model MC-1, spare parts and data for F-105 aircraft, (RFP PE-9-031-4050), (PR PE-9-031-4050), $1,738,487.

Pioneer-Central Division, Bendix Aviation Corp., Davenport, Iowa, altimeter, pressure, 1¾" dial, type AAU-2/A for use in F-105 and F-106 aircraft, (PR PE-9-05C-4019 and 4033), $205,174.

Pioneer-Central Division, Bendix Aviation Corp., Davenport, Iowa, indicator, indicated airspeed, 1¾" dial, integrally lighted, type AVU-2/A, for use in F-105 and F-106 aircraft, (PR PE-9-05C-4020 and PE-9-05C-4034), $93,665.

Westinghouse Electric Corp., Dayton, Ohio, transformers, component spare parts and data, for F-105 aircraft, (RFP PE-8-03C-3823), (PR PE-8-03C-3823), $340,677.

Red Bank Division, Bendix Aviation Corp., Eatontown, N. J., generators, regulators, control panels and data for support of the F-100 series aircraft, (RFP PE-4213, PE-3805, SA-4750 and SA-4748), (PR PE-4213, PE-3805, SA-4750 and SA-4748), $237,294.

G. M. Giannini and Co., Pasadena, Calif., transmitter, synchro, angle of attack, type Q-2 for use on F-105 and F-106 aircraft, (IFB 33-600-59-11), (PR-8-05C-3459, PE-9-05C-4026 and PE-9-05C-4026-1), $198,117.

Eclipse-Pioneer Division, Bendix Aviation Corp., Teterboro, N. J., amplifier, servo, 60-1488, directional control, 60-1485, spare parts, special tools and test equipment and data for various USAF aircraft, (PR MA-8-05A-706, 709, PE-9-05A-4152, 4208 and SA-8-05A-3957), $1,041,710.

Kearfott Co., Inc., Clifton, N. J., control panel, Aerno 60-1486; gyroscope, displacement, Aerno 60-1490; control panel, Aerno 60-1491; gyroscope, displacement, Aerno 60-1493; spare parts, special tools, test equipment and data for various USAF aircraft, (PR MA-8-05A-708, 711, 768 and PE-8-05A-4205), $638,962.

Pioneer-Central Division, Bendix Aviation Corp., Davenport, Iowa, transmitter, rate of flow, fuel, Type MA-2 (Aerno 61-2458) (RFP MA-8-05D-703) (PR MA-8-05D-703), $50,530.

Killian Lists Science Management Aims

Washington—Dr. James R. Killian, special assistant to the President for Science and Technology, outlined his approach to science management in a talk at the 125th annual meeting of the American Assn. for Advancement of Science.

Dr. Killian listed three major points of his management philosophy. They are:

- **Science does not need positive** direction to achieve maximum efficiency and vigor.
- **Past record of progress in science** and technology shows the U.S. must advance in "steps and not by leaps."
- **Science should not be placed** under the direction of a single agency but should be infused into the program of every department. The best way to protect science from political interference and to keep its efficiency high is to give it a direct relationship with all responsible executives as well as the support of advisors from the nation's leading private institutions.

Scientific Advice

Dr. Killian also explained in some detail the activities and functions of the President's Science Advisory Committee, which he heads. Primary purpose of the committee, he said, is to make "scientific advice and analysis available where they are needed in the formulation of national policy." This advice is generated by the 18 committee members and a fluid group of about 75 engineers and scientists who serve on temporary panels which study special problems, and act as consultants and staff. The advice is funneled to Dr. Killian, the primary committee contact with the President, although he said "the Committee has the perogative, when it chooses, to report directly to the President."

The White House has declined to make public the names of the members of these Science Advisory Committee panels which advise the President on the feasibility of many of the major weapon systems and other large federal projects. Primary reason for this secrecy as given by Dr. Killian is that it "would adversely affect the public interest by endangering our national security." Area of study of the panels has been released in only five cases.

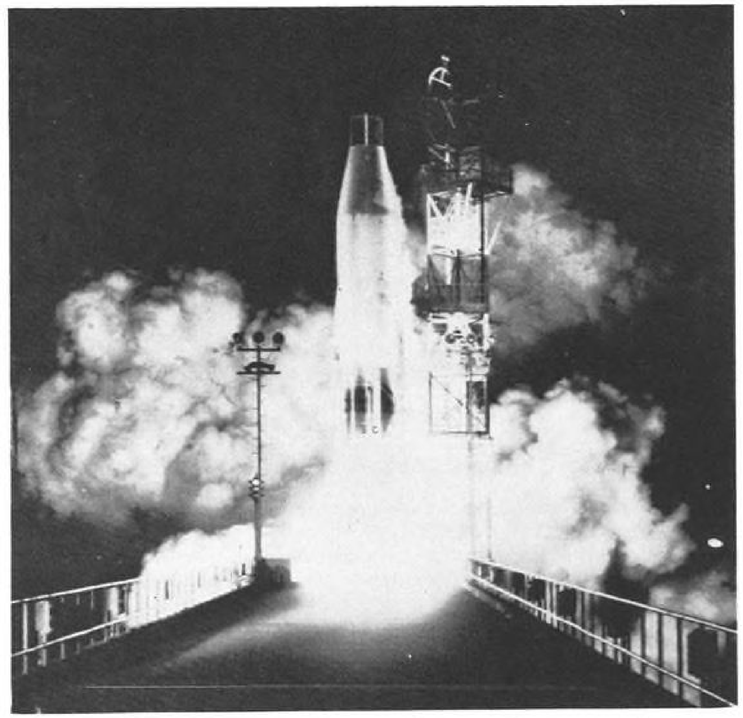
Efforts that have been made by the Administration to improve scientific activity in the U.S. and to relate it more effectively to policy making also were reviewed by Dr. Killian. He listed basic research as a vital need and described the National Science Foundation as "one of the government's major means for advancing science and supporting basic research."

Dr. Killian pointed out that the Foundation had been strengthened by increasing its federal appropriation from $50 million in Fiscal 1958 to $136 million in Fiscal 1959. However, the original Foundation request for $222 million was cut to $136 million by the White House before being sent to the Congress.

