Aviation Week and Space Technology

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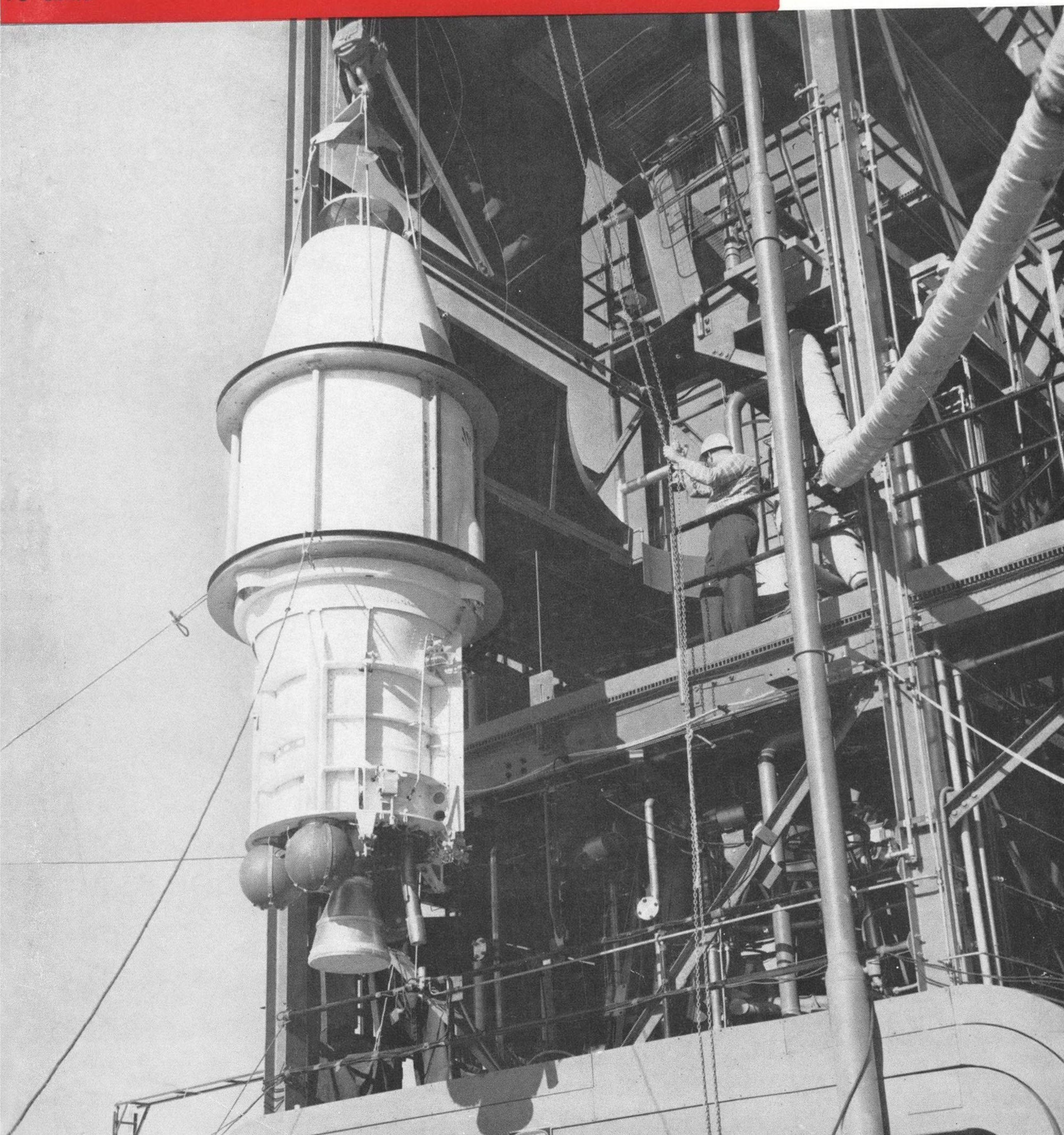
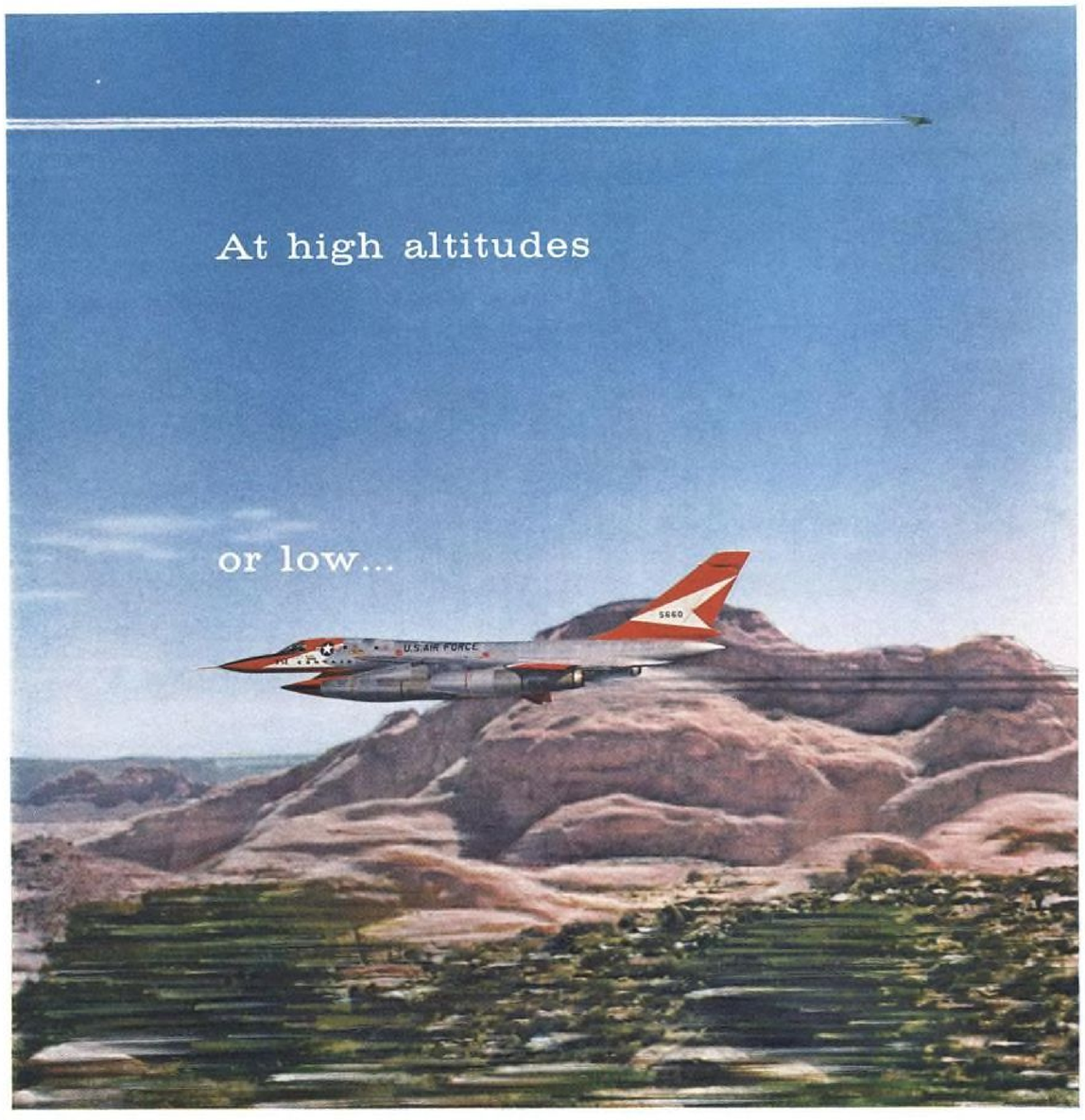
A McGraw-Hill Publication

February 8, 1960

Lockheed Pushes Polaris Weight Reduction Plan

USAF-Lockheed Agena A Satellite in Test Stand





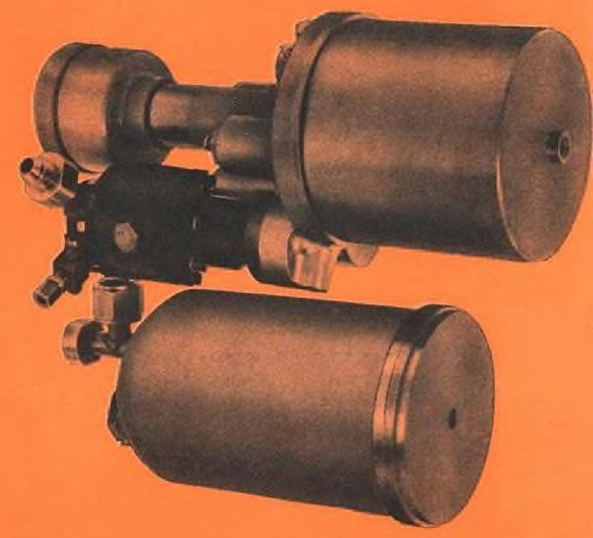
The free world's fastest bomber, Convair's B-58, has penetration capabilities exceeding any other aircraft now in existence. At more than 50,000 feet or under 500 feet – it can do whatever the mission demands! It is now entering service with the U.S.A.F.

CONVAIR
A DIVISION OF GENERAL DYNAMICS CORPORATION

FLIGHT HARDWARE...NOW

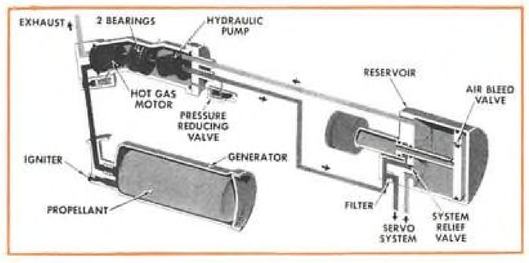
VICKERS HOT GAS AUXILIARY POWER SYSTEMS

for missiles and spacecraft



CONCEPT

Vickers piston motors — as used in virtually all existing commercial and military aircraft — are now modified to operate efficiently on propellant-generated hot gas, or bleed gas from the main propulsion system. Minimum weight is achieved by mounting the hot gas motor "shaft-to-shaft" with a Vickers piston hydraulic pump in a common housing. The motorpump, a simple gas generator, hydraulic reservoir, filter, and relief valve are integrally mounted to form a complete Auxiliary Power System in a compact package.



DEVELOPMENT

Production line Vickers hydraulic motors have been operating on hot gas for over 2 years. Units have run on gases as hot as 2300°F without modification.

The present flight hardware was built and tested after an intensive prototype development effort. Test program motorpumps have accumulated over 100 runs each for 1 minute of operation cycle. Since the current development program is aimed at meeting known APS requirements, no limits have been established on the operating cycle duration for this type of equipment.

CONCLUSIONS

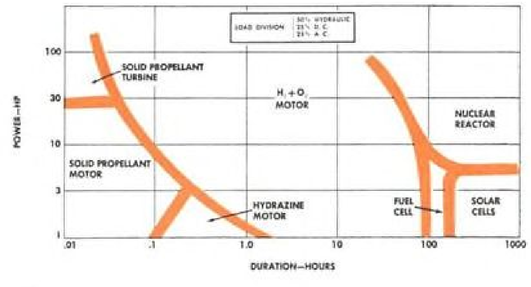
Performance and reliability goals for this concept have been met successfully. A complete hot gas APS package in the 2 - 8 horsepower range, shown above, is available within 90 days. Customer specifications for these and larger systems are invited. Write for Bulletin A-5243

APPLICATIONS

Because of the increasing scope of APS applications, Vickers conducted a series of studies to establish criteria for APS selection. Recent study results (published in March, 1959) indicate that for short duration operation, hot gas motors offer the best weight advantage in the 1 to 30 hp range. See curve below.

Attractive reliability and early delivery resulting from extensive use of proven hardware may extend the application of these systems to an even greater range of second and third generation missiles and spacecraft. Additional advantages include: low speed equipment (up to 10,000 rpm), convenient ground checkout, growth potential, and no alert time required.

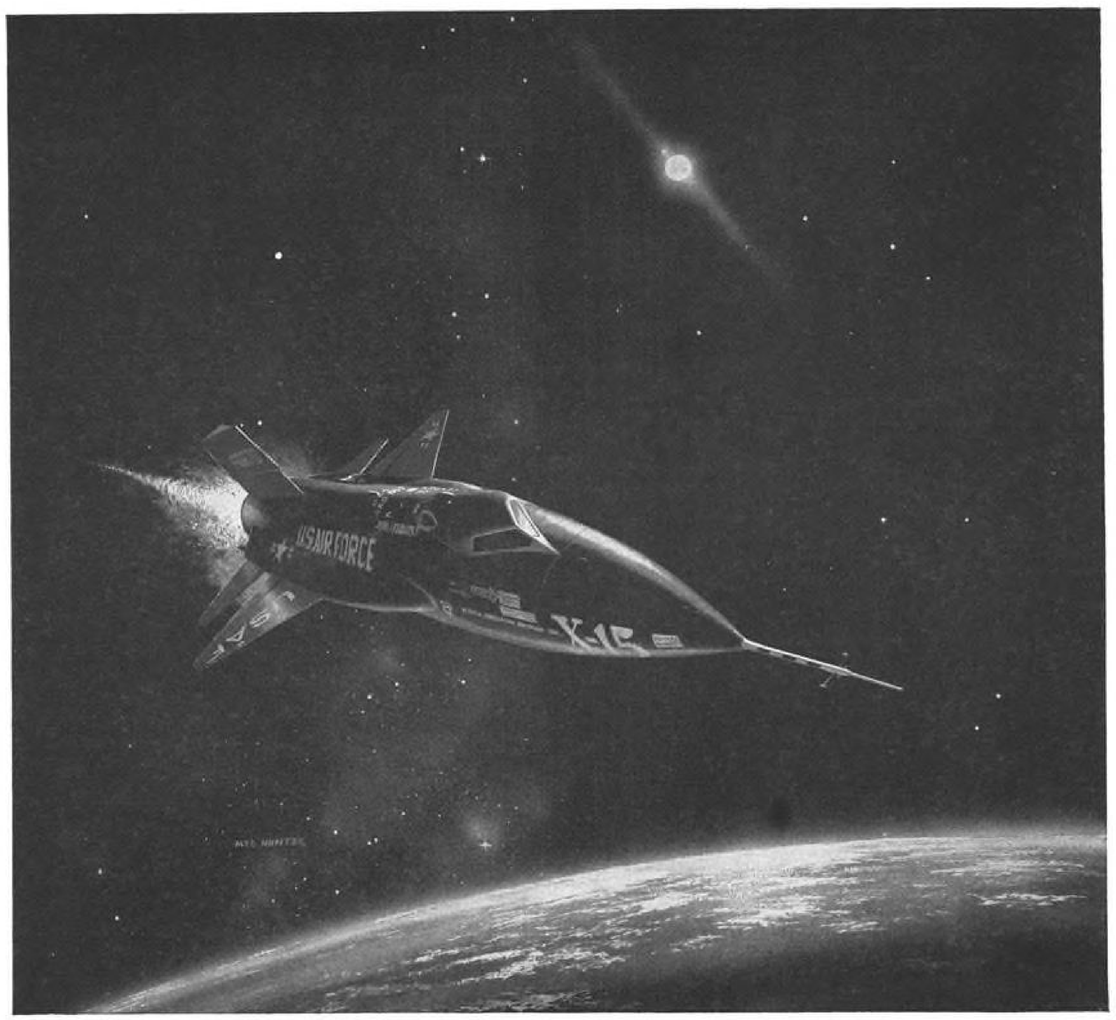
OPTIMUM WEIGHT NON-PROPULSIVE POWER SYSTEMS



AERO HYDRAULICS DIVISION
VICKERS INCORPORATED
DETROIT 32, MICHIGAN

division of:
SPERRY RAND CORPORATION

8386



MISSION: MAN IN SPACE

FILTER APPLICATION: PROTECT HYDRAULIC CONTROLS

FILTER: PUROLATOR

A malfunction in the lines of the hydraulic and pneumatic controls of the X-15 could send it off its programmed trajectory—alter the angle of re-entry—cause deviation from the ballistic arc.

So North American Aviation engineers took advantage of Purolator's know-how and assistance. The ultimate result is that new and unique designs to meet the wide range of operating temperatures, high capacity requirements and exacting space and weight restrictions are being supplied.

The filters designed for the X-15 are just one example of the kind of imaginative engineering that's a specialty at Purolator. Purolator engineers have developed filters in every known medium, to handle temperatures from −420°F to 1,200°F—pressures from 0.000 to 6,000 psi—flow rates from a few drops to thousands of gallons per minute—filtration from submicronic to 700 microns.

These same engineers are ready to work on your problem. A phone call, or a descriptive letter with blueprints will receive their prompt attention.

Filtration For Every Known Fluid

PUROLATOR
PRODUCTS, INC.
RAHWAY, NEW JERSEY, AND TORONTO, ONTARIO, CANADA

AVIATION CALENDAR

Feb. 16-17—Third annual National Missile/Space Conference and Dr. Robert H. Goddard Memorial Dinner, Sheraton Park Hotel, Washington, D. C.

Feb. 16-18—First National Symposium on Nondestructive Testing of Aircraft and Missile Components, Hilton Hotel, San Antonio, Tex. Sponsors: Southwest Section, Society for Nondestructive Testing; Southwest Research Institute.

Feb. 18-19—Symposium on Engineering Aspects of Magnetohydrodynamics, University of Pennsylvania, Philadelphia, Pa. Sponsor: American Institute of Electrical Engineers' Basic Sciences Committee.

Feb. 25-26—Seventh Scintillation Counter Symposium, Hotel Shoreham, Washington, D. C. Sponsors: American Institute of Electrical Engineers; Atomic Energy Commission; Institute of Radio Engineers; National Bureau of Standards.

Mar. 7-8—Fifth Annual Business Aircraft Safety Seminar, Dearborn Inn, Dearborn. Sponsor: Flight Safety Foundation.

Mar. 9-10—Symposium on "Processing Materials for Re-Entry Structures," Miami Hotel, Dayton, Ohio. Sponsor: Midwest Chapter, Society of Aircraft Material & Process Engineers.

Mar. 9-11—Conference on the Mechanical Properties of Engineering Ceramics, North Carolina State College, Raleigh, N. C. Sponsors: North Carolina State College School of Engineering; Office of Ordnance Research, U. S. Army.

Mar. 10-11—National Flight Propulsion Meeting (classified Secret), Institute of the Aeronautical Sciences, Cleveland, Ohio.

Mar. 14-15—Symposium on Load-Carrying Capacity of Bearings, American Society of Mechanical Engineers' Lubrication Division, Engineering Societies Building Auditorium, New York, N. Y.

Mar. 17-18—Synchro Design and Testing

(Continued on page 6)

AVIATION WEEK and Space Technology
February 8, 1960
Vol. 72, No. 6

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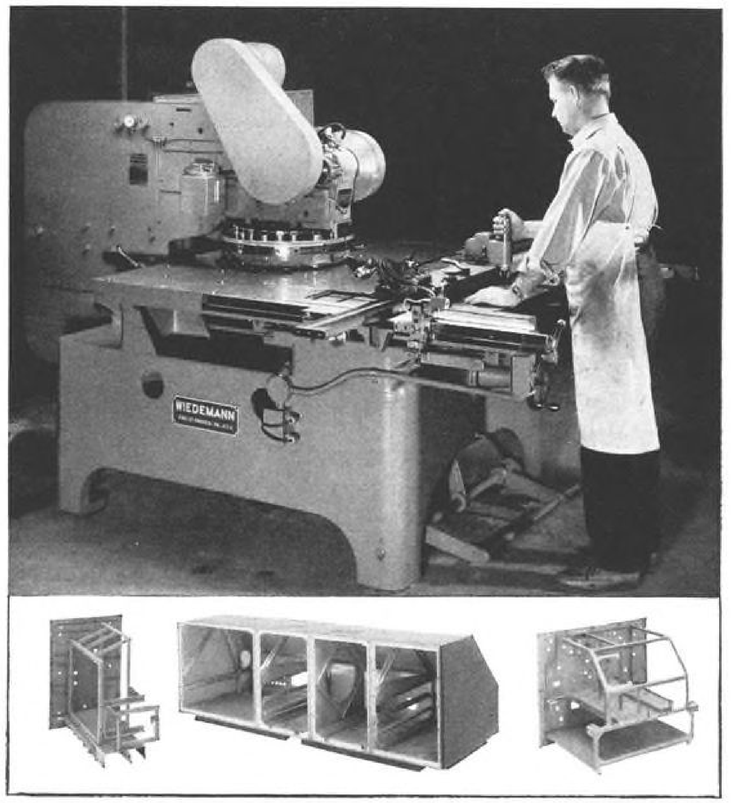


electronic AEROSPACE COMPONENTS BY LAVELLE

For many years, major manufacturers have relied on Lavelle for the production of precision sheet metal components. This experience and reputation for quality can provide the modules, chassis, racks and consoles needed to adequately support and house complex electronic systems.

To keep abreast of new developments in parts and assemblies for the aerospace age, Lavelle has acquired new production facilities, with particular attention to the requirements of the electronics industry. Pictured above is a Wiedemann RA-41P turret punch press, operated by a Lavelle craftsman to produce intricately pierced sheet metal panels used in modules and housings such as shown.

If you require electronic sheet metal components of quality, or parts and assemblies for space vehicles, missiles, jet engines or airframes—Lavelle has the capability. Write for new illustrated facilities brochure.

Lavelle

LAVELLE AIRCRAFT CORPORATION • NEWTOWN, BUCKS COUNTY, PA.
Between Philadelphia, Pa., and Trenton, N.J.

if you think this looks like CEC'S 5-752...

YOU'RE ONLY HALF RIGHT

The picture shown here is of a new, improved version of the famous 5-752 Recorder/Reproducer. We call it Model 5-752A, and it represents the culmination of years of engineering time and practical experience.

Never before such versatility.

Pick a mode . . . any mode: Analog, FM, PDM, CM, Digital. CEC's new 5-752A can handle any or all of them, with interchangeable Plug-In Amplifiers for five modes of recording or playback.

Monitoring versatility too.

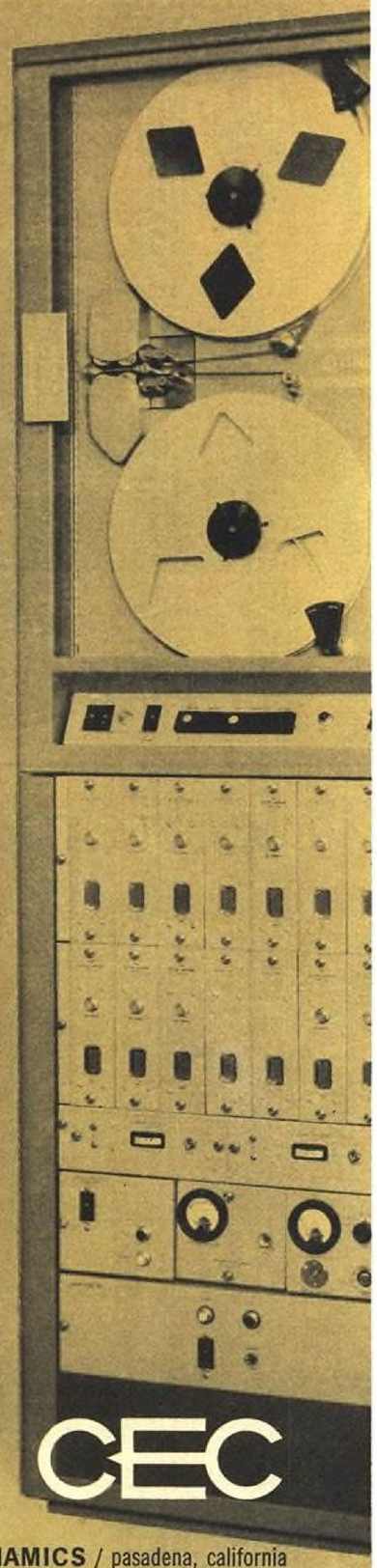
The 5-752A features optional monitoring, either local or remote, of Signal Input/Output. True head-current monitoring also.

New features.

The cabinet is tougher than ever . . . it's all-steel, all-welded . . . all-rigid, too, for such rough environments as mobile or marine installations. And a new, metal-framed, transparent cover closes dust-tight on a gasket seal . . . gives protection where it counts, over the tape and heads.

Specially designed CEC Current Amplifiers slide right into place . . . boost reproduce amplifier signal output . . . give galvanometers, chart recorders, and other allied instrumentation the whole story, loud and clear.

For complete information on this most versatile of instrumentation recorders, call the CEC sales and service office nearest you, or write for Bulletin CEC 1576-X42.



DataTape Division

CONSOLIDATED ELECTRODYNAMICS / pasadena, california

AVIATION CALENDAR

(*Continued from page 5*)

Symposium, Department of Commerce Auditorium, Washington, D. C. Sponsor: Department of the Navy, Bureau of Naval Weapons.

Mar. 21-24—Institute of Radio Engineers' International Convention, Waldorf Astoria and Coliseum, New York, N. Y.

Mar. 23-25—Symposium on Optical Spectrometric Measurement of High Temperatures, University of Chicago, Chicago, Ill. Sponsors: University of Chicago's Applied Science Laboratories; Jarrell-Ash Co.; National Science Foundation.

Mar. 24-25—First Annual Symposium on Human Factors in Electronics, New York, N. Y. Sponsor: Institute of Radio Engineers' Professional Group on Human Factors in Electronics.

Apr. 4-8—Fourth Colloquium, Combustion and Propulsion Panel, Advisory Group for Aeronautical Research and Development, NATO, Milan, Italy. Subject: High Mach Number Air-Breathing Engines.

Apr. 5-8—1960 National Aeronautic Meeting and Missiles and Aircraft Engineering Display, Society of Automotive Engineers, Commodore Hotel, New York, N. Y.

Apr. 6-8—Structural Design of Space Vehicles Conference, Biltmore Hotel, Santa Barbara, Calif. Sponsor: American Rocket Society's Structures and Materials Committee.

Apr. 6-8—1960 National Meeting "Hyper-Environments—Space Frontier," Institute of Environmental Sciences, Biltmore Hotel, Los Angeles, Calif.

Apr. 12-13—14th Annual Spring Technical Conference, Institute of Radio Engineers in conjunction with the American Rocket Society, Hotel Alms, Cincinnati, Ohio.

Apr. 19-21—International Symposium on Active Networks and Feedback Systems, New York, N. Y. Sponsors: Polytechnic Institute of Brooklyn; Department of Defense Research Agencies; Institute of Radio Engineers.

Apr. 20-22 — National Symposium on Manned Space Stations, Institute of the Aeronautical Sciences, Ambassador Hotel, Los Angeles, Calif. Cosponsors: NASA; the Rand Corp.

Apr. 21—Annual Eastern Regional Meeting, Institute of Navigation, Key Bridge Marriott Motor Hotel, Washington, D. C.

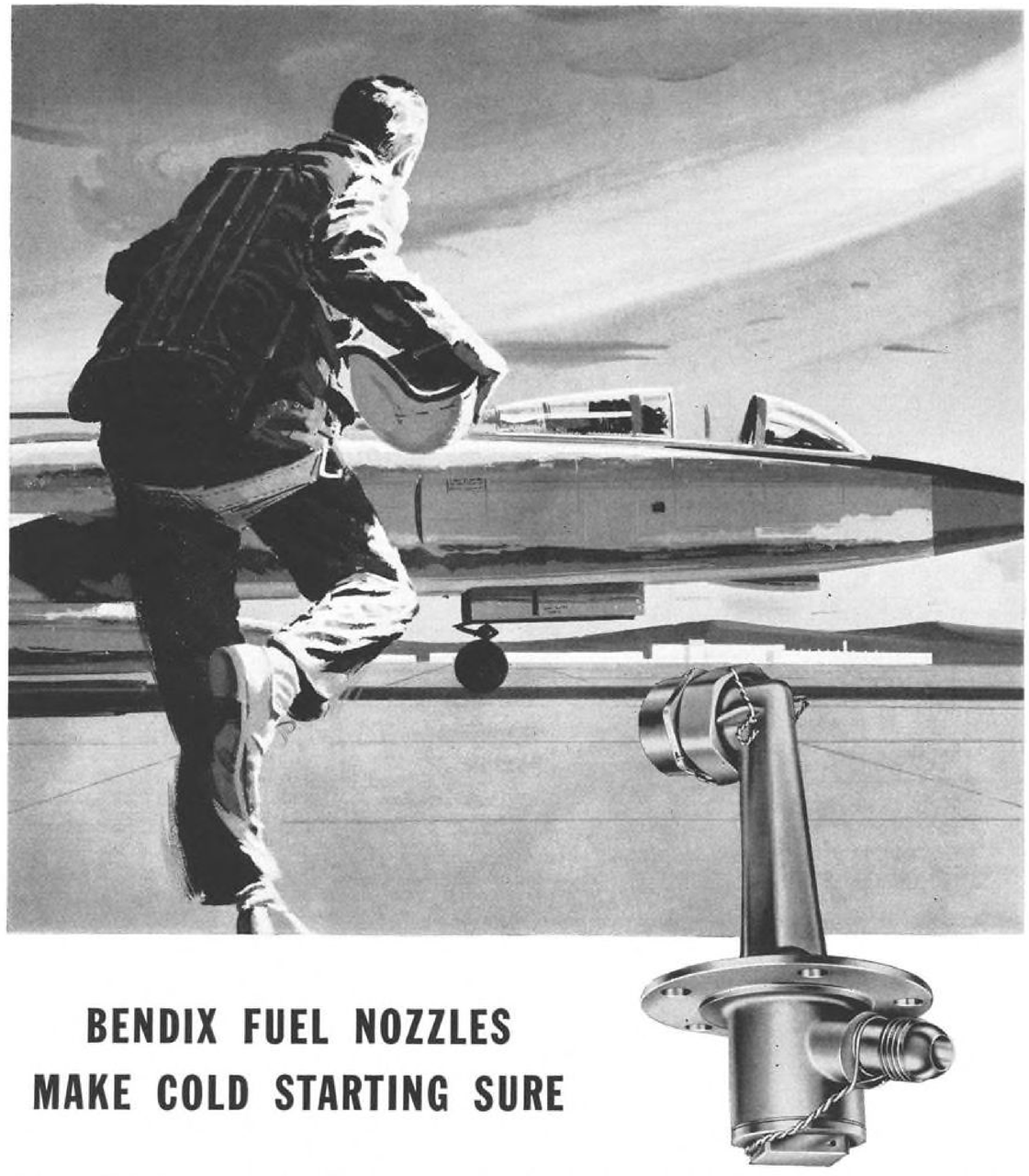
Apr. 21-22—Southwest Metals & Minerals Conference "Metals and Materials for the Space Age," American Institute of Mining, Metallurgical and Petroleum Engineers, Ambassador Hotel, Los Angeles.

Apr. 27-28—National Meeting on Space Age Materials, Cincinnati Chapter of the American Society for Metals, Sheraton Gibson Hotel, Cincinnati, Ohio.

May 2-4—National Aeronautical Electronics Conference, Biltmore and Miami-Pick Hotels, Dayton, Ohio. Sponsor: Institute of Radio Engineers.

May 2-5—Sixth National Flight Test Symposium, Instrument Society of America, San Diego, Calif.

May 9-11—1960 Symposium of the Institute of Radio Engineers' Professional Group on Microwave Theory and Techniques, Hotel del Coronado, San Diego.



BENDIX FUEL NOZZLES MAKE COLD STARTING SURE

When pilots "scramble", there's no time to fool with cold start problems. That's why Bendix Fuel Nozzles are being specified on more and more jet engines—missiles and helicopters, too. Besides overcoming the cold start problem on the ground, these nozzles overcome in-flight starting difficulties after flameouts occur.

Bendix Fuel Nozzles are mass-produced out of long experience to give greater economy and dependable performance through advanced design and manufacturing processes. Today, they are used on engines powering aircraft all the way from the T-37A to the B-47.

Write for details on how Bendix Fuel Nozzles can solve your specific problem.

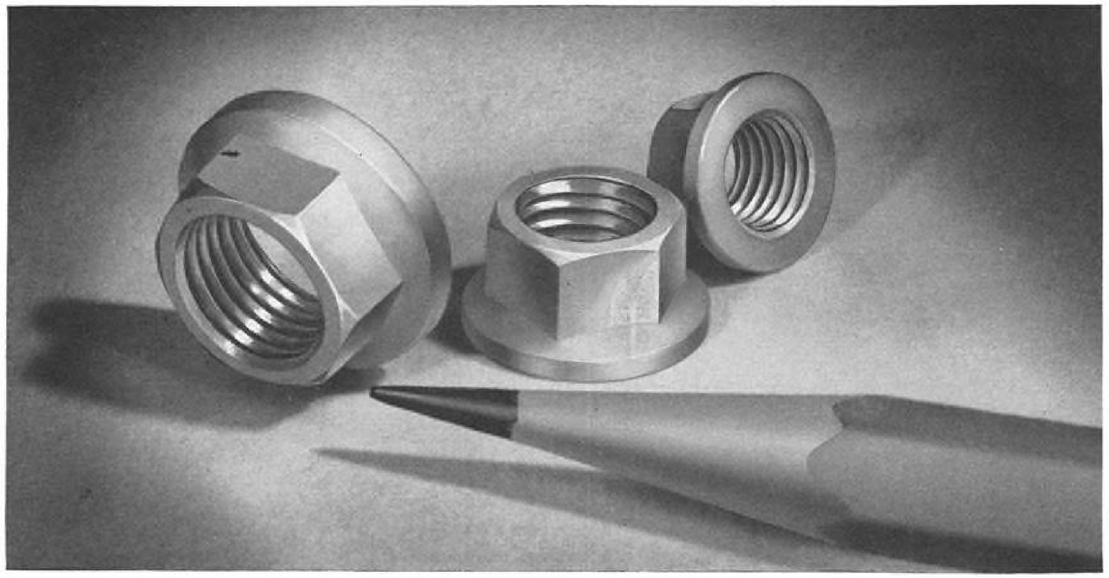
Bendix-Elmira
Eclipse Machine Division
Elmira, N. Y.

Bendix AVIATION CORPORATION

Export Sales & Service: Bendix International, 205 E. 42nd St., New York 17, N. Y.

FIRST TO MEET **MS 21042** AND **NAS 1291**

SPS FN-12 Featherweight locknut replaces NAS 679 and equivalents*—saves up to 72% in locknut weight



SPS FN-12 Series Featherweight locknut was the first to meet new MS 21042 calling for a lighter weight replacement for NAS 679 sheet metal nuts. New forged featherweight offers major weight savings, superior performance, high reliability; also permits secondary weight reductions through use of narrower bolting flanges.

Here is the only nut series that meets the new MS 21042 standard, calling for a lighter weight locknut that can universally replace the heavier-type AN 363, MS 20364, MS 20365 and MS 21040 Series.

The new SPS FN-12 weighs as much as 60% less than NAS 679 sheet metal nuts and counterparts . . . up to 72% less than equivalent MS or AN types.*

The FN-12 saves weight in another way also. Because of its new configuration, it can be installed closer to vertical bulkheads than any other aircraft nut now in use. This allows a narrower bolting flange, with consequent reductions in aircraft weight.

You can specify FN-12 Series Featherweight locknuts in 7 sizes—#4 through 3/8". All sizes are available for immediate delivery. From #4 to 5/16", FN-12 locknut prices are practically the same as NAS 679 locknuts. In the 3/8" size, the price is considerably lower.

For more information, write SPS—manufacturer of precision threaded fasteners and allied products in many metals, including titanium. Request Bulletin 2426.

ACTUAL 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%	2.5	72%
#8-32	1.2	2.1-2.5	43%-52%	4.2	71%
#10-32	1.6	2.5-2.8	40%-47%	4.6	67%
1/4-28	3.5	3.9-4.7	12%-26%	8.5	59%
5/16-24	5.4	6.4-7.2	16%-25%	11.8	54%
3/8-24	7.3	9.3	21%	19.5	63%

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

*MS 20364, MS 20365, MS 21040; NAS 1021, NAS 1022; AN 363, AN 364, AN 365 and AN Plain Nuts

AIRCRAFT / MISSILE Division SPS

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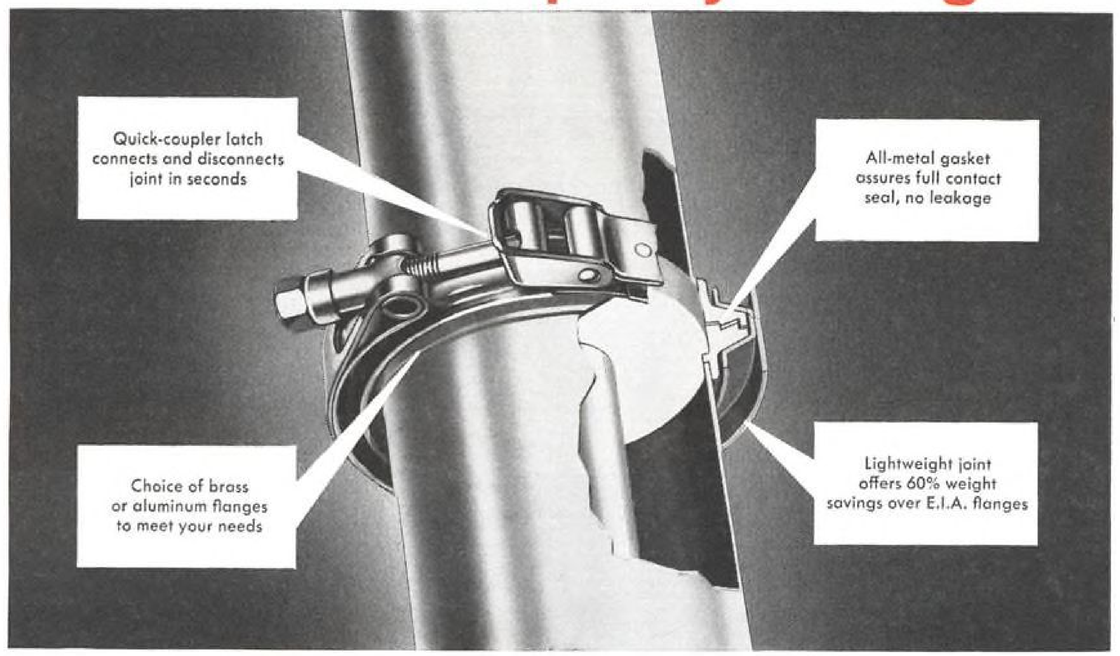
SPS WESTERN, SANTA ANA, CALIF.

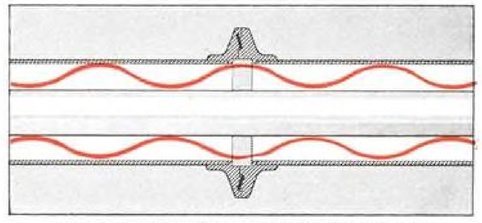
where reliability replaces probability

Zero Radio Frequency Leakage!

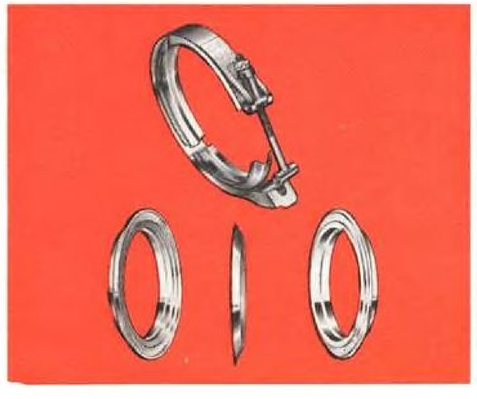


MARMAN All-Metal CONOSEAL Joint Seals Perfectly

INSTALLS QUICKLY ON ALL RIGID COAXIAL LINES



Cross section of coaxial line shows how flanges of CONOSEAL Joint hold metal gasket to provide 100% metal-to-metal line seal.



Marman's CONOSEAL Joint is designed to eliminate radio frequency leakage in coaxial lines. It features an all-metal gasket seal that seals lines subject to increased power. The CONOSEAL also provides a 60% weight savings over standard E.I.A. flanges and can be installed quickly, with minimum care and skill.

Available in standard styles and special couplings for electronic equipment, some versions of the CONOSEAL are designed to operate at temperatures from −300°F. to +2000°F. with pressures up to 20,000 psig. Marman CONOSEAL Joints are now used by Hazeltine Electronics Division.

For full details on Marman CONOSEAL Joints for electronic use, mail the coupon below.

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MARMAN DIVISION

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Please send full information on Marman CONOSEAL Joints for Coaxial Lines.

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Title_____
Company_____
Address_____
City_____ Zone_____ State_____

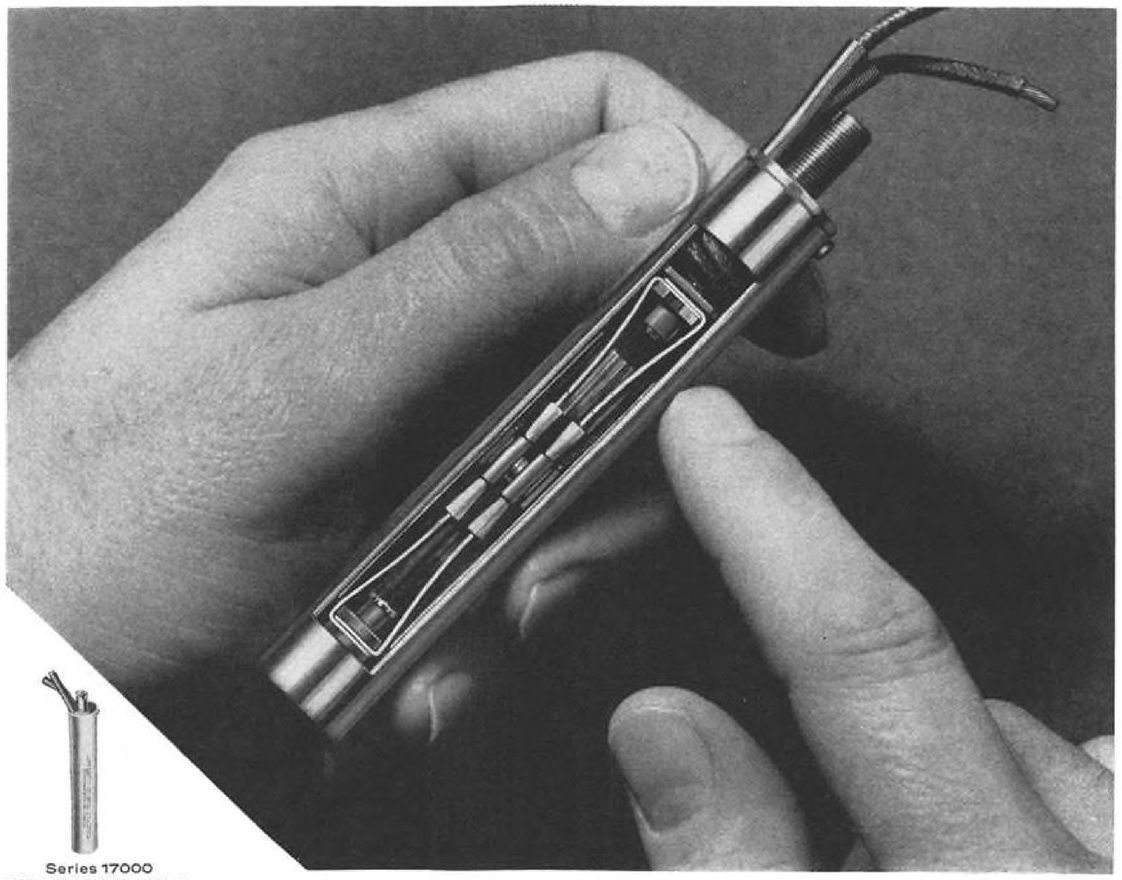
Just 0.1° F Change Gets Fast Action...

from a Fenwal
THERMOSWITCH® Unit

Extreme sensitivity is an outstanding control characteristic of the Fenwal Thermoswitch Unit. Its outer shell is the heat-sensitive element . . . strut-and-shell assembly responds almost instantly to a change in temperature. Contacts are totally enclosed and protected. There's no thermal lag in the unit. *Control is positive and precise.*

The compactness and light weight of Thermoswitch Units ideally suit them for use in missiles and aircraft. They can be used to control temperatures accurately from −100 to +1500°F at currents up to 10 amps, 115VAC. Available as miniature, surface-mounted, or immersion types, with special variations to resist corrosion, extreme vibration, and shock, *they're simple, rugged, and reliable.*

Explore *all* the advantages and application possibilities of Fenwal Thermoswitch Units. For illustrated booklet, write Fenwal Incorporated, 122 Pleasant Street, Ashland, Massachusetts.



Series 17000
THERMOSWITCH Unit

Another example of how **Fenwal** CONTROLS TEMPERATURE . . . PRECISELY

more and more in style for the men who fly and maintain gas turbine helicopters

In National Defense **KAMAN** *is part of the plan*

THE KAMAN AIRCRAFT CORPORATION • BLOOMFIELD, CONNECTICUT

PIONEERS IN TURBINE POWERED HELICOPTERS

XXIX *This is the twenty-ninth of a series of advertisements dealing with basic facts about alloy steels. Though much of the information is elementary, we believe it will be of interest to many in this field, including men of broad experience who may find it useful to review fundamentals from time to time.*

Cold-Finishing of Alloy Steel Bars: Grinding and Polishing

Grinding and polishing of cold-drawn or turned alloy steel bars is the concluding discussion on the subject of cold-finishing. In the processes of turning and polishing, and grinding and polishing (both of which require removal of surface metal), the surface finish of the bars, as well as their dimensional accuracy and alignment, are improved. But the ultimate in quality of bright, smooth surface finish and accuracy is produced by grinding and polishing of either cold-drawn bars or turned bars up to 4-in. diam, inclusive.

GRINDING AND POLISHING

Sizes up to and including 4-in. diam, are generally confined to centerless cylindrical grinders. Larger sizes are ground on centers. A centerless grinder includes a grinding wheel, a regulating wheel for applying pressure against the bar, and a work-rest blade which both supports the bar and guides it between the wheel spacing. Automatic feed of the whole length of the bar is accomplished because the regulating wheel is set at an angle of inclination with respect to the grinding wheel, and thus within this system the bar rotates and feeds during grinding. The bar is then polished to a mirror-like finish by passing through straightening rolls.

Both processes of turning and polishing, and grinding and polishing, are applicable to normalized, annealed, or heat-treated carbon and alloy bars. These operations do not materially affect the mechanical properties. For this reason, the end product can be machined unsymmetrically, with little or no tendency to warp.

Fundamentals Only. In the past four advertisements, we have outlined *basic fundamentals only* on the cold-drawing of alloy bars, the effect of cold-drawing, turning and polishing, and grinding and polishing.

Please keep in mind that Bethlehem metallurgists have given long study to specifications with respect to chemical composition, grain size, hardenability, machinability, and the like, of cold-drawn alloy steel bars. If you would like additional information on cold-drawn products, or alloy steels, our metallurgists will gladly give you all possible help, without cost or obligation.

When you are ready for new supplies of alloy steels, Bethlehem can offer the full range of AISI standard grades, as well as special-analysis steels and all carbon grades.

BETHLEHEM STEEL COMPANY
BETHLEHEM, PA.