Other government action that has resulted from the Soviet earth satellites was characterized by Killian as "an impressive array of organizational innovations for the management of government programs in science and technology and for the provision of scientific advice at policy-making levels."

Innovations he mentioned included the creation of the National Aeronautics and Space Administration, the Advanced Research Projects Agency, the National Aeronautics and Space Council, the science adviser in the State Department, Killian's own post of special assistant to the President for science and technology, the post of Director of Research and Engineering in the Defense Department just filled by Herbert York (AW Jan. 5, p. 22), and the Federal Council for Science and Technology.

Serious problems faced by the nation that are receiving attention from Killian's group include the relatively small investment in new research facilities in



First Atlas-C Fired at Cape Canaveral

First Air Force-Convair Atlas-C intercontinental ballistic missile was fired for less than the full range from Cape Canaveral, Fla., to test guidance, nose cone and air-frame refinements. It was the 17th Atlas launched. Arma all-inertial guidance components were carried, and telemetered what they would have done had they been guiding the missile. Atlas-A series tested boosters, airframe, guidance, etc. Series B tested sustainer engine, nose cone separation, full-range guidance and included the Score satellite. Of the 16 non-orbital firings, 11 have been considered successful.

relation to the size of the scientific task. Dr. Killian said: "Government operations increasingly have brought growing demands for the fruits of research and more support for actual work performed. There has been no comparable provision, however, for new instruments and facilities except in certain specialized fields."

The speech also indicated that no definite plans have as yet been made to remedy this situation. Dr. Killian said, however, that "the (President's Scientific Advisory Committee) panel urges the formulation of thoughtfully conceived policies for the financing and planning of the great multi-million dollar research instruments of modern science . . . which are needed or proposed in various fields."

Policy Group

The panel recommended that a new group be formed to form the policies governing the capital investment in these new facilities and the handling of personnel to man them without reducing the teaching strength of universities. Killian said, "We are at the point where we need to bring together the best available judgment from the domains of government, education and science to determine how far we should go in the establishment of research institutes and what their relations should be with universities."

Educational problems in the U. S. were reviewed by another panel of Dr. Killian's committee. The group called primarily for greater efforts by local governments and the various educational institutions.

While expressing the belief that there is clearly a "national will to be strong in science," Dr. Killian noted that "today we hear voices of doubt and pessimism decrying or questioning the concept of progress. . . ." He said he felt that the scientists themselves must make the true character of science and progress understood and show the close relationship between science and the human values. He pointed to the "great responsibility which rests upon science today in the light of the extraordinary opportunities which it has been given to participate in the formulation of national policy."

Bristol, Rolls-Royce Sell Rotol to Dowty

London—Bristol Aeroplane Co. and Rolls-Royce Ltd. are selling their jointly owned company, Rotol Ltd., manufacturer of aircraft propellers, landing gears and transmissions, to the aircraft component maker, Dowty Group Ltd.

Since financing for the purchase will be raised by an issue of new shares and must receive the British Capital Issues

Committee's consent, the price being paid was not revealed. But Dowty Group Chairman Sir George Dowty says the share issue will run into "several million pounds."

Rotol, with a 4,600 strong labor force and a plant only two miles distant from two of Dowty's aircraft component factories, was formed by Bristol and Rolls-Royce in 1937 to design and manufacture variable-pitch propellers.

Texas Instruments Submits Merger Plan

Dallas—Texas Instruments, Inc., and Metals & Controls Corp. have agreed to merge. Proposed merger plan will be submitted to the stockholders of both companies early in 1959.

The two companies would combine through an exchange of stock in which Metals & Controls stockholders would receive either ¾ of a Texas Instruments common share for each share of Metals & Controls' common or a combination of ⅗ of a share of Texas Instruments convertible preferred stock ($25 par value) and ⅒ of a share of Texas Instruments 4% common for each Metals & Controls common share. Texas Instruments preferred stock will be a special series issued only in connection with the merger plan. Texas Instruments has 3,256,988 common shares outstanding, Metals & Controls has 922,467.

British Contract Set For New Canberra

London—Ministry of Supply has announced that "subject to satisfactory negotiations" work of developing an RAF Canberra replacement will go to a consortium of Vickers-Armstrongs (Aircraft) and English Electric Co.

Main contract is being placed with Vickers-Armstrongs, but work will be shared 50-50 by both companies.

Also subject to final negotiations, development of an engine for the new supersonic fighter-bomber-reconnaissance aircraft is to be undertaken by Bristol-Siddeley engines, Ltd., new company formed last April to coordinate activities of Bristol Aero-Engines and Armstrong Siddeley Motors.

These two companies—subsidiaries of Bristol Aeroplane and Hawker Siddeley, respectively—will be completely merged into the new company.

Size of the order for the TSR-2 (formerly referred to as RAF Operational Requirement OR-339) was not disclosed and no design details were revealed.

The Vickers-Armstrongs and English Electric proposal was chosen from several designs. Chief competition in the final selection was believed to be one proposed by Hawker Siddeley group.

WHO'S WHERE

(*Continued from page 23*)

Changes

Robert G. Siff, field representative for Eitel-McCullough, Inc., San Carlos Calif., at Wright-Patterson AFB and Gentile Air Force Station, Dayton, Ohio.

William G. Newton, industrial engineering manager, Beckman Instruments, Inc., Fullerton, Calif. Also: **Harlan E. Eastman**, purchasing administrator.

Fred Hall, director of management control, Aerojet-General's Solid Rocket Plant, Sacramento, Calif.

Allan Lytel, manager-proposal coordination, Crosley Division, Avco Manufacturing Corp., Cincinnati, Ohio.

Guy J. Sanders, director of engineering, Industrial Acoustics Company, Inc., New York, N. Y.

Edward C. Kluender, manager-military systems engineering, General Electric's Communication Products Department, Syracuse, N. Y.

Dr. Robert J. Rohr, director of research and development, Magnus Chemical Company, Inc., Chicago, Ill.

James S. Galbraith, manager of semiconductor operations, Microwave Associates, Inc., Burlington, Mass.