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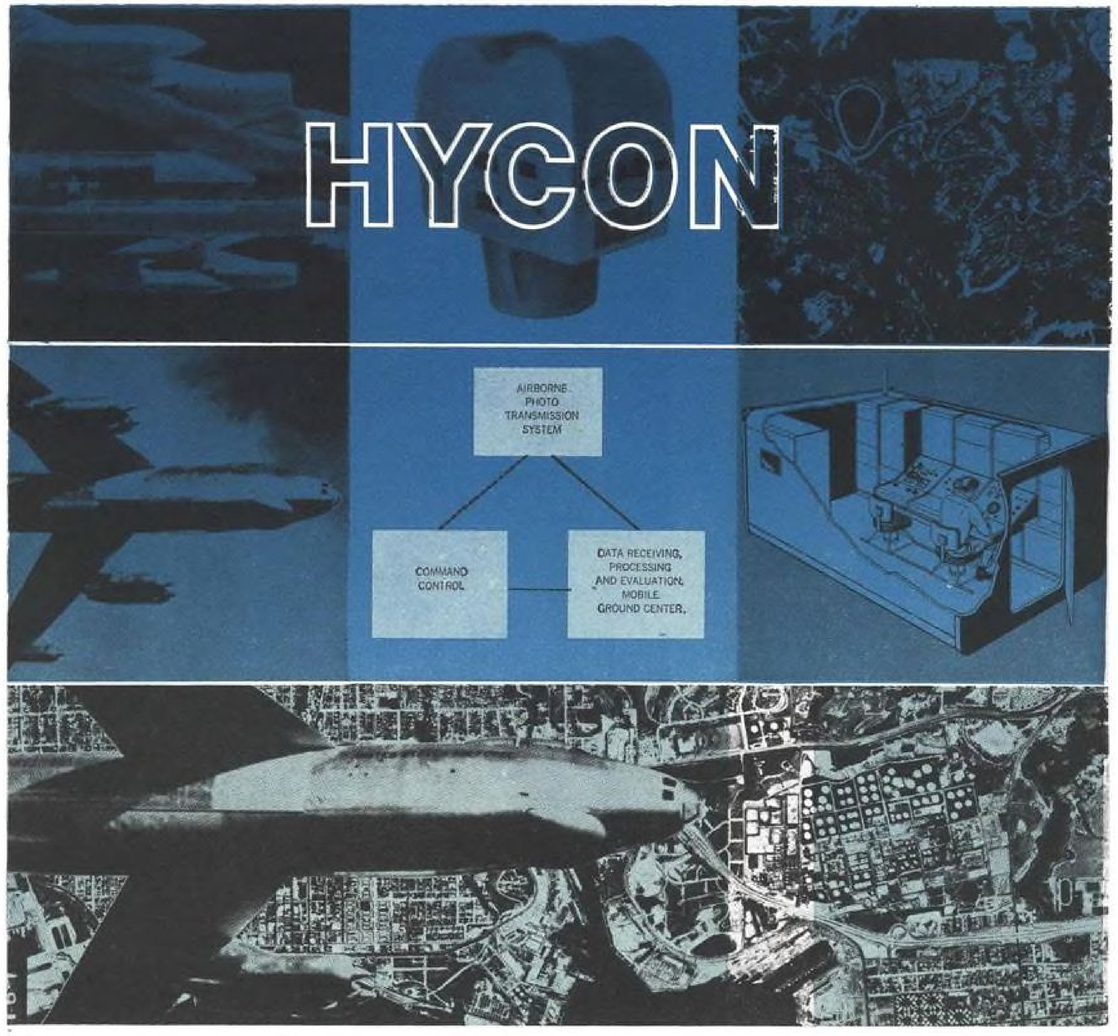

Hycon Complete Systems for Any Aerial Recon Need

Hycon's capabilities in systems management cover the field—right up to complete photo transmission equipment which sends intelligence to the ground instantaneously. Specializing in systems for use from medium to extremely high altitudes, Hycon has complete systems capabilities for infra-red or photographic reconnaissance...mapping...drone reconnaissance...day or night operations...extreme environments. From in-aircraft photographic and closed-loop TV equipment to ground-station receivers, printers, photo rectifiers, Hycon does it all. Possibilities: unlimited.
For more than ten years, Hycon has been solving complex reconnaissance problems and compiling one of the world's most complete stores of systems knowledge, techniques, and components for obtaining accurate intelligence from the air. As a result, Hycon has become one of the nation's top suppliers of aerial reconnaissance systems to the U.S. Armed Forces and NATO countries. Please write for specific or general technical information.

Hycon Mfg. Company
1030 Arroyo Parkway, Pasadena, Cal.
Specialists in research, development and production of aerial reconnaissance systems, automatic test systems, and communications systems.

How CAMCO achieves foolproof maintenance with Ansco X-ray films

Central Aviation and Marine Company, Sayville, Long Island, is America's largest independent rebuilder of aircraft oil coolers. Inspecting a rebuilt cooler once took four hours by the old "rosette" method . . . and it was really an incomplete test that resulted in rejections by both the Air Force and airlines.

Now CAMCO has switched to X-ray examination. Total test time: 9 minutes. Rate of rejection: zero.

Says Ray Bennettson, "We've been using Ansco Industrial X-ray films for years. Other brands have been tried but have failed to provide the combination of speed, gradation and easy readability that we get from Ansco films."

CAMCO is just one example of the many operations depending on Ansco in critical non-destructive testing applications. Why not contact your local Ansco representative today for information. Ansco, Binghamton, N. Y., A Division of General Aniline & Film Corporation.

Ansco

X-ray

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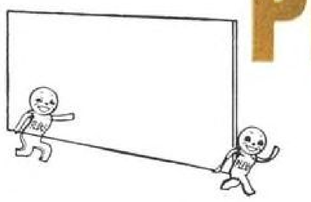

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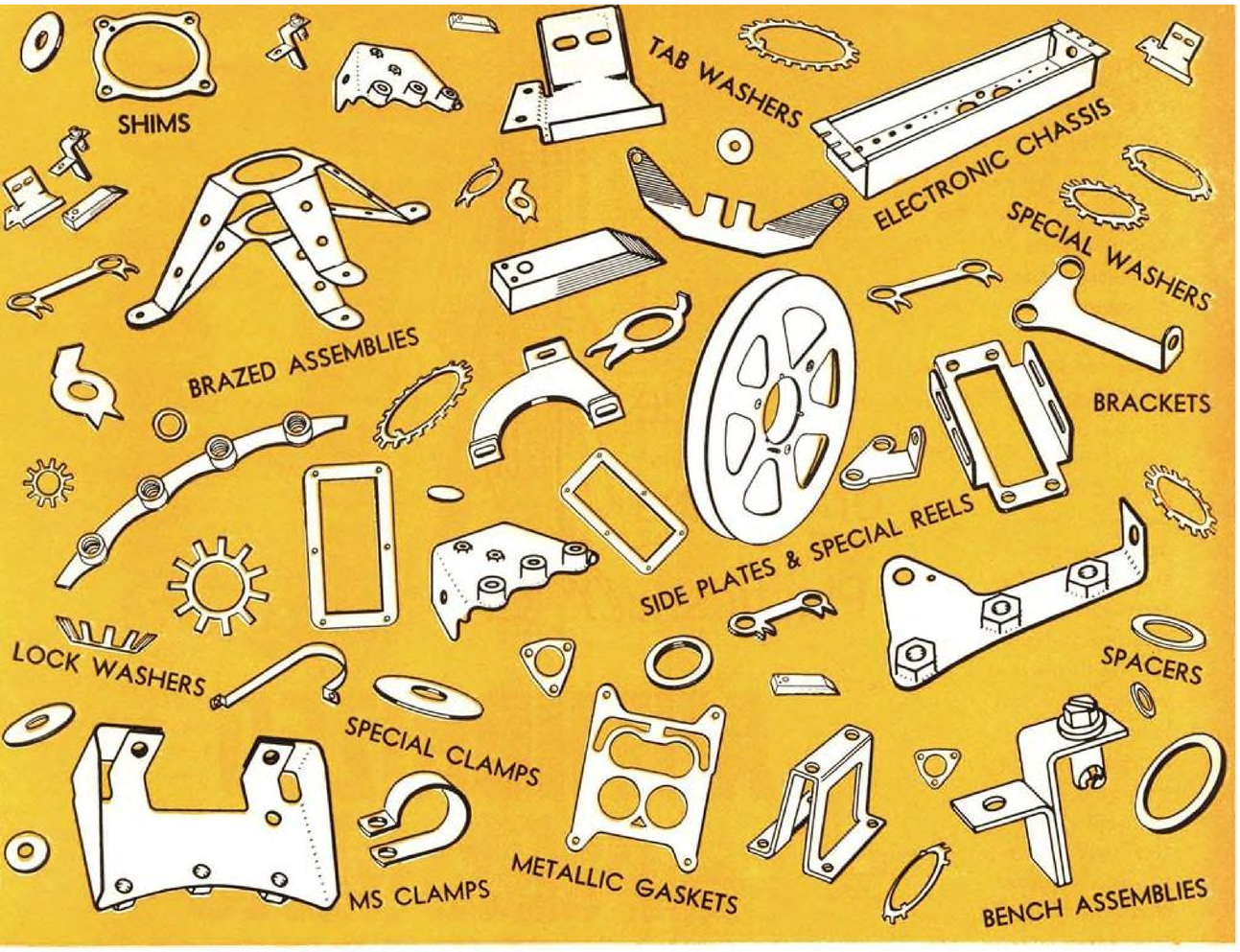

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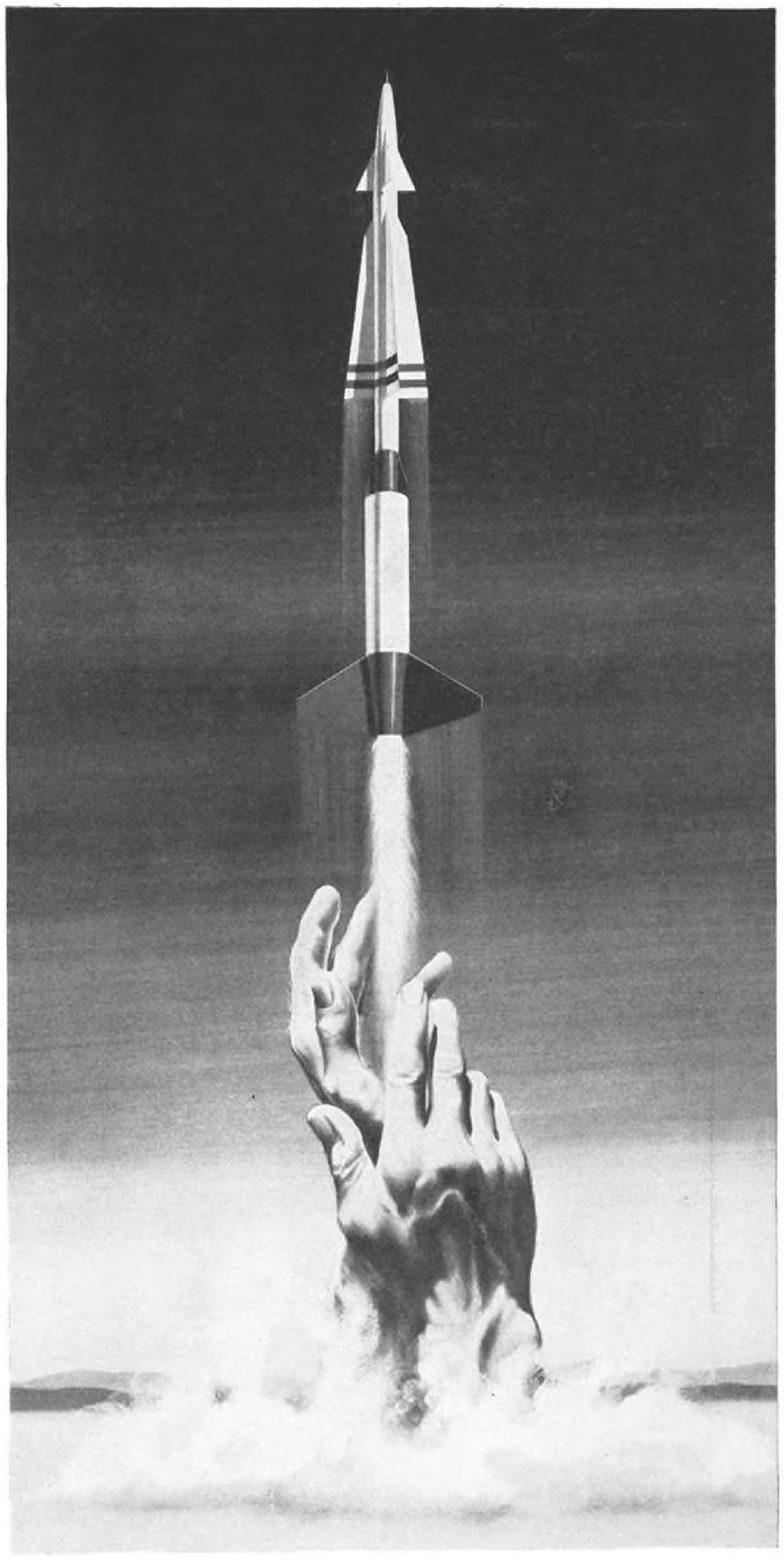

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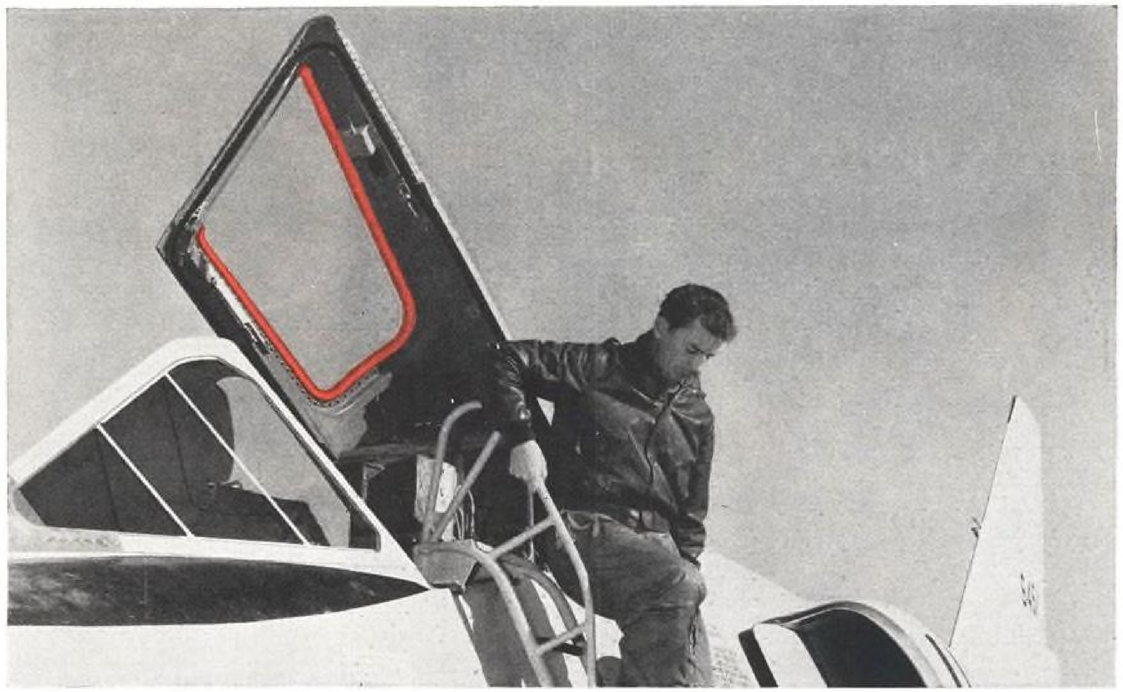

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COVER: USAF-Lockheed Agena A satellite vehicle is prepared for tests in this stand at Lockheed Missiles and Space Division's Santa Cruz, Calif., facility. The Agena A weighs 8,500 lb. at launch and 1,700 lb. at burnout. For details on the Agena B satellite, which features a restartable Bell engine, see p. 73.

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EDITORIAL

Perspective on Safety

Senate hearings conducted by Sen. Monroney's subcommittee on aviation have provided a good perspective on the air safety problems facing civil aviation, particularly the air transport industry. One of the main considerations of the Senate group has been to explore the efficacy of the Federal Aviation Act which created the Federal Aviation Agency a little more than a year ago. It is certainly appropriate to review the operations of this agency to determine whether it has produced the results that this legislation was aimed at.

It is pretty clear from the testimony of most witnesses appearing before the Monroney subcommittee that, while there are many minor differences of opinion on how the Federal Aviation Agency should function, there is general agreement that the act has stood its initial test of time, and the FAA is roaring down the right track.

Biggest criticism of FAA has been of the speed and alleged arbitrariness of its rule-making procedures. There has been an acute need for accelerating the prolonged and often pointless debates that made the old rule-making process so ineffective and kept it so far behind the current operational problem of aviation. We can understand the feeling of urgency that has stimulated Elwood R. "Pete" Quesada, the FAA administrator, to compress this rule-making cycle. We can also sympathize with his impatience at having to listen to the shrill and monotonous tirades of special interest pleaders who infest Washington and use the headlines they gain attacking FAA to impress the dues'-paying members of their respective special groups.

However, it is apparent that whatever the validity and justice of its case, FAA would do well to provide for more informal and public discussion of its proposed rules rather than adhering strictly to the letter of administrative procedures. It is also evident that, while "Pete" Quesada needed to throw the book at violators of air safety regulations without fear or favor to establish the fact that he meant business, some of his subordinates have carried this intent beyond reasonable grounds in some instances and have descended to a "nit picking" and over-legalistic approach to safety enforcement.

There can be no sympathy from the public or air transport industry for the type pilot behavior cited by "Pete" Quesada in his testimony before Sen. Monroney's group. FAA must continue to prosecute this type of irresponsible, willful violator with all the vigor at its command. The Air Line Pilots Assn. and other pilot groups must support this type of safety enforcement or lose their effectiveness as legitimate spokesmen for the majority of pilots who have a most sincere interest and the biggest stake in safety achievements.

Nobody believes that pilots who slept with their feet on the radar, barred FAA inspectors from the cockpit or flew into a mountainside in broad daylight are typical of the majority of airline pilots. But they are typical of an irresponsible minority who must be combed from the air by concerted action, beginning with company qualification programs and supported by FAA as a last resort.

Airline top management too must devote considerably more attention to its safety problems and provide more support for its operations' people in their clashes with comptrollers over the admittedly high cost of many safety contributions. FAA safety regulations are aimed at proving minimum standards, and some airlines have been consistently ahead of FAA in adopting new safety devices, such as airborne radar, and in exceeding FAA requirements in such areas as copilot qualification and the retirement of obsolete equipment. Airline operations' personnel have been more acutely conscious of safety problems as they arise and are vigorous in their attack on them. But all too often, they fall short of achieving their goals because of top management indifference or misunderstanding.

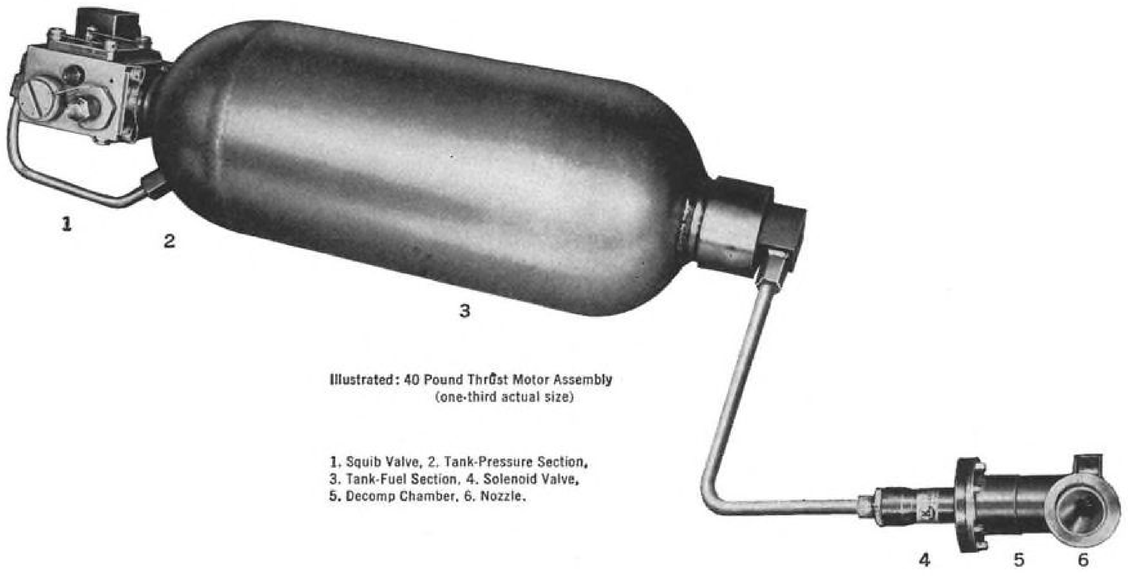
Airlines will find their mailboxes containing less FAA violation notices if they do an increasingly better job of policing their own backyards. Virtually everybody testifying before Sen. Monroney's group agreed on the major unsolved safety problems facing aviation in traffic control and terminal facilities. As we have pointed out so often, the current FAA leadership cannot be held accountable for this deplorable lag in developing, financing and installing a modern electronic navigation and traffic control system and high intensity lights. This is the area that needs concerted effort by all elements of aviation, including Sen. Monroney's group and their legislative colleagues in both the House and Senate.

This is the area where, without effective action today, the safety problems of tomorrow are certain to be compounded. We are getting a little impatient with the monotonous criticism of FAA Administrator Quesada as a "one man show" and "dictator." For it is in this vital area of trying to make up for the precious time lost by a series of "nomad" CAA administrators, who fumbled and bumbled these vital programs, that the first year of the FAA has required the vigorous drive displayed by "Pete" Quesada to overcome the inertia of the broad-seated bureaucrats.

We earnestly hope he can instill more of his vigor into the lower tiers of FAA leadership that he will leave behind him when he retires. There is little profit for anybody in the aviation business in continuing the special interest sniping that has muddied the Washington aviation scene in recent years. Real safety achievements do not come from regulations or legal proceedings. They can be achieved only by a genuine spirit aimed at top-notch performance all down the line.

The immediate problem is to push modernization of navigation, traffic control and airport facilities as fast as possible and to develop an effective industry-government relationship that will keep pushing toward this goal long after the current FAA leadership has retired.

—Robert Hotz



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(*Continued on page 129*)

INDUSTRY OBSERVER

► General Electric is working toward development of a controllable nose cone for the Air Force-Convair Atlas intercontinental ballistic missile to give it the capability of changing its flight path from a straight ballistic trajectory and complicate the task of anti-ICBM defenses. Soviet Union is believed to be working on a similar vehicle.

► **Flight test program for the General Electric J93 turbojet programed for North American Aviation's Mach 3 B-70 bomber has been temporarily delayed, although a Convair B-58 with an underbelly pod structure designed for testing the engine is available at Edwards AFB, Calif. USAF thus far has failed to allocate funds to furnish the engine and conduct the flight test program as originally planned. One engine will be tested this year in the low altitude wind tunnel at Arnold Air Development Center but not in the facility's high altitude and high Mach number wind tunnel.**

► Defense Department is investigating half a dozen techniques for detecting the launching of ballistic missiles which make use of electromagnetic energy reflected off the ionosphere in addition to the Office of Naval Research developed Project Teepee (AW Aug. 17, p. 33). Although the new detection techniques are not expected to be as reliable as the Ballistic Missile Early Warning System (BMEWS), they would require only a few relatively inexpensive, easily installed facilities. The techniques are viewed as supplemental, not competitive, to BMEWS and Project Midas early warning satellites.

► **Advanced Research Projects Agency has dropped its Project Tackle communications satellite program, an instantaneous repeater type that was intended to test microwave system components to be used later in Project Decree, a 24-hr. hovering communications satellite. ARPA is continuing Courier, the delayed repeater communications satellite under development by the Army Signal Corps, and Project Steer, an instantaneous-repeater type polar-orbit satellite being developed by Air Force for use by Strategic Air Command.**

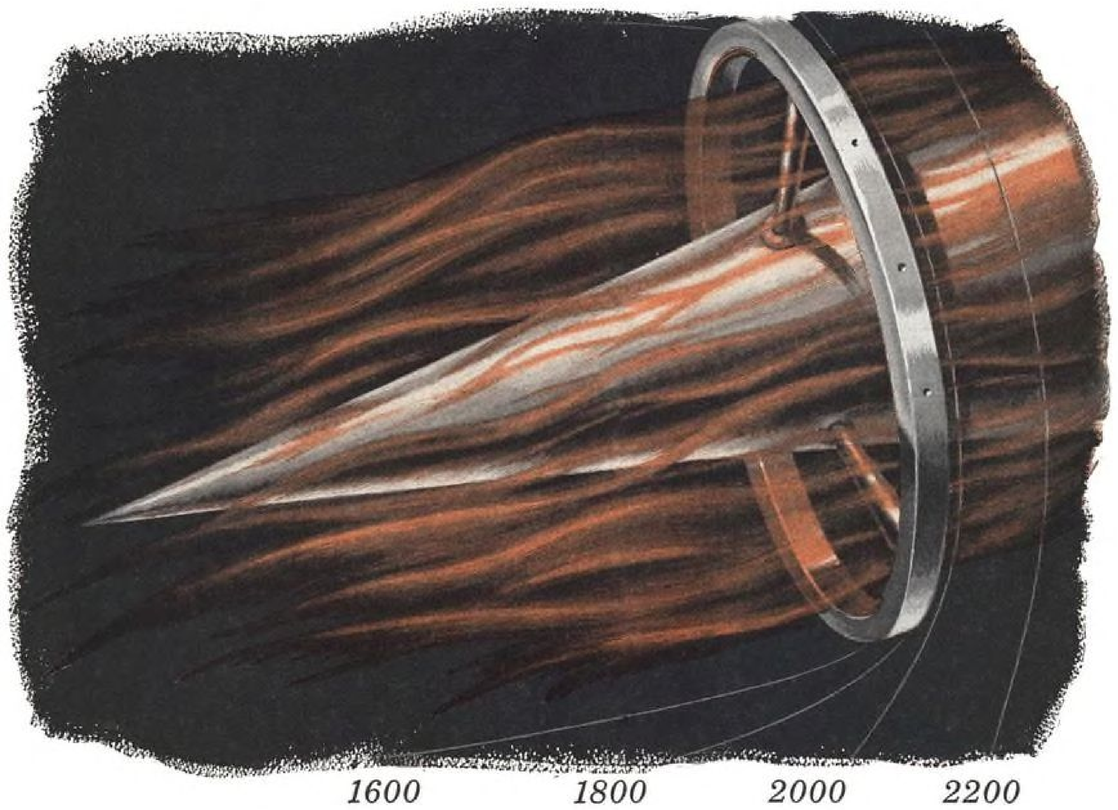
► Air Force within the near future will initiate an experimental operational program to disperse North American F-100s on zero-length launchers to determine the feasibility of adopting the plan on a wider scale (AW Nov. 9, p. 103). Most of the dispersed aircraft under the experimental program will come from Tactical Air Command units stationed in the Far East.

► **Air Force has installed prototype equipment for its Midas early warning satellite in an aircraft to check its ability to monitor and follow the trajectory of U. S. missile test launches.**

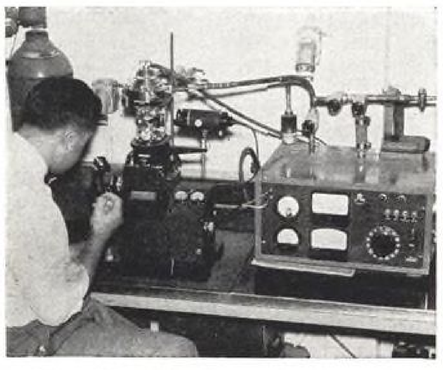
► Hydrazine-unsymmetrical dimethyl hydrazine fuel mixture and nitrogen tetroxide oxidizer is now considered to be the most likely high energy, storable propellant combination for use with Martin's Titan ICBM (AW Feb. 1, p. 24). Specific impulse of this combination—278 sec.—compares well with 286 sec. specific impulse of the present Titan propellant combination of liquid oxygen and RP-1, while its density impulse of 327g-sec./cc. is considerably higher than the 290g-sec./cc of liquid oxygen-RP-1.

► **Wright Air Development Division will soon call for industry proposals for a cryogenic gyroscope, with drift rates in the order of 0.0001 deg. per hour, for use on ballistic missiles (AW Feb. 1, p. 72). Approximately a dozen companies engaged in gyroscopic and/or cryogenic work attended recent WADD pre-bid briefing conference in Dayton.**

► Maritime Staff of Japan's National Defense Agency is drafting a 10-year program leading toward limited production of a Japanese-designed seaplane for anti-submarine patrol. First of the aircraft, designed to replace the Lockheed P2V-7 and Grumman S2F now used by Japan for ASW patrol work, is scheduled to be produced in 1963. Total aircraft planned under the program is 26 by 1970.



Cutting back the Thermal Thicket



Solving high-temperature problems through research is part of Haynes Stellite's complete metallurgical services. This metallograph is used to observe metals at 2200 deg. F.

The great strength and high scaling resistance of HAYNES alloys at temperatures of 2000+ deg. F. are providing long service life in the hottest areas of jet engines. Flame holders, flame steps and afterburners are some of the hot spots where the properties of HAYNES high-temperature alloys are helping combat burnout, erosion, and stress in the jet, ramjet, missile, and rocket fields.

There are twelve HAYNES high-temperature alloys to choose from, formulated to handle virtually any heat condition. Among them: HASTELLOY alloy X with remarkable resistance to oxidation up to 2200 deg. F. HAYNES alloy No. 25 that resists stresses, oxidation, and carburization up to 2000 deg. F. And HASTELLOY alloy R-235, outstanding in the 1500 to 1750 deg. F. range. All are readily available.

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Washington Roundup

Martin Titan Management

Air Force is still not satisfied with Martin Co.'s management of the Titan program and is not completely convinced that Martin Chairman George M. Bunker's move to Denver to take over the program will solve the problem. USAF feels the company should strengthen its management structure with additional executive talent and that there is still a need for Air Force supervision of the way Martin runs the Titan program. Some thought has been given within USAF to possible financial penalties to recoup any losses from Martin shortcomings in the program.

Bunker took personal charge of the Titan program last month and merged Titan operations of the Denver Division, Activation Division and Cocoa Division into a single, integrated division based in Denver (AW Jan. 4, p. 18). Just before Bunker took over as general manager of the Titan program, Air Force Ballistic Missile Division and Space Technology Laboratories completed a management survey of the program, and changes were recommended.

Symington's Pentagon Plan

Reorganization plan for the U. S. military structure proposed by Sen. Stuart Symington (D.-Mo.) last week would impose a centralized management pattern on the Defense Department without actually abolishing the individual services. Under secretaries of defense would replace the service secretaries to handle administrative functions, and the President would establish unified commands for defense, strategic, combatant, logistic and other purposes. Defense secretary would have the power to transfer personnel from one service to another.

Chief of Staff of Defense would be named under the Symington plan to head the Joint Chiefs of Staff with power of final decision over all matters coming before the JCS. Chief of Staff of Defense would be responsible for preparing a single, over-all war plan for all the services and for assigning tasks to the services under this plan. He also would review major personnel and material requirements of the services in light of the war plan and set policy for joint training of the armed forces.

Eisenhower on the Space Race

President Eisenhower continued to deny that the U. S. is in a prestige-laden space race with the Soviet Union last week. At the same time, the Administration was asking Congress for increased funds to hasten progress on the super boosters which represent the nation's only real current prospect for surpassing Russian achievements.

Asked at his news conference about the statement by U. S. Information Agency chief George Allen that U. S. prestige abroad has suffered from Soviet space successes (see p. 61), Eisenhower noted that he had recently returned from a lengthy trip which indicated the nation's prestige is high internationally. Granting that the country wants to move ahead in space as in every other field, the President cautioned that:

"The reason for going into space, except for those activities that are carried on by the Defense Department as having some value to the security of the country, is purely scientific. Therefore, you are not talking about racing them in finding the particular items or in naming the particular course that you are going to run in this race; you work out a proper and an appropriate plan of scientific exploration, and you follow it positively, rather than trying to follow along behind somebody else.

"Now, it is—I have said time and again that because the Soviets are far ahead in this very large booster and engine, that, so far as distant space exploration is concerned, they are going to be ahead in that regard for some time, because it takes time to get that engine built.

"Now, just taking it over, this Saturn project from the Army, I have, after a long study by the space agency—have determined that the amount of money that we took over with that particular thing was not sufficient, and there's another hundred million being devoted, or at least recommended for devotion to it. I believe it will be appropriated, and I believe that—implies not only the determination of the United States to go ahead rapidly with this thing; I believe that we can look forward at the proper time to success."

. . . And Another View

In the same vein, Dr. George B. Kistiakowsky, the President's scientific adviser, recently told a meeting of the American Physical Society that the U. S. "cannot ignore the very real political implications of various (Soviet) spectacular accomplishments in outer space that have come to have symbolic meaning to the world at large."

Dr. Kistiakowsky said it is unfortunate that technological spectaculars tend to be viewed by the public and the press as the sole measure of scientific and technological progress and thus of military power. He said the U. S. scientific achievements in space have easily matched those of the Soviet Union, notwithstanding the greater publicity given to the Soviet "technological spectaculars." He also said the U. S. should not accept a secondary role in future outer space activities requiring large rocket boosters, but added that "we must accept the technical reality that despite a vigorous national effort . . . there are limits on how quickly the gap can be closed, and these limits are largely set by technological factors."

Nuclear Weapons for Allies?

The President also hinted last week that he favors transfer of some nuclear weapon capability to nations allied with the U. S. He told newsmen he would not divulge nuclear information which the Soviet Union does not already have but that, when the Soviets have the information and know-how, "it's pretty hard for me to understand why we don't do something with our allies, as long as they themselves stand with us firmly in defending against the probable aggressive intent of communism."

Justice Studies Vertol Merger

Justice Department is studying the proposed merger between Boeing Airplane Co. and Vertol Aircraft Corp. to determine whether it would violate the anti-merger provisions of the Clayton antitrust law. Under the proposed merger, Boeing would move into the short haul and commuter market by acquiring Vertol and operating it as a division. The merger would be accomplished through an exchange of two shares Boeing stock for each three shares of Vertol stock.

—Washington staff

NASA Plans Two Launches a Month Over Next Decade

By Ford Eastman

Washington—National Aeronautics and Space Administration plans to launch an average of two major space vehicles a month for the next 10 years.

Associate Administrator Richard E. Horner told the House Committee on Science and Astronautics that the number of major firings scheduled for the last half of Fiscal 1960 through Fiscal 1969 totals approximately 260. Missions will range from test firing of boosters and upper stages to deep space scientific probes and manned flight around the earth and moon (AW Feb. 1, p. 25).

Horner also told the committee headed by Rep. Overton Brooks (D.-La.) that in Fiscal 1962 and beyond the present variety of first-stage launch vehicles will be reduced to one solid propellant rocket, the Scout, and three liquid propellant rockets, the Thor, Atlas and Saturn.

He said NASA also may eliminate the Thor earlier than expected, leaving only the Scout, Atlas and Saturn as first stage rockets.

NASA's Anticipated Major Vehicle Launchings

	1960 (last half)	1961 (quarters)				Fiscal Years '62	'63	'64	'65	'66	'67	'68	'69	Totals
Vehicles:														
Redstone	1	2	3	2										8
Atlas	1	2	1	2	1	6	1							14
Juno II	1	1	3											5
Thor-Able	2													2
Atlas-Able	1	1												2
Scout	4	2		2		6	6	6	6	6	6	6	6	56
Thor-Delta	2	1	2	1	1	5								12
Thor-Agena B						1	6	6	6	6	6	6	6	43
Atlas-Agena B				1		3	4	5	6	3	12	12	12	88
Atlas-Centaur					1	5	4	5	6	9				
* Saturn						2	2	3	4	4	4	4	4	27
* Nova Type												1	2	3
	12	29				28	23	25	28	28	28	29	30	260

* Does not include any vehicles to be added under supplemental Fiscal 1961 budget requests.

Horner said NASA also may eliminate the Thor earlier than expected, leaving only the Scout, Atlas and Saturn as first stage rockets.

Development Testing

The 1.5-million-lb.-thrust F-1 engine under development by North American Aviation's Rocketdyne Division is not scheduled to begin development testing until 1968 and is not expected to become operational until some time after that.

Restricting the number of vehicle types will reduce the cost of the program, Horner said, and increase the reliability through more experience with each of a limited number of systems.

Of the 260 shots scheduled, 104 will be made with the Atlas, including 88 with either the Lockheed Agena B upper stage powered by the Bell Hustler engine or the Convair Centaur upper stage powered by two Pratt & Whitney liquid hydrogen engines.

Total of 57 Thor firings are scheduled, including 43 Thor-Agena B vehicles beginning in Fiscal 1962. If the Thor is eliminated, the number of Atlas-Agena B or Atlas-Centaur boosters may be increased.

Next largest number of any one type of booster to be used is the Scout. NASA plans to fire 56, including four in the last quarter of Fiscal 1960 followed by four more in Fiscal 1961 and six a year from then through 1969. Under original plans, when the original Fiscal 1961 budget request of $802 million was made, NASA had planned a total of 27 Saturn vehicles. Under a supplemental $90 million for Scout this number may be increased.

Phase Out

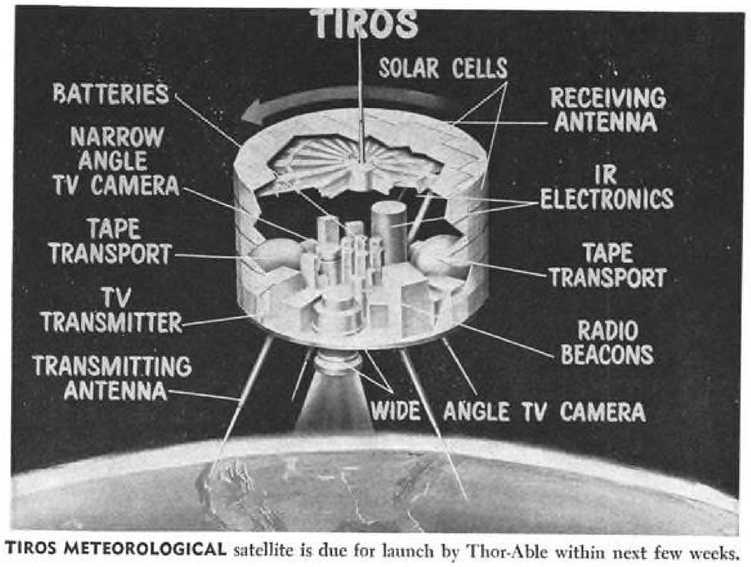
Boosters to be phased out of the program include:

- **Redstone**—One is to be fired during the remainder of the current fiscal year followed by a final seven in Fiscal 1961.
- **Juno II**—Five shots remain, including one this fiscal year, four the next.
- **Thor-Able**—Final two firings are scheduled before the end of March.
- **Atlas-Able**—One is scheduled to be fired between March and the end of the fiscal year, while the final vehicle is to be launched during the first quarter of Fiscal 1961.
- **Thor-Delta**—A total of 12 remains, including two this fiscal year, five the next and five during the first quarter of Fiscal 1962.
- **Atlas**—One Atlas without added stages will be fired during the current fiscal year, six during Fiscal 1961, six more in Fiscal 1962 and one in Fiscal 1963. All other Atlas vehicles to be launched in the 10-year program will have added stages.

Horner warned, however, that NASA in developing its 10-year plan expects to modify it from year to year on the basis of realized experience, development progress and resource availability.

Under the plan, Horner said, increased boost capabilities are expected to be realized starting in late Fiscal 1961 and early Fiscal 1962 through the introduction of Thor-Agena B, Atlas-Agena B and Atlas-Centaur.

Additional capability will be available when the Saturn becomes operational, now expected late in 1964 under the accelerated schedule. Improved upper stages on the Saturn will permit even greater payloads being boosted. Beyond the Saturn is the F-1 Nova with a 1.5 million lb. thrust toward the end of the 1960s.



TIROS METEOROLOGICAL satellite is due for launch by Thor-Able within next few weeks.

No Specific Backups

Horner told the committee that no specific backup boosters would be provided for each payload or experiment, except possibly where some unique program requirements prevail. He said:

"It is our objective to play our experiments in each of the major program areas as a coherent and integrated effort. Each major experiment will be carefully related to the over-all program objectives, based upon the results of previous flights, and generally increasing in sophistication as time progresses.

"Many of the spacecraft will in themselves be related through the use of common structural frames, power supplies and instrumentation. There will also be many which, though differing in their performance objectives, use launch vehicles of the same type.

"In such a program the best utilization of our resources is not realized by providing backup boosters for each payload. Rather, it should be considered that a launch is scheduled periodically, in this case (lunar and interplanetary exploration) each three months and, if a catastrophic failure is experienced with any one launch, then a determination can be made at that time as to whether a similar spacecraft should be flown on the next vehicle.

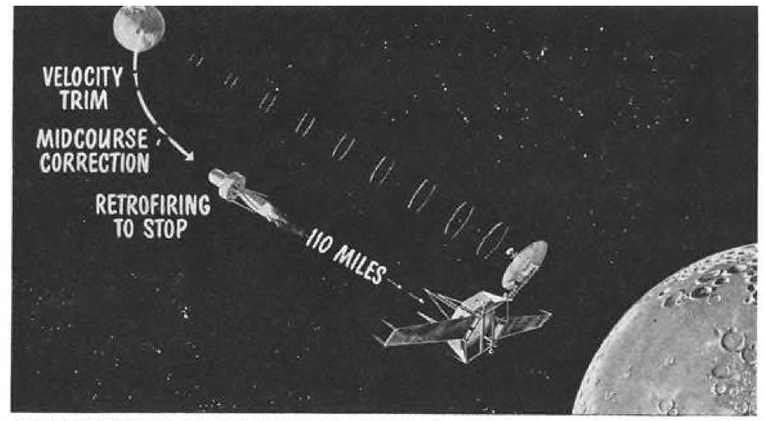
"The need for extensive ground testing of all spacecraft requires that spare devices be produced in each case. It is therefore possible to assemble an additional spacecraft to replace a failure on reasonably short notice."

Increased Cost

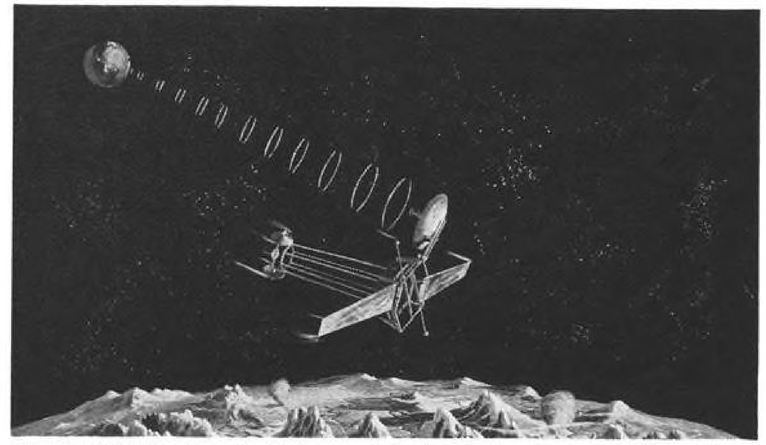
Horner also warned the committee that the cost of the national space program will increase substantially.

"In view of the half billion dollar obligation rate during the current fiscal year," he said, "and the proposed . . . program for Fiscal 1961, it is likely that a natural growth of developments now under way will lead to a budget request of more than $1 billion in the following year with a growth to more than $1.5 billion a few years later."

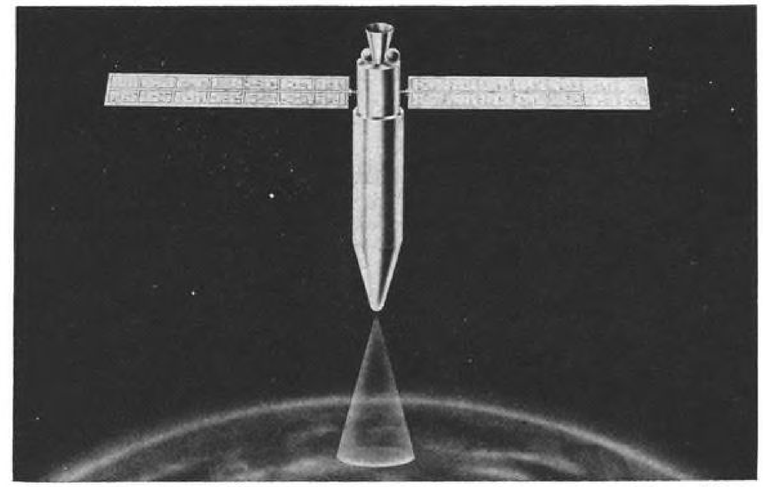
Harold B. Finger, chief of NASA's nuclear engine programs, told the com-



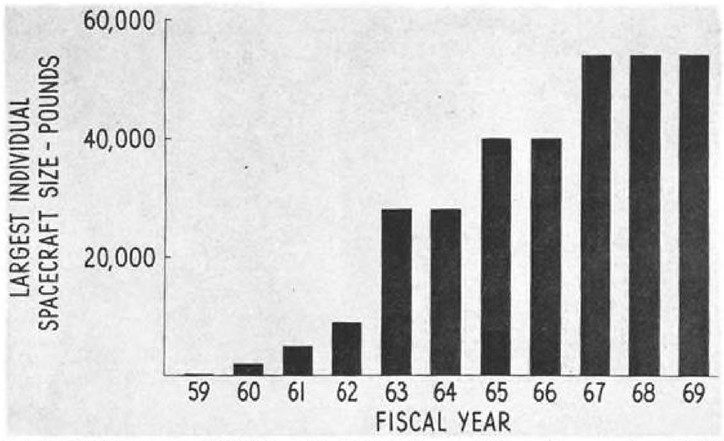
ATLAS-AGENA will be used to impact a spacecraft on the moon, probably late in 1961.



ATLAS-CENTAUR will send probe to nearest planet. First launch may occur late next year.



NIMBUS SATELLITE will follow the Tiros series in National Aeronautics and Space Administration's meteorological satellite program. The 650 lb. Nimbus will be launched by a Thor Agena B booster from the Pacific Missile Range and will scan the earth's surface for weather patterns from a 600 mi. circular polar orbit. Satellite will be earth oriented and stabilized by pneumatic and inertia wheel technique. Solar cells and storage batteries will supply power to Nimbus during its six-month life, and instrumentation will include advanced television and scanning and non-scanning infrared equipment, with later versions to carry spectrometer and radar equipment. NASA is exploring the possibility of establishing a station near the polar area for maximum data acquisition from the polar orbit.



ANTICIPATED growth of NASA's payload launching capability in the years from 1959 to 1969 is shown in terms of weight of satellites sent into near-earth orbits.

mittee that the agency is initiating the development of a liquid hydrogen cooled-jet nozzle to be used in the reactor test program leading to a nuclear rocket engine. The program is being carried on jointly by NASA and the Atomic Energy Commission.

One possible method of flight testing nuclear rocket systems, Finger said, is to use a two-stage Saturn vehicle to boost a nuclear rocket stage into an earth orbit. After the stage is in orbit it could be started and tested under conditions simulating those that would be encountered in a useful long-range mission.

Such an orbital nuclear rocket stage, he said, could be a low thrust, low reactor power system on the order of 200 megawatts.

However, if nuclear rockets were applied as second rather than orbital stages and if they were applied for useful missions to vehicles larger than the Saturn, significantly higher powers would be required, Finger said.

Space Technology

Administration Asks Extra Money To Accelerate Saturn Program

By Craig Lewis

Washington—The Administration increased its space budget request for Fiscal 1961 by $113 million last week to accelerate super booster programs and hasten the day when an operational Saturn booster with liquid hydrogen-fueled upper stages will be available.

National Aeronautics and Space Administration is now trying to decide how to provide additional funds for an accelerated Saturn program during the present fiscal year—probably by transfers from other programs—and, if Congress grants present budget requests, Saturn will dominate the NASA budget in Fiscal 1961, with 25% of the agency's new spending authority.

The $113 million supplemental request was submitted after President Eisenhower asked NASA to determine how much extra money would be needed to accelerate the super booster program (AW Jan. 25, p. 29). It covers work on the F-1 1.5 million lb.-thrust single chamber engine and on a new 200,000 lb.-thrust liquid hydrogen upper stage engine, as well as the newly redesigned Saturn vehicle with its Centaur liquid hydrogen upper stages.

Under the accelerated spending schedule, an interim Saturn vehicle designated C-1 will be operational by 1964. This vehicle will have the Saturn booster with its eight clustered Rocketdyne H-1 engines for a first stage. Second stage will be four 20,000-lb.-thrust liquid hydrogen engines which will be improved versions of the Pratt & Whitney XLR115 Centaur engine. Third stage will be two 15,000 lb. XLR115 engines.

A second interim vehicle, designated C-2, will have a new second stage composed of two of the 200,000 lb. hydrogen engines NASA is planning to develop. Third and fourth stages will be the second and third stages from the C-1 vehicle.

Final version of Saturn will be a five stage vehicle as described by AVIATION WEEK in its Jan. 11 issue (p. 26). First stage will be the clustered Saturn booster, second stage will use four 200,000 lb. hydrogen engines, and the top three stages will be the same as those on the C-2 vehicle.

The latter two versions of the Saturn vehicle will be available as soon as NASA's projected liquid hydrogen-liquid oxygen engine is available. NASA held a meeting here last week to brief prospective bidders on this new engine project.

Companies attending were Bell Aircraft Corp., General Electric Aircraft Gas Turbine Division, Aerojet-General Corp., Rocketdyne Division of North American Aviation, Pratt & Whitney Aircraft Division of United Aircraft Corp., Reaction Motors Division of Thiokol Chemical Corp. and AiResearch Division of the Garrett Corp.

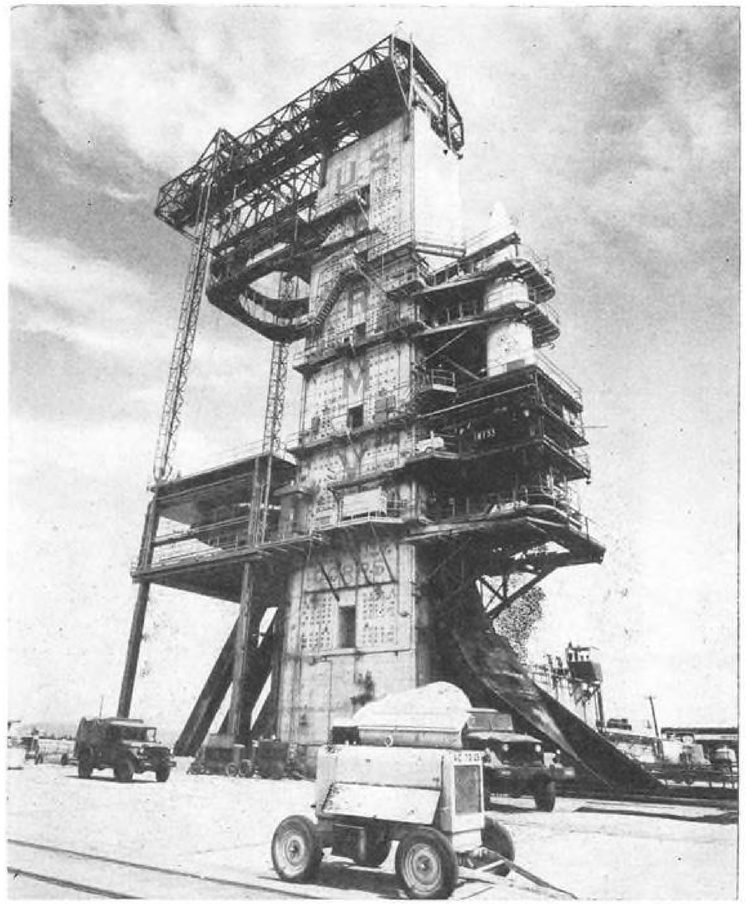
Wernher von Braun, director of Army Ballistic Missile Agency's Development Operations Division, told Congress last week that under previous funding plans one Saturn would have been flight tested in 1961, two in 1962, three in 1963 and four in 1964, with the vehicle becoming operational in 1965. Under the new plan, the first Saturn will be flight tested next year, three will be tested in 1962, five in 1963 and one in 1964 before the vehicle becomes operational in the second quarter of that year.

First three test flights will use only the clustered first stage with dummy upper stages for ballast. Later flights will test the hydrogen-fueled upper stages. Von Braun said all first stage boosters will be recovered. He also said that, while previous funding plans provided for production of four Saturn vehicles a year, production can be increased to six a year with the newly requested funds. After development is completed, production capacity can be increased to 10-to-20 vehicles a year, although no funds are currently being provided for such a rate.

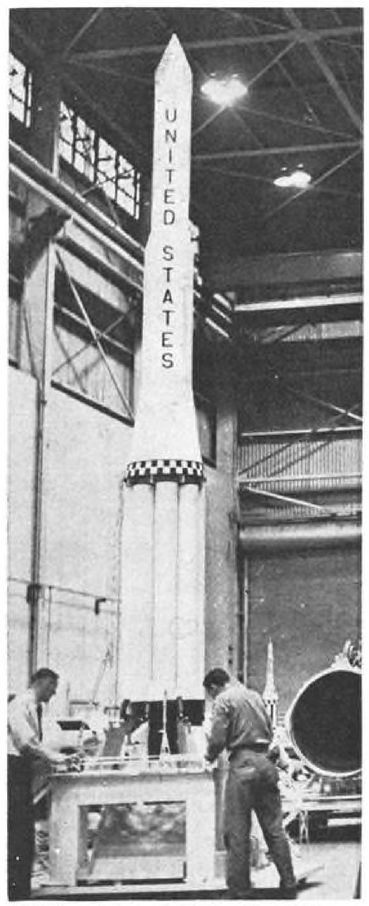
Von Braun's group, which is responsible for Saturn development, is scheduled to be transferred to NASA next month unless Congress objects. No major congressional opposition is expected.

Minuteman Schedule

Washington—First test launchings of Air Force's Minuteman solid-propellant intercontinental ballistic missile are now scheduled for sometime in August, with the missile attaining an initial operational capability in late 1962 or early 1963. Contract for production of the Minuteman second stage was recently awarded Aerojet-General Corp. First stage propulsion units are being developed by Thiokol Chemical Corp.



STATIC TEST STAND at Army Ballistic Missile Agency's Test Laboratory at Huntsville, Ala., has been modified for first static firing of the 1.5 million-lb. thrust Saturn booster. Tower originally was 149 ft. high and used for Redstone and Jupiter missile tests. New height is 175 ft. Forces are absorbed by concrete resting on piling driven into bedrock.



MODEL of Saturn is displayed at Redstone Arsenal. An interim Saturn designated C-1 will be operational by 1964. First Saturn will be launched next year.

Of the $113 million added to the original $802 million NASA budget request, $15 million is for the F-1 engine and $8 million is for the 200,000 lb. hydrogen engine. These funds are added to $26 million for the F-1 and $8 million for the hydrogen engine in the original request.

The remaining $90 million is added to the $140 million previously requested for Saturn, bringing the total to the $230 million originally asked by the Saturn development group when it first submitted its Fiscal 1961 budget to the Administration. Von Braun said Saturn funding in the current fiscal year is $71.5 million, including $1.5 million for overtime work authorized by the President.

The extra $90 million for Fiscal 1961 includes $3.2 million for overtime on Saturn, plus $53.3 million for research and development. The $53.3 million will go to industry, principally for development of the upper stages using the 15,000 lb. and 20,000 lb. Centaur hydrogen engines.

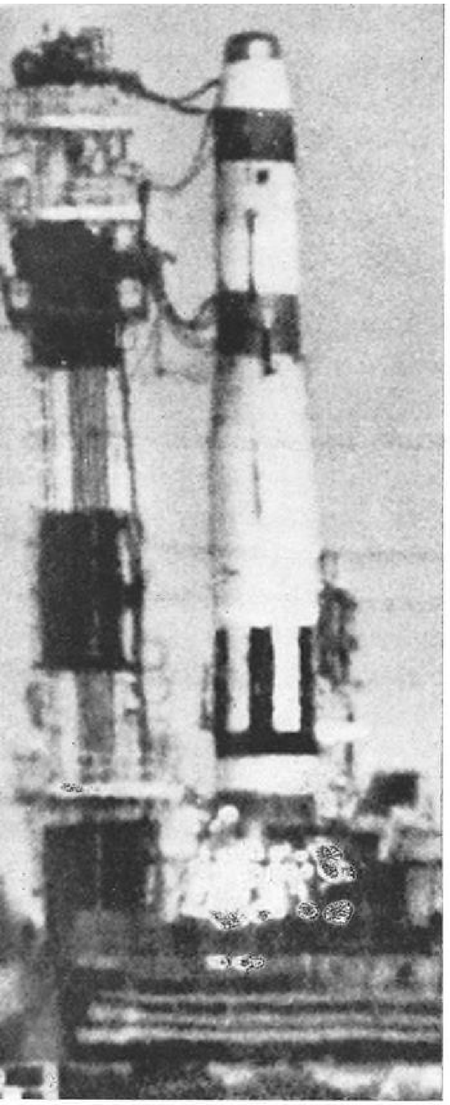
The supplemental request also includes $33.5 million for construction and equipment. This money will be used to enlarge the Saturn assembly area at ABMA's Huntsville facility and to build a second static test stand at Huntsville and a second Saturn launch pad at Atlantic Missile Range.

All these extra funds are for Fiscal 1961, and NASA has to find a way under its already cramped Fiscal 1960 budget to accelerate the super booster programs and launch development of the 200,000 lb. hydrogen engine immediately. One suggested method is to reprogram funds from other sources for the balance of Fiscal 1960, then shift the reprogramed amounts back when extra funds become available July 1.

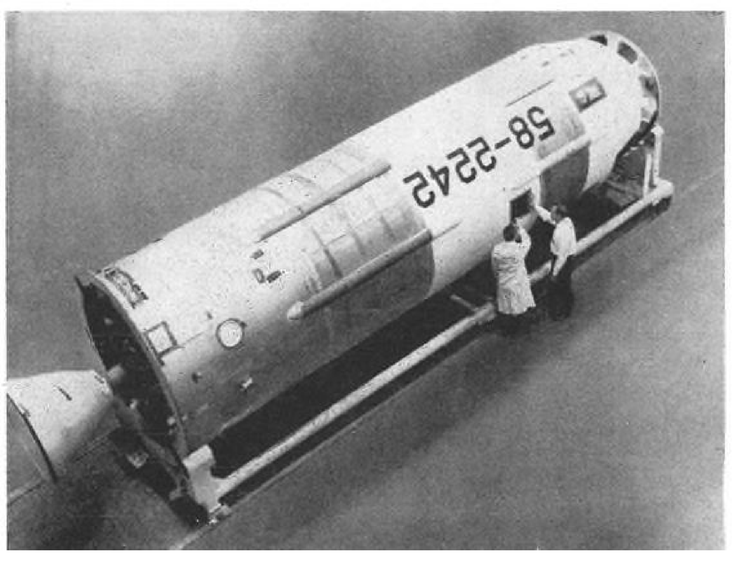
While endorsing the projected transfer of his group to NASA, von Braun said a problem has developed because only about 10% of the 250 top-level jobs authorized for NASA remain unfilled. He said there are not enough of these jobs left to cover the high-level personnel being transferred to NASA, but Rep. George P. Miller (D.-Calif.) said he would introduce legislation to provide 100 additional positions to solve the problem.

Dyna-Soar Crew

Washington—Air Force is now drafting the criteria on which to base the selection and training of pilots for the Dyna-Soar boost glider. USAF may decide that all test pilots of the future should be trained to man Dyna-Soar and Mercury-type vehicles as well as conventional aircraft. Pilots probably will be assigned to Edwards AFB, Calif., for training under the supervision of the already-existing Manned Spacecraft Test Section there.



MALFUNCTION in a pump caused an abort of Titan B-7A at left; at right is successful launch of Titan B-7A. Second stage (below) is 41 ft. long, has 80,000 lb. thrust.



Second Stage Ignition Tested in Titan Flight

Cape Canaveral, Fla.—Air Force-Martin Titan made its first flight in nine months last week, successfully testing both its command guidance system and ignition of its 80,000 lb. thrust second stage engine for the first time. Two earlier attempts to test second stage propulsion failed when the missiles exploded at launch.

Another test flight was scheduled for the end of last week and the first attempt to recover an instrument package, ejected from the nose cone, was to be made.

Titan B-7A was launched from USAF Missile Test Center's Pad 19 at 1:08 p.m. EST on Feb. 2. Separation of the 41-ft., 48,000 lb. second stage and ignition of the Aerojet-General engine occurred about 124 sec. later. This is the largest U. S. engine to be ignited at altitude.

The missile traveled approximately 2,200 mi. Command guidance system developed by Bell Telephone Laboratories and Remington Rand-Univac, carried in the second stage, apparently guided it with great accuracy. The guidance system has been carried on earlier shots but was not coupled to the control system.

The Bell-Remington Rand system will be used in early Titan squadrons and some satellite and space probe projects. Later Titan squadrons will use an all-inertial system being produced by AC Spark Plug and International Business Machines Corp. to a design developed by Massachusetts Institute of Technology's Instrumentation Laboratory.

The Feb. 2 shot was the only B-model that will be fired. Both a B and a C have exploded on their launching pads since last May. Most of the test objectives for the B series were achieved in last week's shot, and the remaining objectives will be incorporated in the similar C-models.

C-series will concentrate on staging, altitude starts, performance of the second stage engine and other systems and on propellant utilization. The C-Model carries an aerodynamic fairing over an Avco re-entry body. When the C-3 exploded on Dec. 12 (AW Dec. 21, p. 19), the recovery unit in the nose cone performed its entire program as the missile burned on the pad, extending its drag parachute, ejecting its dye marker and shark repellent and hoisting its beacon radio antenna.

Another test launch was aborted in late January (AW Feb. 1, p. 27). A sequencer detected an overspeed in a turbine fuel pump and first stage engines were shut off on the pad.

Space Technology

Navy Using Moon As Reflector For Operational Radio Service

Cheltenham, Md.—Moon is now serving as a passive communications satellite for Navy operational radio teletype and facsimile service between Washington and Hawaii.

Navy also is believed to be planning to use the moon as a simple navigation satellite for submarines and surface vessels which can take a radio sight on signals reflected off the moon's surface through use of a radio sextant or direction finder.

Equipment presently installed here at the Navy communications center near Washington provides four two-way radio teletype circuits or one radio facsimile. Navy is using a frequency of 435 to 445 mc. in the UHF band at present but plans to move into the microwave band to obtain greater bandwidths and permit the use of smaller antennas for ship-to-shore and ship-to-ship communications via moon bounce. Additional bandwidth also will provide several voice channels and perhaps television circuits.

All three military services have, or are experimenting with, moon bounce communications, but the Navy is the first to put a system into operational use, although the present facility is still officially classed as an experimental station.

The moon can be used to relay signals between any two points which are within radio view of its surface. Washington and Hawaii can both view the moon for periods ranging from several hours to up to 12 hr., depending upon the moon's orbital position, with the figure averaging about 8 hr.

No Sun Spot Interference

Since the system operates in the UHF band, it is not vulnerable to sun spot or other atmospheric disturbances which can black out high frequency (HF) radio normally used for long-distance communications. The present system was put into operational use by the Navy last November when normal HF communications were disrupted by atmospheric conditions.

With the shift to higher frequencies and the use of masers or parametric amplifiers to increase receiver sensitivity, it should be possible to obtain moon-bounce communications using moderate size antennas. Present system uses four 84-ft. diameter antennas made by D. S. Kennedy, two of them in Hawaii, two in Washington. One at each location is used for transmission, the other for reception. The antennas are steerable so that they can maintain alignment on the moon despite its movement and earth rotation.

Present UHF transmitters have an output of 100 kw., but the antenna gain produces an effective radiated power of 400 mw., according to the Navy. Present system was designed and installed by Developmental Engineering Corp. of Leesburg, Va. Total system cost is approximately $4 million. Other major subcontractors in addition to D. S. Kennedy include Continental Manufacturing Electronics Co., Eitel-McCullough, General Bronze Corp., IT&T Laboratories and Scatter Communications, Inc.

Present System

The present system provides a bandwidth of 16 kc., employs frequency shift keying for both teletypewriter and facsimile, with 7½ kc. shifts. Frequency diversity also is employed in 25 kc. steps to a maximum of 100 kc.

Error rate normally is less than one per 10,000 letters transmitted, according to a Navy spokesman. This is lower than the error rate experienced with conventional HF teletype during favorable conditions.

In the first public demonstration, the Navy transmitted two-way teletype messages between Cheltenham and Hawaii and a facsimile photo from Hawaii to Cheltenham. In addition, a message transmitted from Cheltenham was bounced off the moon, received in Hawaii, and re-transmitted via the moon back to Cheltenham, with the signals covering a total travel distance of close to one million miles.

First Experiments

Army was first to conduct experiments in bouncing radar signals off the moon in 1946. In June, 1954, Naval Research Laboratory successfully passed first continuous wave signals over a moon reflection path and two months later bounced the first voice signals off the lunar surface.

In February, 1956, the Chief of Naval Operations directed the establishment of a moon relay circuit between Washington and Pearl Harbor to evaluate its capabilities and limitations. The contract for the present system was awarded three months later to Development Engineering Corp. Current experiments include voice transmission tests (AW May 12, 1958, p. 32; Aug. 25, 1958, p. 15).

Lockheed Diversifies to Solids

Burbank, Calif.—Lockheed Aircraft Corp. announced plans last week to acquire a 50% interest in Grand Central Rocket Co., of Redlands, Calif., in the latest in a series of moves toward broader diversification.

Under the plan, Grand Central will be jointly owned by Lockheed and Petro-Tex Chemical Corp., a wholly-owned subsidiary of Food Machinery & Chemical Corp. and Tennessee Gas Transmission Co. The Lockheed announcement said Grand Central will retain its name, corporate identity and management personnel.

Founded in 1955, Grand Central became a subsidiary of Petro-Tex in 1958 and has a current annual sales volume of approximately $10 million. Current work includes development of a high-energy propellant for Army's Nike Zeus anti-intercontinental ballistic missile and an escape rocket for National Aeronautics and Space Administration's Project Mercury man-in-space program.

Lockheed's Interests

Lockheed's interests will be guided by L. Eugene Root, the firm's group vice president for corporate electronics and missiles liaison.

Grand Central will continue to concentrate on solid propellant developments, working closely with the Lockheed Missile and Space Division. The tie-up, however, is not expected to affect Lockheed's present relationship with Aerojet-General Corp. in development of the solid-propellant propulsion system for the Navy-Lockheed Polaris fleet ballistic missile.

Lockheed touched off its latest round of diversification moves early last year with the formation of an affiliated company, Lockheed-Azcarate, in Mexico City for production of the Model 60 six-passenger utility aircraft and purchase of controlling interest in the Puget Sound Bridge and Dredging Co., of Seattle (AW Apr. 6, p. 37). Puget Sound last month acquired its first large contract since coming under Lockheed control—a $500,000 order from the University of California for conversion of an oceanographic survey vessel.

In May, Lockheed acquired Stavid Engineering, Inc., which, in December, was merged with the parent firm's Electronics and Avionics Division for the formation of Lockheed Electronics Co. (AW Dec. 14, p. 35). Later in December, Lockheed Aircraft International announced that it had acquired a major stock interest in Aeronautica Macchi, of Varese, Italy, and licensed the firm to build the Model 60.

Zeus Delayed by Technical Doubt, Budget

By Philip J. Klass

Washington—Administration decision to withhold $137 million in Fiscal 1960 funds originally appropriated for the preproduction effort on Army's Nike Zeus anti-ICBM missile and to deny proposals for an additional billion dollars in Fiscal 1961 for Zeus preproduction has set back the earliest possible implementation of the controversial missile defense system by two years to 1966. This is several years after the Soviets are expected to have several hundred intercontinental ballistic missiles on a ready-to-fire basis.

Barring an unforeseen breakthrough in missile defense technology, this means that the nation's sole defense against ballistic missile attack for at least several years in the early and mid-1960s will be the threat of nuclear retaliation. This was acknowledged by Defense Secretary Thomas S. Gates during recent House appropriations hearings (AW Jan. 25, p. 31).

The Administration decision is based upon both financial and technical considerations and follows the recommendations of the Joint Chiefs of Staff and a special group of top scientists that made an extensive appraisal of the Zeus (AW Nov. 2, p. 31).

The President's budget message said the Nike Zeus "will not be placed in production during the coming year during which further testing will be carried out . . . the system should be carefully tested before production is begun and facilities are constructed for its deployment."

Basic Questions Remain

This could be construed as implying that a decision as to whether to put Zeus into production is heavily dependent upon the results of forthcoming tests in the Pacific. Most qualified observers, however, seriously doubt that the Zeus tests now planned could remove the basic questions that exist over whether it, or any similar system, can provide a practical and effective national defense against ballistic missiles. Highly successful tests, however, might generate sufficient pressure to produce a few Zeus systems for defense of a limited number of vital areas.

The group of scientists who spent many months in analyzing Nike Zeus based their appraisal on the assumption that the missile would meet its design specifications and satisfactorily perform the mission for which it is being designed.

There is no serious doubt that Nike Zeus can be built with largely available state of the art.

The basic question to which the scientists and the Joint Chiefs addressed themselves is whether a Zeus-type anti-ICBM missile system can be sufficiently effective to justify an implementation cost of $15 billion or perhaps more. This is the estimated cost to protect vital target areas and major cities.

The group of scientists headed by Dr. George Kistiakowsky, the President's scientific adviser, and Dr. H. R. Skifter, assistant director of defense research and engineering for air defense, made the most comprehensive analysis yet performed on a weapon system, according to one Defense official. He adds that he doubts whether some of the weapons now in the inventory would ever have gone into production if they had been subjected to the same intensive scrutiny in the development stage.

Deferred Decision

Some of those who question whether forthcoming Nike Zeus tests will provide any new data of significance believe the current decision is intended as an interim action to keep the program going until a new Administration comes in and can face the difficult decision of either scrapping the program or providing funds for production and implementation.

Unless the next Administration decides to increase the defense budget by at least several billion dollars, some Defense Department observers doubt that Nike Zeus will ever see more than token production, if that. This does not mean that Zeus itself will require several billion dollars in the Fiscal 1962 budget but that it must compete for any production money with other weapons, primarily those that will increase the nation's retaliatory strength or make existing weapons less vulnerable to surprise attack.

In an election year, congressional critics are expected to level their fire on what some observers see as a major inconsistency in the Administration's air defense policy as expressed in the current budget.

Defense Department officials in appropriations hearings have played down Russia's generally acknowledged superiority in ballistic missiles during the next several years by pointing to United States superiority in aircraft capable of delivering nuclear weapons.

Present Defense Posture

Despite this claim of U.S. superiority in nuclear weapon delivery systems, the Administration is not staking its air defense posture solely on retaliatory deterrence but is asking for more than a half billion dollars in Fiscal 1961 with which to buy additional Bomarc and Nike Hercules air defense missiles and another several hundred million dollars for expansion of the SAGE aircraft early warning system.

Yet five years from now, when ballistic missiles will pose the major threat and the Soviets may have the larger arsenal, the Administration will be relying almost entirely upon retaliatory deterrence for air defense, critics are expected to charge, because it is unwilling to increase federal expenditures by less than 2%, the amount needed now for Zeus preproduction effort.

These critics are expected to ask whether the several billion dollars in capital costs now planned or programed for completion of air defense against manned bombers in Fiscal 1961-63 might not be better spent for Nike Zeus now.

In at least some Defense Department quarters there are reservations over the wisdom of continuing to spend these additional funds for defense against manned bombers. However, it is pointed out that the Soviets still possess a dangerous bomber threat and that relatively little money could be saved by terminating Bomarc or SAGE projects and present program for Hercules improvements at this late date.

Even if it were decided to terminate these programs, some Defense officials believe the funds saved could buy a more effective defense against ballistic missile attack if used to expand production of our own ballistic missiles, increase the hardening and dispersal of our missile sites, provide mobile launching platforms or more Polaris fleet ballistic missile submarines.

In an age of ballistic missiles, nations must face the fact that there is no feasible ballistic missile defense known to science at present, only the passive defense of retaliatory deterrence, these observers believe.

Any defense system can be overwhelmed if any enemy builds and launches sufficient numbers of attacks on the system. In the case of the manned bomber, its cost is considerably more than that of the Bomarc or Nike Hercules required to knock it down, giving the defender an economic advantage. But for a ballistic missile, which can carry a number of low-cost decoys, each of which may require an anti-ICBM missile to knock it down if it cannot be positively identified as a decoy, the defender faces an uneconomic tradeoff. Even without decoys, Zeus critics say the cost of building Nike Zeus missiles plus the required ground radars and computers may force the defender to spend something more than a dollar for every dollar an enemy spends on building ballistic missiles.

Viewed in this light, Nike Zeus cannot provide a real defense against enemy ballistic missiles, only a mechanism which forces an enemy to build additional missiles, according to Zeus critics.

The same result can be achieved at less cost by putting money that would be needed for Zeus implementation into the manufacture of more U.S. ballistic missiles, additional hardening and dispersal of missile sites, mobile launching platforms and/or more Polaris submarines, some Defense officials believe.

To this argument, Zeus supporters point out that the accuracy now being obtained by U.S. ballistic missiles, and those apparently being obtained by the Soviets, make hardening less and less effective in protecting our own retaliatory capability and other vital targets.

It is only a matter of several years before both the Soviets and the U.S. will have ballistic missiles capable of hitting within a radius of less than a mile of the intended impact point, observers believe. With multi-megaton thermonuclear warheads, such near-direct hits will knock out installations hardened to even several hundred pounds per square inch, these observers contend.

Unless some active defense system such as Nike Zeus is installed to provide a measure of protection for vital military command and control centers, there might be no survivors with the authority to direct the nation's counterblow or its subsequent war effort.

At least a few Defense officials have begun to think of the possible desirability of Nike Zeus installations at a handful of locations where vital command and control functions will be carried out. As the impact of ballistic missile guidance accuracies penetrates more deeply, additional support may be gained for at least a few Zeus installations.

If and when this occurs, it could generate strong political pressures to expand the number of Zeus installations for additional areas, forcing the next Administration to reconsider the entire program.

Despite concern expressed by Navy officials over the prospect of Soviet submarine-launched ballistic missiles, the general consensus of Defense Department thinking is that the Russians have not launched a major ballistic missile submarine program, nor are they likely to do so. This is based on the fact that it is easier and more economical for the Soviets to hide land-based ballistic missiles in the vast reaches of the Soviet Union and to coordinate their launching in a surprise attack, than to resort to submarine-launched ballistic missiles with the problem of coordination.

If the Defense Department should revise this appraisal and become seriously concerned over the threat of submarine-launched missiles, this could generate added support for Nike Zeus production. Reason behind this is that the small ballistic missile that can be launched from a submarine cannot carry sufficient payload to permit widespread use of decoys. Furthermore, its intermediate range ballistic trajectory makes the warhead an easier target.

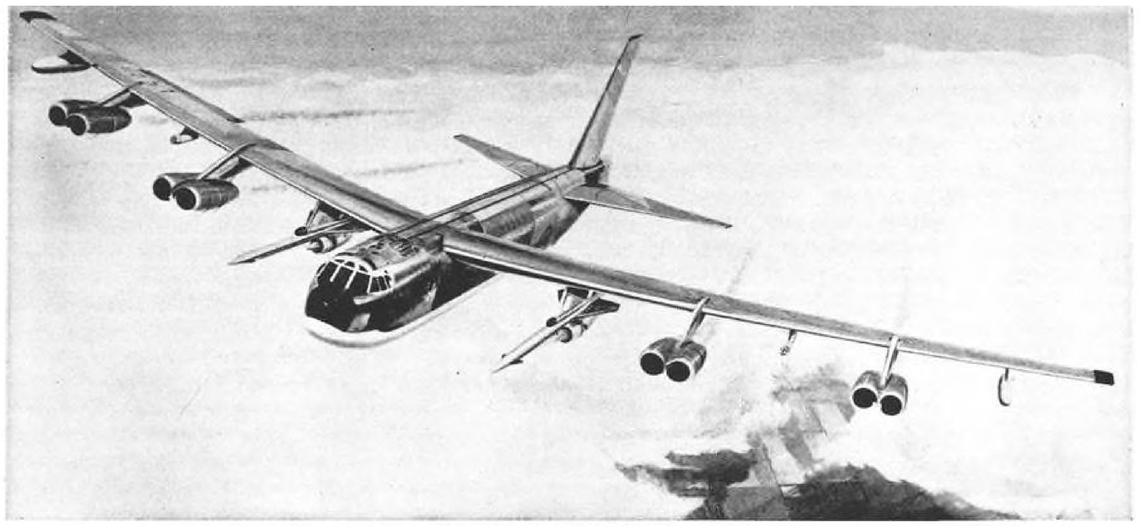
The Administration has asked for $300 million in Fiscal 1961 to continue Nike Zeus research and development and to procure sufficient radars, computers, target and test missiles and test range facilities to carry out full-scale tests near Kwajalein Atoll in the Pacific in 1962.

These tests are expected to provide "valuable knowledge in the whole field of anti-missile work . . . (which) will be highly useful whether or not Nike Zeus ever goes into production," Defense Secretary Gates said during recent House appropriations hearings.

In addition to Nike Zeus, Defense Department's Advanced Research Projects Agency is spending about $100 million on Project Defender, a program intended to learn more about the radar and infrared characteristics of a ballistic missile in flight and its nose cone during re-entry as well as exploring exotic ideas for a possible active defense against ballistic missiles.

Sky Bolt Moves Ahead

Washington—Approval to begin development of the Air Force Sky Bolt air-launched ballistic missile, WS-138A, was granted last week by Director of Defense Research and Engineering Herbert York after revision of original design objectives and timetable to more realistic values (AW Jan. 4, p. 15). Following detailed analysis by Air Force and Douglas, the ALBM prime contractor, it was decided to aim for slightly shorter missile range and for less accuracy and to extend the original timetable. Air Force has established a "Super-WSPO" (weapon system project office) at Wright Air Development Division, staffed with top-level personnel, to manage WS-138A program. Dr. York's office also will monitor progress closely.



Drawing Shows B-52H Configuration

Boeing Airplane Co. artist's conception of a B-52H shows the missile platform armed with two North American Hound Dog missiles. First B-52H will roll out early next year. Engines are turbofan versions of Pratt & Whitney J57. Pods between engines contain rockets used as penetration aids. Aircraft is designed to strike three targets thousands of miles apart on single mission.

Power Reaffirms Stand on Soviet Threat

By Katherine Johnsen

Washington—Gen. Thomas S. Power, head of Air Force's Strategic Air Command, repeated his stand last week for a 24-hr. air alert of SAC's Boeing B-52 striking force as the only sure way of avoiding a knock-out blow by the Soviet Union's intercontinental ballistic missile force despite unwavering opposition to the proposal by the President and his Secretary of Defense.

Gen. Power testified on the U. S. strategic deterrent posture before a crowded joint session of the Senate's Space Committee and Preparedness Investigating Subcommittee, both headed by Sen. Lyndon Johnson (D.-Tex.).

President Eisenhower later dismissed Gen. Power's presentation as that of a special pleader for SAC. Defense Secretary Thomas S. Gates labeled Power's premise that 300 ballistic missiles could destroy U. S. capability to retaliate effectively "unrealistic in consideration of the facts." Gates stressed the nation's "diversified form of retaliatory power," including Navy's nuclear striking force and approximately 1,000 Air Force tactical aircraft equipped with nuclear weapons on fixed bases "circling" Russia.

Gen Power noted that SAC is now "90% of the free world's striking power in TNT." Proposing a constant B-52 air alert, he conceded that "as a field commander, I try to prepare for the worst possible situation . . ."

Administration Program

The Administration program provides for an "on-the-shelf" air alert program involving preparatory steps such as purchasing additional B-52 spares. Total of $185 million has been earmarked for the program in the Fiscal 1960 and Fiscal 1961 budgets. Actual spending is estimated at $20 million in Fiscal 1960 and $90 million in 1961.

Cost of the around-the-clock air alert proposed by Power is estimated at over $1 billion annually.

Duration of the alert, Gen. Power said, should be determined by either of these two developments:

• **Introduction of the mobile** Minuteman solid-propellant intercontinental ballistic missile into SAC in quantity. Gen. Power set this missile "era of plenty"—when the U. S. would regain its capability of a devastating counterblow—in the mid-1960s.

• **Establishment of an effective** missile warning system. "As of this moment," Power reported, SAC would have adequate warning of an incoming bomber attack to get off the ground in 15 min. But as Russia's ICBM power is rapidly building up, SAC will be confronted with a "zero warning" situation. "Warning is the key," he told the Senate committees. "When we are sure we have warning, we can abandon the air alert."

It probably will be two to three years before the Ballistic Missile Early Warning System—the first U. S. missile warning program designated to provide a maximum warning time of 15 min.—will be fully operational. The first BMEWS station in Greenland is scheduled to become partially operational within the next few months. Other two stations in the system will be located in Alaska and Great Britain.

Lt. Gen. Bernard A. Schriever, commander of the Air Research and Development Command, who testified with Gen. Power, urged "very top priority" for the Midas satellite missile warning program, expected to offer earlier and more exact warning than the BMEWS. Gen. Schriever said he is "hopeful" a decision will be reached shortly on proposals to move forward with development of Midas into a weapons system.

Questioning by Democratic senators was sympathetic, by Republican senators skeptical, as Gen. Power defended his contention that Russia with 150 ICBMs and 150 IRBMs could possibly wipe out SAC within 30 min. unless the B-52 force is put on air alert. USSR now is generally recognized to have this IRBM capability. It is expected to build a force of "1,000 or more" ICBMs by the end of 1962, according to a study by the Washington Center of Foreign Policy Research of Johns Hopkins University for the Senate Foreign Relations Committee (AW Dec. 21, p. 68).

President's Stand

Asked at his press conference last week to comment on the testimony of Gen. Power that "our deterrent of heavy bombers cannot be properly safeguarded unless the force is put on a full air alert," the President replied:

"No, I'm—there are too many of these generals have all sorts of ideas; but I do point this out: I have got the Secretary of Defense, whom I trust, and who I know is honest in his study, analysis and conclusion. That is Secretary Gates. And beneath him, assisting him, is the chairman of the Chiefs of Staff, whom I similarly trust; and the Joint Chiefs of Staff, with those two, are my military advisers. And I have been long enough in the military service that I assure you that I cannot be particularly disturbed because everybody with a parochial viewpoint all over the place comes along and takes and says that the bosses know nothing about it.

"Now, I don't think anyone's trying to impugn the patriotism and the earnestness and the integrity of the group I have just mentioned. And I think, myself, they are the ablest people we could get. That's the reason they were selected."

Gen. Power pictured SAC today as "the most powerful strategic force in the history of the world" but added that he is "not satisfied with the plans today for the future."

SAC Strength

Congressional testimony developed these points on the elements of SAC strength:

• **North American B-70.** SAC wants this Mach 3 bomber project, which has been cut back to prototype development work by the Administration (AW Dec. 7, p. 26), "pursued at a high rate" as the prospective replacement for the B-52 in the mid-1960s, Gen. Power said. He reported that a technical evaluation is now being made of the Convair B-58C, equipped with Pratt & Whitney J58 engines, as an alternative to the B-70.

At a Senate Appropriations Committee hearing, Secretary Gates and Sen. Stuart Symington (D.-Mo.) clashed over the stretchout of the B-70 program. Gates argued that $5.5 billion would have to be spent to have an operational aircraft in 1965 and that "there will be four missile systems in being by this time." Even with such an expenditure, Gates added that it is "now doubtful" a successful aircraft could be developed in five years.

Symington emphasized the "positive control" capability the manned B-70 would offer in the missile era and the possibilities that it might evolve into a nuclear-powered aircraft, serve as the first stage of a missile or as a commercial transport. He said the B-70's speed might reach "a Mach up to 6 or 10 after passing the heat barrier."

• **Atlas, Titan programs.** Gen. Schriever testified that it is now "too late" to speed up production of the liquid-fueled Atlas or Titan to close the missile gap. The missiles ordered into production now, he pointed out, would not be ready for SAC until 1963, when the more advanced Minuteman will start closing the gap. At best, Gen. Schriever said, Atlas or Titan "could add a little to the end of 1962."

He described the "gap" between the U. S. and USSR as one of "numbers" and not of missile quality. Pointing out that "17 Atlas shots in a row have been completely satisfactory" and that Titan, which will comprise one-third the SAC missile inventory by the end of 1962, has the "extremely good record of five out of seven successful shots." Schriever declared that "at this time USSR missiles are not more reliable than U. S. missiles."

• **Minuteman.** This "is being pushed as hard as any program can be pushed," Gen. Schriever reported. "It is a high risk program." Secretary Gates left the door open for a future increase in the Minuteman program, when he has "more confidence" in the missile.

• **B-58 medium range bomber.** Gen. Power favored an acceleration in the planned program for this replacement for the obsolescent B-47, which now comprises three-fourths of SAC's fleet. The Fiscal 1961 budget provides for three B-58 wings. One B-58 has been delivered to SAC and the aircraft "are now coming in very rapidly," Gen. Power said.

• **Space satellites.** Gen. Schriever urged "top priority" for two satellite programs, in addition to Midas—the Samos surveillance satellite for obtaining intelligence data on enemy targets, and communications satellites being developed under Advanced Research Projects Agency cognizance. He reported that Samos "is progressing rapidly." There is not "a firm military requirement" at this time for big-thrust rockets and deep space explorations, the general commented.

Soviet Scientists List Rocket Uses As Pacific Test Launchings End

Washington—Soviet scientists continued to speculate on possible uses for Russia's "more powerful" space booster as the first series of test launchings into the Pacific Ocean ended last week after two shots in 11 days.

Russia announced on Feb. 1 that it was freeing the Pacific target area for shipping and air flights "before schedule" and said the "present stage of testing has been completed successfully" with the second launching on Jan. 31. First test launch was made Jan. 20 (AW Jan. 25, p. 36).

Russia had announced on Jan. 8 that the area was being reserved from Jan. 15 to Feb. 15 for "the first launchings" of a number of shots to be made "within the coming months of 1960."

Announcement of the second shot said the last stage and nose cone reached the target area, and the nose cone's point of impact was determined by shipborne radar and optical and acoustic stations. The statement lacked the detail included in the announcement of the first shot, but Prof. Boris Sigaryev of the Sternberg Astronomical Institute said in Moscow that the reason for this was the similarity of data obtained in the two shots. The Soviet news agency Tass said the launchings had been concluded because the necessary information had been obtained.

Soviet scientists continued to talk of using the rocket for lunar and planetary flights, earth satellites carrying astronomical telescopes, manned earth satellites, an earth-orbiting television relay network and weather monitoring satellites.

To reach Mars when it makes its next close approach to the earth, a rocket traveling a minimum energy trajectory at a velocity of about 9.96 miles per second should be launched next Oct. 1. The penalty in velocity needed to make the flight increases slowly for about 30 to 40 days after that date, then increases rapidly. Flight time at the minimum velocity is about 259 days.

Prof. A. A. Blagonravov said early in January that "it is not yet possible to confirm that a vehicle will be sent toward Mars this year, but it is obvious that everything is being done so that such a ballistic flight will be possible at the end of 1960, at a time when Mars will be at a relatively close distance to earth. It will be in 1961 that Venus can be approached with the greatest chance of success." Next favorable date for a shot to Venus occurs next Jan. 13. The flight requires some 6.90 mps. velocity for a minimum energy flight of some 146 days.

Prof. V. V. Dobronravov has said the rocket now being tested with a dummy last stage can, with the addition of an engine in that stage, exceed earth escape velocity of 6.72 mps., travel to the planets (AW Feb. 1, p. 25).

Dobronravov said early in January that launching of "a complete rocket" would follow the early tests, which were aimed at proving that "the calculations are correct, that the propellants of each stage and the guidance system are functioning perfectly." He said launching of the complete rocket "will be the moment of experimentation for a vehicle whose goal is to transform itself into a lunar satellite or to reach other planets."

Last week, Dobronravov said in an interview reported by Tass that a heavy Sputnik can be fitted with "retrorockets, which will safeguard it against disintegration in passing through the dense strata of the earth's atmosphere."

The next stage in developing artificial satellites will be to equip them with a device that will enable their safe return through the atmosphere and a smooth landing, Dobronravov said.

B. Mirtov, master of physics and mathematics, said there is a need for heavy Sputniks carrying a device "comprising automatic regulation and guidance mechanisms, and a big supply of fuel . . . necessary to reduce the speed . . . and enable it to land safely in a prearranged place," according to Tass. ". . . With time, heavy Sputniks will provide a sound basis for the development of a manned space station-observatory," Mirtov said.

Dobronravov also has spoken of a satellite equipped with "engines" and "a fuel reserve which will make braking possible." Applying the same idea to "cosmic rockets" will assure soft landings on the moon and planets, he said, and "finally, it is planned to equip them with everything necessary for them to resume their flight, leave the planets where they landed, and return to earth."

Dutch Talks Stalled

Washington — Negotiations between the Netherlands and the U. S. on an amendment to the 1957 air transport bilateral agreement were broken off last week with the Dutch still determined to reopen the talks at a later date.

Negotiations, which began Jan. 7, ended when the State Department refused to grant the Dutch a Los Angeles-Amsterdam route for KLM Royal Dutch Airlines. Chairman of the Netherlands delegation said he "could not accept" the decision as final on grounds that it represented discrimination against his government. Therefore, he added, "I do not consider the negotiations terminated."

Glennan States Stand On Executive Privilege

Washington—Personal evaluations and recommendations of National Aeronautics and Space Administration officials prepared in connection with letting contracts should not be made public, NASA Administrator T. Keith Glennan told the House Space Committee last week.

Review of these documents by persons outside NASA, Glennan contended, would tend to interfere with normal procedures within NASA because, he said, officials would not feel free to express their personal opinions and evaluations if they knew they were to be made public.

Glennan's statements were made to the committee in answer to charges by the General Accounting Office that NASA has withheld information on two major contracts (AW Feb. 1, p. 15). Glennan told the committee that he had furnished the GAO all information it requested except personal memorandums.

Westland, Fairey Complete Plans To Form Helicopter Combine

London—Government-spurred consolidation of the British aircraft industry now is virtually complete with the agreement to merge Westland Aircraft, Ltd., and United Kingdom aviation interests of the Fairey Co., Ltd., into a group which will comprise almost all Britain's helicopter manufacturing industry.

The agreement is to be effected by sale of the issued share capital of Fairey Aviation, Ltd., to Westland for about $9.24 million in cash and shares. Fairey Aviation, subsidiary of the Fairey Co., operates all Fairey's U. K. aviation interests.

The new combination, which will constitute a specialized helicopter group eligible for government support, will make Westland the largest helicopter manufacturer in Europe. The Westland group already includes Saunders-Roe and the helicopter activities of Bristol Aircraft.

"It will be Westland's aim by a policy of integration to maintain maximum efficiency and to meet at home and abroad the ever-growing competition from foreign helicopter manufacturers," Westland and Fairey stated in a joint announcement of the merger.

Westland will continue to develop the Rotodyne VTOL airliner project, and arrangements have been made for the development contract with the government—believed to be worth about $11.2 million—to be signed "forthwith." Westland will be able to offer a range of seven types of helicopter from the two-seat Skeeter to the Westminster.

The company also plans to develop a twin-Gnome turbine version of the Wessex with increased performance at altitude. The prototype is scheduled to fly this year. A civil version, carrying up to 14 passengers, will be suitable for opening up inter-city, off-shore or other services. A second new type is the Wiltshire (AW Jan. 18, p. 34), a boat-hulled helicopter with twin Gazelle turbines (or later with three turbines) for both military and civil work and carrying up to 23 passengers. The first Wiltshire is expected to fly this year.

Westland also will probably take over work on the Fairey Gannet anti-submarine aircraft.

Fairey investment and activities in the aircraft manufacturing company (Airco) consortium formed to build the DH-121 for British European Airways additionally will be taken over by Westland, it is believed, although Westland will not comment on its Airco plans at this stage.

After shedding Fairey Aviation, the Fairey Co. is left with seven major subsidiaries. Four U.K. subsidiaries are Fairey Engineering (atomic energy), Fairey Marine (pleasure craft and yachts), Aeroplastics (plastics) and Fairey Air Surveys. Abroad, the company's chief subsidiaries are: the Fairey Aviation Co. of Canada, Fairey Aviation Co. of Australasia Pty., and Avions Fairey S.A., Belgium.

Sale of Fairey Aviation capital to Westland will be effected for the following consideration: the issue to the Fairey Co. of two million Westland shares of five shillings (70 cents) each, credited as fully-paid (not ranking for forthcoming Westland issue by way of capitalization or reserves or final dividend for the period ending Sept. 30, 1959), and a cash payment of about $3.9 million.

Shares will be distributed to Fairey Co. shareholders in the proportion of one Westland for every two Fairey shares held. The necessary adjustment, since this involves distribution of more Westland shares than Fairey will receive, will be made by purchase.

NASA Pilot Escapes In Vertiplane Crash

Moffett Field, Calif.—Army-Ryan Vertiplane research VTOL airplane was destroyed in a crash here after it pitched up through 180 deg. and dived 5,000 ft. to the ground in an inverted attitude.

The experimental aircraft was newly turned over to National Aeronautics and Space Administration Ames Laboratory here after completing its Army test program with 21 successful flights in the preceding six weeks.

NASA test pilot Glen W. Stinnett ejected at 1,000 ft. in an inverted position. His back was sprained by the impact of the ejection seat because he was hanging on the seat belt and shoulder harness. A Navion chase plane was flown by Ryan test pilot Lou Everett. The aircraft was in level flight at a low power setting and low flap deflection when the violent pitch-up began.

Army designates Vertiplane the VZ-3-RY. The Army phase of the Vertiplane program ended about three weeks ago and NASA personnel were checking out on the aircraft when the crash occurred. A year ago, the Vertiplane, flown by Ryan test pilot Pete Girard, was damaged in a hard landing when a propeller transmission failure occurred (AW Aug. 31, p. 39).