Milo K. Henry, manager of the Denver, Colo., regional office, Military Products Group, Minneapolis-Honeywell Regulator Co., Minneapolis, Minn.

Col. Daniel B. White (USAF, ret.), assistant manager-eastern operations (Dayton, Ohio), Technical Products Division, Packard-Bell Electronics Corp., Los Angeles, Calif.

Gordon W. Johnson, director of engineering, Pacific Magnetic Corp., Romoland, Calif.

Levin P. Handy, director of the cable unit, Aeronautical and Instrument Division, Robertshaw-Fulton Controls Co., Anaheim, Calif.

Col. James H. Rothrock, manager of defense products, Radio Corporation of America's West Coast Electronic Products Department, Los Angeles, Calif.

Charles K. Fennel, manager of marketing techniques, Texas Instruments, Inc., Dallas, Tex.

Jean Baudreau, cargo sales manager, North, Central American and Caribbean Division of Air France.

Robert P. Norton, resident corporate representative—Wichita Division of Boeing Airplane Co., for American Bosch Arma Corp., Hempstead, N. Y.

Dan E. Baker, marketing manager, Atlas E-E Corp., Woburn, Mass.

Arthur Van Gordon, general manager, Electronic Components Division, Anton Electronic Laboratories, Inc., Brooklyn, N. Y.

Samuel Ochlis, manager, Instrument and Equipment Division, Epsco, Inc., Boston, Mass.

Edwin F. Clark, manufacturing manager, and **Robert W. Cooper**, chief production engineer, Marman Division of Aeroquip Corp., Jackson, Mich.

Charles J. Daniels, director of government projects, All American Engineering Co., Wilmington, Dela.

CLASSIFIED SEARCHLIGHT SECTION ADVERTISING

BUSINESS OPPORTUNITIES — **EQUIPMENT - USED or RESALE**

DISPLAYED RATE:

The advertising rate is $31.00 per inch for all advertising appearing on other than on contract basis. Contract rates on request.

AN ADVERTISING INCH is measured ⅞ inch vertically on one column, 3 columns—30 inches—to a page.

EQUIPMENT WANTED or FOR SALE ADVERTISEMENTS acceptable only in Displayed Style.

UNDISPLAYED RATE:

$2.70 a line, minimum 3 lines. To figure advance payment count 5 average words as a line.

PROPOSALS, $2.70 a line an insertion.

BOX NUMBERS count as one line additional in undisplayed ads.

Send NEW Ads or Inquiries to Classified Adv. Div. of Aviation Week, P. O. Box 12, N. Y. 36, N. Y.

NOW DEAL DIRECTLY WITH OWNER . . .
In Stock Now for Immediate Delivery!

BEECHCRAFT C18S, D18S
One of each available. All Top Quality. Excellent value and excellent terms available.

Cargo C-46F, Airline DC-3 and/or Cargo C-47. All available for sale with terms or for lease with lowest rates ever.

GRUMMAN WIDGEON
G44A Models with Ranger engines, or Custom McKinnon-Hickman Conversion available as a package. Finished product without an equal. And We Mean It! ! !

EXECUTIVE LOCKHEED VENTURA
Gorgeous New Horton & Horton interior, unequalled anywhere. Send for photograph.

265-285 MPH, for the cost of a Beech.

Excellent lease terms available. Send for color photograph.

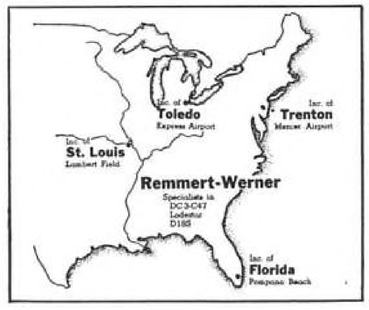
SIKORSKY S-51 HELICOPTERS
CAA Four-place Commercial Licensed with fresh complete overhaul. Six left, with spares. Can be purchased individually "AS IS" if desired.

MILITARY SURPLUS AIRCRAFT
SNJ-7 (T-6G), SNJ-4, 1 PV-2 Harpoon, 1 PBY-5A.—All to be wholesaled flyable with ferry permit, and at very cheap prices. Write or call for details.

GRUMMAN GOOSE
Zero time throughout. Like new. And We Mean It! ! ! New Plane Warranty.
Also available—used Goose, nice shape, at a sacrifice wholesale price. Lease possible.

HANGARS
120 ft. x 200 ft. clear span hangar, 28 ft. headroom. All steel structure plus two-story lean-to's 20 ft. wide on the long sides. Total 40,000 Sq. Ft. floor space. Substantial piece of Real Estate.

FREDERICK B. AYER & ASSOCIATES, INC.
250 Park Ave. — Anthony J. Ming, MUrry Hill 7-1800 — New York 17, N. Y.



FOR ADDITIONAL INFORMATION
About Classified Advertising
Contact The McGraw-Hill Office Nearest You.

ATLANTA, 3—1301 Rhodes-Haverty Bldg. JAckson 3-6951
R. H. POWELL

BOSTON, 16—350 Park Square HUbbard 2-7160
D. J. CASSIDY

CHICAGO, 11—520 No. Michigan Ave. MOHawk 4-5800
W. J. HIGGENS
D. C. JACKMAN

CLEVELAND, 13—1164 Illuminating Bldg., 55 Public Square SUperior 1-7000
W. B. SULLIVAN

DALLAS, 1—1712 Commerce St., Vaughan Bldg. RIverside 7-5117
GORDON JONES
F. E. HOLLAND

DETROIT, 26—856 Penobscot Bldg. WOodward 2-1793
D. M. WATSON

LOS ANGELES, 17—1125 W. 6 St. MAdison 6-9351
R. L. YOCOM

NEW YORK, 36—500 Fifth Ave. OXford 5-5959
D. T. COSTER - R. P. LAWLESS

PHILADELPHIA, 3—Six Penn Center Plaza LOcust 8-4330
H. W. BOZARTH - T. W. McLURE

ST. LOUIS, 8—3615 Olive St. JEfferson 5-4867
SAN FRANCISCO, 4—68 Post St. DOuglas 2-4600
W. C. WOOLSTON

FOR SALE
C-46F AIRCRAFT
Passenger and Cargo
With or Without
T-Category Kit Installed
Immediate Delivery
THE FLYING TIGER LINE INC.
Burbank, Calif.
Call or Cable
FRED BENNINGER
Executive Vice President
Tel: Stanley 7-3411 Cable: Flytiger

Immediate Delivery
We stock, overhaul, and install
PRATT & WHITNEY R1830 —75, —92, —94
WRIGHT R1820 —202, —5, —72
R985 R1340 R2000
and our most popular DC3 engine
R1830 - SUPER - 92
ENGINE WORKS INC.
Lambert Field Inc. — St. Louis, Mo.