News Digest

Atomic Energy Commission awarded a contract to Blaw-Knox Co. last week to study the facilities required to test an indirect cycle nuclear engine system of the type currently under development by Pratt & Whitney Division of United Aircraft Corp. for AEC and the Air Force. Facilities will be located at the AEC Nuclear Reactor Testing Station where all present test facilities are designed for direct cycle powerplants such as the system under development by General Electric.

Molecular microwave amplifier is being developed by TRG, Inc., Syosset, N. Y., under a $110,000 Rome Air Development Center contract. The low noise amplifier operates on a new principle and differs from both parametric and Maser amplifiers, although it has characteristics in common with both.

Martin Co. will continue research and development of the Pershing ballistic missile system under an $82,599,690 follow-on contract from Department of the Army. Contract brings total Fiscal 1960 funding for Pershing to $118,057,000. It covers production of missiles, ground support equipment, training and flight and environmental testing.

Raytheon Co. and Compagnie Generale de TSF, of France, have signed an agreement to exchange data in the microwave tube field.

Helicopter Assn. of Great Britain has been liquidated and its activities transferred to the newly formed Rotorcraft Section of the Royal Aeronautical Society.

Aeronutronic Division of Ford Motor Co. will study design of a system to aid scientists in cataloging and computing satellite orbits under a contract from Air Research and Development Command.

First hardware for machine translation of Russian scientific and technical literature for USAF will include an International Business Machines computer capable of translating 150 characters per second into English. Other hardware is a Baird-Atomic print reader and a Shephard adapted output printer.

Hiller X-18 VTOL has completed flight test phase in conventional aircraft configuration, including flutter tests. After maintenance and instrumentation checks, the tilt-wing research craft will start in transition flying, changing the wing from conventional toward full-up position in small increments.

Tu-114 Flies Russian Delegation to New York

Manufacturing refinements and minor changes from the Russian Tu-114 Serial No. 5611 that brought Premier Khrushchev to the U. S. last year indicate that this turboprop airplane parked at the New York International Airport at Idlewild is a newer one. This airplane brought a delegation of premiers of Russian republics here for a U. S. tour last week. The serial number—76460—is not an indication of newness itself since the Russian numbering system was revised last year. It may be significant, however, that this is the first time an aircraft other than 5611 has appeared in a photograph, except in the cases of Tu-114D. Modifications include reduction of the rudder tab to about half its previous span and elimination of the de-icing boot on the leading edge of the fin. Contrarotating propellers do not show the buffing effect that appeared on the rear of the blades of No. 5611 and the markings are new—using only a single horizontal stripe on the fuselage instead of multiple stripes on 5611 (AW Aug. 17, p. 50). On its nonstop flight from Moscow to Idlewild, the Tu-114 spent 11 hr. 53 min. in the air, at least 30 min. of which was over the New York airport. Routing might have slowed the flight down somewhat. It arrived via Keflavik, overflew Greenland and crossed into northern Canada before coming back over Gander and in to the New York area. Cruise altitude was around 32,000 ft.

Crew Issue Sparks New Labor Debates

Salary costs could triple within next two years; pilots may make strong bid to cut flying hours.

By Robert H. Cook

Washington—Status of the controversial "third-pilot" station on jet transport crews is shaping into a key factor that may play a major role in labor-management contract negotiations during the coming year, touching off new inter-union as well as labor-management battles.

Heavy expenses already incurred by the airlines in extra salaries for addition of a third pilot, as the Air Line Pilots Assn. demands, while retaining a flight engineer, as the Flight Engineers International Assn. demands, are expected to triple within the next two years.

ALPA, which sees no need for a non-pilot-trained flight engineer on jet transport crews, contends that a third pilot is necessary in order to provide a "fail-safe" crew complement.

The three airlines which have accepted the third pilot thus far—American, Eastern and Trans World—contend that the fourth crew member was added in order to bring contract negotiations to a successful close rather in recognition of the validity of ALPA's "fail-safe" concept. The three carriers also have retained flight engineers on jet crews.

ALPA, on the other hand, says it still intends to fight for a three-man crew, all of them pilot-trained.

Intensity of the dispute recently approached a new crisis when Eastern sought a court injunction to require its pilots to take Douglas DC-8 flight training.

Company spokesmen said the ALPA chapter's refusal to take the training voluntarily was based primarily upon a desire to acquire flight engineer training beyond the amount agreed upon a year ago. The pilots contend additional training is needed, while the flight engineers have said submission to ALPA demands will be regarded as a contract violation. Some airline observers believe the pilots' union may use the third-pilot issue as a pawn in forthcoming contract negotiations. One possibility which already has the backing of individual pilot groups would be to relinquish the demand for a third pilot in return for a reduction in maximum flight hours to a point below the present standard of 85 hr. a month. ALPA headquarters, however, is strongly resisting any attempts at dropping the third-pilot demand.

ALPA Council No. 4 in Los Angeles, where a high percentage of TWA jet pilots are domiciled for transcontinental flights, is on record as favoring elimination of the third pilot.

Objecting to an official reply by ALPA headquarters executives that their desire to abandon the third pilot on jet flights and accept, in exchange, lower monthly flight hours, represents the views of a "minority group" in "collusion with management to the detriment of ALPA," the council asked that the union's board of directors permit a poll of individual TWA pilots on the third pilot stand by approving the following resolution:

• "**Whereas . . . experience** in operating jet aircraft 85 hr. per month for flight crews has imposed intolerable working conditions with attendant fatigue factors that may well develop into hazardous health and safety considerations, and:

• "**Whereas . . . TWA management** has repeatedly expressed a willingness to reduce the monthly hours and pay the rates consistent with the formulae adopted by the 1956 (policy) convention provided ALPA's demand for a third pilot is abandoned and:

• "**Whereas . . . experience** has proved conclusively that a third pilot on jets is not needed (even less than on propeller-driven aircraft) for safety reasons or otherwise and:

• **Whereas . . . pilots assigned** as second officers have been placed in a humiliating role where their proficiency as a pilot fast degenerates and:

• "**Whereas . . . a reduction** in monthly flying hours on jets will restore acceptable working conditions; provide for a hedge against technological unemployment; make for better job opportunity for every TWA pilot and:

• "**Whereas . . . traditionally** the only accepted method to combat technological unemployment in the labor movement has been a reduction in working hours:

• "**Therefore, be it resolved** that . . . the TWA pilots be polled via a mail ballot on the following proposal: That the TWA Master Executive Council obtain permission from the Board of Directors of ALPA to permit the TWA pilots to reopen the contract pertaining to jets for the purpose of reducing the monthly maximum (flying hours), increase the rates of pay (pegged speeds) and remove the demand for three pilots."

ALPA headquarters spokesmen in Chicago were unable to confirm late last week whether the resolution request had been approved or rejected but noted that, while the reduced working hours could be negotiated with the company by TWA councils, any move to drop the third pilot would require a vote of ALPA's board of directors to change the union's industry-wide policy.

Trans World Airlines spokesmen say the airline has received a mounting number of inquiries from individual pilots on the company's stand on maximum pilot hours on jets suggesting the possibility of discarding "our requirement for three pilots on jet operations."

Noting that TWA accepted the third pilot only because of its contract agreement, the airline executive said, in a general letter of reply to the queries, that TWA has not changed its position that a third pilot is surplus, since, it says, neither the Boeing 707 nor the Convair 880 turbojet transport is designed to carry the extra crew member. The airline says a third pilot is unnecessary for either a safe or efficient aircraft operation.

The airline's letter to the pilots continued: "We think that both the pilots and the company would, in the long run, benefit by the elimination of the contractual requirement for a second officer."

It added that any discussion of the possibility of reducing pilot hours could only be conducted with ALPA.

Average experience of these pilots ranges from three-to-four years, placing them in the $12,000 a year bracket and raising each carrier's operational costs by an estimated $1 million a year. By 1962, American, TWA and Eastern will have a total turbojet fleet of 149 aircraft, which they say will require 600 third pilots at an additional cost of almost $8 million a year for the three airlines. At present, third pilots are just beginning to enter Eastern's payroll.

Third pilot expense breakdown would be approximately $3.6 million for American, $2.4 million for TWA and $1.2 million for Eastern by 1962.

Actual duties of the second officer are the same at both TWA and American, where, the airlines say, he generally functions as an "administrative assistant" to the pilot in command by helping maintain log books and records, assisting in radio and navigational communications, watching for flight traffic and manning a cockpit station in the event of emergency, except that of the pilot in command. He is listed as third in command by both airlines and must have the minimum copilot qualifications, including a commercial pilot's license, instrument rating and ability to fly the aircraft.

Eastern Air Lines' spokesmen say they intend to make maximum use of their third pilots, who will divide their time between "paperwork" duty in flight and actual time at the jet controls. Eastern plans to give the third pilot equal flight experience with the first officer by relieving the copilot on many flight segments.

Further fuel has been added to the third pilot issue with recent reports that some TWA captains had advised second officers to sign their paycards and remain at home.

A notice from the ALPA chapter chairman at TWA called pilots' attention to the fact that "in one known instance the suggestion was actually carried out." The notice warned that such action was in direct violation of company regulations and ALPA's contract agreement. TWA also posted special bulletins to flight crews urging against such measures and asking that any violations be reported. Company officials say they have not found any proof of the alleged violations.

Delta's First Production 880 Makes Maiden Flight

Maiden flight of Delta Air Lines' first production Convair 880 turbojet transport lasted 3 hr. 11 min., with William B. Harwell, Convair's chief of production flight, at the controls. Delta expects Federal Aviation Agency certification by May, and then will put the 880 on scheduled service from Miami and Atlanta to the West Coast; airline has ordered a fleet of 10. So far, three flight test 880s have logged more than 740 hr. of flight time.

British Order 707 Modifications

Seattle—British Air Registration Board has called for a series of modifications on the Boeing 707-420 transports on order by British Overseas Airways Corp. before it will certificate the aircraft for scheduled BOAC service.

Specifically, the British board has ordered a 35 in. extension of the vertical fin, full-time rudder boost, modification of the yaw damper and the inclusion of a small ventral fin. Boeing is conforming with the order and has returned the first two of BOAC's airplanes, which have been flying, for modifications.

Two other aircraft, which are scheduled for roll-out in about three weeks, are nearing completion and probably will receive the modifications in the factory. BOAC has 15 of the 707-420s, which are powered with the Rolls-Royce Conway bypass engine, on order.

No specific reasons have been given for the changes. However, ARB chief pilot D. P. Davies flew the aircraft for about 10 hr. some time ago and, at that time, said certain tail modifications would make the plane acceptable.

Two weeks ago, ARB notified the manufacturer that the 707-420 would be required to demonstrate control and stability in approach, refused landings and climb-out with two engines out on the same side. Federal Aviation Agency is not requiring this performance test on the aircraft because of the small probability of losing two engines on the same side under operating conditions.

The test is made more difficult because the Conway engine has about 1,000 lb. more thrust than the commercial rating of the Pratt & Whitney J75 turbojet engine. The added thrust tends to increase yawing movement considerably due to asymmetrical thrust.

Ventral fin and rudder boost modifications are intended to cope with the problem created by the two-engine-on-one-wing-out situation. Yaw damper modification is designed to add a little redundancy to the circuit. Ventral fin is small—about two feet deep and six to seven feet wide. Vertical fin extension will be accomplished by adding a cap.

Boeing is satisfied with Rolls-Royce construction of pods, pylons and suppressor-reversers for the Conway.

Douglas Aircraft Co. spokesmen say that geometry and system of the Conway-powered DC-8 will be exactly the same as the DC-8 equipped with the J75 but that minimum controllable speed with an engine out will be higher.

Douglas does not have to run an ARB certification test since it has sold no turbojets to British operators.

BOAC Considers Super VC.10 Transport

London — British Overseas Airways Corp. may strengthen its long-range services by the purchase of a number of Super VC.10 jet transports from Vickers-Armstrongs (Aircraft), Ltd. BOAC order is understood to be under consideration. The Super VC.10 will carry up to 200 passengers, 50 more than the VC.10. Fuselage is extended about 30 ft. more divided fore and aft from the wing.

If the project goes ahead, the airline would bring the Super VC.10 into service around 1964-1965, after the VC.10 (AW Sept. 21, p. 39). Currently, BOAC has 35 VC.10s on order from Vickers-Armstrongs, with an option for 20 more.

Air France jets were flying before Gigi was born!

Gigi is six. Yet it was *more* than six years ago (February 19, 1953, to be exact) that Air France began flying regularly scheduled pure jet aircraft!

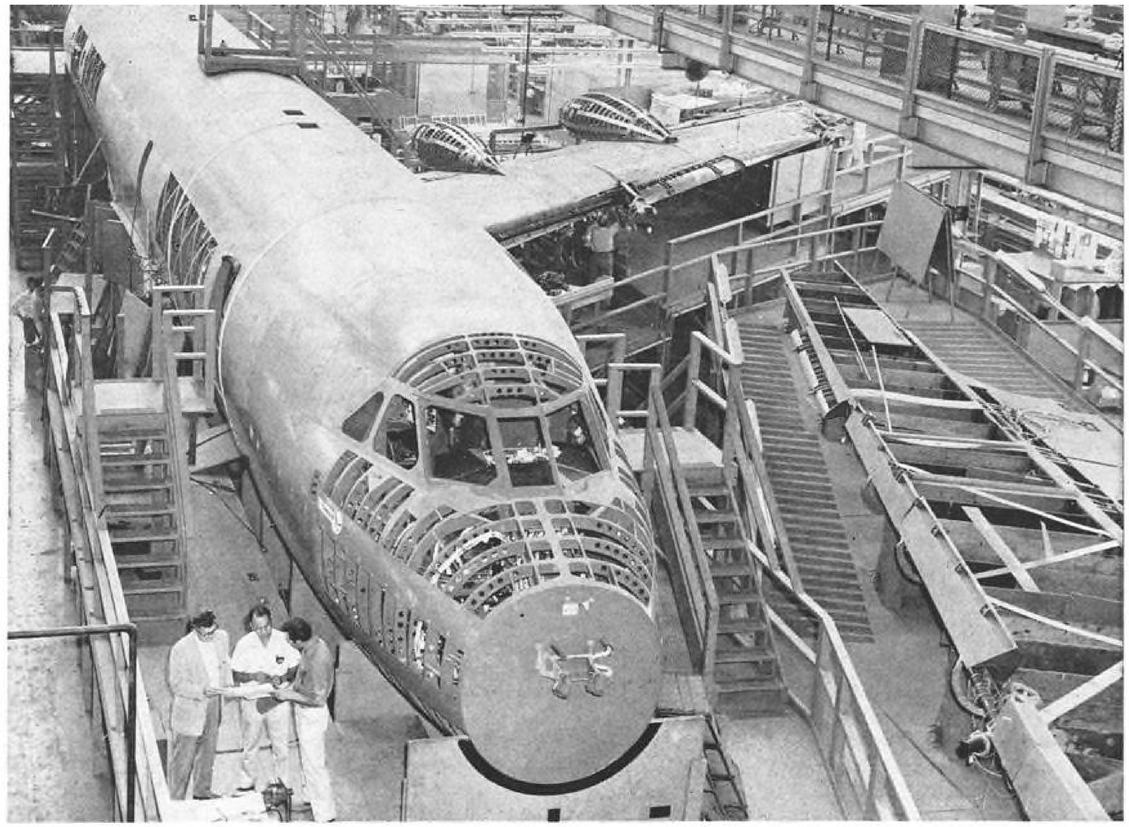
Since then, Air France has logged over 4 million jet passenger miles. First, with the sleek, vibrationless, 500-mile-an-hour Caravelle. And now, Air France has added the fabulous new Boeing 707 Intercontinental to its fast-growing pure jet fleet. The Intercontinental is the world's fastest, largest, longest-range jetliner crossing the Atlantic non-stop between New York and Paris in only 6½ hours.

The Boeing 707 Intercontinental is the most thoroughly tested airliner in aviation history. First, with thousands of hours of testing on the ground; then, more thousands of hours of actual flights.

Yes, Air France jets were flying before Gigi was born. A reassuring fact to remember whenever you fly overseas on *the world's largest airline.*

AIR FRANCE JET

WORLD'S FASTEST JETLINER / WORLD'S LARGEST AIRLINE



Convair Builds Metal Mockup of 600 Jet Transport

Metal mockup of Convair 600 turbojet transport will be used to check out design changes for customers and to assure uniformity of electrical wiring, hydraulic lines, instrumentation, flight controls and tubing. Aerodynamic anti-shock bodies (AW Sept. 8, 1958, p. 50) on upper wing surface are designed to improve speed capabilities; the 600 is expected to attain 635 mph. Wing leading edge slats are incorporated on the metal mockup. First aircraft (background) is scheduled for factory completion in July.

Airlines, Post Office Clash Over Mail Rates

Washington—Civil Aeronautics Board hearings in the Non-Priority Mail Rate Case opened last week with the Post Office Department and air carriers still differing sharply on the level of mail rates that should be established (AW Nov. 2, p. 41).

In a joint trial brief, nine trunklines stated that the non-priority mail should include only regular first-class and other preferential mail and that rates established for this category should not apply to air mail and air parcel post. The carriers said they wanted rates for non-priority mail to be set at 100% of terminal charges—costs attained in the ground-handling of the mail—plus 50% of the line-haul charges now in effect for regular air mail under the present multi-element formula.

The carriers also asked that a minimum of $4.00 per shipment for the non-priority mail be established. All non-priority mail would be carried on a strictly space-available basis.

The Post Office wants charges representing 50% of both line-haul and terminal charges, the rate level proposed by the CAB in its original order.

In testimony before the Board George M. Moore, assistant postmaster general in charge of the Bureau of Transportation, said the airlines would not be used for the transportation of mail at rates above 50% of the present air mail rates now in effect. He told hearing Examiner Ralph L. Wiser that Post Office budget limitations would prevent such an "airlift" now and in the foreseeable future. On the subject of priority, which also proved to be a matter of disagreement between the carriers and the Post Office, Moore agreed that non-priority mail should be handled on a space-available basis without obligating a carrier.

He added, however, that the Post Office would have no objection to the Board setting down legal ground rules that would establish a priority for mail lower than that for regular air freight but higher than deferred air freight. He said this should be applied to all carriers at the option of each one.

The nine carriers said in their joint statement that leaving the discretion of moving mail in relation to the movement of air freight to the individual airlines would allow the "Post Office Department to play one carrier against the other."

The carriers are: American, Braniff, Delta, National, Northeast, Northwest, TWA, United and Western.

Convair Turboprop

Burbank, Calif—Nearly 80% of the flight evaluation testing of the Allison 501-D13 turboprop-powered Super Convair for Federal Aviation Agency certification has already been completed. Full certification is expected by Mar. 31.

Conversion to turboprop configuration has been done by PacAero Engineering Corp., a wholly-owned subsidiary of Pacific Airmotive Corp.

Allison reports firm purchase orders for 11 corporate conversions of the Super Convair, plus five airline conversions for Lake Central Airlines, which also has option for 10 additional conversions.

The new Boeing 720 offers airlines the lowest seat-mile cost of any jetliner

The newest jetliner in the world—the Boeing 720—is pictured above during a recent test flight. Delivery of the first 720 is scheduled for this spring. To date, forty-six Boeing 720s have been ordered by leading world airlines.

The new 720 is designed to operate efficiently and profitably over short-to-medium range routes. The 720 cruises at speeds in excess of 600 miles an hour, and has the lowest seat-mile cost of any jetliner. In addition, the 720 can operate more economically from shorter fields than any other jetliner. Seating capacity ranges from 80 to 150 passengers, allowing airlines unusual flexibility in seating arrangements.

As demonstrated by Boeing jets already in service, the 720 will bring airlines unprecedented passenger appeal and high daily utilization.

Boeing 707 jets have already flown more than 60,000,000 miles in scheduled operations and have carried more than 2,000,000 passengers.

BOEING 720

CAB Postpones New Subsidy Formula

Washington—Local service airlines won a 30-day reprieve last week from new Civil Aeronautics Board subsidy standards designed to confine subsidy payments to a strict formula of flight scheduling.

Formulated by CAB as a means of getting all local service carriers on final mail rates by next Dec. 1 (AW Feb. 1, p. 28), the plan has been under serious fire from the carriers. They have contended that they had less than a week's notice of the proposal before it was to have gone into effect Feb. 1.

Extending this date to Mar. 1 to permit the airlines to file their comment, CAB noted that time for comment customarily allowed in regular proposed rule changes was not deemed necessary in this case, since the proposed formula is intended only as a "guide line" for future local service scheduling to permit a more precise computation of subsidy payments. Any specific problems the new scheduling standards might create will be considered on an individual airline basis during mail rate hearings planned this year.

CAB said the scheduling standard concept, which generally confines subsidy to six daily round trips on a flight segment, is not new but has been applied in the past in compiling subsidy based upon a schedule for four round trips per day. Expanding the standards to cover five and six trips, the Board said, is intended to cover a situation generated by increased scheduling and follows CAB philosophy that local service schedules should produce higher load factors with the addition of more flights in order to justify subsidies.

Local airlines claim that observance of CAB's new rules may result in a severe cut back in flight schedules and a resultant stifling of industry growth. They contend that the plan amounts to CAB selection of the subsidy control features of the industry-favored class mail rate subsidy formula (AW May 25, p. 41) recently shelved for study by the Board without any of the incentive benefits of the industry plan, such as a station subsidy allowance or profit-sharing provisions. Some local-service critics term the CAB standards a "strict disallowance schedule" designed to curb local service subsidy needs.

While the Board will tailor its schedule standards to the specific route segments of each local service airline, airline scheduling and revenue per flight will follow this general formula:

- **One round trip.** Subsidy provided to cover the gap between total operating expenses and commercial revenues on Douglas DC-3 flights. Seven to eight passengers will be required on larger aircraft before subsidy will be paid.
- **Two round trips.** Traffic must average five passengers per plane mile for the DC-3, nine to 10 passengers for larger aircraft in order to qualify for subsidy.
- **Three round trips.** Revenue must equal direct flight costs.
- **Four round trips.** Revenue must equal direct costs plus 35% of ground and indirect costs.
- **Five round trips.** Revenue must equal direct costs plus 65% of indirect costs.
- **Six round trips.** Direct costs plus 85% of indirect costs.
- **More than six round trips.** Airline must earn revenues equal to entire direct, ground and indirect costs.

The CAB noted that its table is based on an average first class yield of 7.20 cents per revenue passenger mile, plus five cents per plane mile for other commercial revenues.

The Board said that any increase in carrier scheduling per route segment will not be recognized for subsidy purposes unless the service already provided meets the new scheduling standards.

As an example, a carrier's earnings on a three round trip frequency would have to meet CAB's standards for the four round trips—revenues at least equal to direct costs plus 35% of ground and indirect expenses—before the airline could experiment with an additional flight. Should the airline meet these requirements, the added flight would be recognized for a six-month period and thereafter if it continued to meet the four round trip standards.

The Board cautioned that "it should not be assumed" that CAB's recognition for the six-month period will be automatic, so that any schedule increase inaugurated during a period of seasonally low traffic would not ordinarily be recognized.

In the event any expansion of flight frequencies fails to meet the CAB standards, the Board will apply a disallowance formula that will permit the carrier to retain from 30% to 80% of the earned commercial revenues, with progressive increments of 10% for more than six round trips. As an example, on a five round trip frequency, the carrier would be permitted to retain 60% of the earned commercial revenues but would be disallowed direct flight costs plus 65% of ground and indirect costs for the mileage not recognized.

A breakdown of CAB's estimate of per plane mile revenues and average passenger loads necessary to meet the new standards, covering DC-3s and other aircraft, such as Martins, Convairs and Fairchild F-27s, includes:

- **One round trip.** DC-3, no requirements. Other aircraft earnings of 55.40 cents per revenue plane mile, with an average load per mile of seven passengers.
- **Two round trips.** DC-3, five passengers and 41 cents. Others, nine passengers and 69.80 cents.
- **Three round trips.** DC-3, 8.33 passengers with 65 cents. Others, 13.19 passengers plus one dollar.
- **Four round trips.** DC-3, 11.25 passengers with revenues of 86 cents. Others, 17.33 passengers and revenue of $1.30 per revenue plane mile.
- **Five round trips.** DC-3, 13.75 passengers, $1.04 revenue. Other aircraft, 20.87 passengers, revenue of $1.55.
- **Six round trips.** DC-3, 15.42 passengers and revenue of $1.16. Others, 23.23 passengers and revenue of $1.72.
- **Seven or more round trips.** DC-3, 16.67 passengers per mile with revenue of $1.25 per plane mile. Other aircraft, 25 passengers and revenue of $1.85 cents per plane mile.

Mohawk Leaves ALTA

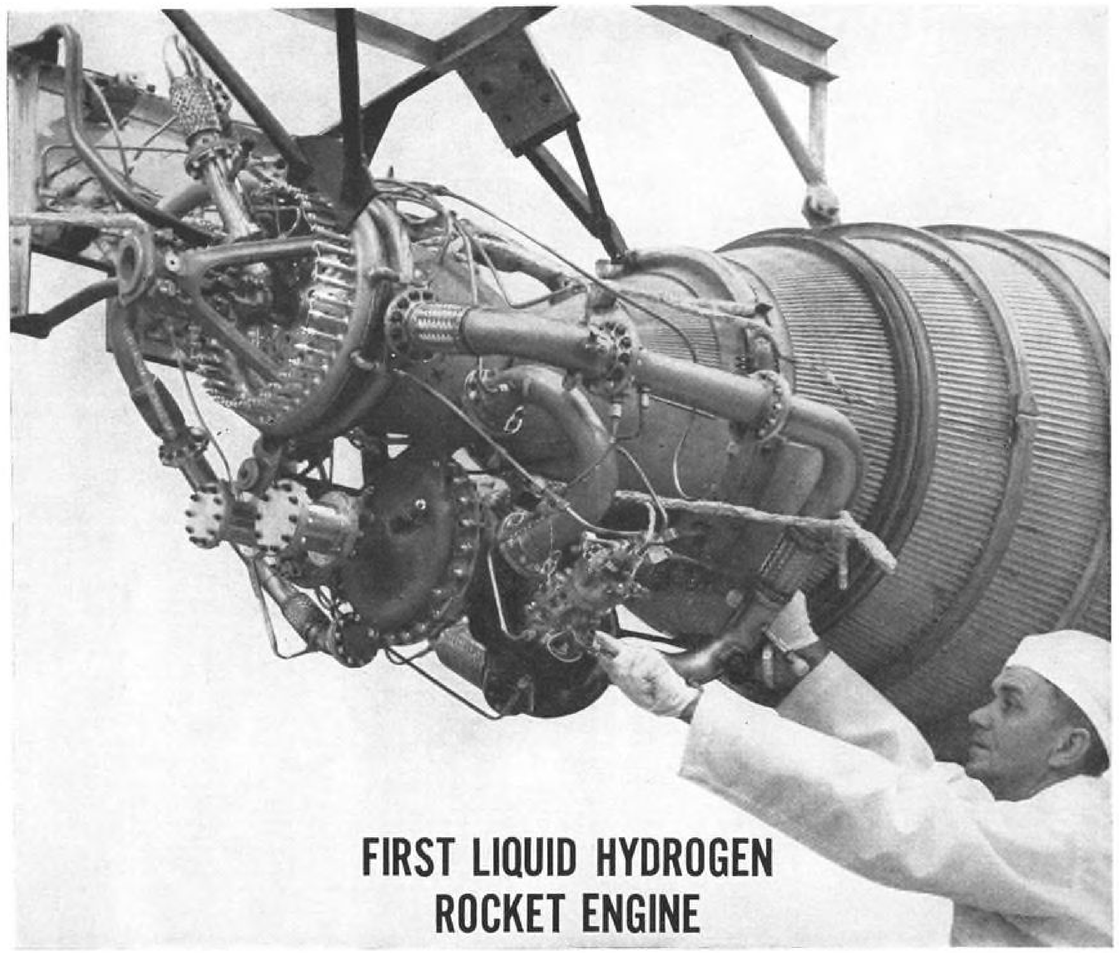
Washington—Mohawk Airlines resigned from the Assn. of Local Transport Airlines last week in a move apparently stemming from the carrier's dissatisfaction with a special research report prepared for ALTA.

Mohawk resigned, effective Feb. 26, in a letter to the industry organization and all other ALTA and non-ALTA local service carriers.

Prime objector among local service operators to the industry-favored "class mail rate plan" for subsidy, Mohawk officially stated its resignation was not based on any one particular issue but stemmed from "continuous disagreement" with ALTA policy.

Other industry sources, however, contend the airline specifically objected to a study of the industry by Planning Research Corp., of Los Angeles, Calif., (AW Feb. 1, p. 28) on grounds that the company reported that Mohawk collected $2.7 million in subsidy for 1959 while the carrier was on a final mail rate of only $2 million during the year. Mohawk accounts for the extra $700,000 as retroactive subsidy from the prior year.

The airline also was understood to have objected to other portions of the report covering Convair 240 operational efficiency and to a discussion of subsidy allocations by station, which estimated Mohawk's major traffic center of Utica, N. Y., which is the carrier's headquarters, would require greater subsidy support than a majority of cities dependent on local service schedules.



FIRST LIQUID HYDROGEN ROCKET ENGINE

Pratt & Whitney Aircraft's XLR-115

Develops 30% Greater Specific Impulse... Offers Unlimited Potential in Size and Power

The first of a new family of liquid hydrogen rocket engines for missiles and space vehicles has recently been demonstrated at Pratt & Whitney Aircraft's Florida Research and Development Center. The engine developed 15,000 pounds of thrust under simulated space conditions, and produced 30% higher specific impulse than conventional LOX-kerosene engines. The successful development of this engine opened the way for immediate development of hydrogen engines offering far larger size and power.

The new Pratt & Whitney Aircraft engine has been chosen to power the *Centaur* space vehicle atop a modified *Atlas* missile. It will also power an upper stage of *Saturn*, the booster that will be used to place 35,000-pound satellites in orbit 300 miles above the earth or send a 12,000-pound space probe to another planet. Current developments indicate liquid hydrogen, substituted for LOX-kerosene stages, can multiply payload as much as 3½ times.

A new pumping system — termed "bootstrap" pumping — eliminates the need for an auxiliary gas generator. Pumping power is provided by the expansion of the hydrogen itself.

Pioneering work in liquid hydrogen has been in progress at Pratt & Whitney Aircraft since 1955.

PRATT & WHITNEY AIRCRAFT

East Hartford, Connecticut

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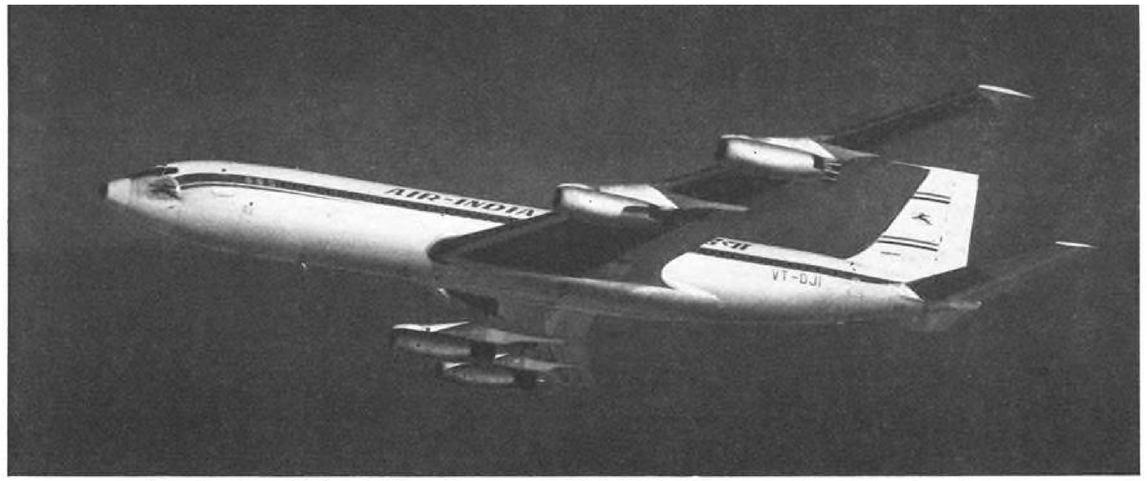


Air-India Schedules Boeing 707-420 Transatlantic Service

Air-India International announced plans recently to begin transatlantic service with Boeing 707-420 turbojet equipment on May 14. Initial service will include three flights per week between New York and, alternately, Bombay and Calcutta. Flights will operate nonstop between New York and London, serving these intermediate points on the London-India leg of the route; Paris, Rome, Frankfurt, Geneva, Beirut and Cairo. Delivery of the first of four Boeing 707-420s on order was completed last month, and the company is scheduled to receive two more in early March. The planes will be powered by Rolls-Royce Conway bypass engines and carry 40 first-class passengers plus 80 economy-class passengers. The new route will be opened on the basis of a foreign air carrier permit signed last November by President Eisenhower under the terms of a bilateral air transport agreement between India and the U. S.

General Dynamics Chief Presses For Common Air Freight Carrier

New York—Airlines soon will have to get into the cargo business seriously—perhaps through the formation of a common air freighter company on the order of the railroad Pullman company—or their customers or surface competitors may have their own fleets first, Earl D. Johnson, president of General Dynamics Corp., said here last week.

Making no pretense that General Dynamics was not vitally concerned in this field because of its Canadian subsidiary Canadair's CL-44 turboprop project, Johnson told the Sales Executives Club one manufacturer General Dynamics had studied could afford to buy a fleet of 15 CL-44s now and run them on a daily schedule.

He did not identify the manufacturer or even the country. But he also made frequent references to auto parts shipments from Detroit to assembly plants in Kansas City as examples of air freight markets and both General Motors and Ford have sizable operations of this type.

Candid References

Johnson discarded his prepared speech, and his spontaneous talk was studded with pungent references not only to air freight—his advertised subject—but to the aviation business as well:

• **"Today you can sell a jet** transport to anybody you can give the money to buy it."

• **Sales of the CL-44** are not moving as fast as the company would like. He added wryly: "When we look at airline balance sheets on the short term, we can forgive airline managements for this attitude. But when we look down the road, we see the tremendous cash flows that will be generated by the jets and it looks as if it won't be too long before it will be possible for them to buy these freighters."

• **"Uncle Sugar"** is not going to sponsor aircraft any more, except in a few cases ". . . letting manufacturers rectify their mistakes with change orders . . . underwriting prototypes that don't work out . . . supporting expensive projects that may or may not have some usefulness."

A good many attitudes are going to have to change, Johnson asserted, not only among manufacturers and airlines, but among regulatory agencies and financial people, if the aviation business is going to adjust to the future.

In the air freight field, for example, he pointed to the eventual necessity for separate terminals for air freight. "We have had to have air freight handled at passenger facilities up to now," he said. "But the New York Central doesn't have its passenger terminal in the middle of its freight marshaling yards."

Specialized facilities and specialized ground handling equipment will be needed for the coming air freight market and he called for particular attention to this problem from financial interests.

Another practice that he said will need soul-searching is "indulging the whim" of each pilot or group of pilots on less essential changes of the locations of various instruments and controls so that each airplane becomes a piece of custom equipment at added cost.

Military pilots handle standardized aircraft, he said, and military airplanes can be maintained on a standardized basis.

Standardized Freighter

Thus a standardized air freighter—owned by a common Pullman-like company in turn owned by various airlines—could be flown to Kansas City and maintained by Trans World Airlines, to Tulsa and maintained by American and to San Francisco and maintained by United.

Foreign airlines are going to force some such combination, he said, pointing to the Air Union organization. "How long can we stand cutting each others' throats in needless areas?" he asked.

Both the railroads and the truckers are moving into air freight, he said. The railroads know they cannot fight the advent of air freight.

"We know this," he said, "because of the people who are knocking at our door."

He said that as far ahead as he could see, air freight will not become as cheap as the railroad 1½-2 cent ton mile costs. But air freight already is siphoning off the rails' high profit margin business.

U.S. Supersonic Transport Action Urged

By Glenn Garrison

New York—Timetable for supersonic transport service has been placed around 1965 by two major manufacturers—but there are some important reservations.

North American Aviation, which made clear its determination to enter the supersonic commercial field at the Institute of the Aeronautical Sciences meeting here, and Lockheed Aircraft Corp. both said that a U.S. Mach 3 transport could be flying airline routes at about that time, if an aggressive development program was started immediately. Both warned—and were in effect supported last week by Civil Aeronautics Board Chairman James R. Durfee—that U.S. delay might mean a loss to foreign competition.

Some airlines, however, were looking further into the future for the first supersonic commercial operations. Besides the big question of where the money will come from to build and buy the transports, airline engineers were setting the likely technical target date closer to 1970.

The carriers want to see positive answers to many economic and operational problems before they line up to replace their costly new subsonic jets with the supersonic variety. Several airline engineering officials surveyed by AVIATION WEEK said it would be two or three years before any manufacturer had a firm design to sell, although there have for some time been discussions between airlines and manufacturers on supersonic prospects. Translating a finite design into a working airplane—with unique problems involved in venturing into the supersonic regime—would carry the start-of-service time up to at least 1968 or 1970, they say.

Comet Experience

The U.S. approach to beginning subsonic jet service was contrasted by one official with the British de Havilland Comet I experience. American air carriers, it was pointed out, worked for years with the manufacturers to raise and solve as many questions as possible before going ahead with service aircraft. The British, according to this view, went ahead too fast to anticipate problems that further analysis might have revealed.

Among the development problems that will take time to work out, in the airline view, is that of certification of a supersonic transport. This process will involve whole new areas of standards and techniques.

North American and Lockheed presented their argument for an immediate development program at the IAS meeting here.

North American called for an aggressive U.S. program to be undertaken without delay. J. B. Pearson, Jr., and R. James Pfeiffer reported that the U.S. industry is in an excellent position to maintain its leadership in jet transport competition and could place a supersonic airplane in service by 1965 with a level of risk comparable with introduction of current jet transports.

But North American's time estimate was based on "a firm go-ahead now," and the officials foresaw higher development costs as well as a competitive disadvantage if the program were delayed.

The presentation marked North American's opening pitch in the supersonic commercial contest as far as official policy is concerned. The company has had and is continuing talks with the airlines about supersonic possibilities, but had not publicly discussed them at the high-management level as other manufacturers have.

Pfeiffer, who is North American's new manager-commercial aircraft marketing, told AVIATION WEEK that no policy decision has been made on a supersonic project, which is "purely in the study and planning stage." Firmer plans would depend in part on solving the development costs problem, and on immediate beginning of the development of a fan engine for the supersonic transport—the fan principle being considered by North American the best compromise.

North American's B-70 powerplant is the General Electric J93. But Pfeiffer said both General Electric and Pratt & Whitney plan versions of existing military engines that could power a supersonic transport, so North American is not specifying at this point. Pratt & Whitney's competing engine is the J58.

As prime contractor for the B-70 Mach 3 bomber, North American appears to have a strong lead over most other manufacturers in the supersonic field, some airline sources feel. Convair's B-58 is in the Mach 2 category and therefore is not considered a great advantage in Mach 3 manufacture.

Lockheed Aircraft Corp., also considered a strong supersonic contender, sees no technical, operational or economic reason why the U.S. should not operate a supersonic transport between 1965 and 1970. In their IAS report, B. C. Monesmith and Robert A. Bailey suggested pooling the resources of two or more manufacturers as a possible approach to the development problem. One basic aircraft, it is generally agreed, will serve all U.S. carriers, it being doubtful that more than one design could be economically successful.

Durfee, in a letter to Chairman Warren G. Magnuson (D.-Wash.), of the Senate Committee on Interstate and Foreign Commerce, said economic studies by U.S. manufacturers indicate that the entire requirement of all the world's air carriers could be met with 100 to 200 supersonic airplanes. Estimated cost of each airplane, Durfee said, is between $12 and $25 million.

No manufacturer, according to Durfee's information, could build without 40 to 80 orders for supersonic aircraft. Airlines probably would use interchange agreements to get sufficient utilization to warrant the investments.

Durfee said CAB was concerned that a one- to three-year delay in supersonic transport development in this country might mean that in the early or mid-1960s "the American long-range carriers may be forced by competitive reasons to place orders for supersonic aircraft to be built elsewhere in the world" and the favored position of the U.S. would be lost for decades.

The CAB chairman's letter might be construed as laying the ground work for government subsidy of a supersonic transport program in some form. Help from the government also was suggested as an alternative by the manufacturers, and seems to be emerging as a main approach to the problem. Stretch-out of the B-70 program has been mentioned in this connection as an unfavorable development.

Regarding the foreign competition aspect, Durfee said CAB has been told that both Great Britain and Russia are "targeting for an operating supersonic transport between 1965 and 1968." According to one rumor, Durfee said, "one of the countries is already 'cutting metal' for its first supersonic transport aircraft."

The presentations to the IAS supersonic transport session were keyed to some 103 questions submitted by top airline engineering officials. This approach was suggested by questions concerning supersonic transport operations presented by Charles Froesch, Eastern Air Lines' vice-president-engineering, at an IAS meeting last fall.

The questions covered last month concerned noise, structural design, powerplants, performance, financial aspects, operational factors and national policy.

The two manufacturers disagreed on the probable structural material of the Mach 3 category transport. North American maintained that considerable honeycomb sandwich construction with steel or titanium would be used to handle aerodynamic fuel heating, low aspect ratio wing, acoustical and other problems. Lockheed, however, foresaw a steel airplane with honeycomb construction used only in a few critical areas in a transport aircraft. Honeycombing and its attendant problems could increase the cost prohibitively, according to Lockheed.

Development Costs

Lockheed estimated the development cost of a 250,000-lb. supersonic steel airplane at $160 million and the cost of a 500,000-lb. airplane at $210 million. Cost per copy of the lighter plane would run about $11 million if 100 were produced, according to Lockheed.

Windows were back in the supersonic transport in Lockheed's discussion. Some previous proposals had eliminated passenger windows because of weight and structural requirements at supersonic regimes. But Lockheed believes the claustrophobic passenger, and those who want to look out, can be provided with windows without a significant penalty.

The passenger also will tilt with the plane as it climbs instead of sitting in a swivel seat—another previous proposal—by Lockheed and North American's current thinking. Maximum nose-up angles expected, according to North American, range from seven to 14 deg. during takeoff, climb and landing. Seats of current design should be sufficiently comfortable.

Shock wave, boundary layer and engine noise problems should be considered in the early design stage of the supersonic transport, according to three scientists from NASA's Langley Research Center. Lindsay J. Lina, Domenic J. Maglieri and Harvey H. Hubbard pointed out that millions of people from coast to coast would hear the booms produced by a transcontinental jet cruising at 70,000 ft. at Mach 3. The area exposed to booms on such a flight would be 70 mi. wide. Real hope for solution to the sonic boom problem lies in how the aircraft is operated, according to the Langley scientists. Boundary layer noise as a possible source of structural damage imposes a much more severe requirement in the supersonic airplane than in the subsonic, they said.

Lockheed held that sonic boom problems would be avoided by the following typical climb program, which also is considered optimum for other operating reasons:

- **Constant equivalent airspeed** of 312 kt. to 37,500 ft.
- **Constant acceleration** at 37,500 ft. to equivalent airspeed of 550 kt.
- **Constant equivalent airspeed** climb at 550 kt. to the Mach 3 initial cruise altitude.

North American favored stored air-breathing systems for supersonic transports, rather than ram air systems, on the basis of weight, power and reliability requirements. An emergency ram air system also would be provided. The manufacturer finds the turbofan engine with fan afterburning as the best powerplant compromise currently in sight. Ideally, an engine would combine the installed weight of the afterburning cycle, the specific fuel consumption of the dry turbojet, and the noise level of the turbofan.

North American also advocated a buried engine configuration, for drag and structural weight considerations.

Operating costs of the supersonic transport, in North American's estimate, would be less than three cents per seat mile over long range routes. Required runway lengths, the two manufacturers agreed, would not exceed 10,500 ft. under standard conditions.

Supersonic Airliner Development

New York—Officials of two major airlines say the commercial supersonic transport is at least a decade away from service and that the status of the North American B-70 program will affect its development time.

The president of a third airline—TWA's Charles S. Thomas—predicted supersonic operation around 1967.

Thomas said supersonic airliners could be available in three years, but the development costs would run to $250 million.

American Airlines President C. R. Smith told a National Transportation Institute panel here last month that neither the manufacturers nor the airlines have capital enough to develop a supersonic airplane.

Earlier last month J. A. Herlihy, United Air Lines senior vice president-engineering and maintenance, expressed a "conservative" view of supersonic airliner prospects to members of the Yale Engineering Assn. of New York City. He predicted the aircraft would not be in operation for at least 10 years.

Smith said "it is difficult to predict" that a supersonic transport will be in airline service within the next 10 years. He also questioned whether there is sufficient evidence that operation of such an airliner would be profitable, and said there is no assured source of capital for its development.

Governmental decision on the B-70 will greatly affect the development rate of the supersonic transport, according to Smith.

Herlihy said financing and limitations of the human body were the two major problems in development of commercial supersonic aircraft. Development costs might reach a billion dollars according to the estimate of a Douglas Aircraft engineering official, Herlihy said.

Herlihy spoke of the difficulties involved in designing a supersonic airliner cabin that would be completely safe from pressure loss. Noise, high temperatures and sonic boom were also among the problems to be solved, according to the United official.

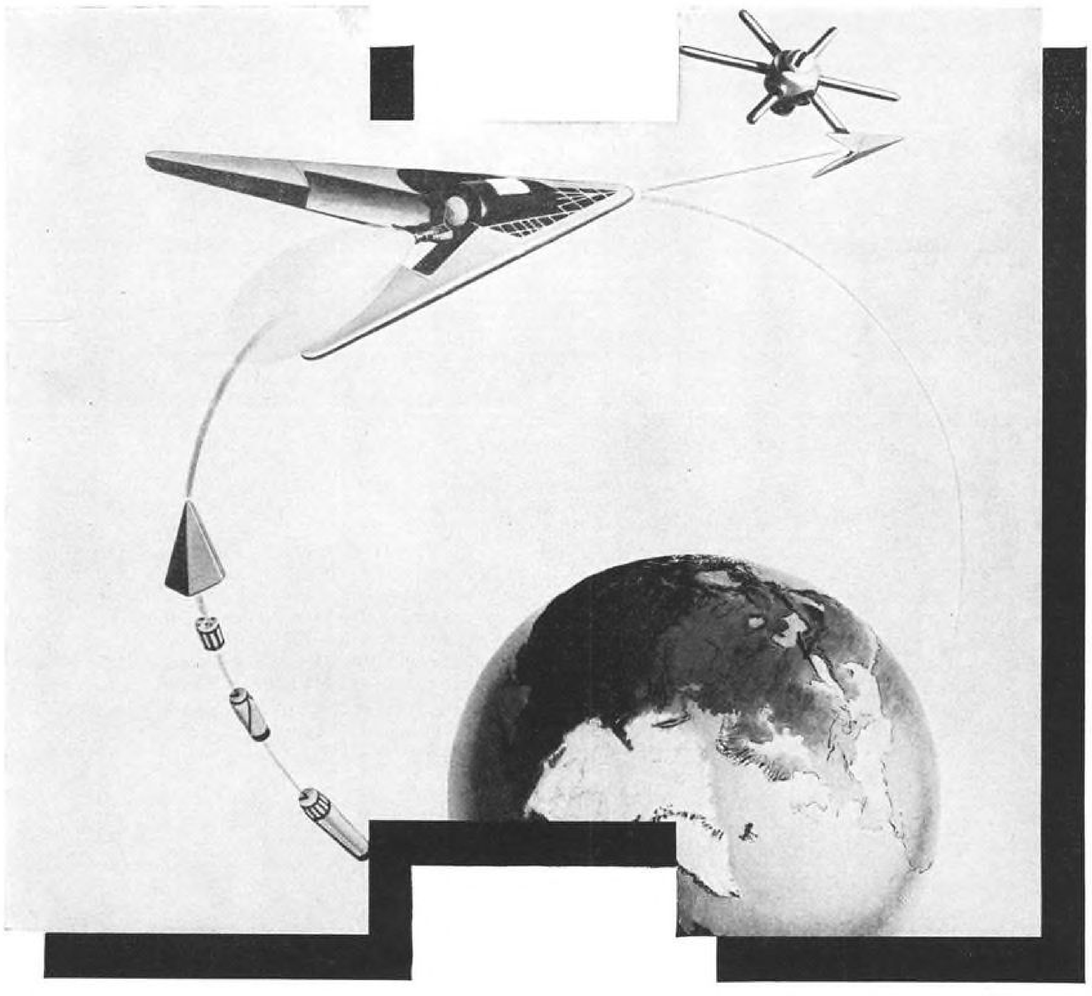
"I think some of the forecasters of early supersonic transports have been slowed down a little by the recent stretch-out of the B-70 program," Herlihy said.

Admitting his view was "on the conservative side," Herlihy forecast that it will be "at least the early '70s" before supersonic airliner operation is in service.

First Sud Caravelle for Air Algerie

First Sud Caravelle turbojet transport for Air Algerie, the Algerian airline, is shown just prior to delivery. The Caravelle is the 18th of its type to be delivered for scheduled service and is the first of four for Air Algerie for schedules between Paris and Algeria.

Earth-to-space ferry for Astronauts



Combining the features of a space ship, guided missile and a conventional airplane, the new Space Ferry was designed by Hughes-Lockheed Project teams to shuttle men and materials between earth and outer space.

The Space Ferry would carry a pilot and 3 commuters. Payload would be about 14,000 pounds; cargo could vary from flight to flight.

Taking off from earth the Space Ferry would orbit at 300 to 500 miles, rendezvous with other space craft, transfer passengers and cargo, and return to earth... all on a routine schedule.

The Hughes-designed Navigation and Guidance System would utilize an inertial platform and a digital computer. It would automatically control boost to orbit, bringing the Ferry to within 20 to 50 miles of its destination.

The Hughes Attitude and Flight Path Control System would incorporate several novel features: A space attitude and translation control system, based on velocity feedbacks, would give the pilot easy control for rendezvous and final soft contact with the platform. For re-entry and flight in atmosphere, the system would use structural temperature as a signal for automatic control during the critical heating phase. The resulting maneuver eliminates the characteristic skipping oscillations of uncontrolled re-entries. Either pitch or bank (or both) maneuvers would be selected with elevons as primary controls.

"Vest Pocket Air Defense System"—*Hughes mobile digital computer and display unit, linked to a Hughes 3-D scanning radar antenna, assigns enemy targets to missile batteries.*

The new Space Ferry reflects the many stimulating outlets available to Hughes engineers. Other projects include nuclear electronics, spatial communications systems, advanced airborne electronics systems, three-dimensional radar systems, new semiconductor materials, electron storage tubes...and many others.

A diversity of advanced projects, a history of continued growth, technically oriented company philosphy — these factors make Hughes the ideal environment for engineers interested in building a rewarding future.

Newly instituted programs at Hughes have created immediate openings for engineers experienced in the following areas:

Electroluminescence	Equipment Engineering
Infra-red	Microwave & Storage Tubes
Plasma Physics	Communications Systems
Digital Computers	Micro Electronics
Reliability & Quality Assurance	Engineering Writing
Systems Design & Analysis	Circuit Design & Evaluation

Write in confidence to Mr. R. A. Martin
Hughes General Offices, Bldg. 6-A2, Culver City, Calif.

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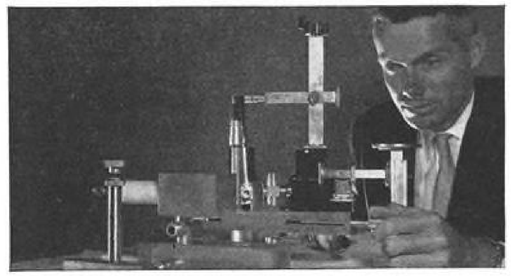
HUGHES AIRCRAFT COMPANY
Culver City, El Segundo, Fullerton, Newport Beach, Malibu, Santa Barbara, Oceanside and Los Angeles, California
Tucson, Arizona

"Paramp" *(parametric amplifier) developed by Hughes research engineers and scientists, can double effective range of today's radar units.*



AIRLINE OBSERVER

► Hughes Tool Co. has refused to accept the first two of eight Convair 880 turbojet transports it has on order for lease to Trans World Airlines. No reason is being given for the refusal, but this much is known: both planes are ready for delivery, Convair wants to deliver them right away, and, since Hughes has paid at least $26 million down on the purchase price of the fleet, money is not considered a factor behind the postponed acceptance of the two airplanes. To get at least one of the aircraft in the air, Convair last week began flying it as a company-owned airplane.

► Wall Street sources believe chances are better for action on TWA financing since the carrier's earning picture brightened notably last year. Earnings have been added to net worth so that equity financing may not be necessary since the carrier may now meet the debt/equity ratio required for long term loans, at least by some lenders. However, the lenders have been ready to act on some type of financing for months but they still are waiting for the Hughes interests to give the word.

► Capital Airlines has voluntarily replaced turbine blades and nozzle guide vanes on all its Rolls-Royce Dart turboprop engines. The program, completed in October, was undertaken when normal inspection disclosed that the parts were not meeting the expected life-time of two to three engine overhaul periods before replacement was necessary under the company's regular maintenance schedule. Higher quality blades and vanes were installed in the engine as a means of preventing future replacements prematurely.

► United Air Lines is still strongly interested in a fleet of Sud Aviation Caravelle transports powered with General Electric aft turbofan engines (AW Nov. 23, p. 47). Carrier wants the aircraft for its medium-range routes.

► Civil Aeronautics Board has granted exemptions to Braniff Airways and Pan American World Airways that will permit the carriers to serve Brasilia, Brazil, beginning Apr. 1 on South American routes. Addition of Brasilia as an intermediate point on these routes was requested on grounds that traffic to and from the city will be substantial when the capital of Brazil is transferred from Rio de Janeiro to Brasilia Apr. 21.

► Hearings by Senate Aviation Subcommittee on the proposed bill that would authorize the Civil Aeronautics Board to guarantee loans for the purchase of cargo transports will begin today. Under the bill as it is now written, loans up to 75% of the purchase price of each aircraft would be authorized, with a maximum loan restriction of $75 million on each airline. CAB would guarantee 90% of the balance of each loan.

► Eastern Air Lines will convert five Lockheed Super Constellation transports to all-cargo aircraft, with the first of the fleet to be in service May 1. In announcing the conversion program, Thomas Armstrong, executive vice president-finance, noted that air freight potential cannot be fully developed "until a more suitable all-cargo airplane can be operated."

► Trans World Airlines has estimated that around-the-world passengers will total 37,000 annually by 1962. E. O. Cocke, TWA senior vice president and system general manager, made the forecast during testimony presented in Civil Aeronautics Board's Transpacific Route Case in which the carrier is seeking an extension of its Far East route from India and Ceylon to Hong Kong and Tokyo via Bangkok.

► Lufthansa German Airlines has ordered five Boeing 720B transports powered with Pratt & Whitney turbofan engines for delivery beginning in April, 1961. The carrier also increased its order for Boeing 707-420 Intercontinental transports powered with Rolls-Royce Conway bypass engines from three to a total of four.

► Air Transport Assn. has contracted with the Stanford Research Institute to undertake a study of airport economics. Chief purpose of the study is to define economic benefits of airports to the users and the communities airports serve and to determine proper allocation of costs between users and communities.

SHORTLINES

► **Air France** will begin Boeing 707-320 turbojet service from Los Angeles to Paris via Montreal on a twice weekly basis and from Chicago to Montreal and Paris three times a week in early April. The French carrier recently began daily nonstop transatlantic 707-320 service from New York to Paris. By the end of 1960, Air France expects to have 17 Boeing 707-320s in service.

► **Aloha Airlines** has started construction on a new $3 million headquarters building near the new Honolulu International Airport. The airline hopes to move into the new 14,000 sq. ft. building from its present offices in downtown Honolulu by Dec. 1.

► **American Airlines** reports its fleet of Boeing 707 turbojets had carried over 800,000 passengers 1,578 billion revenue passenger miles by Jan. 25, one year after its inauguration of 707 service. Of the 800,000 passengers carried, 230,000 were flown over the New York-Los Angeles route which showed a Jan. 25 year-end load factor of 80% for the year ending Jan. 25. American serves nine cities with 48 daily 707 flights.

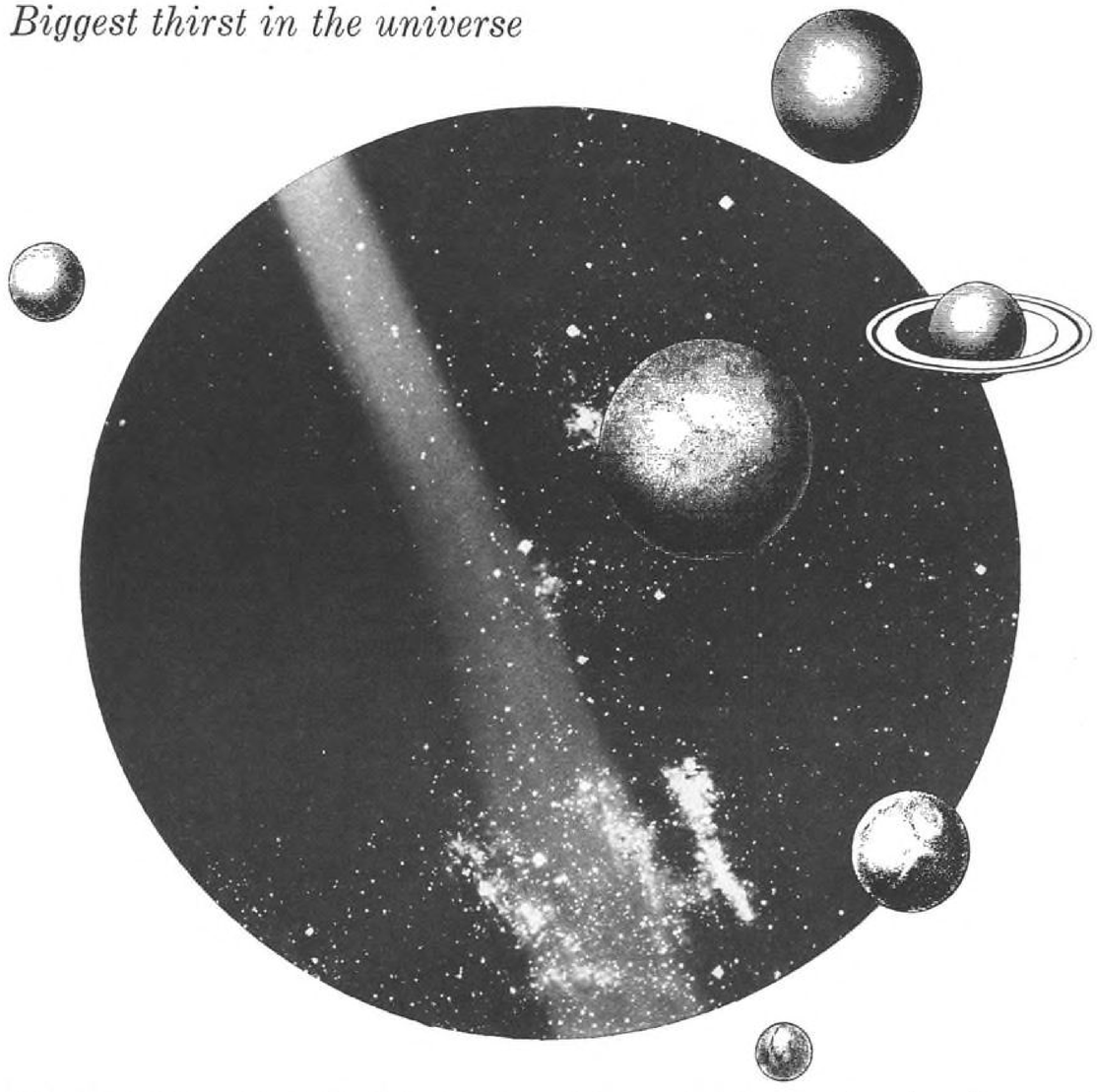
► **British Overseas Airways Corp.** plans to start daily nonstop Boston-London service June 13 using de Havilland Comet 4 turbojet airliners. Current New York-Boston-London service operates four times a week and will be continued.

► **Irish Tourist Office** has announced that a $3 million airport will be built at Ballygarven, four miles from Cork City in southern Ireland. The new facility will have runways 4,500 ft. long and 3,800 ft. long, both of which can be lengthened as the need arises. Completion date has been set for early 1961.

► **Sabena Belgian World Airlines** last month inaugurated the first transatlantic Boeing 707-320 jet service by a foreign-flag airline. Sabena began New York-Brussels service Jan. 24, offering an initial two weekly round trips and a 96 economy, 34 first class seat configuration.

► **Trans World Airlines** will begin Boeing 707 Intercontinental service to Lisbon and Madrid on May 18 with three flights a week. The flights will originate in New York and fly nonstop to Lisbon and on to Madrid. The new service will bring to six the number of flights TWA will offer to the Iberian Peninsula. The airline currently has three Lockheed 1649 Constellation flights weekly in service on this route.

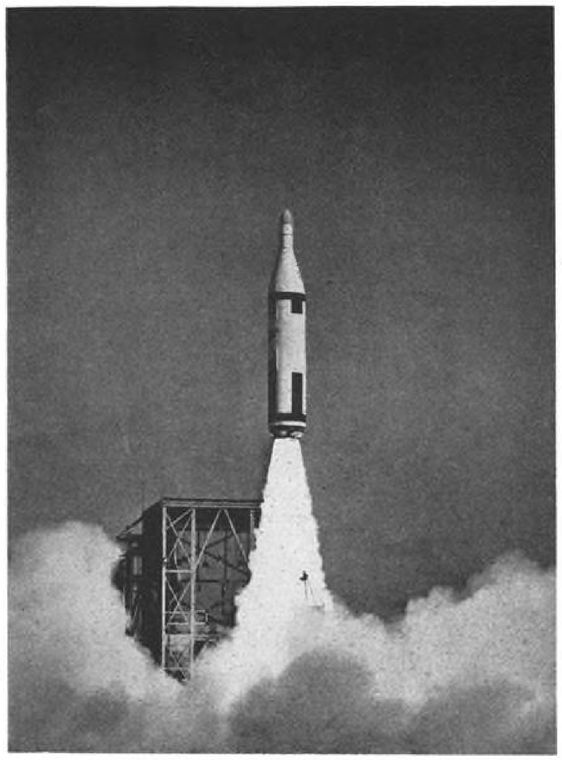
Biggest thirst in the universe

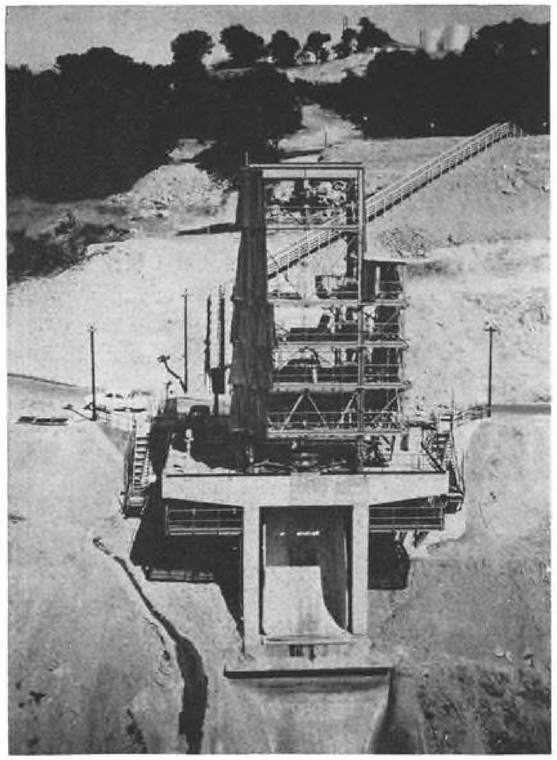


Each 6,000,000 pound thrust rocket ship now being planned for manned interplanetary exploration will gulp as much propellant as the entire capacity of a 170 passenger DC-8 Jetliner in less than 4 seconds! It will consume 1,140 tons in the rocket's approximately 2 minutes of burning time. Required to carry this vast quantity of propellant will be tanks tall as 8 story buildings, strong enough to withstand tremendous G forces, yet of minimum weight. Douglas is especially qualified to build giant-sized space ships of this type because of familiarity with every structural and environmental problem involved. This has been gained through 18 years of experience in producing missile and space systems.

Dr. Henry Ponsford, Chief, Structures Section, discusses valve and fuel flow requirements for space vehicles with Donald W. Douglas, Jr., President of **DOUGLAS**

MISSILE AND SPACE SYSTEMS ■ MILITARY AIRCRAFT ■ DC-8 JETLINERS ■ CARGO TRANSPORTS ■ AIRCOMB ■ GROUND SUPPORT EQUIPMENT





ONE of a series of Polaris test vehicles is launched from its Cape Canaveral, Fla., Missile Test Center pad. At right is the Lockheed Missiles and Space Division's dynamic test stand at Santa Cruz, used to test Polaris under simulated flight conditions.

Lockheed Trims Polaris Vehicle's Weight

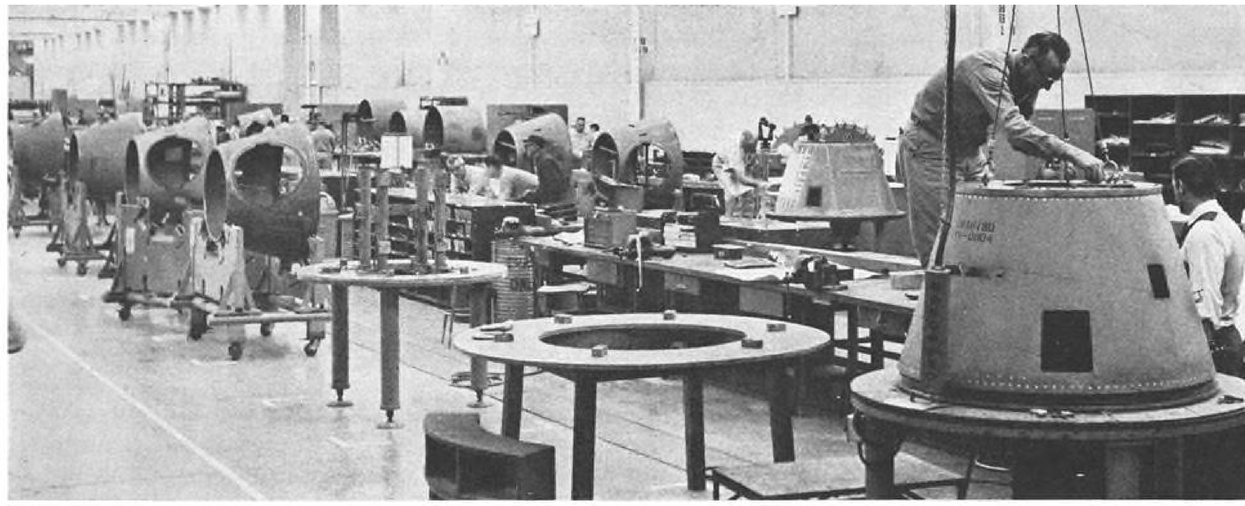
LOCKHEED technicians prepare controls and data recording equipment for high-g loading tests on a Polaris vehicle. Equipment controls a dynamic load applicator in adjacent room.

By William S. Reed

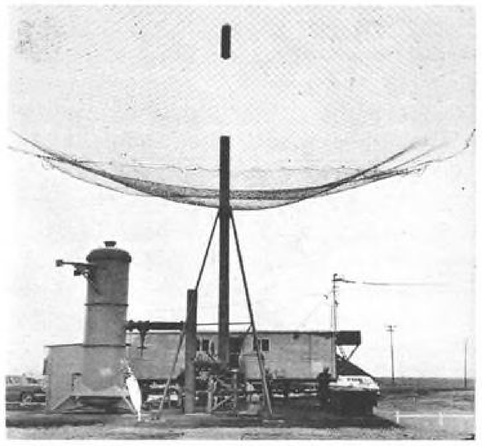
Sunnyvale, Calif.—Recent fully-guided flights of Polaris missile test vehicles over the Atlantic Missile Range which attained 900 mi. range indicate that the goal of 1,200 mi. range may be met by the end of this year, Lockheed Missiles and Space Division officials believe.

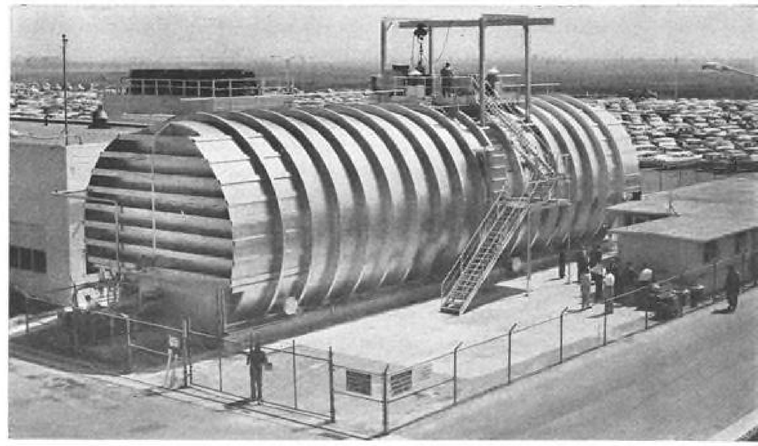
Range increase will be achieved mainly by an intensive weight reduction program which will trim the fat from Polaris from an overweight test configuration to operational requirements. Weight from successive flight test articles will be cut mainly in the area of heat shields and intentionally overdesigned subsystems.

Range objective scheduled for 1962 under the original development program was 1,500 naut. mi. but when two years were lopped off the program at Navy insistance one unavoidable compromise was a reduction in range. Ultimate 1,500 mi. goal still will be met, perhaps considerably sooner than

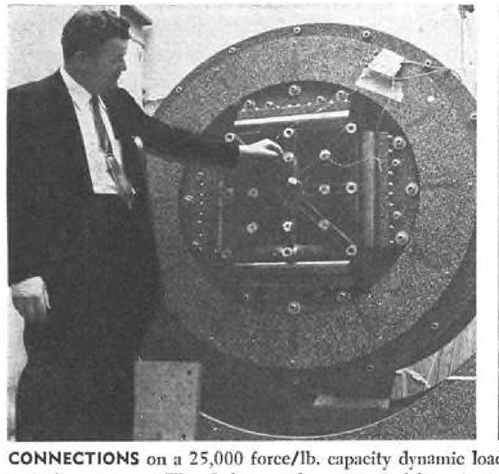


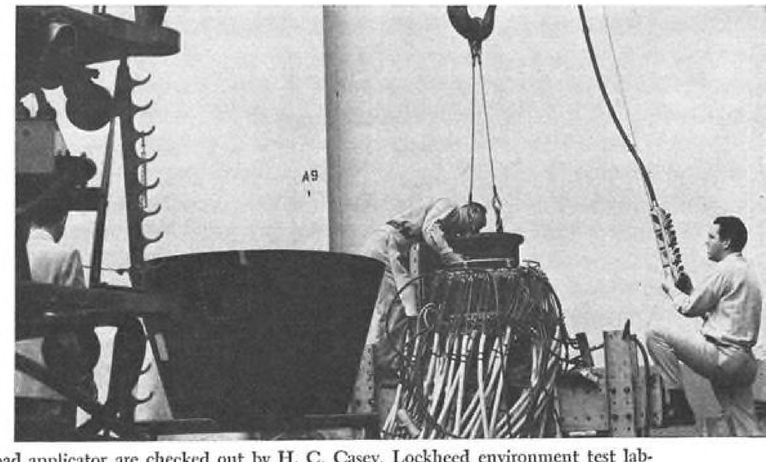
INSTRUMENT sections for Polaris test vehicles are shown on the production line at a naval industrial reserve ordnance plant at Lockheed's Sunnyvale, Calif., facility. A total of 47 Polaris vehicles have been launched with 31 shots fully successful.



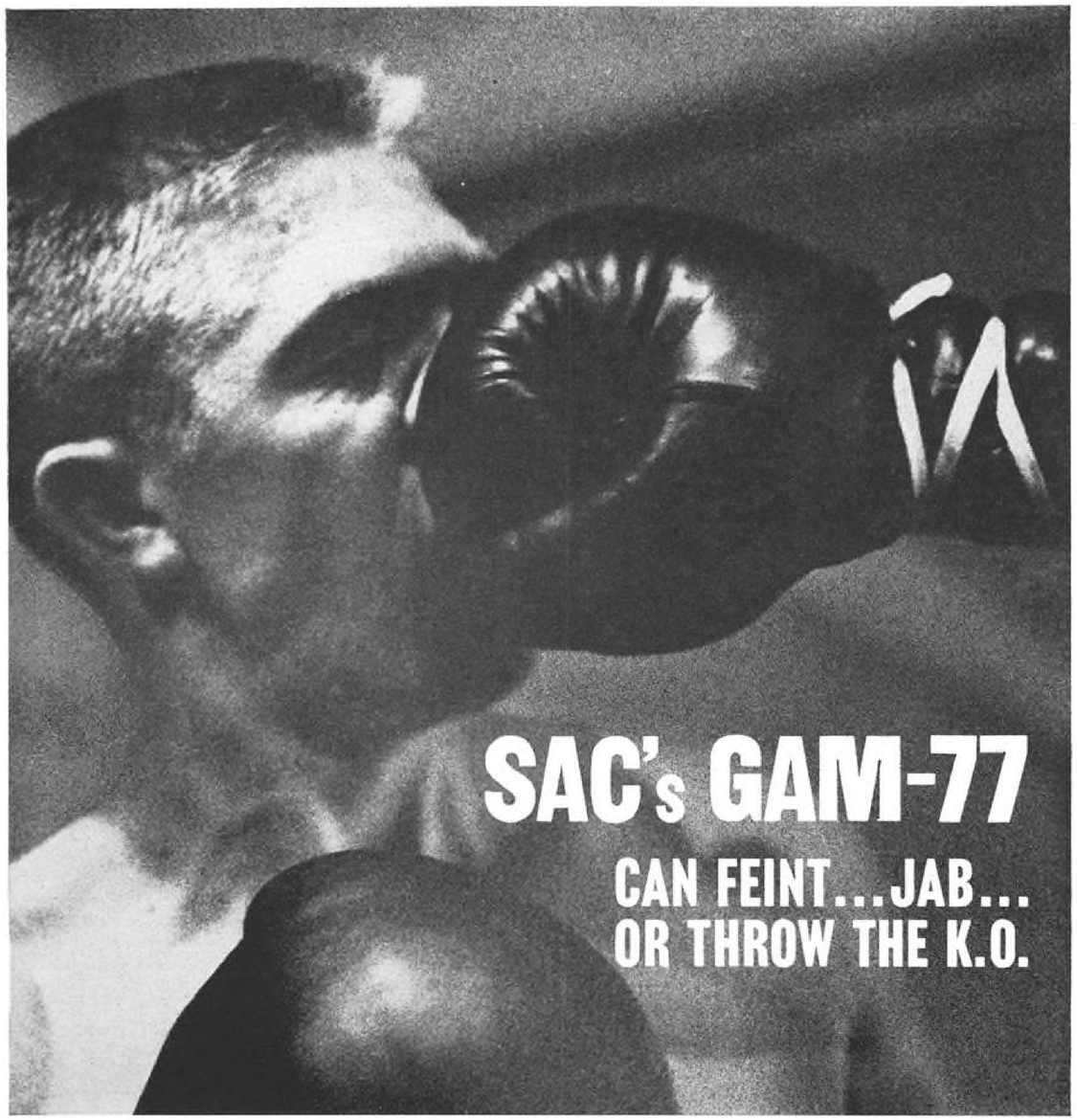


GUN charged by compressed air fires small Polaris components into the air (left) as part of a shock and acceleration test before actual installation on the vehicle. The gun originally was used in design development for liquid oxygen component packages. At right is an 80 x 20 ft. pressure vessel for water tests of Polaris shapes. Wave generator produces near-hurricane forces.





CONNECTIONS on a 25,000 force/lb. capacity dynamic load applicator are checked out by H. C. Casey, Lockheed environment test laboratories manager. The shaker can be programed by a tape recording of load factors and stresses which the test vehicle will undergo during the initial launch and flight. At right, Lockheed technicians conduct a wiring test on the instrument section prior to installing it.



GAM-77 HOUND DOG air-to-surface missiles give SAC's B-52G intercontinental bombers the versatility of a champion boxer. Even while the aircraft carrying the GAM-77 missiles is airborne, a new target can be selected. Then reaching out at supersonic speeds after launch, the GAM-77's can flatten opposition for the bomber to deliver its own Sunday punch... or independently destroy the primary target. These jet-powered missiles vastly increase the striking power of the giant Boeing B-52... give it a triple-punch capability.

Guided by a self-contained inertial autonavigator—set before launch by the B-52's crew—the GAM-77 can't be jammed, can't be decoyed. The GAM-77 Hound Dog was designed and is being produced for the USAF by the Missile Division of North American Aviation.

MISSILE DIVISION

NORTH AMERICAN AVIATION, INC.

Downey, California

the end of 1962, by a continuous process of refinement and development after the interim operational date set for the end of 1960.

Accuracy and reliability, rather than range, are the goals presently sought in the Polaris flight test program.

Test Highlights

Highlights of the test program which has brought Polaris to its present state of development and which will provide the background for increased capability are:

- **Underwater tests** on scale models and full-size dummy shapes. The launch tests have resolved basic problems and are being continued mainly to refine the underwater-launch technique.
- **Integrated or combined systems tests.** Starting with exhaustive tests of individual components and subsystems, two or more components or subsystems are tested together, not only to establish operation and reliability of each, but to check their operating interrelation.
- **Static firings** of complete assemblies on a "soft" test stand. Inputs similar to those which will be presented to the missile's autopilot and guidance system during flight can be simulated on the soft stand because the entire assembly can be displaced while the Aerojet-General rocket motors are firing.
- **Sea-going laboratory tests** aboard the USS Observation Island. Manned by Navy and Lockheed personnel, the ship can perform all operational functions of a Polaris mission with the exception of underwater launching.

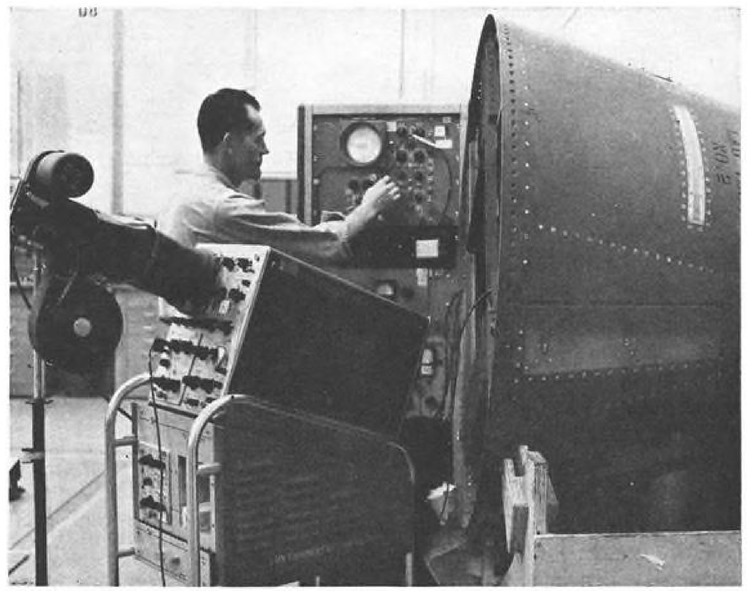
Underwater Tests

Underwater tests of $\frac{1}{10}$ and $\frac{1}{5}$-scale models at the Lockheed Underwater Missile Facility (LUMF) here, together with underwater launching tests of full-scale dummy shapes at San Clemente Island and in San Francisco Bay, continue to provide data which Lockheed says proves that underwater launching of Polaris is a known quantity. Hydrodynamicists insisted at first that the missile would tumble on its way to the surface unless guided by fins or rudders. Both full-scale and model tests have disproved the necessity for underwater control, because those characteristics of external configuration which make for good aerodynamics apply equally in contributing to good hydrodynamic characteristics.

Early in the test program it was thought that the missile might have to be completely encapsulated for underwater launch or be equipped with a plastic overlay or possibly protected by some sort of dropaway structure. Originally considered to be critical test items were the rocket nozzles and jetavators, which many said would not operate after being exposed to sea water. Another doubtful area was differential between chamber pressure and decreasing external pressure as the missile ascended, possibly creating problems with ignition.

But tests on instrumented dummy shapes launched from a submerged, modified Regulus missile hangar off San Clemente indicate no difficulty in either of these areas. Validity of scale model tests in the underwater tank has been substantiated by the full-scale dummy launches. Scale effects similar to those experienced in wind tunnel model tests have proved to be readily calculable.

The tank recently has been completely enclosed so that it can be pressurized to simulate launches from varying depths. Scale-model tests run in the tank are providing more valuable data than full-scale tests since sea states up to hurricane conditions readily are controlled in the model tank.



MEMBER of the Lockheed environment test staff prepares a Polaris instrument section for a dynamic load test. In foreground is a techtronic scope for calibration, and a camera.

Effects of pressure against the missile's outer surface during underwater launches from varying depths have received major attention in the tank. Inherent ruggedness of the rocket motor case, coupled with the relatively hard rubber-like nature of the solid propellant grain, provides sufficient strength. Interface section connecting the first and second stages, and the forward equipment bay section ahead of the second stage, also are built to rugged specifications to provide necessary strength. Both interface and equipment section structures are built from heavy gage dural skin approximately $\frac{1}{8}$-in. thick.

Launch Technique

Structural ruggedness also is dictated by the rigorous requirement of the launching technique during which Polaris is ejected from the submarine tubes by compressed gas. Missile does not fit snugly into the bore of the tube, but compression is maintained by "wadding" which affords a "piston ring" effect by creating a seal.

A double advantage is involved in having the bore of the tube larger than the missile diameter—internal friction is minimized during launch and room for growth in missile diameter is provided to match the normal 20-year operational lifespan of a submarine. Polaris test officials say that criteria for launching a missile does not differ greatly from that required for a torpedo firing. Similarity is that conditions of roll, yaw, and heave must be satisfied before the fire control computer will allow the missile to be

Polaris Box Score

- Total flight firings, as of mid-January-47. Of these, 31 have been classed as fully successful, 14 as partial successes and two as failures.
- A1X series (current) so far includes eight firings with operational Polaris configuration.
- Earlier AX series encompassed 17 firings between September, 1958, and September 1959. Each successive AX firing approached closer to operational type.
- Prior to this, there were 22 test rockets of various makeup built to explore design aspects such as propulsion, re-entry, and guidance.

launched. Feasibility of the gas-expansion launching (expelling) technique of the 33,000 lb. Polaris has already been demonstrated in launch tests of live missiles from a hydraulically operated ship-motion simulator at Cape Canaveral.

Before live Polaris vehicles are fired in the test program from aboard the recently commissioned submarine USS George Washington (AW Dec. 7, p. 57), dummy configurations will be used for final shakedown information in the submarine's fire control system. Crew training will also receive a final shakedown with Polaris dummies.

Static Firing

Dynamic static tests are conducted with complete Polaris vehicles on a soft test stand located in the Santa Cruz mountains near here. Designed to give the missile a slight degree of freedom, the soft test stand is used to check guidance system, autopilot, thrust vector control, thrust termination, stage separation and other subsystem performance parameters. While the rocket motors are firing, delivering full power, the vehicle is displaced, providing both quantitative and qualitative operational data.

Static firings are conducted with telemetry and also with "hard" wiring affording a closed loop connection between the Polaris test instrumentation and data recorders. This double check permits accurate calibration of the telemetry for reference during free flight tests.

Stage separation, always difficult to observe, is another function which Lockheed is able to check on the soft test stand.

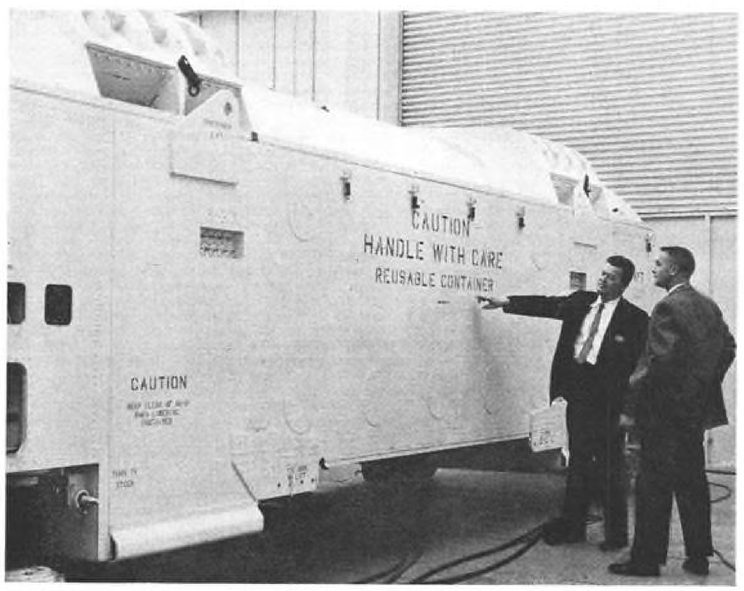
Explosive separation is used in Polaris, but explosive bolts are not employed, as in other missiles.

Midair ignition of the solid-propellant first stage motor is a critical test item since there is no time for the traditional approach which allows for gradual thrust buildup and a last second check of systems operation before liftoff. Thrust buildup of solid propellants is almost instantaneous with ignition as compared with the more gradual thrust buildup of liquid-fuel rockets. Test results show that Polaris does not pause as it emerges from the launching tube, but continues to accelerate into the powered portion of the flight.

Second Grain

Solid propellant rocket motor cases and nozzles are not reusable as are those in liquid-fuel engines. A second grain could be cast into a case, and the nozzles reworked, but a "recharged" motor would not have acceptable reliability. Building in the quality necessary to withstand repeated firings would necessitate considerable refinement in manufacturing methods and materials, and cost increase would be out of proportion to the saving that might be effected through the reuse of the cases and nozzles.

Cooling for first and second stage cases during static firings is no problem despite the absence of a slipstream. Propellant grain is cast around a star-shaped mandrel running lengthwise through the grain. Burning occurs radially from the inside out and since the



SPECIALLY designed Polaris shipping and storage container is shown to William S. Reed, Aviation Week associate editor, by H. C. Casey, of Lockheed. Unit is wired for static tests.

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DOW | *Now in magnesium and aluminum*

FOUR DOW PLANTS OFFER AIRCRAFT AND MISSILE MEN WIDE CHOICE OF MAGNESIUM WARES

Coiled sheet, thin wall castings, many other production items are now available from Dow's big rolling mill, foundry and fabrication facilities.

Aircraft and missiles manufacturers on the alert for improved materials and production methods would enjoy a personal tour of the four Dow plants that turn out magnesium products. Next best thing is this quick rundown on the new ways of forming and fabricating magnesium now being practiced in these plants to open up new uses for the lightweight metal . . .

TOOLING PLATE, extra flat, is annealed to eliminate residual stresses.

At the huge Madison, Illinois, rolling mill, for example, they're making magnesium sheet that doesn't require stress relief after welding. This is a major step forward in light metal technology and a boon to manufacturers using magnesium assemblies. Madison has also increased the maximum width of sheet to six feet. Five different sheet alloys, including elevated temperature alloys, are now available either flat or in coils.

To keep abreast of the rapidly increasing demand for precision jigs and fixtures, Madison keeps a close watch on the tolerances of Dow magnesium tooling plate. Typical flatness tolerances, for example, are 0.010 inches in any six feet. This means greater accuracy and less machining for users of Dow tooling plate. Madison is now turning out both magnesium and aluminum extrusions that cover a wide range of sizes: from delicate precision parts to a 30-inch circumscribed circle size—made by Madison's mammoth 13,200 ton extrusion press.

Over in Bay City, Michigan, interesting things are happening, too. At the well-equipped Dow magnesium foundry, largest in the U. S., sand and permanent mold castings of all sizes and shapes are being produced on a volume basis. Complete facilities are maintained for heat treatment, styrene DMI impregnation and chemical treatment. A well-staffed quality control team makes sure that all specifications are met or exceeded, and that the most modern equipment and techniques are fully utilized.

The Bay City foundry casts many complex and difficult designs. Large castings with walls as thin as 0.100 are now being produced. Other useful developments include cast-in tubeless passageways for use as hydraulic lines, special coring techniques for casting enclosed shapes, and new magnesium casting alloys.

DOW FOUNDRY offers production capacity for sand and permanent mold castings of all sizes.

A new die casting plant is now on stream at Bay City. This facility houses the most advanced magnesium die casting equipment, including cold chamber metering units which automatically feed metal to the machines and contribute to unusually high production rates. To assure close alloy composition control on both die casting plant and foundry, a direct reading spectrometer provides frequent and precise analyses of the molten metal. Similarly, X-ray equipment is also available where radiography is needed in quality control.

The Dow fabrication plant, also in Bay City, offers capacity for volume work on magnesium assemblies. Here, too, developmental work on magnesium is constantly in progress. The plant is set up to handle large or small jobs, and plenty of both. Its activities include deep drawing, bending, spinning, stamping, piercing, machining, arc and spot welding, assembly, chemical treatment and painting. This plant has pioneered many "firsts" in magnesium production, such as hot drawing, spot welding and automatic welding.

For more information about Dow's magnesium production facilities, contact the nearest Dow sales office or THE DOW METAL PRODUCTS COMPANY, Midland, Michigan, Merchandising Department 1000X2-8.

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Division of The Dow Chemical Company

rate of burning is greater than the rate of heat transfer across the grain, unburned propellant actually serves as an insulator for the case. Test engineers say that the case would be only slightly warm to the touch during a run and immediately after burnout, but will build up heat gradually after the propellant is expended. Static tests have proved that heat shielding between first and second stage motors is not critical.

Laboratory tests are conducted on each individual component as the first step in the combined systems or integrated test program. These individual tests form the basis for a "Christmas tree" or pyramid-like structure which is the framework of the test program. Combined tests are run on components in pairs with particular emphasis on their interrelation. Point of contact between the two, whether it is an electrical or mechanical connection or the structure between first and second stages is referred to as the interface. As the pairs of components are qualified in combined tests, two pairs will be subjected to combined tests and this progression continued until testing of final subassembly is reached.

Test Economics

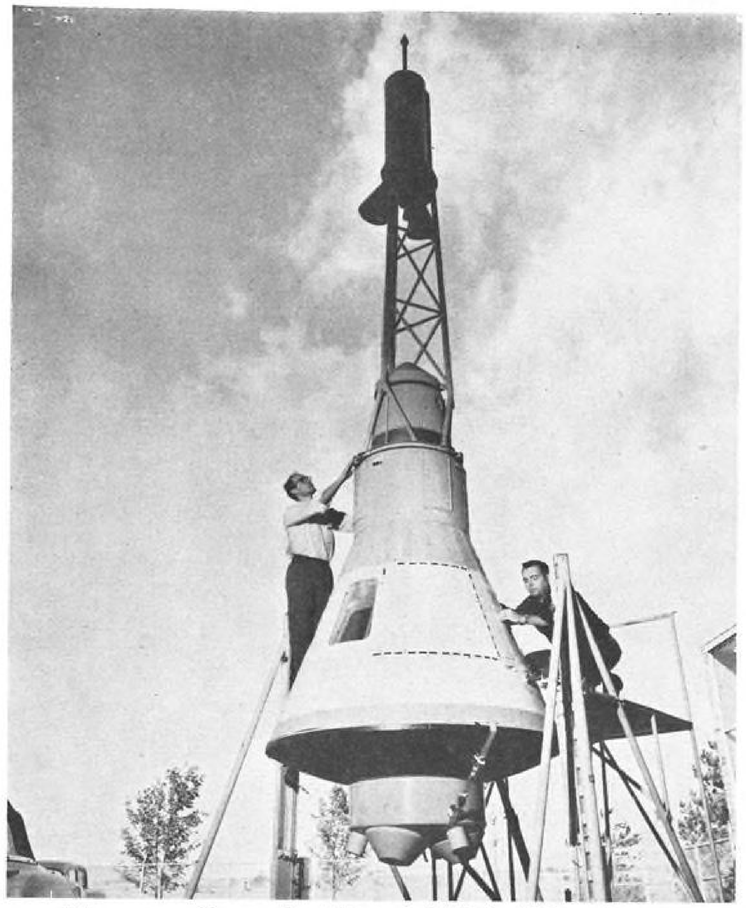
Development of test equipment for Polaris is a matter of "dollars versus necessity." Specifically tailored equipment has been developed only where none existed for conducting a needed test.

One such piece of equipment is a re-entry body test chamber capable of evacuation to a pressure equivalent to 500,000 ft. altitude and capable of maintaining temperatures ranging from −65 to 1,000F. Internal capacity of the chamber is a cube measuring four feet on each side.

Any combination of temperature and pressure can be programed onto tapes which feed information to computers for automatic control of test conditions. Dynamic load applicators also are used which permit exact load factors recorded in test vehicle flights to be programed into ground tests so that subsystems can be studied under realistic conditions. Power source for one such applicator is a 20,000 kw. amplifier.

Some tests designed originally for development purposes have proven so satisfactory that they are continued on production items as quality assurance tests.

One example is the air rifle, or popgun, test used to prove out the interlock device which prevents first stage ignition until conditions of acceleration, time and environment have been satisfied. Popgun tests simulate the acceleration and shock of the gas-operated launch from the submarine missile tube. Since the popgun test is nondestructive, with the interlock packages being caught in a net, it has been continued for routine checks of each production item.



Mercury Capsule Fitted With View Ports

Four-pane high temperature glass used in Mercury capsule view ports (AW Jan. 25, p. 23) has outer pane shaped to capsule contour. Air spaces between panes retard heat transfer. The glass was developed by Corning Glass Works.

At one time, Lockheed considered conversion of a standard fleet submarine to include at least one Polaris launching tube. Request for the test submarine was actively pursued for a time but abandoned when it was determined that the cost of such a conversion would have been too great. Navy and Lockheed decided that the funds would be more usefully applied to the operational submarine inventory.