C-47'S FOR SALE DC-3'S
ALSO
REPAIR OVERHAUL MODIFICATION
VOLITAN AVIATION INC.
12820 Pierce St. — Pacoima, Calif.
Phone EM-9-1283

C-47
ENGINE MOUNTS
5110599 Perfect Condition Certified
$695.00
PACIFIC AERO SUPPLY
421 N. PRAIRIE HAWTHORNE, CALIF.
OS 5-8153

OXYGEN EQUIPMENT
SALES & SERVICE
REGULATORS — MASKS — VALVES
PORTABLES & CYLINDERS
FIXED INSTALLATIONS
GOV'T. APPROVED REPAIR STATION
ZEP AERO — Phone: ORegon 8-1161 — EL SEGUNDO, CALIFORNIA

FINEST AIRCRAFT MAINTENANCE
Twin Beech - DC-3 - Lodestar
CAA Approved Repair Station #3964
Class 1 & 3 No Limitations

SINCE 1937 Page AIRWAYS INC.
ROCHESTER AIRPORT
PHONE: FAirview 8-2720
ROCHESTER 11, N.Y.

RADAR
AUTOMATIC PILOTS, NAVIGATION & COMMUNICATION SYSTEMS
Collins, Bendix, Sperry, Lear, ARC, Wilcox

EMPLOYMENT OPPORTUNITIES

NATIONAL COVERAGE

DISPLAYED ——RATES—— **UNDISPLAYED**

The advertising rate is $45.00 per inch for all advertising appearing on other than a contract basis. Contract rates quoted on request.
An advertising inch is measured ⅞" vertically on a column—3 columns, 30 inches to a page.
Subject to Agency Commission.

$2.70 per line, minimum 3 lines. To figure payment count 5 average words as a line. Box Numbers—counts as 1 line.
Position Wanted ads. ½ of above rate.
Discount of 10% if full payment is made in advance for 4 consecutive insertions.
Not subject to Agency Commission.

Send NEW ADS and Inquiries to Classified Advertising Division of Aviation Week, P. O. Box 12, N. Y. 36, N. Y.

ENGINEERING PILOT
Must have engineering or science degree and recent B-52 pilot time. Engineering experience desirable. Include educational background and flight time breakdown for past 5 years in initial reply. Southeast location. Write to

P-9575, Aviation Week
Class. Adv. Div., P.O. Box 12, N.Y. 36, N.Y.

TOOLING MANAGER
A position at executive managerial level is available for a man capable of directing the activities of a complete Tool Engineering and Tool Manufacturing Division. Located in So. Calif. Aircraft exp. desired.
To the professional Engineer with previous management exposure, this is opportunity!
Please send complete resume & photo in confidence to

P-9584, Aviation Week
68 Post St., San Francisco 4, Calif.

MANUFACTURER'S AGENTS WANTED
. . . by Eastern producer of Aircraft Accessories such as electro-mechanical assemblies, actuators, winches, etc. Reply with information on experience, present products, area and type of company served.

RW-9675 Aviation Week
Class. Adv. Div., P.O. Box 12, N.Y. 36, N.Y.

NEEDED
Top Flight—Aircraft—Missile—Hydraulic Sales Engineer, for executive position with expanding air frame manufacturer. Future unlimited. Excellent salary and other benefits. Submit complete resume. Information will be treated confidentially.

P-9548, Aviation Week
520 N. Michigan Ave., Chicago 11, Ill.

Your Inquiries to Advertisers Will Have Special Value . . .

—for you—the advertiser—and the publisher, if you mention this publication. Advertisers value highly this evidence of the publication you read. Satisfied advertisers enable the publishers to secure more advertisers and—more advertisers mean more information on more products or better service—more value—to YOU.

PROFESSIONAL PERSONNEL REQUISITION

JET ENGINE CONTROLS ENGINEER

Experienced in pneumatic, hydraulic, or electro-mechanical controls; including servo mechanisms, mechanical computers, and actuators. Requires ability to develop appropriate testing criteria and ability to supervise fabrication and test operations for fuel metering devices, inlet diffusers, fuel injection nozzles and control sensors.

Will work with a small group of highly specialized ramjet controls and fuel systems engineers in a creative engineering environment.

New IBM digital computer, large custom designed analog computer, and full facilities of the Marquardt Jet Laboratory are available to the project group. For further information contact:

FLOYD E. HARGISS, Manager, Professional Personnel
16551 Saticoy Street, Van Nuys, California

Advanced power and weapons support systems for air and space
Marquardt AIRCRAFT CO.
VAN NUYS AND POMONA, CALIFORNIA · OGDEN, UTAH

---

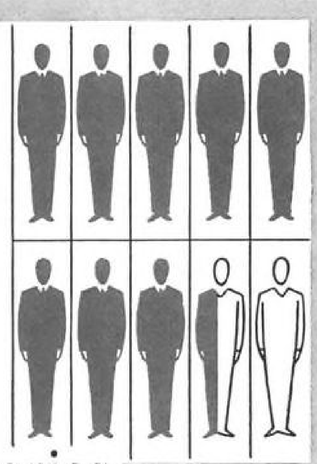
to an **EXECUTIVE ENGINEER**

WHO WOULD LIKE TO LIVE IN DENVER and assume a position as DIRECTOR OF ENGINEERING