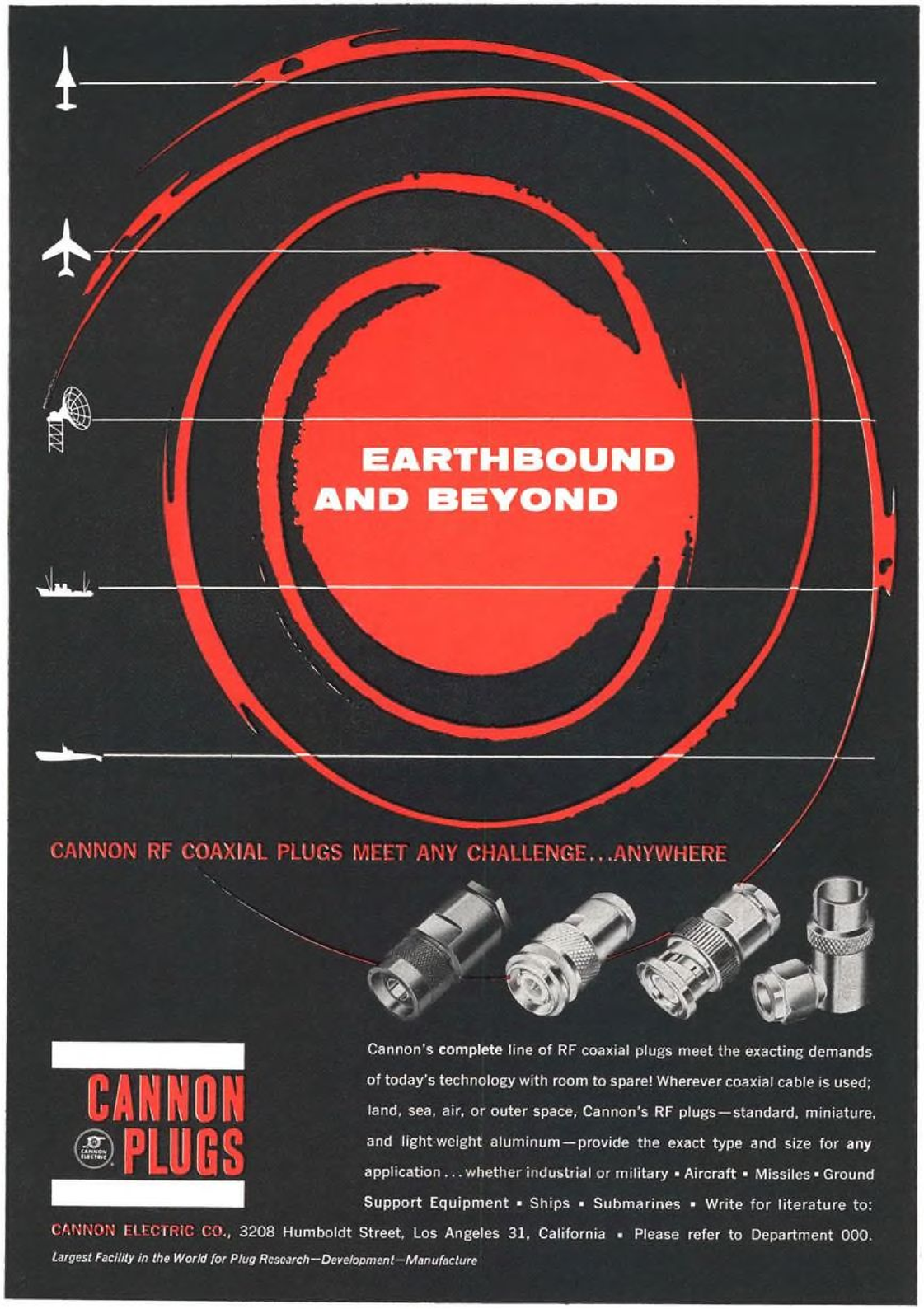
Lockheed officials credit the integrated test program with being the main factor by which the Polaris development program could be cut from five years to three. These combined systems tests have progressed at rates which allow extrapolating along the development curve to show that Polaris will become operational by the end of 1960 instead of the end of 1962.

Also under test at Lockheed is a 16,320 lb. shipping container designed to transport a fully assembled missile. Container is pressurized, heated and dehumidified, and needs only the application of external electrical power to maintain an environment suitable for the temperature-sensitive propellant. Other containers, designed to carry the missile in smaller subsections also are under development.

Practice so far has been to ship the parts for final on-site assembly at Cape Canaveral, Fla. or at the Navy Weapons Annex, Charleston, S. C., which will be the storage and issuing activity when Polaris becomes operational late this year.

For example, first and second stage motors are delivered by Aerojet complete, except for final exterior painting.

However, operational Polaris missiles will be assembled at Sunnyvale before delivery to the Navy, Lockheed says.



Allen Documents Russian Space Impact

(George V. Allen, director of the U. S. Information Agency, recently presented a broad documentation of the impact Soviet space successes have had upon U.S. allies and neutrals, the resultant loss to U.S. prestige and the "revised Soviet image" these successes have produced. In his documentation before the House Science and Astronautics Committee, Mr. Allen said that "regardless of how Americans may feel about it, the world sees the U.S. in a space race with the USSR." AVIATION WEEK is reprinting Mr. Allen's statement below because of the perspective in which it places U.S. and Soviet space achievements to date.)

. . . Our sources of information include reports from our own offices overseas and from other agencies of this government. In addition, public opinion polls and analyses are conducted by survey organizations overseas and we frequently have access to the results, just as other countries utilize the various polls taken in the United States. (You may be certain, for example, that the Soviet Embassy in Washington keeps Moscow closely informed of the results of Gallup Polls taken in the U. S. I may add, incidentally, that the Soviet Embassy will also follow with great interest the hearings of this committee.)

Response to Sputnik

The successful launching of Sputnik I created an intensity of reaction throughout the world which has rarely been paralleled by another other single discovery or invention. The public awareness of the first Sputnik was almost universal. People in remote areas of even the most remote countries knew of this sensational event within a few days.

The element of drama was, of course, pronounced. The achievement was generally regarded as opening a new era—the era of space. Most people around the world saw it as such.

Added to this drama was the element of shock. The United States had announced, as early as July 25, 1955, our own earth-satellite program, now known as Vanguard. The developments in our program had been reported from time to time in meticulous detail. On the other hand, a low-keyed Soviet announcement implied that the USSR would probably launch an earth satellite, with no statement as to when but with some details of proposed weight and orbit. The announcement received little attention in the general or even scientific press of the world.

Consequently, those who were interested in impending satellite launchings generally expected the United States to achieve the first—and perhaps the only—results.

The achievement of placing in orbit the first earth satellite, without great advance fanfare, increased the prestige of the Soviet Union tremendously and produced a corresponding loss of United States prestige, due primarily to the contrast. The Soviets were greatly exceeding world expectation of their scientific and technological capacities; we, on the other hand, were falling short of world expectation of us. An important element in underlining this contrast to the rest of the world was the reaction in the United States itself. We ourselves seemed confused, dismayed and shaken by the developments. Our own domestic debate helped make the Soviet achievement seem even more significant, and tended to put the whole matter into a framework of U.S.-USSR rivalry.

As time passed, highly colored press and radio treatment of space matters gave way to more sophisticated judgments and more balanced reactions. This welcome change was helped greatly by our successes in launching a series of satellites and obtaining information from them, though our payloads were of a lesser magnitude than those of the Soviet Union.

We also began to see editorials abroad which pointed out the difference between "American openness" in letting the world in on our failures as well as our successes and Soviet failure to announce attempts as well as achievements.

During the 18-month period following the first Sputnik, our reports showed that the United States steadily regained prestige. At the same time, the prestige that accompanied Soviet achievements also continued to increase, so our regaining of stature did not approach the commanding position that we had enjoyed before Sputnik I. Furthermore, our failure to equal Soviet accomplishment in terms the world sees as important—success in placing very large payloads in orbit—made the Soviet program even more impressive.

For a period of many months, the prevailing world opinion seemed to anticipate a kind of seesaw, with first the U. S. and then the Soviet Union accomplishing some noteworthy activity. This was accompanied by some hopeful notes that the U. S. would overtake the Soviets in payload weight, guidance accuracy, and so on.

USSR Successes, U. S. Failure

Then came the two dramatic and successful Soviet moon shots followed by the failure of our own. As a consequence of these events, the seesaw seems to have tipped solidly in the Soviet direction, in world opinion. Today, although we continue to see the hope expressed abroad that the U. S. will catch up, we also see growing doubt that this is likely during the next five or even 10 years.

Except for the most dramatic of space events, the world press now is less inclined to give startling headlines to every development. At the same time, general world interest in space has grown steadily, in both seriousness and depth of coverage—and along with this has been a surge in interest in all aspects of science and technology. Here the United States has an advantage: the vastly greater accessibility of our research, and our general willingness to share our findings with others.

These two factors help to sustain our position.

However, we now see increasing speculative stories on what the Soviet Union will do next. There seems to be a prevailing view that the first spacemen will be from the Soviet Union. We have seen wry comments, some made in America, that Americans, landing on the moon, will find Russians there. In other words, the great expectations of American achievements in space are no longer in evidence. Soviet

George V. Allen, 54, director of the U. S. Information Agency since November, 1945, had been a member of the Foreign Service for 28 years prior to his appointment, including tours as U. S. ambassador to Greece, Yugoslavia, India and Iran.

Mr. Allen, who holds a master's degree and the Charles Sumner Prize in International Relations from Harvard University, also has held the position of Assistant Secretary of State on two occasions and, during one of these tours, headed the overseas information and cultural activities of the U. S., including the Voice of America, radio broadcasts and the press, library and cultural relations work abroad.

A specialist in Near Eastern and Asian affairs, Mr. Allen attended the World War II Cairo conference between President Roosevelt and Prime Minister Churchill, the 1945 conference which wrote the U. N. Charter in San Francisco and the postwar Truman-Churchill-Stalin conference at Potsdam. He was chairman of the U. S. delegations at the UNESCO conference at Beirut in 1948 and at Paris in 1949.

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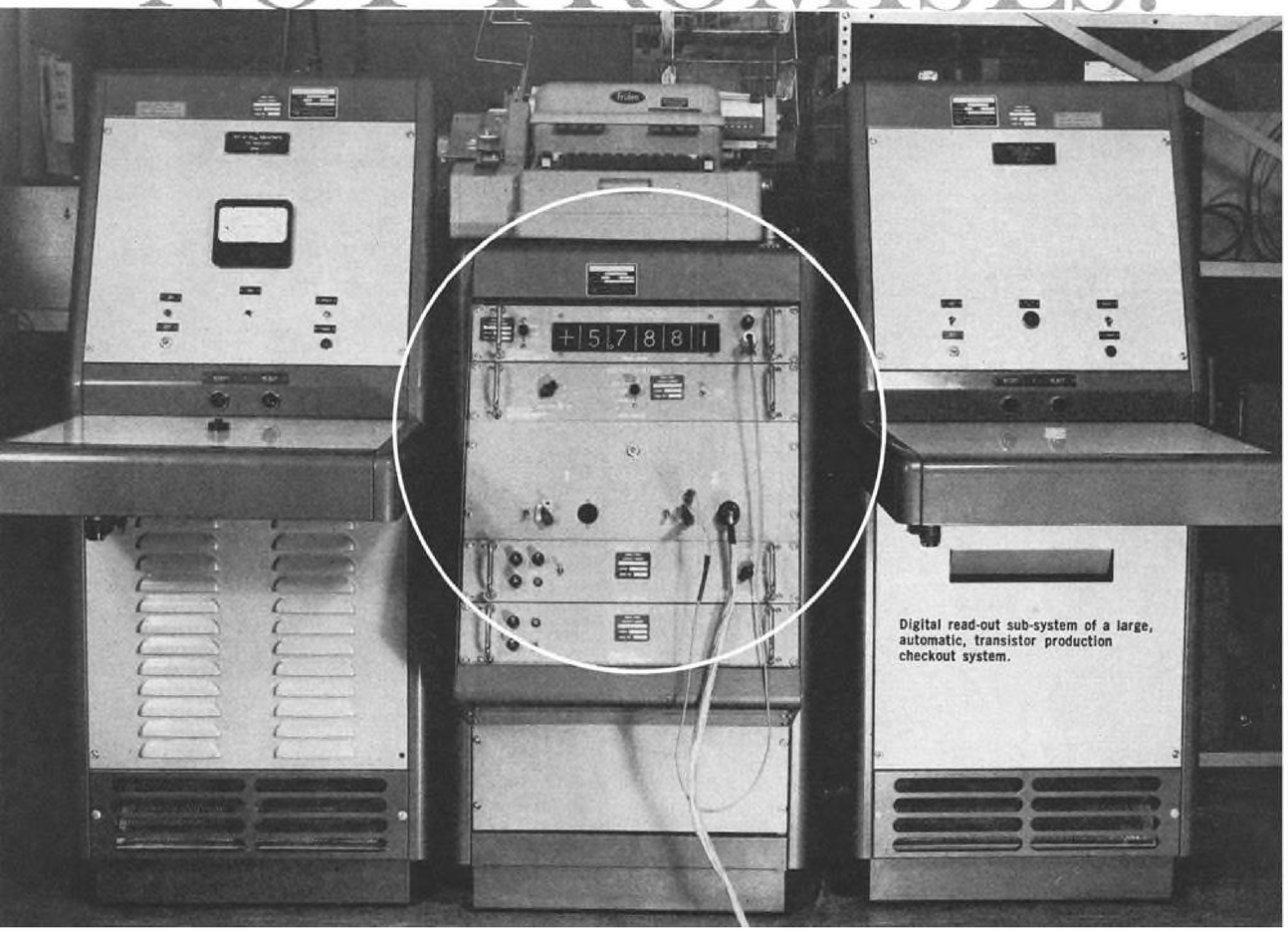

Digital read-out sub-system of a large, automatic, transistor production checkout system.

Sub-system for the ground support equipment on the B-58 **Hustler** program. Measures AC and DC single-ended voltages and ratios, and AC and DC differential voltages and transients. Chosen for its excellent operating characteristics under adverse environments.

Systems shown here are typical of more than 200 designed and built by EI and now in use. They range in complexity from data logging systems for automatic scanning, measurement and recording of data from multiple transducers... to high speed, automatic checkout systems for missile and aircraft...to systems for automating industrial processes.

Because of the EI modular design approach, many of these systems can be delivered on virtually an off-the-shelf basis, eliminating the long delivery times usually associated with system development. This approach also results in a low cost system because the modules are manufactured in large quantities. Cost is almost a linear function of performance capabilities desired.

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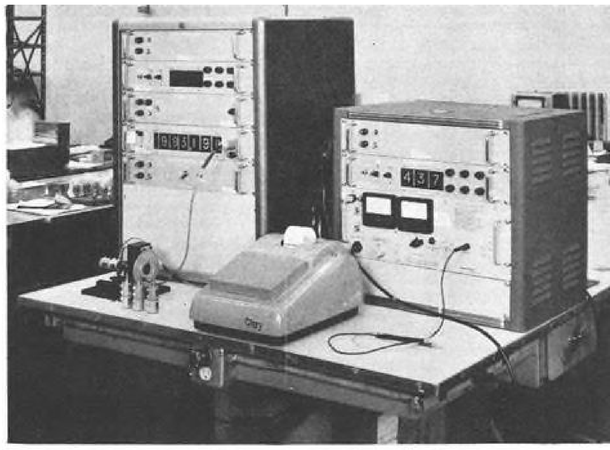
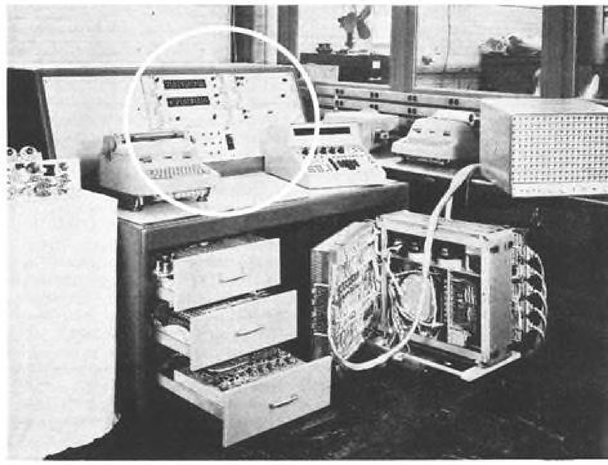


Resistance measuring system – Used as a secondary standard to make accurate, resistance measurements required for checking linearity of multi-turn potentiometers.



Multi-purpose digital measuring and recording system measures AC volts, DC volts, ohms and ratios. Prints and punches information for immediate reading by the operator and subsequent data reduction.

Resistor scanning unit – Scans large numbers of resistors, measures values from 0.1% to 0.01% and records the information on punched cards. Operation is automatic and operates entirely unattended.

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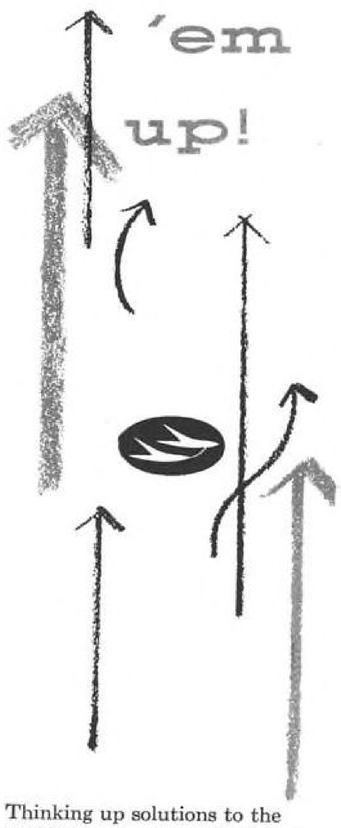

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space leadership has been widely accepted.

The implications of this acceptance are important. The world looks at both America and the Soviet Union with new eyes today.

'Revised Soviet Image'

Probably the most significant result of the Soviet successes is a change in the overall impression of the people of the world about the Soviet Union. In public opinion parlance, we speak of this as the revised Soviet image. The change goes beyond the field of space technology. It covers all of Soviet science and technology, plus Soviet military power and general standing.

Before Sputnik I, few people of the free world believed the Soviet Union was currently in a position to challenge America in the broad fields of science, technology and production. Now, the Sputniks and Lunniks are taken as evidence that the Soviet Union is able to challenge America successfully in all these fields, including even production.

It is hardly an overstatement to say that space has become for many people the primary symbol of world leadership in all areas of science and technology.

Some science and engineering students are being attracted to the Soviet Union for this reason. Soviet technological and cultural exports are getting a better reception around the world. Soviet scientists and technicans are being accorded greater prestige, are speaking with increased authority and are being listened to more attentively.

One interesting—and perhaps dangerous—effect of Soviet success in space has been the new credibility it has lent to Soviet claims in these other fields. Before Sputnik, most Soviet pronouncements of spectacular achievements were usually dismissed as propaganda. Since Sputnik, their claims have been much more often believed.

Premier Khrushchev, in a speech at Krasnoyarsk on Oct. 9, 1959, following his return from the U. S., made this statement: "The Americans now frankly admit their lag behind the Soviet Union in several most important fields. Today, for instance, I read a statement by American General Medaris, head of the chief technical and rocket administration of the United States. He says that, should the Soviet Union suspend its space program, the United States would need three to five years to catch up with us or to overtake us. This is a valuable and sensible admission."

'Principal Danger'

The principal danger in the situation seems to me to be the cockiness which these successes have engendered in Soviet officials themselves. If it were a question merely of competition in scientific achievements, no one could properly begrudge the Soviets their magnificent successes, any more than we should begrudge their economic progress. Nor should one begrudge their new-found feeling of self-confidence. Most foreigners who visited America during the first half of the nineteenth century found our self-confidence showing on every side. However, if this new-found Soviet cockiness (arrogance is not too strong a word) translates itself into adventuresomeness in foreign affairs, the world is in for a good deal of trouble.

Even though Soviet officials themselves have generally sought to present their space program as peaceful and scientific, the world public's reaction has been to read into space activities a military implication. Premier Khrushchev's statement that the USSR has now shown that it can hit any spot on the earth's surface, found an echo in an editorial in the Danish newspaper Information on Sept. 14, 1959. Commenting on the Soviet success in hitting the moon, this editorial declared, ". . . now we know . . . that an H-bomb-carrying rocket can, with precision, hit New York." . . . Berliner Morgenpost, also of Sept. 14 (said): "If we had to choose between freedom and moon rocket, we would choose freedom. However, we need not make such a choice because the U. S. will accomplish a moon shot tomorrow or the day after."

Obviously, to maintain this confidence in us, we must push forward vigorously with space exploration.

Many people of the world are showing growing concern over the potential military dangers of an unchecked space race, and there is widespread concern over the need for international agreements to assure that space will be explored for peaceful purposes only.

'U. S. in Space Race'

All space activities are now seen within the framework of Soviet-American competition. Regardless of how Americans may feel about it, the world sees the U. S. in a space race with the USSR. Recent British interest in instrumenting an earth satellite is a helpful development. More international activity in space will tend to interest more people in international control.

In summary, I should like to respond to the committee's specific question on the "importance our space program may have as a factor in international relations, world prestige and in the minds of peoples of other countries" by concluding that our space program has an importance far beyond the field of the activity itself, that it bears on almost every aspect of our relations with people of other countries and on their view of us as compared with the USSR. Our space program may be considered as a measure of our vitality and our ability to compete with a formidable rival, and as a criterion of our ability to maintain technological eminence worthy of emulation by other peoples.

Second Kiwi-A Readied for Testing

Las Vegas, Nev.—Preparation has begun for field experiments with Kiwi-A Prime, second in the Project Rover series of experimental nuclear rocket reactors.

A team of Los Alamos Scientific Laboratory experts is at the Atomic Energy Commission's Nevada Test Site here to lay the groundwork for test operations. Kiwi-A Prime experiments are scheduled to start this summer. The scientists who will actually conduct them have not yet arrived in Nevada. Heading the group will be Keith Boyer.

Kiwi-A Prime is the successor to Kiwi-A, the first rocket reactor in the

Philco has designed and built the world's largest 3-axis tracking antenna

The world's largest 3-axis tracking antenna was recently completed at the Philco Western Development Laboratories in Palo Alto. It will be used at one of the world-wide satellite tracking stations to receive vast amounts of scientific information from outer space. By employing the unique design feature of tri-axial mounting, this extremely accurate and complex instrument, designed and built by Philco, has complete flexibility of movement and can provide continuous coverage of telemetered information and data from satellites and missiles during any phase of flight.

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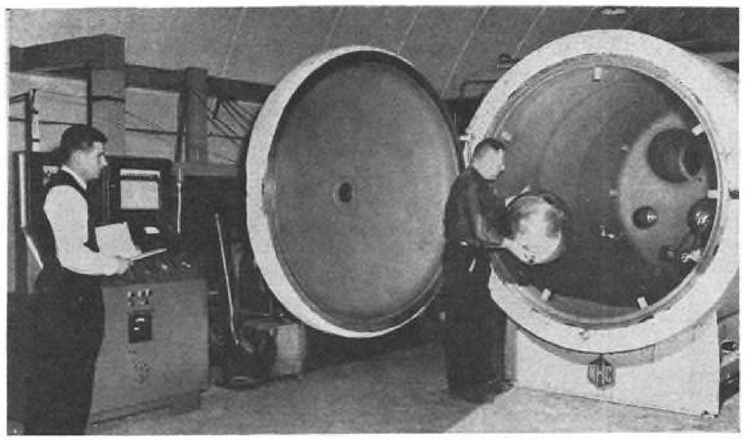
This Philco 3-axis antenna stands 80 feet high and weighs over 130 tons. One of its most unique features is the 60-foot reflector—a solid aluminum skin paraboloidal structure manufactured to a tolerance of 65/1000 of an inch over its entire surface to provide maximum reception under the most severe environmental conditions. The antenna maintains its accuracy in winds up to 60 miles per hour and its mechanical efficiency in winds up to 140 miles per hour.



Test Chamber Simulates 100-mi. Altitude

Altitude of 100 mi. is simulated in environmental test chamber at Army Signal Research and Development Laboratory, Ft. Monmouth, N. J., where altitude-sensitive parts for missiles and satellites are checked out. Satellite instrumentation is about to be tested above.

Rover series, which began research operations last summer (AW June 29, p. 28). Prime will look much like the original Kiwi-A but internal arrangements and components will be different. Los Alamos now is making fuel elements for the reactor. The shell and some of the internal components are being made by ACF Industries, Inc., at the commission's South Albuquerque Works. ACF Industries also operates the disassembly bay of the Maintenance, Assembly and Disassembly Building in the Rover Area at Jackass Flats.

Hydrogen for Kiwi-A Prime experiments will be supplied by National Aeronautics and Space Administration, cosponsor with AEC of Project Rover. The hydrogen facility will be operated under contract by Air Products, Inc. Rocketdyne is fabricating the nozzle, as it did for the earlier reactor. Edgerton, Germeshausen and Grier, Inc., will continue to provide and operate instrumentation.

COSPAR Plan for Advance Data On Space Launches Has Loopholes

Nice, France—Agreements to supply advance worldwide information on future satellite and space probe launchings remain vague after meetings here of COSPAR's working group on data and coordination.

Member countries of the Committee on Space Research of the International Council of Scientific Unions agreed such launchings should be announced "within hours" after a successful shot, but left loopholes in any commitments to supply pre-launch information.

One of these: future satellite launchings need not be announced in advance unless "in the judgment of a launching nation" there are significant changes in transmission frequencies, orbital elements or other characteristics.

Communication system for future notice of firings will be in the Spacewarn network, comprising four Satellite Regional Warning Centers (SRWC) in Darmstadt, Germany (Code: Ionosphere), Moscow, USSR (Code: Cosmos), Tokyo, Japan (Code: Kokobunji) and Washington, D. C. (Code: Agiwarn). For some time to come, such data will originate either in Russia or in the U.S., go first to either Cosmos or Agiwarn and then be circulated to the other centers.

Spacewarn also should be used for announcement of successful launchings after the firings and for distributing satellite orbital elements periodically and on a current basis during the useful life of the experiment, the group recommended.

But for the space probes, COSPAR has suggested that the launching group make private arrangements with the specialized stations capable of acquisition and tracking of the probes so that the acquisition data can be transmitted rapidly. This provides another loophole, according to some observers, because any country can claim that only its own tracking facilities can really handle the acquisition.

While much progress was made by COSPAR during its working sessions that paralleled the First International Space Symposium here, the committee suffers from the problems that plague any international organization without teeth.

Such an organization can recommend procedures, but without the power to enforce them, international cooperation becomes a matter of willingness of member nations to cooperate.

One example of the problem is in the advance warning of satellite launchings. The U.S. has agreed to make pre-launch information for all future National Aeronautics and Space Administration satellite launchings available to all countries in COSPAR. But the Russians have not agreed to publicize their shots in advance. Soviets say there is no need to do so because orbital inclinations and transmission characteristics of their various Sputniks have remained unchanged.

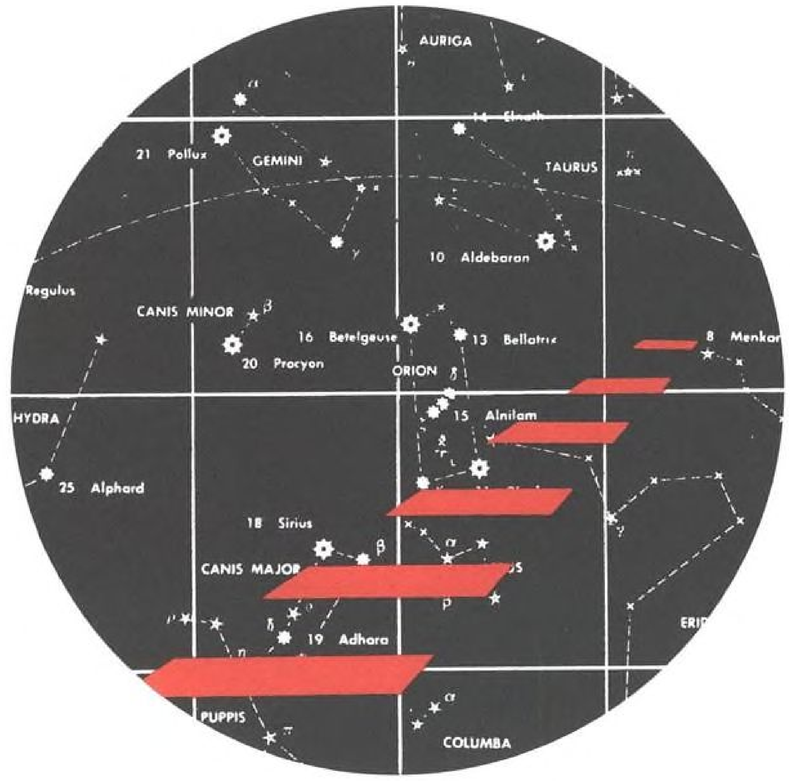
This is true so far as it goes, but it should be noted that there are generally six accepted orbital elements which define the position of a satellite. For the Russian Sputniks, only one of these six—the orbital inclination—remained essentially constant.

The Russians earlier made a formal complaint through their Academy of Sciences that no orbital data on the American Discoverer satellites was made available to Soviet scientists, who were especially interested in polar orbits. But U.S. scientists answered the protest by emphasizing that Discoverer shots were under the Department of Defense and were not part of the experiments made during the IGY and IGC program.

Observers at the COSPAR meeting pointed out that Russian announcement of possible future impact areas in the Pacific was made before that country had accepted, by its presence at the symposium here, the basic concept of COSPAR as an international agency for cooperation in space science. These observers still wondered whether that announcement was made as part of a genuine desire to cooperate or as part of the long-term psychological warfare program that has gone hand-in-hand with Russian space achievements.

Third X-15 Flight-Test Checks Skid Landing Gear

First powered flight of the No. 3 North American X-15 research plane took the plane to an altitude of about 65,000 ft. and speeds in excess of 1,600 mph. Prime flight purpose was to check out the skid-type landing gear, which functioned normally in a 200 mph. touchdown. Design mission now has been tentatively fixed at 250,000 ft. The aircraft will have a speed capability of about 4,500 mph., observers close to the project believe.



kollsman

From inner marker to outer space

"What's my Kollsman number?"

Ask any veteran pilot. As he approached the field for a landing, he would radio the control tower—as a matter of habit—for his "Kollsman number." Then, as a matter of course, he would make the correct setting on the Kollsman altimeter in front of him.

Ever since the Lindbergh era, the flying world has known Kollsman. And Kollsman knows the flying world. Today, there is a Kollsman instrument aboard almost every known aircraft. Often more than one. Usually a complete system.

From the first sensitive altimeter designed and manufactured by Kollsman back in 1928 to the Kollsman Integrated Flight Instrument System of today, Kollsman has led aviation's rapid advances in instrumentation...

For prop flight... Kollsman produces a complete line of flight monitoring and control systems ranging from true airspeed indicators and engine instruments to automatic cabin pressure controls.

For jet flight... Kollsman produces fully integrated flight, navigation, and turbine monitoring and control systems capable of coping with split-second problems... from take-off to over 100,000 feet.

For missile flight... Kollsman produces equipments from the ground up—from Ground Support Equipment to miniaturized components, instruments, and space navigation systems.

For 32 years, Kollsman craftsmanship has established a standard yet unequalled. Kollsman is synonymous with quality and precision in flight instrumentation. That's why it is said—

If it flies, it relies on Kollsman

from heavy bombers to Hound Dogs

kollsman

STAR TRACKERS

Altitude: 40,000 feet. A B-52 on a mission. Slung under each swept-back wing, waiting on streamlined pylons, are poised two deadly Hound Dog missiles.

A tiny transparent dome barely protrudes above the top skin of the bomber. Two more peep out from the forward tips of the pylons. Three eyes in all. The eyes are Kollsman astro trackers, each locked on a star.

One guides the bomber. It's a Kollsman automatic celestial navigation system. The other two will give faithful commands to the missiles, if they must be launched.

Navigation in space—This advanced automatic celestial navigation system was conceived, researched, developed, and crafted by Kollsman. It is being used in classified missile programs. The basic system is also operating aboard the B-58 Hustler, in bomb navigation systems, and in submarines.

The Kollsman automatic celestial navigation system is not just an R&D project—the system is in quantity production. Designed for today, it is proof of Kollsman's "space" capability. A very real one. For space navigation requires the ability to track sun, stars, and planets...to triangulate automatically, precisely, with high accuracy.

Kollsman systems have tomorrow's ability—today.

Truly, if you fly, you rely on Kollsman

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kollsman systems free

Mach 0.9. No time to compute true airspeed. In 6 seconds, the ship has shot forward a mile...too fast to figure.

But with KIFIS*, instrument readings are automatically corrected and computed, integrated in a familiar display. The pilot concentrates on just one function: decision making.

KIFIS is one of a generation of new flight systems.

Another advanced flight system is the new Kollsman Takeoff Monitor. Jet takeoffs involve instantaneous hairline decisions because of the jet's constant thrust characteristics and its relatively slow acceleration. From the instant he begins to roll—all the while he is roaring down the runway to gain flight speed—the pilot can check his Takeoff Monitor and know every instant the probability for a safe takeoff.

*Kollsman Integrated Flight Instrument System

FLIGHT INSTRUMENTS
- Airspeed Indicators: Standard • Sensitive • True • Mach • Maximum Allowable • Helicopter
- Altimeters: Sensitive • Drum • Counter Pointer • Cabin
- Angle of Attack Indicators and Transmitters
- Angle of Yaw Indicators and Transmitters
- Dual Altimeter and Differential Pressure Gages
- Differential Pressure Gages
- KIFIS—Kollsman Integrated Flight Instrument Systems
- Machmeters
- Takeoff Monitors
- Vertical Speed or Rate of Climb Indicators

ENGINE INSTRUMENTS
- Electric Tachometer Indicators, Generators
- Pressure Ratio Indicators and Transmitters (Thrustmeters)
- Manifold Pressure Gages
- Synchroscopes

NAVIGATION INSTRUMENTS
- Compasses: Magnetic • Astro • Direction Indicators • Sky
- Sextants: Periscopic • Handheld • Photoelectric
- Photoelectric Tracking Systems (Star Trackers)
- Computing Systems to provide data for automatic celestial navigation

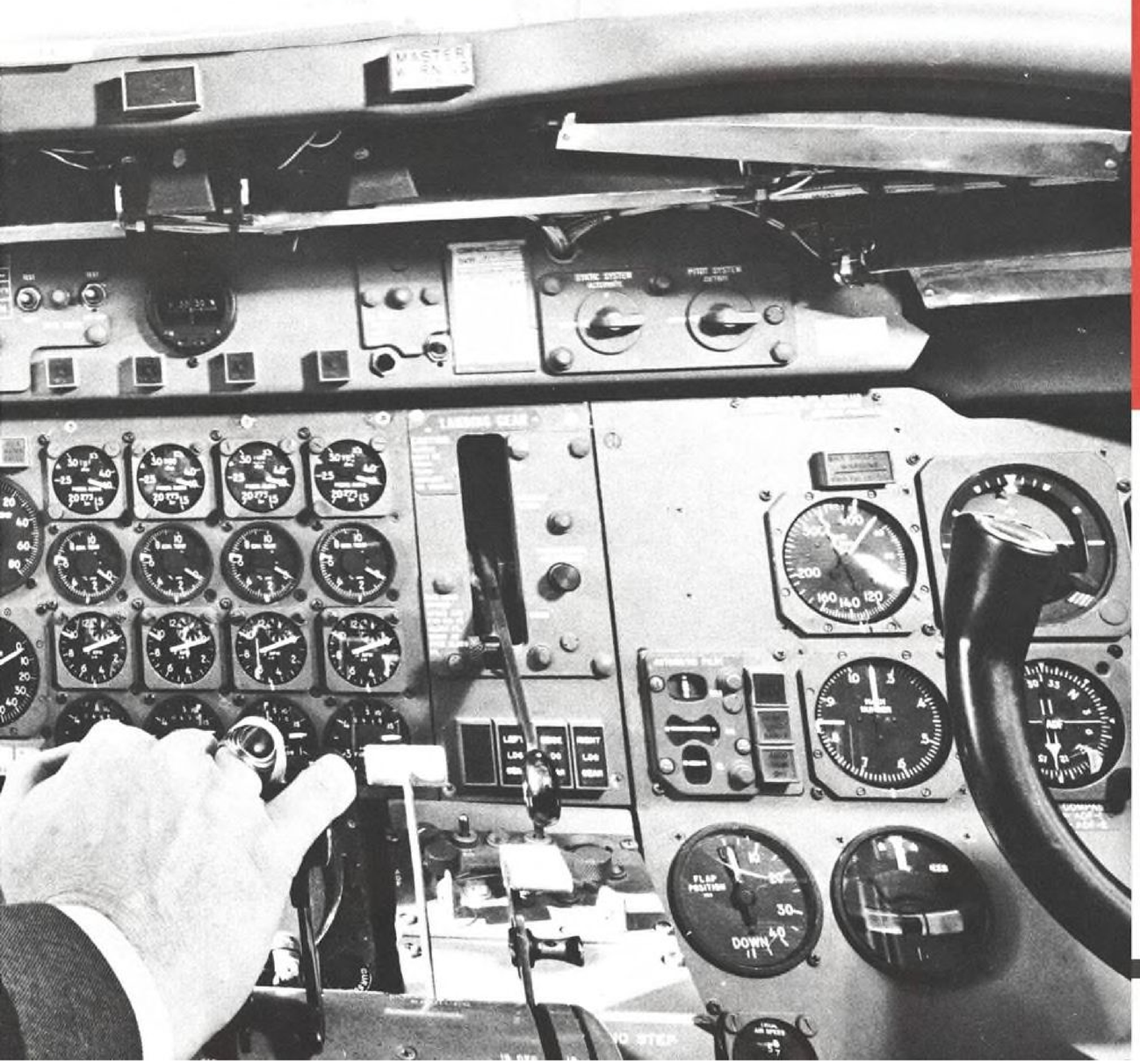
(Note—Flight and engine instruments available in different ranges, as required.)

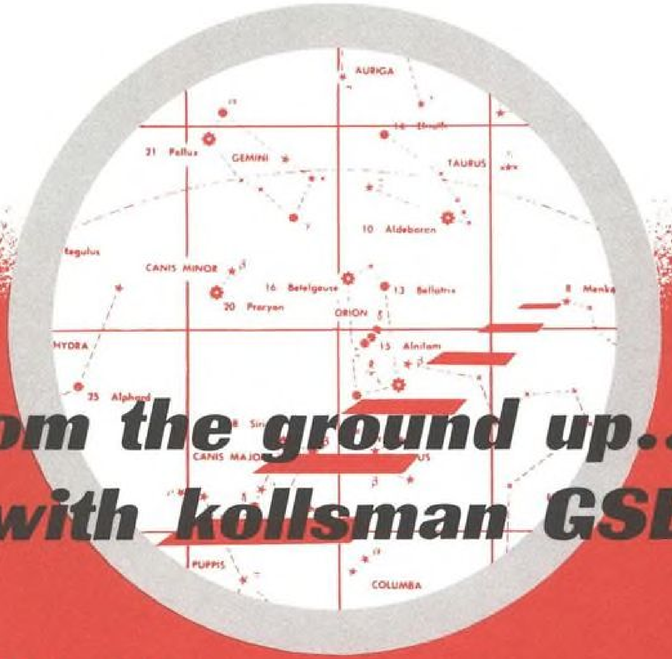
the pilot for jet flight decisions

Both KIFIS and the Takeoff Monitor show distinct Kollsman capabilities for space. In space, the pilot must be able to anticipate where he will be—and what will happen—30 seconds from now. The future must be brought into the present. At missile or manned vehicle speeds, he must take into account the 150 miles that leap by as he looks . . . as he thinks . . . as his finger reaches out and flicks a switch.

You can count on Kollsman to provide this space flight instrument system.

Truly, if you fly, you will always rely on Kollsman





Support from the ground up... with kollsman GSE

Kollsman began making "Ground Support Equipment" three decades ago. Sophisticated equipment for its day, it was not called such, perhaps. Terminology may change, but not the mission. Today, Kollsman offers the most comprehensive GSE capability available—anywhere.

Whether the Ground Support Equipment is for our own products, or for sophisticated space and missile programs, Kollsman has demonstrated its capability. Whether exacting specifications demand unusual electronic, mechanical, electromechanical, or optical know-how—Kollsman assures imaginative development engineering, uncompromising craftsmanship, and proved production techniques.

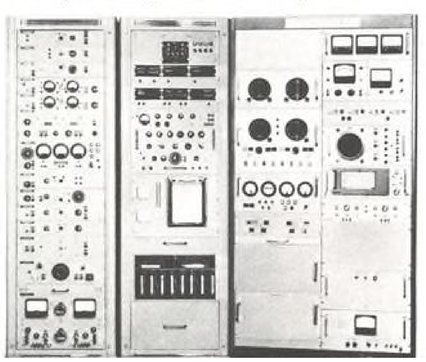
From contact to countdown

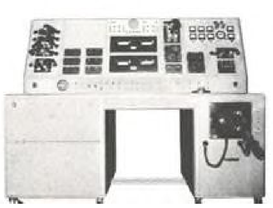
Kollsman provides reliable systems backed by a complete service. From simple flight line go—no go testers to room-filling multi-variable check out systems, Kollsman assures user confidence.

Kollsman has produced a full range of GSE representing matured applications of State of the Art techniques in electronics, optics, electromechanics, pneumatics—to name a few. These equipments are in reality complete systems laboratories triggered into action at the flip of a switch. Laboratory-precise results are presented unambiguously in analog or digital form.

Kollsman GSE does not end with delivery of hardware alone. Field service teams provide classroom instruction and supervise instructor, technician, and mechanic training. These teams are available whenever—and practically wherever—required.

If it flies, it relies on Kollsman





32 years of experience . . . unequalled craftsmanship spell unchallenged leadership in the design and production of precision flight instruments, automatic celestial navigation, electromechanical, and avionic systems for the aviation industry.

There's a Kollsman instrument aboard almost every known aircraft. Proof of dependability. Proof of craftsmanship. Proof of acceptance in a field which can't tinker with chance. Kollsman engineering and manufacturing complexes produce precision instruments, flight systems, missile modules, and ground support equipments of unmatched excellence. Kollsman leads the world in automatic celestial navigation systems. More than three decades of Kollsman specialization serve as a springboard to the stars.

If it flies it relies on kollsman

Astro trackers
Automatic astro compass
Air data computers
Electromechanical systems
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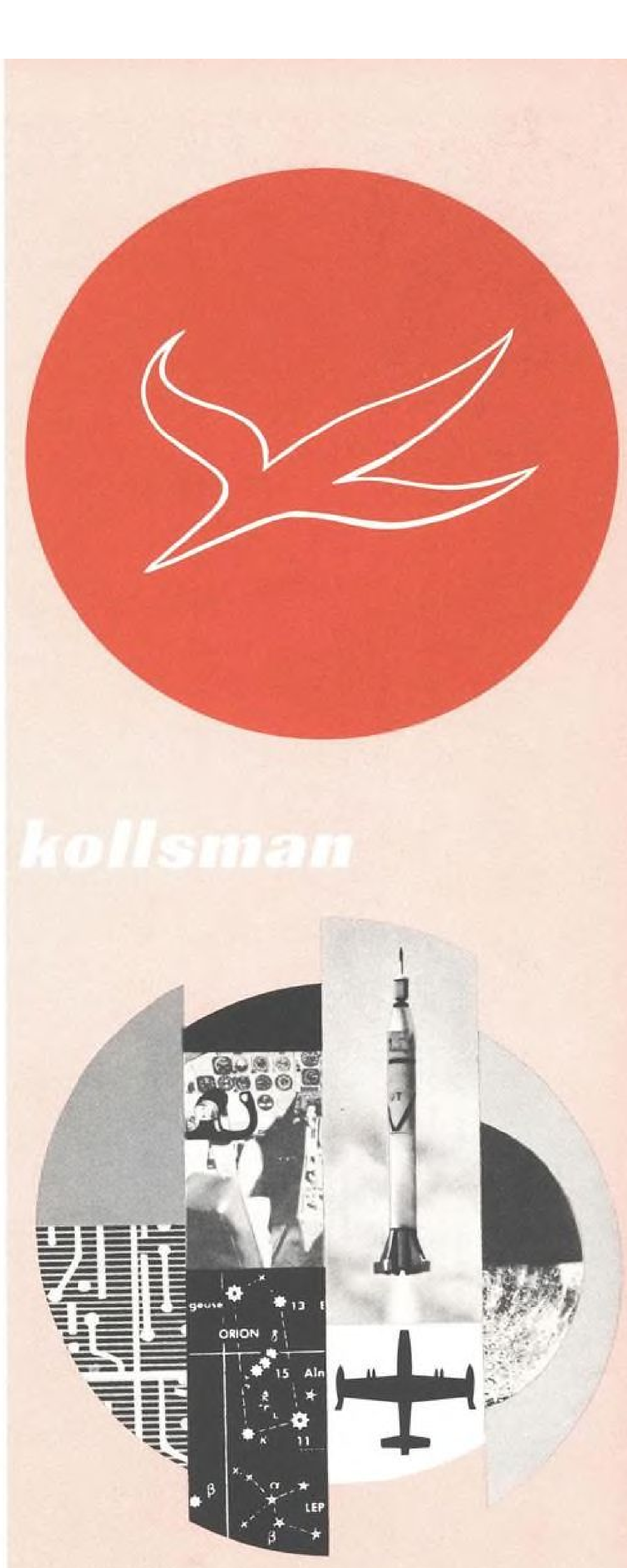
Jet engine instruments
Flight instruments
Kollsman Integrated Flight Instrument System
Optical systems & components
Doppler computation systems
Sextants (periscopic—handheld—photoelectric)
Pressure-sensitive controls
Flight simulator instruments
Laboratory test instruments

For a complete detailed list of Kollsman products, send for illustrated Product List.



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AGENA satellite test stand complex is located in heavily wooded area. Blockhouse is central control center for both stands.

Agena B to Put Samos, Midas in Orbit

Sunnyvale, Calif.—USAF-Lockheed Agena B satellite vehicle, featuring a restartable rocket engine, will be used to inject heavy payloads into large-radius orbits for Air Force's Samos photographic and Midas infrared detection advanced reconnaissance systems.

The Agena B (AW Dec. 21, p. 18), embodying an advanced Bell Hustler engine, is being tested at Lockheed Missile and Space Division in preparation for launch atop an Atlas intercontinental ballistic missile booster later this year. This was revealed at the activation of the 6549th Test Wing (Satellite) here by Lt. Gen. Bernard A. Schriever, commander, Air Research and Development Command.

Greater payloads will be orbited by the Agena B because the engine can be shut down after orbital velocity is achieved at the perigee of an elliptical orbit.

Once the vehicle has reached the orbit apogee, the engine will be restarted and the remaining thrust used to achieve a circular orbit starting at the apogee of the ellipse. This coasting technique will permit a heavier payload to be placed in a higher, circular orbit at practically no expense of energy.