We offer a top paying position with one of America's fastest growing research and development companies . . . a challenging job in an ideal city where climatic, housing, school and recreational conditions are unsurpassed. If you have had considerable experience in technical as well as administrative work, have an M. S. degree in Engineering or equivalent and 8 to 10 years aircraft experience, your inquiry may bring you a once-in-a-lifetime opportunity.

write today

T. J. Dalton, Personnel Mgr.
STANLEY AVIATION CORPORATION
2501 Dallas
Denver 8, Colorado



More than **8 OUT OF 10 ENGINEERS** say "yes" to an invitation to join Norden Laboratories

The ratio of 8.3 acceptances for every 10 engineers invited to join Norden Laboratories' professional staff is unusually high, especially in the opportunity-rich electronics industry. We went right to the source and checked new members of our engineering groups, who revealed these factors impelling their decision in favor of Norden:

- *Pioneering Nature of the Work in Diversified Electronic Areas*
- *Small R & D Groups Fostering Individual Accomplishment*
- *Close Contact With Management*
- *Flexibility of Assignments*
- *30-Year Company History of Achievement in Precision Electronics*

If this partial description of the professional environment at Norden Laboratories appeals to you, look into these immediate openings on a variety of advanced projects at both White Plains, New York and Stamford, Connecticut locations:

TELEVISION & PASSIVE DETECTION • Transistor Circuit Development • High & Low Light Level TV Camera Design • Video Information Processing • TV Monitors & Contact Analog Displays • Military Transistorized TV Systems *(Also openings for recent EE grads)*

RADAR & COMMUNICATIONS Design & Development of: Antennas • ECM • Microwave Systems & Components • Receivers • Transmitter Modulators • Displays • Pulse Circuitry (VT & Transistors) • AMTI • Data Transmission

DIGITAL • Digital (Senior) Design: Logical, Circuit, Magnetic Storage

QUALITY ASSURANCE • Reliability Analysis • Standards • Environmental Test

PROJECT ENGINEERING • SENIOR ENGINEERS — Engineering Program Management

FUTURE PROGRAMS • SYSTEMS ENGINEER (SR) — Broad creative background, ability to communicate — experience in radar, TV systems — supervise R&D proposals.

• SENIOR ENGINEER — Cost development for R&D proposals Require broad technical experience in electro-mechanical and electronic systems

ENGINEERING DESIGN • Electronic Packaging

STABILIZATION & NAVIGATION • Servo Loops for gyro stabilization, antenna stabilization, accelerometer force balance, antenna scanning • Repeater Servos • Transistorized Integrator, DC Amplifier, Servo Amplifier • Magnetic Amplifiers • Transistorized DC & AC power supplies • Gyros & Accelerometers

SYSTEMS ENGINEERING • Synthesis, analysis & integration of electronic & electro-mechanical systems

• *Descriptive Brochure Available Upon Request*

After-hour interviews arranged at your convenience.

Send resume in confidence to: **TECHNICAL EMPLOYMENT MANAGER**

NORDEN LABORATORIES

NORDEN DIVISION — UNITED AIRCRAFT CORP.
121 Westmoreland Avenue • White Plains, New York

White Plains, New York — Stamford, Connecticut

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

Aircraft Tubing—Man with knowledge of Aircraft Tubular Products Specs. acquainted with aircraft mfgrs. and contractors to contact their Purchasing & Engineering Depts. Should have some sales or Engr. experience. Fine opportunity. P-9538, Aviation Week.

Export Manager wanted by active and well known New York exporters to establish new department for aviation parts, electronics generators, pumps, oil drilling, construction equipment, and other technical lines. Only experienced go-getters, possibly with purchasing connections, should apply. Lifetime opportunity. Basic salary plus profit share. P-9654, Aviation Week.

Structures Analyst. MS or PhD. Minimum 5 years' experience in aircraft or missile field. For research on light weight structures for propulsion systems, and propellant tanks for missiles and spacecraft. Submit resume to Placement Officer, Lewis Research Center, National Aeronautics and Space Administration, 21000 Brookpark Road, Cleveland 35, Ohio.

POSITIONS WANTED

Commercial Instrument Instructor Pilot avail- able. Age 33. ATR written completed. 7000 hours military and airline experience. Resume on request. PW-9617 Aviation Week.

Commercial Pilot-220 hours, single, age 24, speak Italian fluently, free to travel, desire flying position foreign or domestic. PW-9670, Aviation Week.

Coast Guard Pilot. 39, 6000 hrs. TT. 750 helicopter, Bell & Sikorsky, S-55. Comm. lic. helo, smels. 16 yrs. exp. Avail. Feb. 1959. PW-9679, Aviation Week.

SELLING OPPORTUNITY WANTED

Manufacturer's representative, successful sales background, pilot, college degree, young, desires an opportunity to grow with young company. Will relocate. RA-9676, Aviation Week.

FOR LEASE

Cessna 310. Late Model. 440 hours. Excel- lent Condition, Lease Purchase Arrangements. Write P. O. Box 312, Lancaster, California.

MISCELLANEOUS

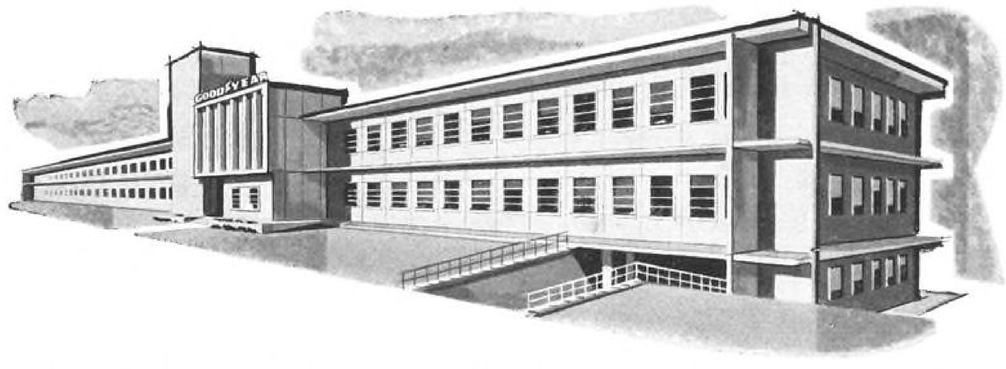
Helicopter. Blue Prints and Technical Con- struction data. Send $1.00 for 3 view drawing. Pioneer Helicopter Co., Hallandale, Florida.

What is *your* problem?

Competent men for your staff? . . . employment? . . . or are you looking for—or offering—a business opportunity of special interest to readers of this publication? You can get their attention—at small cost—through an advertisement in the Employment Section of AVIATION WEEK.

FOR ENGINEERS AND SCIENTISTS:

Address for challenges with a future



New developments at Goodyear, as well as new complexities in the international scene, have intensified our need for missile engineers — and engineers of all kinds.

If you're a man of talent, training and imagination, we want you — and we want you now.

We want you at Goodyear Aircraft in research, development, design, production.

We want your skills on such vital projects as SUBROC — the new antisubmarine weapon system which is spearheaded by an underwater guided missile. On REGULUS II, MACE, and NIKE ZEUS. On missile nose cones, radar, radar structures, radomes, ballistic missile early warning systems, ground support equipment, and an array of bold challenges with a future.

You'll find salaries and benefits at Goodyear Aircraft are fine. You can continue academic studies — company-paid tuition courses leading to advanced degrees are available at nearby colleges.

For further information on your career opportunities at Goodyear Aircraft, write: Mr. C. G. Jones, Personnel Dept., Goodyear Aircraft Corporation, Akron 15, Ohio.

GOODYEAR AIRCRAFT

Brilliant Ground-floor Opportunities for

SIX HIGH-LEVEL ENGINEERS

in a New Creative Missile Group

IN SUNNY SAN DIEGO

Six brilliant opportunities are open for creative engineers in Solar's new missile group. The projects involved are exceptionally exciting and challenging but cannot be publicly announced at this time. The right six men joining now will get in on the ground floor and gain key creative positions in their fields of interest.

AREAS OF EXPERIENCE SOUGHT

Flight mechanics, analysis of missile trajectories..., missile dynamics, stability and control, aeroballistics... airborne fire control computers, data links... statistical error and control response error analysis...servo-mechanisms, precision airborne hydraulic servos.

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. Solar is making many significant contributions to space age technology and 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.

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-334, Solar Aircraft Company, 2200 Pacific Highway, San Diego 12, Calif.

SOLAR
AIRCRAFT COMPANY
SAN DIEGO
DES MOINES

CONTRACT ADMINISTRATOR

with

Honeywell Aeronautical Division
Minneapolis, Minn.

Challenging opportunity for individuals with management aspirations.

Position requires:

- Experience in administration of contracts and purchase orders.
- Aptitude for directing activities related to engineering, production, legal, accounting and marketing functions in order to fulfill contract obligations efficiently.
- Ability to work effectively with all levels of managerial and non-managerial personnel

MBA and 2 to 3 years' experience in industry or government desired.

All replies held in strictest confidence.
Send resume to

BRUCE D. WOOD — *Employment Manager*
T-1A, 1433 Stinson Boulevard
Minneapolis 13, Minn.

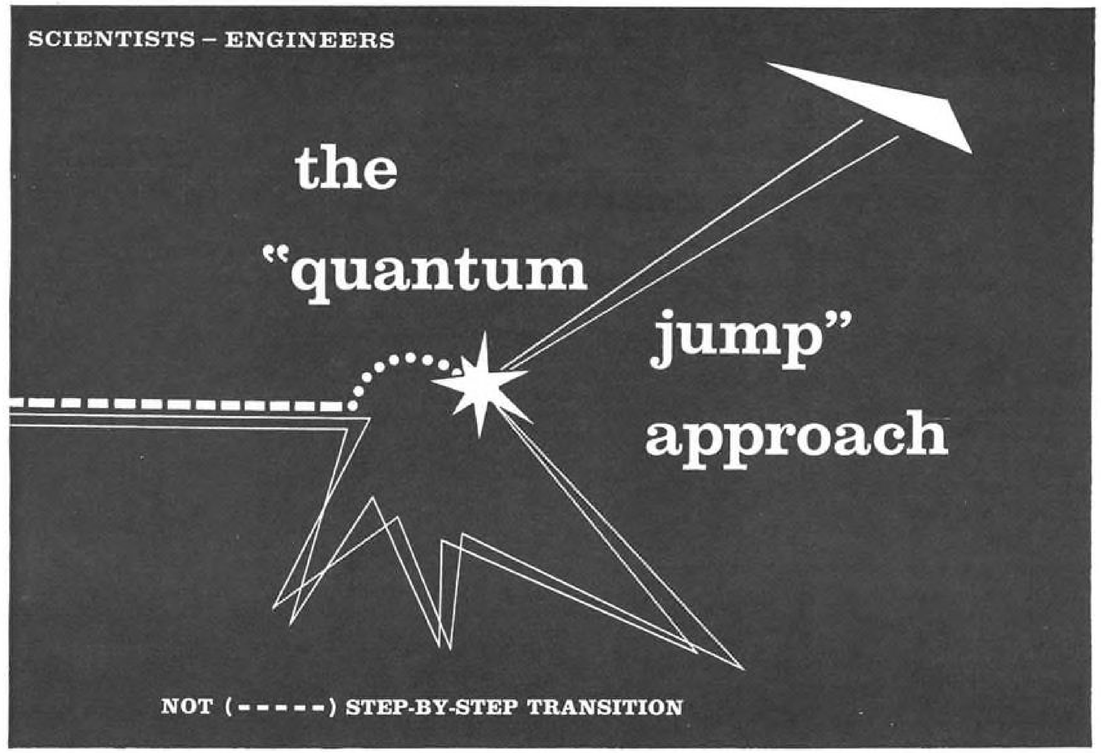
USE NATIONAL CLASSIFIED ADVERTISING

for bringing business needs or opportunities to the attention of men associated in administrative, executive, management, sales and responsible technical, engineering and operating capacities with the industries served by McGraw-Hill publications. For advertising rates or other information write:

Classified Advertising Division

McGraw-Hill Publishing Co., Inc.
P. O. BOX 12
New York 36, New York

SCIENTISTS – ENGINEERS



How Republic's Engineers & Scientists Attack Today's Missile, Aircraft and Space Problems

There's something in the environment at Republic Aviation that fires the imagination and sharpens the logical faculties.