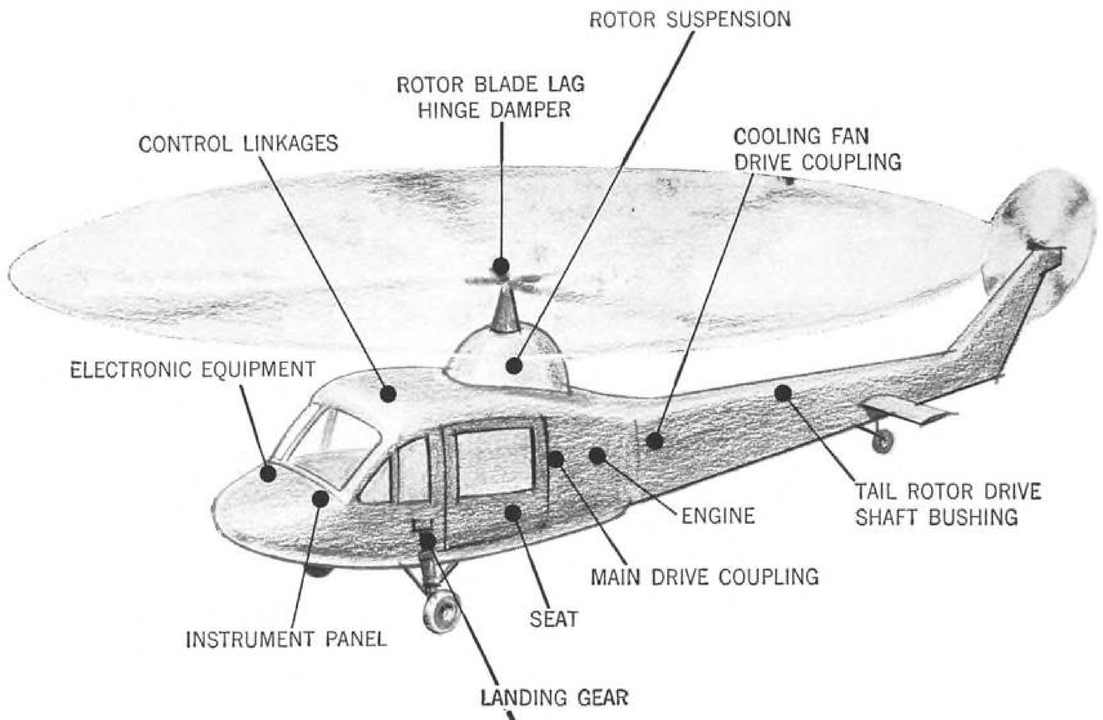
During the seventh test firing of the Agena B engine at Lockheed's nearby Santa Cruz facility, the programed 240-sec. run of the engine was terminated by the test director after 163 sec. when an engine fire broke out. A restart was not scheduled for this particular test run, but Lockheed officials say that the engine has been restarted "many times in near vacuum conditions" at the Air Force Arnold Engineering Research Center, Tullahoma, Tenn.

One of the principal reasons for the tests at Arnold Engineering Research Center was to find a combination of fuel and oxidizer that would be hypergolic at the very low pressures the vehicle would encounter in space. After a series of tests, Bell scientists came up with a liquid propellant combination believed to be unsymmetrical dimethyl hydrazine and red fuming nitric acid, that was both hypergolic at high altitudes and more powerful than propellant used in original Hustler engine.

Agena B differs from the Agena A vehicles used in Discoverer satellite orbits so far mainly because the B version has about double the fuel tankage. Added space for the increased fuel load was gained by lengthening the vehicle rather than increasing its diameter.

Agena A vehicles weigh 8,500 lb. at launch and 1,700 lb. after engine burnout. Double fuel capacity might bring the liftoff weight of Agena B to around

CONTROL center at Santa Cruz includes television displays (top) for component inspection.



critical points for *vibration/shock/noise* control

Improved flight characteristics, less noise and increased service life are major design objectives of helicopter engineers. LORD offers maximum assistance through advanced vibration/shock/noise control techniques and superior materials.

At critical points, LORD elastomeric mountings combat the undesirable effects of engine vibration, rotor disturbances, unbalance, taxiing shocks, operational noise, shaft misalignment and blade bottoming.

Close teamwork between helicopter engineers and LORD results in vital "breakthroughs" in cost, size, weight or service life. For example, an elastomeric rotor blade lag hinge damper provides improved performance with substantial savings in cost and weight.

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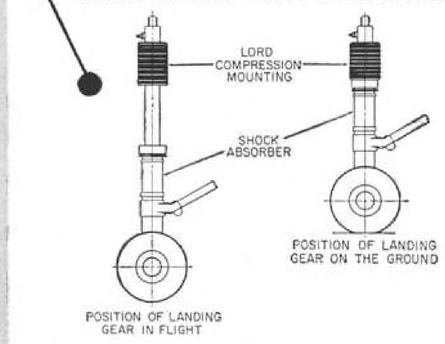

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Agena A Specifications

Following are the approximate specifications of the Agena A vehicle (engine plus payload) used in the Discoverer series. Liftoff weight so far has been a maximum of 8,500 lb. and burnout weight put into orbit has been 1,700 lb. Earlier vehicles were about 400 lb. lighter:

Agena A	Weight (pounds)
Engine	280
Tankage installation	175
Ullage control rockets	35
Pressurization system	90
Hydraulic actuators	35
Attitude and roll control	70
Auxiliary power supply	155
Telemetry and communications	128
Vehicle structure	425

Structure is magnesium with extruded magnesium ribs.

Fuel is JP-4 and inhibited red fuming nitric acid. Thrust of the Bell Hustler engine is 15,200 lb. Engine is gimbaled to maintain proper track after first stage has been exhausted and drops away. Agena A is 19 ft. in length.

Agena B has about double the fuel capacity and is longer. Agena B will carry about 13,500 lb. of fuel, bringing the weight at liftoff to about 15,000 lb.

15,000 lb. and result in an approximate increase in length from 19 ft. to 23 ft.

Schriever emphasized that both Midas and Samos are passive and not offensive systems, but "will reduce the inequality in intelligence" between what the Soviets know about the U. S. and what the U. S. knows about Russian activities. Neither system will have a strike capability against any target.

Funding for the Samos project is "adequate," Schriever declared, adding that Midas P is "in an adequate position" also, although still in the research and development phase. Midas is not being developed concurrently with Samos, he said.

Initial test capability for Midas and Samos communications already is well under way in the new Satellite Test Center. Officials pointed out that the center is an operating activity of the 6594th Test Wing (Satellite) which is an element of the Air Force Ballistic Missile Division.

The building is owned by the Air Force and is built on land donated by Lockheed. The facility will be operated jointly by the 6594th and Lockheed. Construction of a $1 million addition to the $1.2 million facility is under way, will be completed this summer.

The center (AW Oct. 5, 1959, p. 28) is a data collection and command point for Project Discoverer launches. Although referred to as a control center, the STC does not actually control the satellites while in orbit. In the case of Discoverer, data are collected from tracking and acquisition stations at Vandenberg AFB, and Pt. Mugu, Calif., Kodiak, Alaska, Kaena Point, Hawaii, and from two Navy ships, one downrange from Vandenberg and the other on-station between Alaska and Hawaii.

Actual command executions will be from either the Alaska or Hawaii stations on instructions over voice land line from the test center. Instructions for initiating recovery will come from the STC after computers in Lockheed's Palo Alto Scientific Research Center calculate the precise time for re-entry.

Dual facilities presently are installed in the center, providing the capability for handling two satellites simultaneously. Facilities for handling additional satellites will be available when the second building is completed, allowing "several" satellites to be worked at the same time.

The building contains administrative, planning, operational and communications offices. The heart of the building is the satellite control room, the satellite command post which provides a communications focal point for command surveillance and direction during launch, orbital, and recovery activities.

Control room equipment includes:

• **Consoles**—Each of the directors and controllers sits at a console which contains a closed-circuit television screen, a push-button communications panel, and speaker-receiver headset. The lower consoles have remote control over two tape recorders which record all hot-line conversations.

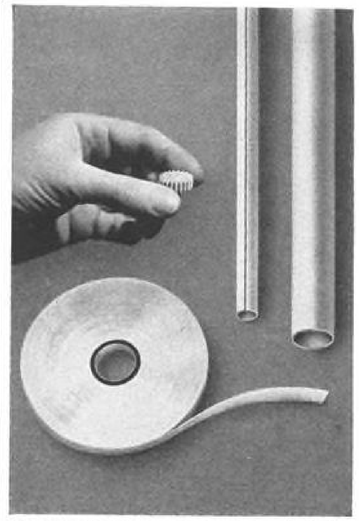
• **Television**—The closed-circuit TV screens permit surveillance of satellite and ejection capsule plotting boards, and of the incoming teletypewriter messages in the communications center.

• **Communications panels**—All consoles include a communications panel which provides push-button election of voice lines to all stations. A central assignment panel, controlled by the communications officer, can assign any combination of voice lines to any or all consoles.

• **Vu-Graphs**—Three Vu-Graph screens facing the consoles permit controllers and directors to see current weather conditions, keep up to date by the staff meteorologist, maps, plots, and other information provided by the operators in the adjacent room.

• **Clocks and timers**—Above the Vu-Graph screens are clocks which indicate the local times at all stations, an elapsed-time indicator, and a synchronized electronic system time indicator.

• **Lighting**—Lighting in the satellite control room is variable, and can be reduced to about five candlepower to alleviate eye strain for controllers and directors who participate in the 24-hr. manning during certain phases.



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For component miniaturization, THINK "TEFLON" from R/M

One way to smaller electrical conductors and other high-heat components, as you know, is through "Teflon"* insulation. In fact, there's just no substitute for the fluorocarbons in many critical applications.

It will pay you to call on the experience of R/M in processing "Teflon" into rods, sheets, tubes, tape, bondable "Teflon," and machined aircraft parts. R/M offers *complete "Teflon" service* backed by unmatched "Teflon" know-how. When you think "Teflon," remember the facilities of R/M to produce and deliver in production quantities to your specifications.

Call your nearest R/M district office (listed below) for further information on R/M "Teflon" service. Or write Plastic Products Division, Raybestos-Manhattan, Inc., Manheim, Pa.

*Du Pont trademark for its TFE-fluorocarbon resin

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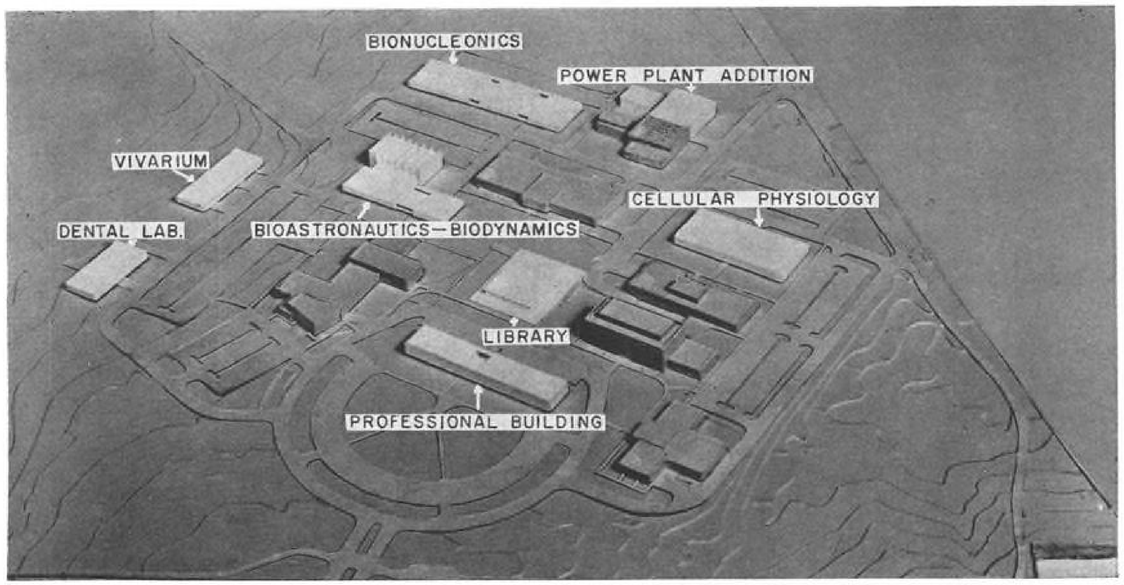

EXPANSION program for USAF Aerospace Medical Center's School of Aviation Medicine at Brooks AFB, Tex., would more than double present facilities. New buildings are shown on this model, along with existing facilities. Facilities costing some $12 million would permit sophisticated studies of the effects of space environments on humans and animals.

Medical Center Broadens Space Studies

San Antonio, Tex.—Expansion program, more than doubling present facilities, is blueprinted for USAF Aerospace Medical Center at the School of Aviation Medicine (SAM) toward a goal of ensuring that U. S. astronauts and weapon crews will be able to survive and function in the strange new environments of space (AW Feb. 1, p. 68).

The plan will cost some $12 million in new construction and is designed to provide needed capabilities fitting the school's mission, the importance of which was emphasized when late last year aerospace medical facilities were elevated to the status of an Air Force Center. The school commandant, Maj. Gen. Otis O. Benson, Jr., commands both the school and the new center.

Future Funding

The $12 million in funds necessary to erect planned additional facilities here at Brooks AFB have been authorized by Congress, but just failed becoming an appropriation because of Congressional adjournment in the last session before it could be approved, Gen. Benson noted. He noted that during a recent visit to the school Sen. Lyndon B. Johnson (D-Tex.) and Rep. Paul J. Kilday (D-Tex.) both pledged that they would make special efforts to secure the appropriation during the 1960 Congressional session.

Facilities awaiting the appropriation:

• **Bioastronautics-Biodynamics** Laboratory, which will house a pilot's centrifuge having a 40-ft. diameter arm, plus a small simpler animal centrifuge, both having a capability of developing 20g forces to provide detailed experiments on acceleration forces that may be encountered in aerospace travel. High-vacuum chambers, smaller internal capsules and other equipment for space-equivalent studies will be provided here.

• **Bionucleonics Laboratory,** which along with the Bioastronautics Laboratory, is considered by Col. John E. Pickering, director of medical research at the School of Aviation Medicine, to be the two top-priority items in the expansion program. Bionucleonics facility will be capable of housing potential hazardous materials or processes with elaborate safeguards for researchers and subjects and the community for much-needed study of radiation hazards in the aerospace regime. A nuclear laboratory would contain a neutron generator and radio-chemical laboratories, a biological laboratory for study of bacteria, viruses and other potentially infectious agents and their reactions under radiation environments, and a toxicological laboratory where research on toxic vapors, fumes, dusts and gases will be studied.

• **Cellular Physiology Laboratory** will provide facilities to develop cellular and molecular research in physical chemistry, radiobiology, biochemistry, biophysics, pharmacology, physiology and microbiology. The numerous environmental factors and stresses relating to USAF operations such as pressure, weightlessness, noise, vibration, acceleration and radiation will be studied here.

• **Vivarium Support Facility** will house a sub-human primate colony, a dog colony and other large animals used in space research; small animals will continue to be housed in the Research Institute at Brooks.

• **Professional Building** will handle aeromedical records to provide centralized receipt and processing of clinical records including electrocardiograms, audiograms and full clinical records of personnel examined by the School's Directorate of Consultive Services. Here also will be the Biometrics Services Section providing mathematical analysis of experimental data.

• **Aeromedical Library** will be designed to collect the most definitive and latest source material on flight and space travel medicine, including books and periodicals and will also provide translation services.

• **Dental Research Laboratory** will handle experimental work in these various specialties, including restorative dentistry and oral surgery. The school has been given prime responsibility for USAF's dental research program.

With the new facilities in operation, it is estimated that the school will be spending some $18 million annually in the area on payrolls and contracts and will be staffed by some 2,500 persons.

Although official figures are difficult to obtain on research budgets for the school, indications are that it has generally been provided "sympathetic" support of Congress. Annual budgets for research at the school have approximated $3.4 million in fiscal year 1960, $2.8 million in FY 1959 and $2.2 million in FY 1958, which are for actual research and do not include civilian pay.

Generally, a considerable amount of the school's research is contracted outside the Brooks facility. For example, some $2.1 million of FY 1960's research budget was contracted and in-house work received approximately $1.2 million.

Approximately half of the number of research projects initiated at the school are contracted to other organizations, such as universities.

Honeywell Develops Space Test Chamber

San Antonio—Detailed studies of aerospace medical problems that may be encountered by crews operating space weapons for extended periods will be studied in the future using the new Minneapolis-Honeywell two-man space cabin simulator installed at USAF School of Aviation Medicine, Aerospace Medical Center, Brooks AFB.

New two-man chamber, which is expected to be operational in the next few weeks, provides considerably more complex instrumentation and facilities allowing more sophisticated research than has been possible with the school's one-man chamber.

With initial capability of doubling crew members that can be "sent into space" for protracted periods, the chamber's design incorporates "stretch" permitting it to be extended in the future, and permitting further increases in the number of crews that can undergo aerospace medical research in a weapons system environment, Dr. George T. Hauty, professor of experimental psychology, told AVIATION WEEK. This modular concept will provide sufficient area for detailed research on the most efficient presentation of aerospace weapons system cabin hardware for optimum crew operation as well as development of working criteria.

Also possible, with the two-man cabin, will be communications links between the new chamber and the previous one-man chamber.

This will permit simulation of missions such as space platform support and rescue and studies of medical problems involved, he added.

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:

Norden Division, United Aircraft Corp., Milford, Conn., four ea., transmitters, engine pressure ratio, in accordance with exhibit WCLCI-2-277 dated Oct. 21, 1958, used on F-106A, F-105 and B-58 aircraft, IFB 33-600-60-73, (PR EA-9-05D-4728), $81,000.

Utica Drop Forge & Tool Division, Kelsey Hayes Co., Utica, N. Y., preparing facilities for shipment, (PR PB-9-F-9043), $143,000.

Curtiss-Wright Corp., South Bend, Ind., preparing facilities for shipment, (PR B1-O-S-9100), $400,000.

Hamilton Standard Division, United Aircraft Corp., Windsor Locks, Conn., repair and overhaul of C-130B aircraft propeller equipment, (PR PE-8-03A-3095), $30,000.

Hamilton Standard Division, United Aircraft Corp., Windsor Locks, Conn., product improvement program for type MA-11 combustion starter, for use on F-106 aircraft, (PR EA-9-03J-4937), $120,718.

Sperry Gyroscope Co. Division, Sperry-Rand Corp., Great Neck, L. I., N. Y., components of radar set AN/APN-59 and data, end use: C-133A, C-KC-135A aircraft, (PR MD-0-5841-16151), $2,210,594.

Laboratory for Electronics, Inc., Boston, Mass., engineering development for radar set AN/APN-116(XY-1) and data for unknown aircraft, (PR EC-9-16K1-4698), 0334,201.

Alexandria Division, American Machine & Foundry Co., Alexandria, Va., six ea., tachometer transmitters, high temperature, radiation resistance, data and reports, (PR EA-9-ST-4875), $44,383.

S-E-I-R, Inc., Washington, D. C., 500 hr. of IBM 709 computer time, (PR EM-0-S-6429), $195,031.

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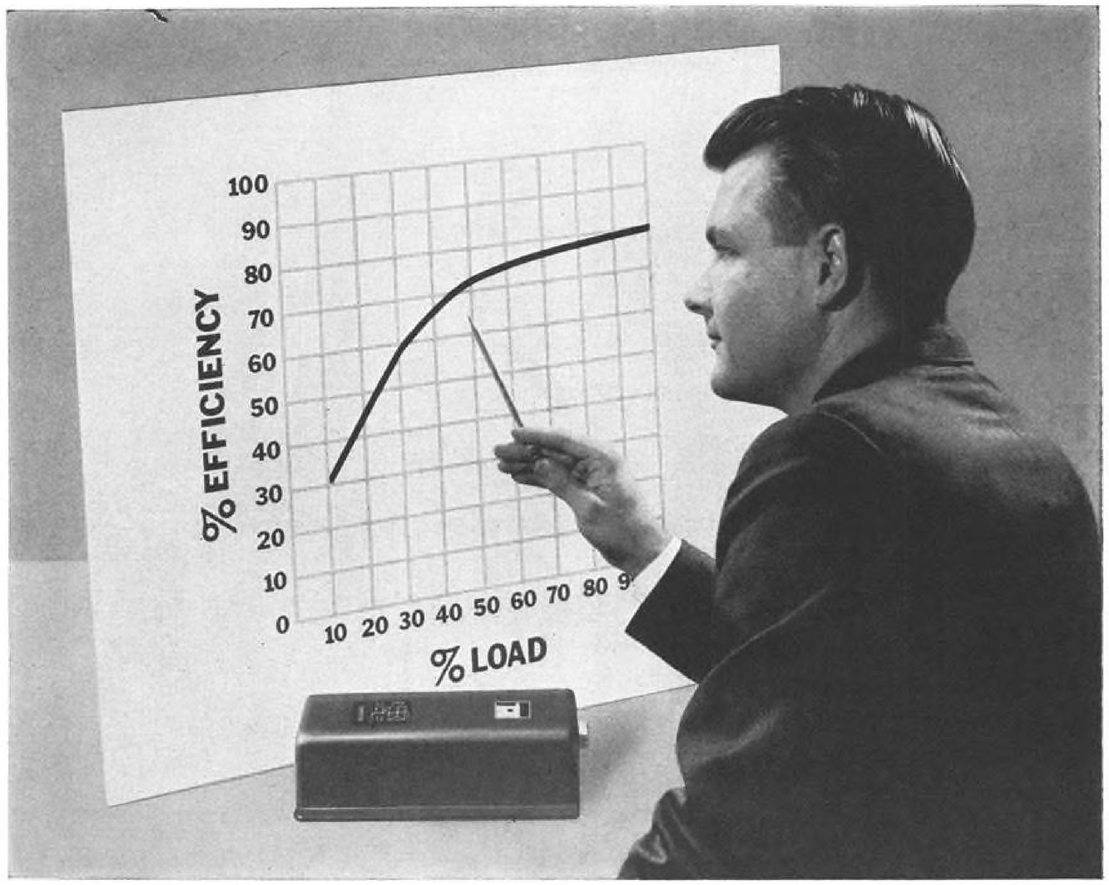

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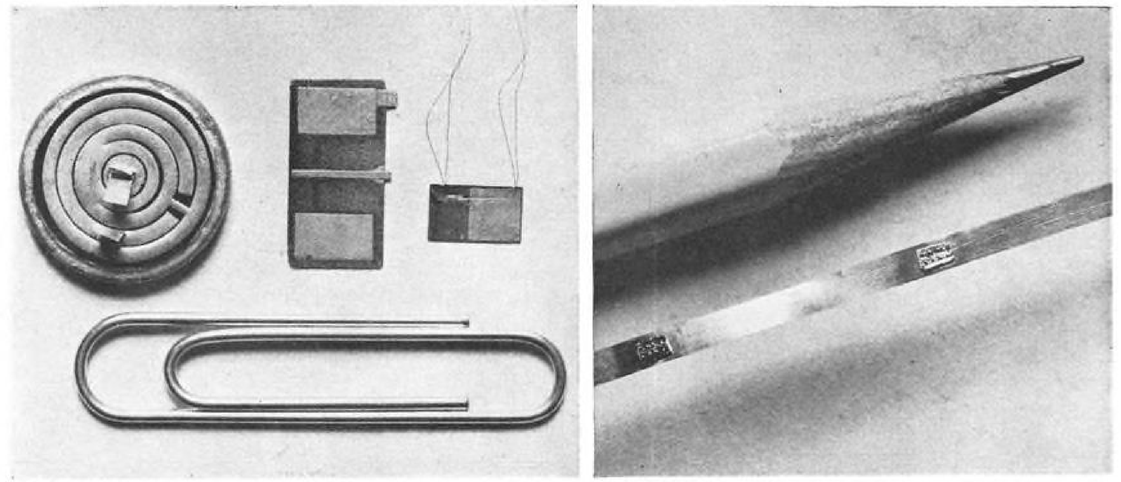


MOLECTRONIC functional elements (left photo), three of nearly 20 developed by Westinghouse Electric under USAF sponsorship, include (l. to r.) a 5-watt audio amplifier, a free-running multivibrator and a two-stage video amplifier which operates at 3 mc. Dendritic semiconductor crystal (right photo), which grows in the form of a thin ribbon, can be fabricated into a complete transistor or molectronic element while being grown or drawn into the furnace using new techniques developed by Westinghouse scientists.

Molectronic Developments Demonstrated

By Philip J. Klass

Washington—Techniques which make it possible to fabricate complex molectronic circuits and complete semiconductor devices while the semiconductor crystal is being grown have been developed by Westinghouse Electric Corp.

This was revealed during the first public progress report on the Air Force-sponsored molectronics program at which Westinghouse demonstrated nearly 20 moderately complex circuit functions which can now be performed using tiny new molectronic elements. Each consists of one or more semiconductor materials, fabricated as an integral circuit without conventional resistors, capacitors, inductors, transistors or circuit interconnections.

Westinghouse has made "remarkable progress" in the first nine months of its program, according to Col. W. S. Heavner, chief of Wright Air Development Division's Electronic Technology Laboratory.

Exceeded Expectations

Top Westinghouse officials and scientists who were extremely optimistic nine months ago, at the start of the program, privately admitted to AVIATION WEEK that progress to date has greatly exceeded their original expectations.

Details on the Air Force/Westinghouse program were first disclosed by AVIATION WEEK (Apr. 27, 1959, p. 54).

Under the $2 million Air Force contract, aimed at determining the feasibility of the molectronics concept, Westinghouse was to attempt to develop molectronic versions of eight functional circuits that are widely used in avionic equipment during the subsequent year. In only nine months, Westinghouse has come up with nearly 20 different molectronic circuit functions and the pace of development is accelerating.

'It Is Here Today'

"Molecular electronics is feasible and it is here today," Col. Heavner said. He disclosed that Air Force hopes to provide another $2 million to Westinghouse for continued molectronics effort during the coming year. AVIATION WEEK also learned that USAF has given Texas Instruments a $1 million contract to design and fabricate an entire airborne digital computer which will utilize the molectronic techniques throughout.

Westinghouse revealed that it has scored important advances in its novel dendritic process for growing semiconductor crystals which not only opens up new molectronic possibilities but which also could have a major impact on the manufacture of conventional transistors and other semiconductor devices.

Nine months ago Westinghouse disclosed that it had developed a process for growing semiconductor crystals in the form of extremely thin, narrow ribbons whose surfaces have optical flat-

Future Impact of Molectronics

Molectronics will have a big impact on companies that now manufacture conventional components and they were urged to "get on board" the new technology by Col. W. S. Heavner, Wright Air Development Center Electronic Technology Laboratory. A similar warning was sounded nearly two years ago by Aviation Week (June 2, 1958, p. 66). "Molecular circuitry may upset traditional lines of demarcation between electronic component and equipment manufacturers. Because molecular circuitry poses a direct threat to conventional parts, it is logical to expect component manufacturers to move to protect their position. However, molecular circuitry development will require much more research and know-how than many of the smaller component manufacturers now possess.

"Smaller component manufacturers also will be handicapped because molecular circuitry seeks to produce functional circuits rather than merely to reproduce existing combinations of conventional components by a new manufacturing process. Thus the developer of molecular circuitry also requires considerable knowledge of electronic circuitry and its function in the equipment in which it will be used."

ness and a mirror-like finish. This in itself eliminated the costly operations of cutting, dicing, etching and lapping normally required to reduce a large ingot of semiconductor crystals produced by conventional techniques to the tiny slices required for a transistor.

Westinghouse now has developed a new technique which enables it to carry out the diffusion, plating and evaporation steps required for transistor manufacture directly on the dendritic crystal as it grows from the furnace melt, Dr. S. W. Herwald revealed. Herwald is company vice president in charge of research.

Using this new technique, it is possible to produce a series of transistors on the long semiconductor ribbon which need only be cut off the ribbon and have their leads attached to become completed operating devices, "with a yield very near 100%," Dr. Herwald said.

Because these ribbons consist of a series of tiny amplifying elements, an amplifier of almost any desired gain can be produced by merely cutting off a strip with the required number of individual devices, Herwald indicated.

An even more recent and significant achievement, Herwald said, is the discovery of how to grow multi-zoned crystals as dendrites, directly from the furnace melt. This makes it possible to grow crystals which have at least three layers of zones and two interfaces, eliminating the need for diffusion, evaporation and plating processes for many types of devices.

'Major Event'

This new development is a "major event in the new technology of molecular electronics," Herwald said. The ability to grow multi-zoned crystals and to perform operations on the crystal at the time it is growing in the furnace opens the way to near-automatic production of semiconductor devices and molectronic circuit elements, he added.

"It is probable," Herwald said, "that we will eventually be able to grow from a pool of molten semiconductor materials some items of electronic equipment that today are of the order of complexity of radio receivers and amplifiers."

Westinghouse has fabricated a complete multivibrator element entirely by the crystal drawing process, a spokesman reported.

Demonstrated Functions

Here are some of the molectronic functional elements, developed by Westinghouse, which were demonstrated recently for representatives of the three services and the Defense Department:

- **Audio amplifier,** with output of five watts (when fitted with a heat sink) and a frequency range from zero to 20 kc. measures about ¾ in. in diameter.
- **Direct-current amplifier,** whose 40-watt output is controlled by about four milliamperes current.
- **Video amplifier,** two stage, with response essentially flat out to a frequency of about 3 mc., measures roughly ¼ x ⅜ x $\frac{1}{16}$ in.
- **Tuned amplifier,** using a semiconductor notch filter, which has a sharp frequency selectivity and a higher figure of merit than can be obtained through use of large coils in conventional circuits. Frequency of the tuned amplifier can be varied by changing applied voltage. Tuning range is far wider than the broadcast band, the company says.
- **Multivibrators** of three types were demonstrated: bi-stable, mono-stable and astable. The bi-stable type is used in computer applications; the mono-stable for delaying a signal, broading a pulse or regenerating a weak pulse; the astable is used for synchronization of radar and television receivers. Westinghouse demonstrated multivibrators capable of operating at frequencies as low as 0.1 cps. to as high as 3 mc.—the latter occupied a volume of about one-hundred-thousandth of a cubic inch. Company has fabricated a series of 12 multivibrators on a ribbon of dendritic semiconductor measuring only ¼ in. long.
- **Logic switch,** which can function as an "AND" or an "OR" switch with five input signals and five output leads.
- **Variable potentiometer,** with no moving parts, which generates a signal proportional to the product of two signal inputs. The entire device occupies a space no longer than the soldering terminal on conventional multiplier potentiometers.
- **Optical and infrared tracker,** whose output frequency varies as a direction function of the relative position of a source of radiation.
- **Sonobuoy transmitter,** using a barium titanate pressure sensor, in which the molectronic transmitter itself is about the size of the head of a kitchen match. Other molectronic circuit elements demonstrated included a modulator, oscillator, sawtooth generator, pulse generator, notch filter, infrared tracker, an analog-to-digital converter using an NPNP relaxation oscillator, and a multiple NPNP switch with a firing electrode.

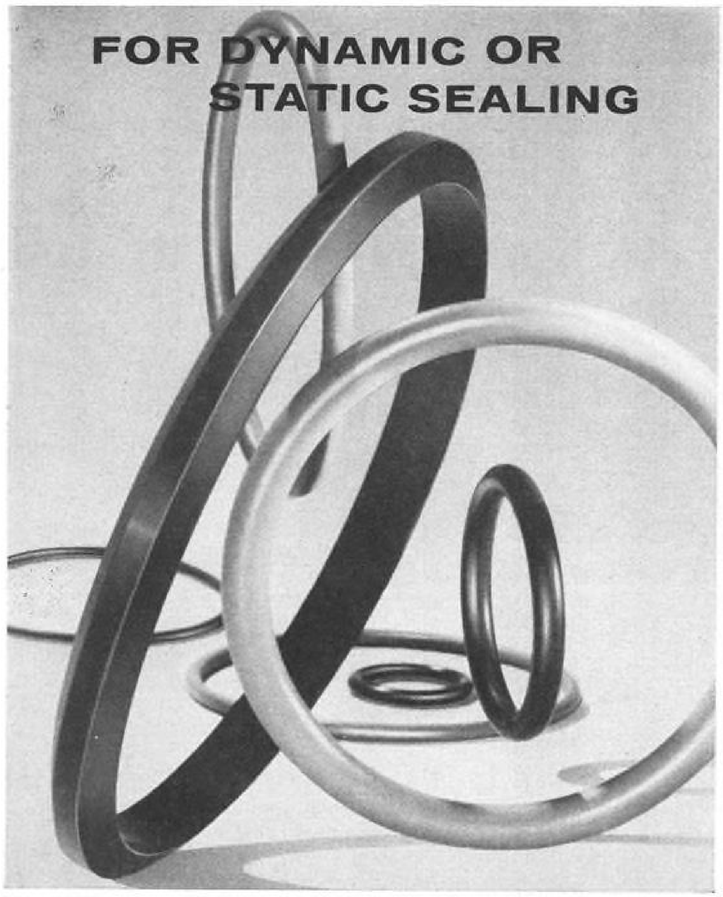
Next Step

During the next year, Westinghouse will continue to develop new molectronic ideas for performing additional circuit functions. This will include exploration of new semiconductor materials, including the three-five compounds.

Company also will devote more effort to the mating of existing circuit functions in an effort to develop a complete equipment using only molectronic techniques. One specific objective will be a very high frequency (VHF) communications receiver, or a VHF transceiver. To realize the full inherent advantages of molectronics will require that most if not all of an equipment use these techniques, Air Force and Westinghouse believe. However, Col. Heavner said USAF will encourage avionic equipment manufacturers to start applying presently available molectronic functional elements wherever feasible.

Westinghouse has been so heavily engaged in research and development that it has not yet decided whether to market these functional elements as separate devices. However, other companies that are interested in picking up such developments and marketing them will be able to obtain license rights to any techniques which were developed with Westinghouse funds, Col. Heavner believes.

Dr. Herwald predicts that in three to five years "we will see the molecular electronic concept widely applied in air/space electronic systems for such important applications as telemetering, fire control guidance, communications, countermeasures and flight control systems."



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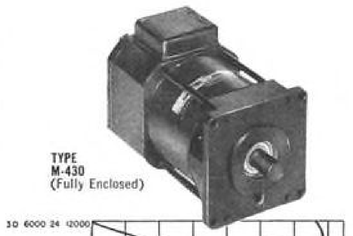
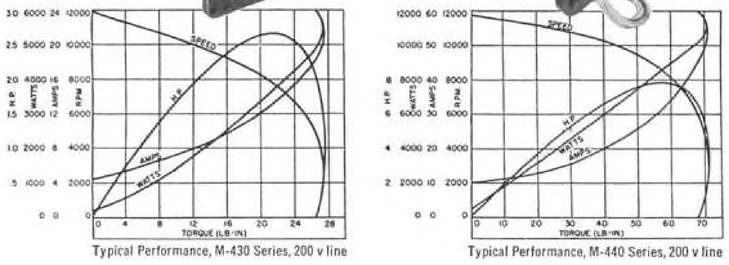
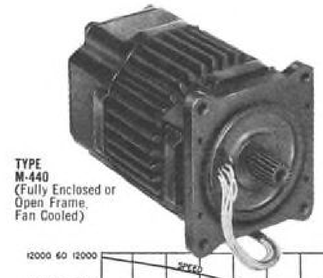




Typical Performance, M-430 Series, 200 v line



Typical Performance, M-440 Series, 200 v line

M-430 Series, 3-in. frame

Intermittent duty ratings to 1.8 hp; continuous ratings to 1.0 hp. Available with magnetic brake which will stop motors in 22 rev. from no-load speed and provide 30 in.-lb. holding torque. Model shown is a 7.5 lb. brake-equipped motor rated 1.5 hp at 10,000 rpm under a duty cycle of 0.5 min. on, 9 min. off.

M-440 Series, 4-in. frame

Intermittent duty ratings to 5 hp; continuous ratings to 2.5 hp (neither of these are absolute ceilings). Optional brake provides holding torque of 140 in.-lb., stops motors in 20-40 rev. from no-load speed. Model shown weighs 13.2 lb. with brake, is rated 4.0 hp at 10,000 rpm—1 min. on, 1 min. off.

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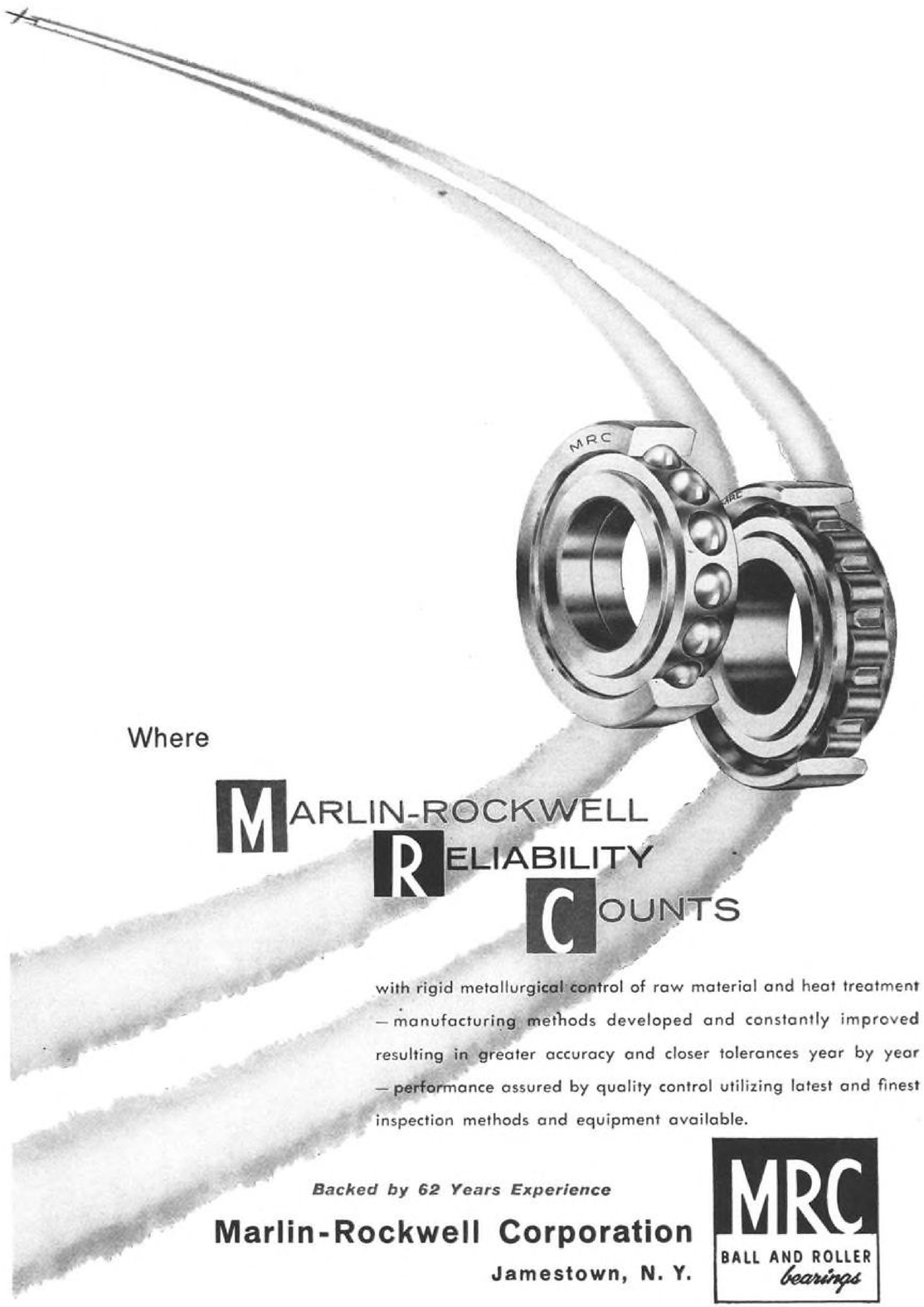


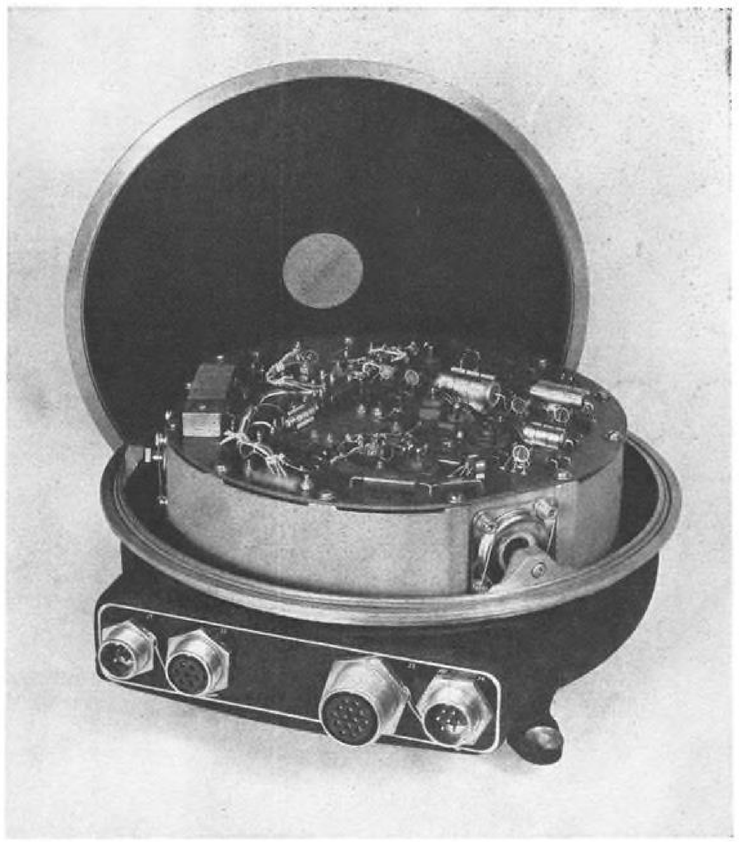
Electronic Fuel Control Tested on T56

Dallas, Tex.—An all-transistorized solid-state electronic temperature-reference control developed here by Texas Instruments, Inc., now is undergoing qualification on the Allison T56-A-10W turboprop engine scheduled for the Lockheed P3V-1 and Grumman A2F-1 patrol and attack aircraft.

A prime feature of the equipment is that it permits the turboprop powerplant to be operated closely to the engine's overheat limit for optimum efficiency in power and fuel economy. As a gage of its effectiveness, its installation on the Allison 501-D13 engine permits turbine inlet temperatures to vary only between 957C and 977C at full takeoff power, compared with a spread of 904C to 1,091C that could be experienced without such control, according to Eugene Reed, section chief, accessories section, surveillance and accessories department of Texas Instrument's Apparatus Division.

Reliability of the unit, proven in commercial operation on the 501-D13 turboprops installed in the Lockheed Electra, is indicated by the fact that it attained some 138,000 hr. usage by 11 airlines without a single airborne failure and has gone some 347,000 flying hours in service with only two substantiated airborne failures, he told AVIATION WEEK.

Fail-safe feature of the equipment provides for control to continue to be handled by the hydromechanical portion of the system directly under the pilot's jurisdiction, with the pilot flying by reference to the turbine inlet temperature indication on his gages.



ELECTRONIC fuel control package for Allison 501-D13 turboprop has circuitry designed in a modular layout for rapid removal and replacement of components.

Other Applications

Success with their entry into the electronic fuel control field has led company engineers to consider other applications of such equipment to the broad spectrum of jet, rocket and nuclear propulsion. For optimum results and considering the economics of new equipment installation, indications are that "backfit" programs are unlikely. Best promise lies in starting fresh with a new engine that has not yet reached production configuration.

Unofficially, it appears that Texas Instruments is working closely with General Electric in an electronic fuel control installation on the industrial version of the T58 axial-flow turbojet. Indications are that it has also studied systems for the Rocketdyne 1.5-million-lb.-thrust single rocket motor, which would entail providing a signal computing fuel and oxidizer ratios to provide proper mixture that would give thrust demanded by a programer—actual thrust would be compared with demand and fuel ratios varied accordingly.

Limited production of such powerplant systems evidently has caused some producers to initially consider maintaining this work in-house, but Texas Instruments apparently feels that there is a market when production quantities are achieved. The company also feels that the nuclear propulsion field offers a good market, particularly since nuclear technicians are thoroughly versed in electronic control applications.

Basically the Texas Instruments' Model 400260-3 electronic fuel control provides two operational modes, turbine inlet temperature limiting and controlling, which vary depending on the angular setting of the pilot's lever. There are two temperature limiting levels in the limit mode: 871C and 977C. The bottom end of this temperature scale is experienced during engine start and low-speed taxi. The change from low-speed taxi limiting to normal limiting at 977C occurs at 13,000 rpm. with the power level angle at 30 deg. From 30 deg. to 64 deg. power lever settings, normal turbine inlet temperature limiting occurs.

All through the limit modes, the electronic temperature-reference fuel control unit relinquishes fuel scheduling to the hydromechanical portion of the system, but remains on standby to keep engine temperatures within safety limits.

Mode Transition

At 64 deg. setting of the pilot's power level, a transition occurs from the limiting mode to the controlling mode. Throughout this latter model, the pilot selects desired power by means of the lever, with mechanical linkage transmitting his commands to the main fuel control. The main fuel control passes to the fuel metering valve fuel equal to 120% of the engine requirement.