You find it, at its quintessence, within the research groups, whose members have recently come up with a feasible design for a "Magnetic Pinch Plasma Engine" to operate in space. *A design utilizing a novel application of basic knowledge in the field of magneto-hydrodynamics.*

The same spirit of bold inquiry, of looking beyond the immediate, conventional solution of a problem for new and better answers, permeates the entire professional staff. You'll find it in development engineers working on new missiles for new missions ..in experimental engineers studying the behavior of a prototype aircraft. You'll find it in the metallurgical and electronics labs.

THE RESULT – "quantum-jump" advances in many technologies vital to the conquest of upper atmosphere and space flight.

Engineers and Scientists who share Republic's views on Creative Problem-Solving are invited to discuss opportunities now open in the following areas:

THERMO, AERODYNAMICS

Theoretical Gasdynamics • Hyper-Velocity Studies • Astronautics Precision Trajectories • Airplane/Missile Performance • Air Load and Aeroelasticity • Stability and Controls • Flutter & Vibration • Vehicle Dynamics & System Designs • High Altitude Atmosphere Physics • Advanced Propulsion • Engineer Performance • Re-entry Heat Transfer • Supersonic/Hypersonic Wind Tunnels • Shock Tunnel • Plasma Tunnel • Magneto-Hydrodynamics • Ground Control Equipment

ELECTRONICS

Inertial Guidance • Inertial Navigation • Digital Computer Development • Radar Design • Systems Engineering • Telemetry-SSB Technique • Information Theory • Doppler Radar • Countermeasures • Radio Altimeters • Radome & Antenna Design • Microwave Circuitry & Components • Receiver & Transmitter Design • Airborne Navigational Systems • Missile Checkout Systems • Missile Arming & Fusing • Jamming & Anti-Jamming • Miniaturization-Transistorization • Ranging Systems • Propagation Studies • Ground Support Equipment

REPUBLIC AVIATION is investing $35,000,000 in bold new R & D Program designed to arrive at Major Breakthroughs inTransition from Aeronautics to Astronautics.

Send resume in complete confidence to:
Mr. George R. Hickman, Engineering Employment Manager

REPUBLIC AVIATION
Farmingdale, Long Island, New York

ADVERTISERS IN THIS ISSUE

AVIATION WEEK, JANUARY 12, 1959

CLASSIFIED ADVERTISING

F. J. Eberle, Business Mgr.

ADVERTISERS INDEX

LETTERS

Replies to Edwards

I would like to congratulate Pilot Newt Edwards whose letter in the Dec. 15 edition of AVIATION WEEK (p. 122) has done much to cut through the "trite" which you editors have been passing out. To re-emphasize his thoughtful points I respectively ask permission to quote from college-educated, former shoe salesman Edwards' letter.

You editors have been presenting "prejudiced articles" on both sides of a controversary instead of "reliable openions". You have lost all kinds of honor "in nor correctly evaluating the situation," and it's about time somebody like Edwards set you straight. He's my kind of chap.

"The ALPA," he says, "is more intelligently governed and advised now than any time since I have been associated." I don't know how long Mr. Edwards has been "associated" (possibly he may mean incorporated), but he cuts right to the heart of the matter in the next sentence: "Corrections we are making in crew compliments were errors made by previous ill informed leaders." As an honorably-withdrawn former ALPA member I had no idea our informed leaders of yesteryear were sick, but Pilot Edwards evidently knows where the skeletons are buried, and it's about time the word got around. Having been a crew member for nearly 15 years, I don't want somebody complimenting me when he's not up to scratch. Compliments are scarce enough as it is, and probably it would be a good thing to do away with them altogether.

Pilot Edwards is really socko on my list when he gives you the well deserved smasheroo. He clues in everybody that "you are now engaging in a new tact to belittle one of the finest and most honored professions of all times by discrediting their association ALPA." Edwards isn't going to stand for this sort of rot and apparently the BOAC pilots, from what he says, aren't either. I didn't realize the honorable defenders of Britain had 180'd their gunsights towards the flight engineer's station, but I guess I'm behind on my IFALPA news. "The effort to correct a situation which must be corrected should be commended rather than condemed", and in case Big Brother should be tuned to my frequency I want to say right now that I'm no condemer. Certainly not when I'm in the vicinity of Airstrip No. 1. Correct away.

In case anybody has been misled by "rediculous" reports that the ALPA is trying to steal the engineer's chair (and in all sincerity I must own up to a fleeting suspicion) I was thankful for Edwards' correction. What ALPA is really doing (and they've "lost public appreciation" for doing so) is "steering a bold straight course." Now my heart leaps up at the sight of anyone steering a bold straight course. When this bold straight course just happens to lead to a "hypothetical" 42,000 clams, it's all too easy to misunderstand a person's altruistic motives in clambering over the bodies of his fellow crewmen (or crewwomen, as the case may be). I'm glad I've been straightened out on that one.

AVIATION WEEK, however, may find some consolation in Edwards' gratitude for

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.

"your poor editorial policy" which, he says, may stimulate "our need for public education of our profession." I'm not certain how many pilots would put in for additional education, particularly public education, and it is not entirely clear just where the money would come from. It is, nevertheless, difficult to "disapprove" education, especially when it might produce more letters of the caliber of the one by Pilot Newt Edwards to whom I present—my complements.

J. P. KOUCHAN
Plainview, N. Y.

Probably the only thing Newt Edwards has proven is that he is a "loyal ALPA member" and has learned the "party line."

Speaking of the "ALPA Party Line," it usually implies or, out and out declares, that everyone but ALPA is wrong and ALPA is always right.

Let's see what Newt says: "The press has lost honor" (for allowing anything critical of ALPA to be printed), is "ill advised," prints "unsavory" and prejudicial articles, and government agencies are guilty of "poor planning."

He suggests no executives come near the qualities pilots possess, and that only pilots contribute to increased productivity, safety, etc.

Finally, Newt says (and this is a relatively new pitch): "Never before has so much been owed to so few." This, of course, is a clumsy attempt to imply that all ALPA pilots are heroes and that this country owes these people more than we can pay. There isn't a responsible veteran group that would make such a suggestion, but Newt would.

With the exception of the "hero line" we have heard it all before, and instead of becoming more convincing, it becomes more obvious that this is the Goebbel's type (a lie becomes the truth if repeated often enough) propaganda from the Chicago ALPA Headquarters and parroted by the Newts.

D. K. CARSON, Chairman
Flight Engineers International Assn.
Eastern Air Lines Chapter, IDL-LGA
Bayside, N. Y.

In the Letters section of your Dec. 15 issue (p. 122), Mr. Newt Edwards complains that you have "lacked discretion" in editing material concerning the pilots' union and its various campaigns to straighten out the industry.

I join Mr. Edwards in his desire for factual correction of quoted partisan misstatements. I realize, though, that the job of minutely researching each such statement would be an impossible burden for your staff.

This leaves it up to your readers to attempt to set the factual record straight wherever possible via the Letters section.

Let me now do so with respect to this quote appearing on p. 45 of your Nov. 17 issue: "The pilots' union also says that approximately 50% of the airline industry now employs pilot-qualified engineers who are ALPA members."

Out of curiosity, I compiled a list of all U.S. airlines using flight-engineered aircraft, and came up with the following figures: As of April 21, 1958 (the latest date for which I have complete figures), there were 814 civil aircraft requiring the services of a flight engineer; 720 of these aircraft were flown by companies whose flight engineers are represented by the FEIA, 9 by engineers of the IAM, leaving only 85 aircraft flown by engineers belonging to ALPA or other organizations.

Thus ALPA at most represents approximately 10% of the nations flight engineers, while they claim 50%!

As it would be churlish to assume that spokesmen for "one of the finest and most honored professions of all times" would deliberately distort figures to misinform the public, this error in presentation must have been made in good faith.

Mr. Edwards goes on to say that "Corrections we (ALPA) are making in crew compliments were errors made by previous ill informed leaders."

I hope my letter will in a small way help him and the officers of his union in their continued efforts to inform, educate and enlighten.

W. K. WOODMANSEE
Pleasant Hill, Calif.

X-18 Fuselage

The Dec. 15 article on the X-18 (p. 34) makes several references to the use of portions of a Fairchild C-123. Actually, the components are from the earlier Chase C-122 which entered troop carrier service in limited test quantity some years back. The smaller and lighter (8,000 lb. payload) C-122 was probably better suited to this particular conversion.

B. G. DUDLEY
CAPT., USAF
Bordentown, N. J.

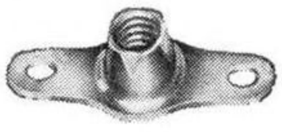
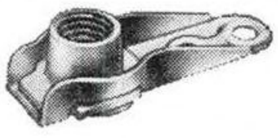
Helicopter CG

In an article on helicopters on p. 47 of your Dec. 8 issue, reference is made to the ". . . . center of gravity problem present in single-rotor craft." This error has been repeated so many times that it has come, unfortunately, to take on an aura of truth. The fact is, however, that use of the offset hinge on single-rotor helicopters gives these craft a center of gravity travel more than sufficient to handle all operational conditions. In fact, the single rotor helicopter with offset hinge has a CG travel some 60% more than that of the standard fixed wing airliner. Sikorsky engineers will be happy to provide technical details upon request to further clarify this subject.

M. E. GLUHAREFF
Engineering Manager
Sikorsky Aircraft
Stratford, Conn.

SELECTION CHART

of new counterbored, low height, standard and miniature ESNA/NAS self-locking nuts

Standard—550° F. (Carbon Steels)	Standard—900° F. (A286 Stainless)	Miniatures—550° F. (Carbon Steels)	Miniatures—900° F. (A286 Stainless)
 LHTE (NAS 679)	 LHTE2860	 LH1660	 79LH1660 (303 Stainless)
 LHTA51 (NAS 680)	 LHTA51-2860	 LHTA51M (NAS 697)	 LHTA51M2860
 LHTA58 (NAS 681) 100° Ctsk	 LHTA58-2860 100° Ctsk	 LHTA575M (NAS 1067)	 LHTA575M2860
 LHTA57 (NAS 682)	 LHTA57-2860	 LHTA57M (NAS 696)	 LHTA57M2860
 LHTA55 (NAS 684)	 LHTA55-2860	 LHTA55M (NAS 698)	 LHTA55M2860
 LHTA521 (NAS 686)	 LHTA521-2860	 LHTA521M (NAS 1068)	 LHTA3300
 LHTA517 (NAS 687)	 LHTA517-2860	 LHHA3575	
 LHTG51 (NAS 688-92)	 LHTG51-2860		
 LHTA54 (NAS 683) 100° Ctsk			
 LHTA35 (NAS 685) 100° Ctsk			
 LHTG55 (NAS 693-5) 100° Ctsk			

To meet the requirements of the aircraft, missile and avionic industries for lighter-weight, reduced-dimension fasteners for elevated temperature service, ESNA has designed and is *currently producing* all of these new self-locking nuts. Every part conforms to NAS specifications and the entire line has full Military Services approval.

This is just a part of the *complete line* of self-locking Elastic Stop® nuts which only ESNA offers as standard parts, including AN 362, 363, 364, 365 and 366 types; also special designs such as high tensile, barrel and self-aligning fasteners, all types of straight and radius gang channels and very high temperature all-metal slotted beam designs for use on jet engine applications at temperatures in a range of 1200°F.

For free copy of ESNA/NAS conversion table containing both NAS drawings and ESNA equivalents with full details, write Dept. S12-125, Elastic Stop Nut Corporation of America, 2330 Vauxhall Road, Union, N. J.

ESNA® TRADE MARK

ELASTIC STOP NUT CORPORATION OF AMERICA