Normally, the fuel metering valve meters 100% of the fuel requirement and bypasses the surplus which has been received from the main fuel control. The mechanical linkage, which passes pilot's power demands to the main fuel

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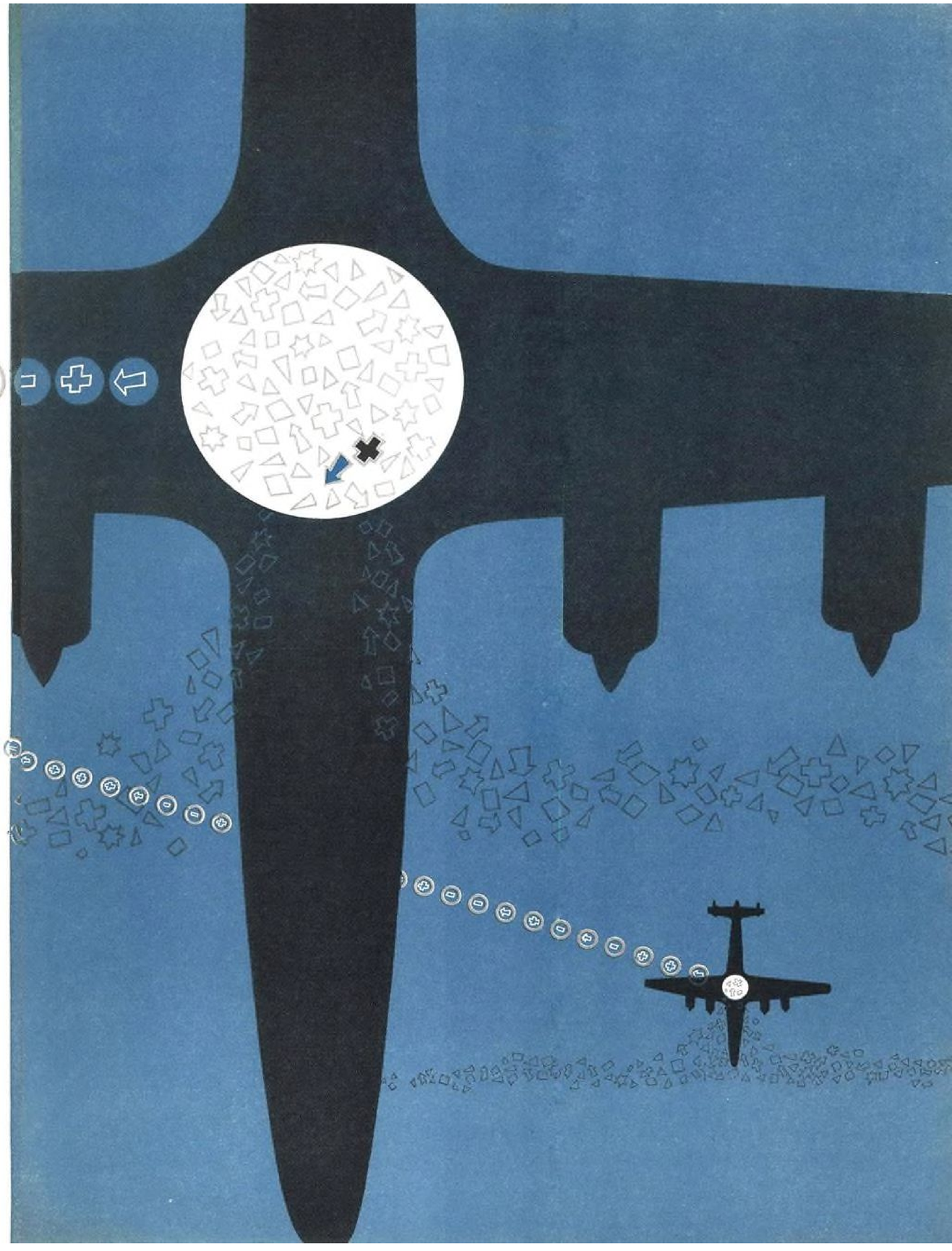

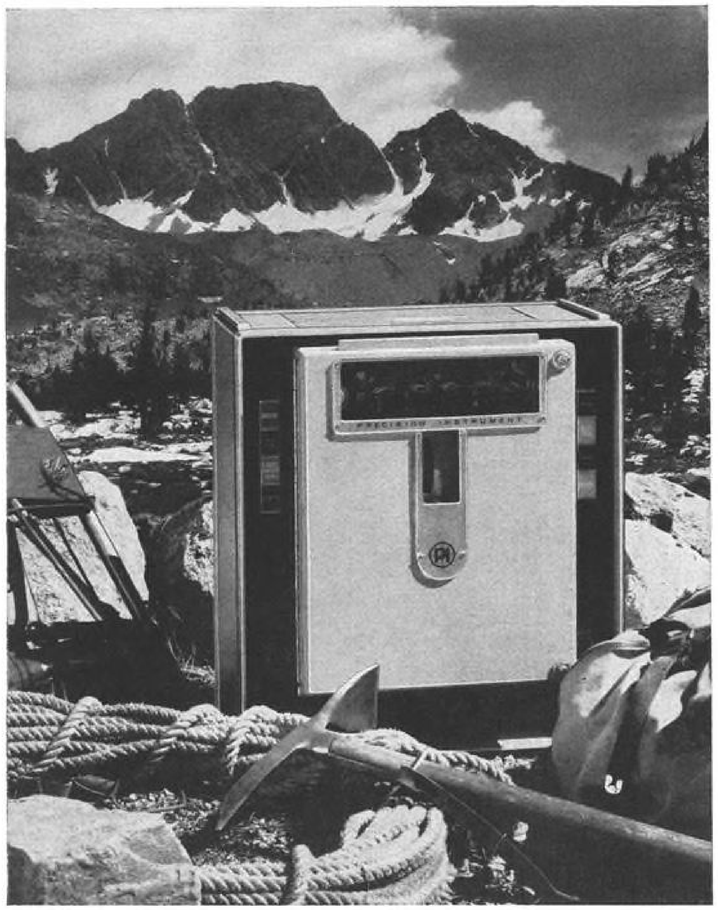

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controls, passes through an electromechanical coordinator. This coordinator integrates lever setting command with known constants and sends a desired temperature signal to the electronic fuel control unit.

In the unit, desired temperature signal is compared with the actual turbine inlet temperature signal, received from thermocouples at the inlet. After comparison, a correction signal is sent to the metering valve, increasing or decreasing fuel flow through the fuel metering valve to the engine to reestablish temperature balance.

Detailed view of the operation indicates that the electronic control operates in conjunction with the coordinator potentiometer, engine relay box, a set of 18 chrome-alumel thermocouples and the temperature datum valve, maintaining selected turbine inlet temperatures in the flight range of engine operation and limiting maximum temperatures throughout the operating range.

Bypass Device

The temperature datum valve, operated by the electronic temperature datum control, is utilized as a bypassing device in the engine fuel system, with the datum valve located between the main fuel control and the engine fuel manifold. The datum valve has a null position, at which point a fixed percentage of main fuel control output is bypassed back to the engine fuel pumps. The datum valve is at null when the engine is operating "on-temperature," and no signal is supplied from the electronic control to a two-phase motor in the datum valve.

Electronic control response to a turbine inlet over-temperature causes the datum valve to bypass a greater amount of fuel to reduce turbine inlet temperature to a preselected value. This reduction, in event of over-temperature, occurs when the electronic control is aligned for either the limiting or controlling operation.

For controlling operation, electronic control response to a turbine inlet under-temperature causes the datum valve to bypass less fuel, increasing engine fuel flow and turbine inlet temperature, In the limiting mode, electronic control response to an under-temperature will not provide a signal large enough to cause the datum valve motor to make a temperature/fuel flow correction, although engine fuel flow and turbine inlet temperature will be increased slightly if the fuel flow through the datum valve has previously been corrected to relieve over-temperature.

A small signal from the electronic control will aid datum valve return to its null position, against normal hysteresis, from the reduced fuel position, resulting in a corresponding slight increase in fuel flow and temperature.

During engine start and operation up to stabilizing speed, only temperature limiting circuitry within the electronic control is operative. If turbine inlet temperature exceeds a preselected value, electronic control action causes the temperature datum valve to reduce engine fuel flow to relieve over-temperature.

In the 65-90-deg. normal flight range power lever travel, temperature controlling circuitry is operative, electronic control action causing the temperature datum valve to trim engine fuel flow to maintain turbine inlet temperature scheduled by the power lever for an increase or decrease of fuel flow.

During landing, a manual switch returns the electronic control to limiting action from the normal flight temperature controlling action. A 24-v. circuit to the solenoid-operated brake on the datum valve motor shaft is re-energized to engage the brake. The brake then locks the datum valve in its operating position at the time the switch was closed. If engine over-temperature develops, electronic control causes the solenoid brake to release and the same over-temperature signal that caused this action causes the datum valve to reduce fuel flow to reduce temperature.

Limit Functions

The electronic temperature datum control consists of a thermocouple millivoltage comparison and modulation circuit, an a.c. amplification circuit, a demodulation and output circuit and a power supply. Other circuitry in the control permits switching the reference temperature for either limiting or controlling functions and permits release of the solenoid brake on the datum valve motor. The solenoid brake release action occurs only when engine circuitry has been manually switched for limiting operation and an over-temperature occurs.

In the comparison circuit, thermocouple generated voltage is compared with a reference millivoltage, the millivoltage difference or error between the two is modulated and amplified as an a.c. signal. The amplified a.c. signal is demodulated, phase discriminated and applied to control windings of a saturable reactor, which in turn controls variable phase output from the control to the datum valve motor. Electronic control circuitry is switched for either limiting or controlling operation by the m limiter selector relay in the control.

Control output is both fixed and variable-phase 400-cycle voltage supplied to a two-phase induction motor in the associated datum valve. Motor response to the variable phase voltage regulates fuel by-passing of the datum valve to regulate engine fuel supply and turbine inlet temperature. Magnitude and phase of the variable phase output voltage is set by the amount and direction that turbine inlet temperature varies from the reference temperature.

During both limiting and controlling operation, a generator located on the same shaft as the datum valve motor produces an a.c. voltage proportional to motor rotational speed. Phase of the a.c. voltages, referenced to generator excitation, is determined by the direction of motor rotation. This a.c. voltage is fed back to the electronic control to damp the error signal and reduce its amplitude as a turbine inlet temperature correction is being made. This feedback system allows high motor starting torques to meet system needs and provide stability.

Packaged Circuits

Components in the system are derated 50% of the supplier's ratings to build reliability under varied environments. Circuits are packaged in modular form to provide easy maintenance. The unit is designed to pass environmental tests including an operational temperature range of −75F to +125F, ambient pressure at 61,000-ft. altitude, operation in air containing 1.5 grams per cubic foot of sand and dust moving at 100 fpm., operation after exposure for 15 days to clean water vapor atmosphere with 95% humidity and temperature of 70F through 130F.

Also tested was operation at sustained acceleration of 10g along each of its three perpendicular axes and after 24 impact shocks of 30g each through its three axes and during vibration in frequency range of 5 to 250 cps. and at amplitudes of 0.1 in. or 5g.

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► **Organic Compound Photoconductors**—Doping films of phthalocyanine, a class of organic chemical compounds normally used as dyes, with orthochloranil increases the dark conductivity of the films by as much as 10 million times and the steady-state photoconductivity by 100,000 times. Work was performed at the University of California under contract from the Atomic Energy Commission.

► **Solar Battery Damage**—Radiation in outer space appears to damage and degrade operation of solar battery sources, according to Dr. James Van Allen. He attributes unexpectedly early fadeout of signals from paddlewheel satellite to such damage.

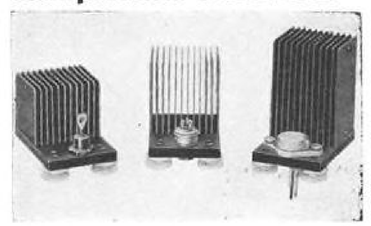
► **Optical Masers**—Race for successful operation of first optical Maser now appears narrowed to three groups—a Columbia University team under Dr. Charles H. Townes, Bell Telephone Laboratory's Drs. Ali Javan and W. R. Bennett, Jr., and a 25-man team at Technical Research Group, Inc. Next four months should be decisive.

► **Turnable K-band Amplifier**—First model of a gas cell amplifier, based on new technique involving molecular transitions in hydrocyanide, is in early stages of development at Technical Research Group, Inc., under a near-$100,000 contract from Rome Air Development Center. Initial operation aimed at V-band in millimeter range, then tailored down to device's lower-frequency end in K-band. Amplifier is not expected to have low-noise capabilities of Maser and parametric amplifier, but should operate at higher frequencies than the latter, at room temperatures and without magnets, according to RADC source.

► **High Resolution, Small Antenna Radar**—Developed by Project Michigan, airborne radar makes small antenna behave like larger one by using aircraft's forward motion, sampling, storing and correlating returns for resolved target image. System resolution is effectively independent of range. This Project Michigan work is sponsored by Army Combat Surveillance Agency.

NEW AVIONIC PRODUCTS

Components & Devices



• **Semiconductor radiators,** Types R-5010 for rectifier, R-5020 for zener diode and R-5030 for transistor as shown in this order in photo, can dissipate 5 to 100 w. with forced convection. Transistor, normally rated at 10 w. may be operated with forced convection at 30 w., firm says. Radiator series are available in copper or aluminum with surfaces machined to within 0.0002 in. flatness and screw holes provided for any transistor type. Wakefield Engineering, Inc., 11 Broadway, Wakefield, Mass.

• **Microminiature relay container,** made on steel with cadmium plate finish, consists of post which screws through one of two sockets mounting holes in standard microminiature relay socket and secures socket to chassis. Spring-loaded

SMALLEST LIGHTEST CARCINOTRONS

with wide band sole tuning

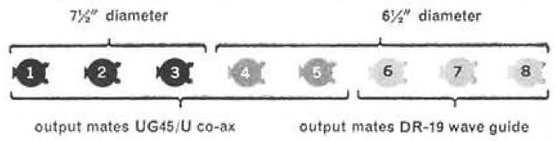
Though it has just recently made its debut into the high society of Litton microwave tubes, this carcinotron (our model L-3298) has already been commended by the military for its exceptionally clean design. Every engineer concerned with upgrading the performance of ECM equipment will surely find much of interest in this medium-power tube, with which Litton takes a major stride toward truly simultaneous noise-jamming capability by affording faster tuning rates than any previously attainable.

The Litton family of eight electrically-compatible carcinotrons is the first to incorporate the critical capability of wide band sole tuning without frequency or power holes when the tube is operated into as much as a 1.5-to-1 mismatch. Litton carcinotrons are the first to use wider-than-normal-band RF output couplers, minimizing many system components such as antennae, waveguide plumbing, and load isolators.

We cite these firsts not for glory's sake, but rather for their meaningful contribution to more efficient system design, smaller size and lighter weight.

The notable suitability of these carcinotrons is not limited to ECM. You can also consider them for other military applications such as drivers for communications links—in fact, wherever medium-power tubes with extremely rapid tuning and low tuning power are required.

Because of their mechanical and electrical compatibility the eight tubes in the family are interchangeable, as shown.



These versatile tubes are not just drawingboard products—you can order them now.

Write concerning voltage-tuned power oscillators of whatever nature to Litton Industries, Electron Tube Division, Office A9, 960 Industrial Road, San Carlos, California. Your request for our Carcinotron Catalog or for answers to your specific questions will be honored promptly.

LITTON INDUSTRIES Electron Tube Division

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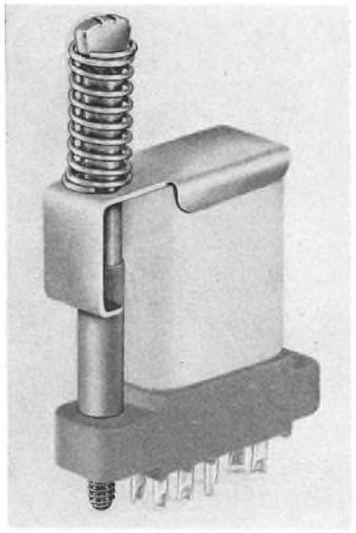
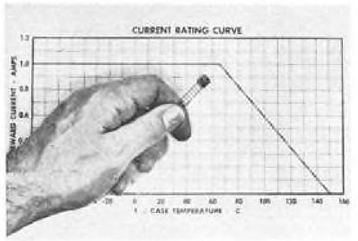


cap swings out of way for service or replacement. Container is available in five sizes with post heights ranging from 1⅛ in. to 2⅝ in. The Birtcher Corp., 4371 Valley Blvd., Los Angeles 32, Calif.

• **Silicon controlled rectifiers,** Types TI-110 through TI-114, are rated at 1 amp. from 50 to 400 v. and are packaged in JEDEC TO-5 case. The pnpn diffused silicon rectifiers provide 1 amp. outputs at 65C case temperature and average rectified forward currents

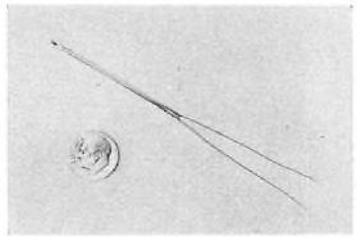


of 300 ma. at 125C case temperature with piv and min. forward breakover voltages from 50 to 400 v. Maximum required turn-on gate current is 20 ma. with max. holding current of 25 ma. and max. leakage at piv of 1 ma. Texas Instruments, Inc., P. O. Box 312, Dallas, Tex.

• **Low-level multicoders,** SL series, can sample up to 88 low-level differential data inputs and are available in single speed or multiple speed models capable of providing all standard IRIG signals. Separate outputs are provided for standard PAM signal with master pulse, standard PDM, and differentiated PDM output. Accuracy is said to be ½% or signals of 10 mv. amplitude full scale. Units measure 4 in. x 4 in. x 7 in., weigh 6 lb., draw less than 5 w. from 28 v.d.c. source, and use silicon devices throughout. General Devices, Inc., Box 253, Princeton, N. J.

• **Precision potentiometers,** TP series, are single-turn, rotary, wirewound types designed for durable and reliable operation under severe environments, with built-in torque device to hold the shaft in position under shock or vibration. Stops can withstand 8 in.-lb. torque. TP series range in size from ½ in. subminiature to 2 in. diameter. Technology Instrument Corp., Main St., Acton, Mass.

• **Thermistor,** Type O5A8, hermetically sealed in glass probe, offers 100,000 ohms resistance plus or minus 50% at liquid nitrogen temperatures (approxi-



mately 77K). Time constant of device is less than 1 sec. and temperature coefficient is minus 20%/degree K both referred to liquid nitrogen temperatures.

Instruments

• **Secondary time standard,** WWV-1, is portable, battery-powered time standard accurate to 16 sec. a year and used to control telemetered transmitters and recording instruments. Device is transistorized, measures 7 x 11 x 7 in. in handle-borne case, weighs 9 lb. complete with two batteries which will operate for several months before need for replacement, according to firm, Zenith Radio Corp., 6001 W. Dickens Ave., Chicago 39, Ill.

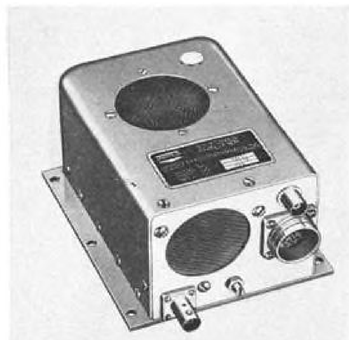
• **Paper-to-magnetic tape** converter, Model D104, can convert punched paper tape produced by teletype transceivers to magnetic tape or vice versa. Paper tape data is introduced into the

D104 by a photoelectric reader operating at 300 characters per second and magnetic tape can be read or prepared in form compatible with computer it is to feed, according to the firm. Converter will delete from translation onto tape typing errors, extraneous notes, and sign-off messages. Digitronics Corp., Albertson Ave., Albertson, N. Y.

• **Oscilloscope,** Type 425, features direct digital reading system and can be used over frequency range from d.c. to 60 mc. (down 3 db. at 35 mc.). Model

consists of five basic modules built into main case for maintenance and repair, and has interchangeable amplifiers for versatility and insurance against obsolescence.

Accuracy of numerical readings of time and amplitude is 2%, according to the firm, Allen B. DuMont Laboratories, Inc., Clifton, N. J.



• **Telemetry amplifier,** Model PA-15, designed to boost a 2-w. signal up to 100 w., operates in 225 to 260 mc. band over a temperature range from minus 67F to 176F. Power amplifier can withstand vibration of 10g from 20 to 2,000 cps., shock and acceleration of 100g each. An internally contained 400-cps. blower cools unit for maximum RF output. United ElectroDynamics, Inc., 200 Allendale Rd., Pasadena, Calif.

ACs RIGHT FOR RICK

ACs Spark Rick Helicopters from Arctic to Tropics . . .

James S. Ricklefs, President of Rick Helicopters, Inc., talks about the superior performance of AC Aircraft Spark Plugs with his maintenance manager, Art Miner.

From checking highway construction to air-lifting telephone poles into the mountains . . . from crop spraying to forest fire fighting . . . reliability characterizes the service of Rick Helicopters, Inc. Based in San Francisco, Rick is one of the largest and most experienced helicopter operators in the country.

Here's why Art Miner, Rick's maintenance manager, insists that reliable AC Aircraft Spark Plugs are right for Rick: "AC plugs require a minimum of maintenance and replacement; the anti-fouling characteristics of ACs eliminate delays caused by spark plug fouling."

This is especially true of AC Spark Plugs with platinum electrodes. The excellent long life quality of platinum and the small diameter center electrodes permit a long, thin insulator tip design. This design improves oil and lead anti-fouling characteristics.

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SINGLE-ENGINE service ceiling of the Piper Aztec, with full fuel and five passengers plus baggage, is specified as 7,400 ft.

Aviation Week Pilot Report:

Piper's New Twin Shows Flight Advances

By Robert I. Stanfield

New York—Inherited design features plus the power of Piper's new five-place PA-23-250 Aztec are reflected in performance of the executive light-twin, which combines a good rate of climb with 200 mph.-plus cruise speeds. It has docile stall characteristics and is responsive and stable during both slow flight and engine-out procedures.

The Aztec is basically a derivative of the twin Apache. Physical exceptions are a new empennage, including a swept rudder and single-piece stabilator similar to that of the Comanche, and two rear windows which have been added abreast of the rear fifth seat. The Aztec also utilizes systems (such as electrical and hydraulic) and components of the Apache.

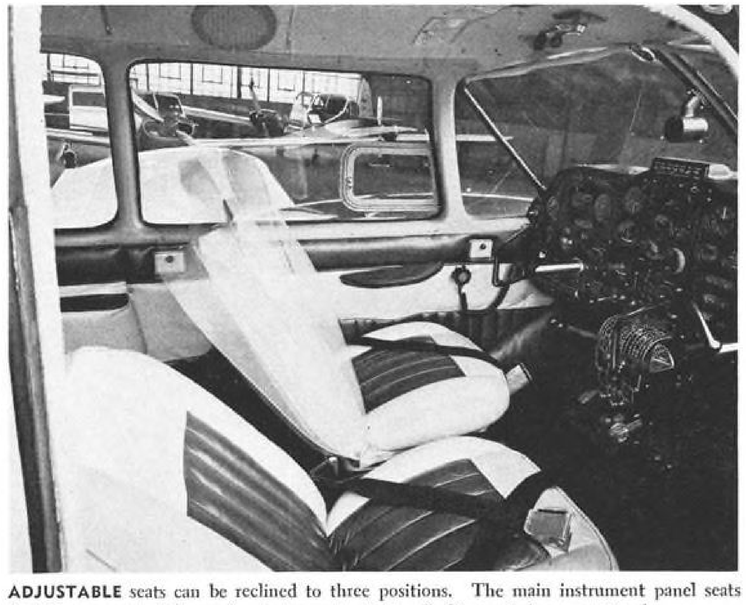
Rated Power

Power is furnished by two Lyconing 0-540-A1B5 six-cylinder engines, each rated at 250 hp. at 2,575 rpm. Compression ratio is 8.5:1. Fuel grade is 91/96 octane. Propellers are two-bladed Hartzell HC-82XK-2C1 constant-speed controllable full-feathering units.

Specifications and performance tables for the Aztec were listed in the Nov. 2 issue of AVIATION WEEK (pp. 112-113). The standard model has an empty weight of 2,775 lb. Useful load is 2,025 lb. and maximum gross weight 4,800 lb. Span is 37 ft., length 27.6 ft. and height, 10.3 ft. Baggage capacity is 200 lb., fuel capacity 144 gal. Fuel consumption, 65% power, is 24 gal./hr.

Top speed of the airplane is 215 mph. and specified rate of climb is 1,650 fpm. Service ceiling is 22,500 ft. Single-engine ceiling, which Piper says is the highest for any light-twin of the Aztec class, with full fuel, five passengers, baggage and equipment is 7,400 ft. At a gross weight of 4,400 lb., the single-engine ceiling is 10,500 ft.

Fully equipped, full fueled, the Aztec with five passengers has more than 150 lb. baggage allowance. Cruising range, 75% power, is 1,025 stat. mi. (5.5 hr.); economy cruise range, 45% power at



ADJUSTABLE seats can be reclined to three positions. The main instrument panel seats flight instruments left, engine instruments right. Radio controls are centered.

Cutler-Hammer "Firsts"!

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New Miniature Toggle Switches...

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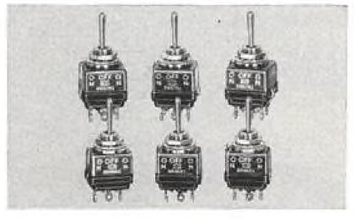
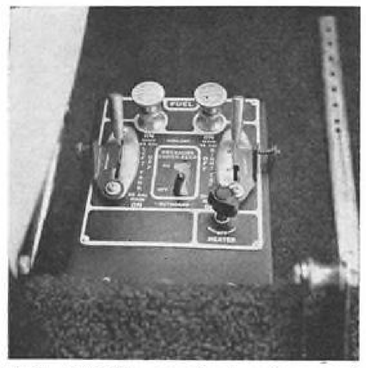


CUTLER-HAMMER CONTROL C-H

CUTLER-HAMMER

Cutler-Hammer Inc., Milwaukee, Wis. • *Division:* **Airborne Instruments Laboratory.** • *Subsidiary:* **Cutler-Hammer International, C. A.**

Associates: Canadian Cutler-Hammer, Ltd.; Cutler-Hammer Mexicana, S. A.; Intercontinental Electronics Corporation.



FUEL VALVES, cross-feed, primers and heater controls sit between the front seats.

BATTERY, 12-v. 33-amp./hr., is mounted on the right side of the nose section.

10,000 ft., is 1,400 stat. mi. (8 hr.).

Aztec performance characteristics evidenced during AVIATION WEEK flight evaluation included:

• **Rate of climb.** Weighing close to 4,300 lb. at takeoff into a 25-kt. wind, the Aztec initially ascended at 2,000 fpm., indicating 110 mph. Holding this airspeed constant, the airplane climbed through 3,500 ft. at 1,600 fpm., 5,000 ft. at 1,400 fpm. and 9,000 ft. at 1,100 fpm.

• **Cruise speeds.** At 7,000 ft., outside air temperature of −6C, and pulling 75% power, 22.25 in. manifold pressure and 2,400 rpm., the Aztec indicated 190 mph. for a true airspeed of 208 mph. At 10,000 ft., temperature −11C, power to 65% and 20 in. and 2,400 rpm., the light-twin indicated 180 mph. for a true reading of 207 mph.

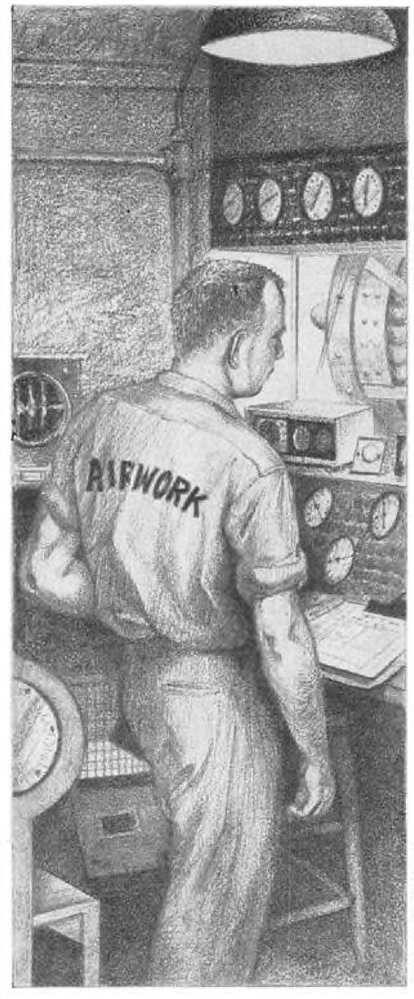
• **Stall and slow-flight.** At 7,500 ft. gentle, straight-ahead fall-aways resulted from a power-off stall, clean, at 68 mph., and, with gear and full flaps extended, at 62 mph. With standard recovery procedures there is little loss of altitude. Good elevator control and directional stability were apparent at slow and approach speeds. The Aztec lands short. Into the 25-kt. wind, the roll approximated 600 ft.

• **Single-engine.** With the right propeller feathered at 7,000 ft. and the left engine pulling 75% power, the airplane indicated 145 mph. Climb rate from this altitude, holding an indicated 108 mph., was 400 fpm. During simulated single-engine takeoff, power on the right engine reduced to 10.5 in., the airplane, once cleaned up, climbed at 1,200 fpm. at 120 mph. Minimum controllable single-engine speed is 80 mph.

Selected by Navy

The Navy has selected the equivalent of the Autoflite Aztec (with a special radio package)—designated the UO-1—as its "off-the-shelf" utility/administrative aircraft following an evaluation in competition with other light-twins (AW Jan. 4, p. 26). Initial Navy contract for 20 airplanes, which will be utilized within the continental limits of the U.S., runs about $1 million. Piper has proposed that the UO-1s be serviced, and spares maintained, by its distributor-dealer organization.

Cost of the standard Aztec, less radio-navigation equipment, is $49,500. The super custom model, priced at $53,355, includes Narco Omnigator Mk. 2 two-way VHF communications and VOR/ILS localizer indicator, Narco Mark 5 transmitter/receiver, Narco CS-3A VOR/ILS localizer indicator, and



The Hours Here Are The Most Critical

Run-in is the most critical time in the life of an engine. Run-in burnishes the parts, guarantees, to an amazing degree, the successful life of the engine. More care in the test cell means more long term protection for your pocketbook.

Here's four typical Airwork Test Cell Extras that make sure your engine is ready for maximum service:

Oil pressures and temperatures are read in many different parts of the engine — helping us pinpoint possible malfunctions before they occur. The volume of oil moving through the engine is measured, too.

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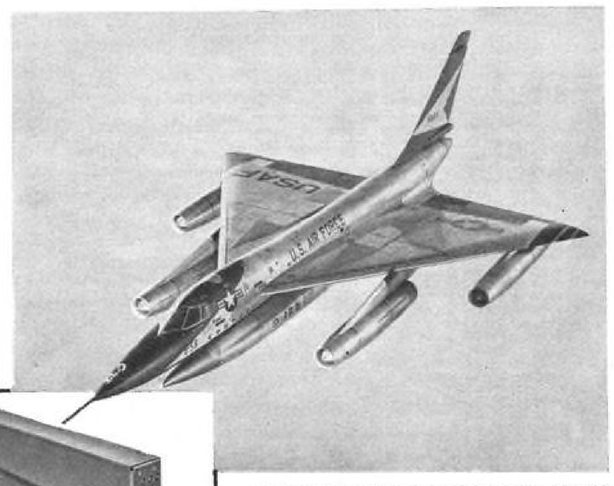
Airwork

The Univac Automatic Antenna Coupler (Series 3200) has been installed in the Boeing 707 aircraft for all major airlines, the USAF KC-135 and the President's airplane, the VC-137. Both of the units shown on this page were developed by the staff which produced the first high altitude antenna coupler.



Originally developed for the Hughes AN/URC air-to-ground communication system, the Univac Automatic Antenna Coupler (Series 3300), has been adopted by Hughes Aircraft Co. for Convair's B-58 "Hustler".

From the REMINGTON RAND UNIVAC

Military Division

A Demonstration of Capabilities in Specialized Electronic Equipment

Aboard the Convair B-58 Hustler and the Boeing 707, "black boxes" automatically attune HF radio communications to the speed, range and altitude of modern supersonic flight. The Univac Automatic Antenna Couplers are examples of specialized electronic equipment from the Remington Rand Univac Military Division. This equipment, though outside the realm of the large-scale data processing and control systems for which the Division is best known, demonstrates important capabilities.

The Antenna Coupler program is significant to those responsible for defense requirements for two reasons: First because it is an example of airborne equipment which meets severe operational and reliability specifications, and secondly because it demonstrates experience in the development of communications and control devices.

The Univac Automatic Antenna Coupler exhibits characteristics which have become identified with Remington Rand Univac equipment in all fields—compact size, high speed of operation and reliability under extreme environmental stress conditions.

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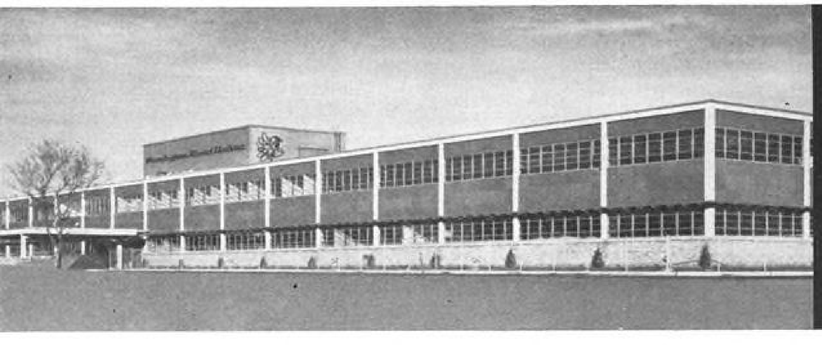

Remington Rand

UNIVAC

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Univac Park, St. Paul 16, Minnesota

Control and data systems developed by the Remington Rand Univac Military Division include:

ATHENA, the Ground Guidance Computer for the U.S. Air Force ICBM TITAN.

TACS AN/TSQ-13 (Tactical Air Control System for the U. S. Air Force)

BOMARC Computer for the U. S. Air Force Target Intercept Program

SEA SURVEILLANCE SYSTEM FOR THE U. S. NAVY

AN/USQ-20 (Advanced Computer for the U. S. Navy)

Additional information describing capabilities and experience or career opportunities may be obtained by writing to Remington Rand Univac at the above address.

AZTEC has a span of 37 ft., length of 27.6 ft. and height of 10.3 ft. Empty weight is 2,775 lb., maximum gross weight is 4,800 lb.

Lear ADF-12E automatic direction finder. The Autoflite Aztec, which costs $54,105, has Piper's AutoControl automatic flight system in addition to the above radio package.

The Aztec, with its swept tail and single-piece stabilator, is a neat looking airplane. The fuselage is composed of four basic units: the sheet metal tail cone, cabin section, nose section, and steel tubular structure extending from tail cone to the nose wheel. Finish on the tubular unit and other steel structures is zinc chromate primer with synthetic enamel.

Rectangular wing structure consists of a stepped-down main spar, a front and rear spar, lateral stringers, longitudinal ribs, stressed skin sheets and a detachable wing-tip section. Wings are attached to the tubular center section structure with fittings at the side and in the center of this structure. The main spars are bolted to each other with high-strength butt fittings in the center of the fuselage.

Main Gear

Main wheels are Cleveland Aircraft Products 600 x 6 units with disk type brakes and 700 x 6 tires with an eight-ply rating. Nose wheel is a 600 x 6 model fitted with a four-ply 600 x 6 tire. All tires have tubes. Main gear brakes are actuated by the left-hand rudder pedals. The nose wheel is steerable, via rudder pedals, through a 30 deg. arc. Steering linkage disconnects as gear retracts.

The stabilator horizontal tail includes an anti-servo tab also used for longitudinal trim. All control surfaces are cable controlled and are conventional sheet metal structures. Ailerons and rudder are cable-connected with the wheel and the pedals. The rudder servo tab also acts as a directional trim tab.

Engine mounts are of steel tubing and incorporate Lord Engineering mounts, to absorb vibration. Cowls are largely interchangeable and are cantilever structures attached at the firewall. Side panels are removable. The nose section is split for quick removal. Exhaust gases are directed into jet augmenter tubes located on the outboard side of each engine.

Fuel Cells

Fuel is located in four 36-gal. nylon and neoprene cells located outboard of the engines. Fuel can be pumped from any tank to both engines; a cross-feed is provided. Takeoffs and landings can be conducted using either inboard or outboard tanks. Two engine-driven fuel pumps are supplemented by four electrically operated booster pumps. Fuel strainers and drain valves are located in the inboard sides of the main wheel wells.

Aztec interior is tastefully upholstered; wall-to-wall carpeting and separate leather chairs, with head-rests, are standard equipment. Each seat can be individually adjusted and front and center seats can be reclined. Fresh air outlets are provided adjacent to each seat, as are large windows. Soundproofing is via a cabin envelope of glass fiber.

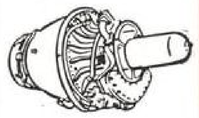
Aircraft flown by AVIATION WEEK was N 4502P, the second production Autoflite model. Aboard was Howard Greaves, in charge of Piper's flight operations, and one passenger. With the three of us, some baggage, and full fuel-oil load added to the empty weight of 2,835 lb., the Aztec weighed about 4,294 lb. at the ramp.

Aztec Cockpit

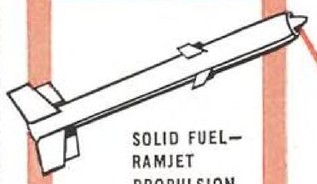
The cockpit of the Aztec is comfortable and roomy, and is accessible through a right-side door. Flight instruments are mounted to the left of the main panel. Radios are centered and engine instruments are on the right. Circuit breakers are located to the left, under the pilot's control wheel. Fuel selector valves, cross-feed, primers and heater fuel supply (for 27,500 Btu. Southwind heater) controls are mounted on a console between the two front seats. Engine controls are located on the centered quadrant.

After a few prime strokes the engines started quickly, and the Aztec was eased out and to takeoff position with a minimum of breaking. At takeoff sea level pressure was 29.91 in. Outside air temperature was 37F. Wind was from the southwest at 25 kt. (about 29 mph.).

With full power applied, the Aztec moved swiftly down the runway, controls becoming quite effective shortly before fly-off at 80 mph. The airplane was off the ground after a run of about 700 ft., and with gear retracted and air-



TURBINE PROPULSION



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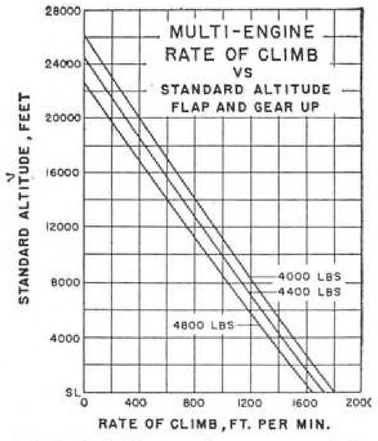
GENERAL OFFICES AND RESEARCH AND DEVELOPMENT DEPARTMENTS AT 12700 KERCHEVAL AVENUE, DETROIT 15, MICHIGAN . . . PRODUCTION DIVISION AND FIELD SUPPORT, 1330 LASKEY ROAD, TOLEDO, OHIO.

SUBSIDIARY OF CONTINENTAL MOTORS CORPORATION



RATE of climb at maximum gross weight, 4,800 lb., is about 1,650 fpm.

speed at 110 mph. (best rate of climb) ascended at 2,000 fpm.

Climb was continued to 7,000 ft., at climb power of 24 in. manifold pressure and 2,400 rpm., first power reduction. Leaning of mixtures was initiated at 3,000 ft. Visibility was good during the climb and throughout the flight. Rates of climb, as stated earlier, ran from 1,600 fpm. at 3,500 ft. to 1,400 fpm. going through 5,000 ft. The airplane responded smoothly and firmly to control pressures; trimmed out, it did a good job of flying by itself.

Aztec engines can be cruised at any percent of power from 75% down. Economical cruise runs down to 1,800 rpm.; 2,400 rpm. is recommended for maximum cruise performance. Propellers turned 2,400 rpm. at both 7,000 ft. and 10,000 ft. to obtain the indicated airspeeds of 190 mph. and 180 mph. previously stated. These, in turn, produced a true reading of 208 and 207 mph. Climb from 7,000 ft. to 10,000 ft., at 20.5 in. and 2,400 rpm., holding 110 mph., averaged 1,100 fpm.

Quick Feathering

Prop feathering is accomplished by moving the pitch lever fully aft through the high-pitch detent into the feathering position. The right propeller was feathered at 7,000 ft., feathering time about 3 sec. The procedure was quick and the aircraft was easy to manage. Slight rudder pressure and a minimum of aileron pressure held directional control. Little trim would be necessary. Normal single-engine cruising speed at low altitudes is 135 mph. With the left engine pulling 22 in. and 2,400 rpm. (75% power) the Aztec indicated 145 mph.

Without trimming, the airplane was pulled up gently until airspeed indicated 108 mph. Rate of climb was 400 fpm. Before unfeathering, medium to steep

turns were made both left and right; no dishonest tendencies were evidenced.

A half-dozen stalls, both in clean and landing configuration, resulted in docile "breaks" at 68 mph. and 62 mph., respectively. Airplane porpoised from one to the other. The Aztec is equipped with a Safe Flight stall warning indicator that is activated about 10 mph. preceding stall.

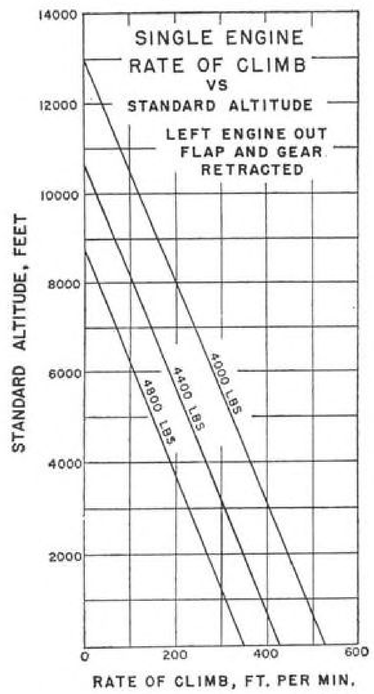
During this flight, at temperatures to −11C, the Aztec was comfortable and noise level was not excessive. Only defroster heat was used, which did a fine job. Normal conversation was possible throughout this evaluation.

Caution Range

Aztec airspeed is redlined at 249 mph. The caution range begins at 198 mph. A safety factor of about 5 mph. is added to the 80-mph. minimum single-engine control speed. The gear can be extended at speeds under 150 mph.; flaps under 125 mph. Normal approach speed is about 90-95 mph. A good approach angle can be set up with about 12 in. manifold pressure and 2,400 rpm.

Descent from 10,000 ft. was made with power reduction to 13 in. manifold pressure, which produced a good angle and a 500 fpm. rate of descent. Aztec trim tab is responsive, and a small control adjustment gives a rapid attitude change.

Several landings were made at Mac-



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Civil Aircraft, Engine Shipments

Shipments by Plants Manufacturing Complete Civilian Aircraft and Engines

Item	1959 November	Totals Jan.-Nov. 1959
Complete aircraft, total airframe weight.....(add 000 lb.)..	2,048.7	20,526.7
By weight of plane:		
Under 3,000 lb. airframe weight.....do.....	650.4	7,176.9
3,000 lb. airframe weight and over.....do.....	1,398.3	13,349.8
By number of places:		
1- and 2-place.....do.....	602.7	6,627.0
3- and 5-place.....do.....		
Over 5-place.....do.....	1,446.0	13,899.7
By total rated horsepower, all engines:		
Under 100 hp.....do.....	583.2	6,170.4
100-399 hp.....do.....		
400 hp. and over.....do.....	1,465.5	14,356.3
Aircraft engines:		
Reciprocating.....Number....	1,060	10,101
Gas turbine.....do.....	(D)	(D)
Aircraft engines, total horsepower:		
Reciprocating.....(add 000 hp)..	285.6	2,223.1
Gas Turbine.....do.....	(D)	(D)
Complete aircraft.....Number....	705	7,456
By weight of plane:		
Under 3,000 lb. airframe weight.....do.....	658	7,056
3,000 lb. airframe weight and over.....do.....	47	400
By number of places:		
1- and 2-place.....do.....	641	6,860
3- and 5-place.....do.....		
Over 5-place.....do.....	64	596
By total rated horsepower, all engines:		
Under 100 hp.....do.....	631	6,626
100-399 hp.....do.....		
400 hp. and over.....do.....	74	830
Value of shipments of complete aircraft and parts, total.....($1,000)...	85,489	869,426
Aircraft, total.....do.....	76,911	788,092
Under 3,000 lb. airframe weight.....do.....	10,499	114,401
3,000 lb. airframe weight and over.....do.....	66,412	673,691
Aircraft parts.....do.....	8,578	81,334
Value of shipments of aircraft engines and parts, total.do.....	16,509	156,317
Aircraft engines:		
Reciprocating.....do.....	4,319	29,845
Gas turbine.....do.....	(D)	(D)
Engine parts.....do.....	12,190	126,472
Unfilled orders (planes 3,000 lb. airframe weight and over).....Number....	472	...

D=Withheld to avoid disclosing figures for individual companies. Data prepared by Bureau of the Census, Industry Division, Machinery & Equipment, received from 22 companies operating 22 plants producing complete aircraft and seven engine companies operating seven plants.

Arthur Field, Islip, using an average 95 mph. approach speed. In event of a hydraulic pump failure, or left engine (driving the pump) failure, gear or flaps would have been extended via the manual hydraulic pump located on the center quadrant. A gear-up emergency landing can be made without extensive structural damage, since all three wheels protrude about one-third of their diameter when retracted.

With full flaps extended, approach rate of descent was 400 fpm. The airplane was brought over the fence at 80 mph. and touched down at 70 mph. Low speed lateral control and directional stability are pronounced in this airplane. The Aztec rolled no more than 600 ft., with a minimum of braking action, into the 25 kt. wind.

The Aztec has been flown off the runway easily with one propeller feathered. To simulate this condition, full power was applied on takeoff and once the Aztec was rolling manifold pressure on the right engine was reduced to 10.5 in. The airplane was held down until 100 mph. was indicated, then flew itself off. With gear retracted, airspeed to 120 mph., initial climb was 1,000 fpm. which increased to 1,200 fpm. Feathering is not possible if an engine freezes, but single-engine flight can be maintained with the dead engine propeller unfeathered.

Final Landing

Prior to final landing at Flushing Airport the Aztec was cruised at 2,500 ft.

At this low altitude, with power to 22 in. mainfold pressure and 2,300 rpm., the airplane indicated 180 mph. The light-twin is trim and sleek; it moves fast with a minimum of power and doesn't slow easily.

Included in the standard model Aztec are dual vacuum pumps, a fifth seat, a rotating beacon, a heated pitot tube, and complete instrumentation for instrument flight rule operation.

Both engines on all Aztecs are equipped with a geared starter, generator, vacuum pump, float-type carburetor, two magnetos, shielded harness and spark plugs, diaphragm fuel pump, propeller governor and oil thermostat. The left engine only is equipped with a hydraulic pump.

The hydraulic system is used both for extension and retraction of the gear and flaps, operated from the control pedestal. Gear retraction-extension normally occurs within 10-12 sec.; flap operations requires about 4 sec. In addition to the hand pump, a CO^2 pneumatic system provides a third gear extension method.

The 12-v. 33-amp./hr. battery is mounted in the nose section on the right side. Wing, tail surfaces and propeller deicing systems are available as optional equipment.

In January the Aztecs were rolling off the Piper production line at Lock Haven, Pa., at the rate of one a day. In February the rate increased to two-a-day. To accelerate Aztec deliveries to dealers, Piper has stopped Apache production which will resume in March.

For the completely equipped Aztec, which Piper estimates would cost $55,000, hourly direct costs are specified as $18.19. This includes $11.48 for gas and oil, $2.93 for inspection and maintenance, and $3.78 as reserve for engine and propeller overhaul. Annual indirect costs are estimated at $2,041. This includes hangar rent ($40 a month) of $480, insurance $1,320, and single limit liability of $250,000 (five seats) for $241.

On the basis of hours flown, total hourly operating costs are estimated as follows: 300 hr.—$24.99; 500 hr.—$22.27; 800 hr.—$20.74. Operating cost per mile, at 200 mph. (block to block), for these hours flown are estimated at, respectively, 12.5 cents, 11.1 cents and 10.4 cents. For business purposes, depreciation per mile (16% per year —20% residual after five years) for the same three hourly periods is specified as 14.7 cents, 8.8 cents and 5.5 cents. Adding operating costs per mile and depreciation per mile gives a total cost per mile, for 300, 500 and 800 hr., of 27.2 cents, 19.9 cents and 15.9 cents.

For business purposes, depreciation of a completely equipped $55,000 airplane, 16% per year with a 20% residual at the end of five years, would be $8,800.

Shinn Engineering to Build Morrisey 2150

Two-place Morrisey 2150 utility aircraft will be manufactured by Shinn Engineering, Inc., Santa Ana, Calif. Under the agreement, William Morrisey, the aircraft's designer, will direct sales, engineering and product development. The 2150, powered by a Lycoming 150-hp. engine, has a top speed of 148 mph., lands at 52 mph. and climbs at 1,450 fpm. Ceiling of the all-metal aircraft is listed as 22,500 ft.; flyaway price from Santa Ana is $8,245.

PRIVATE LINES

Hooker Chemical Co., Niagara Falls, N. Y., has purchased a new Beech Super G18S twin for use in transporting personnel between nine Hooker plants east of the Mississippi River. Chief pilot is J. P. Navik. The plane is fitted with JATO bottles (AW Feb. 1, p. 89) and a crosswind landing gear.

Western Sport Parachute Center has opened at Ryan Airport, Los Angeles, Calif., as a resort lodge for professionals and jump students. The resort is owned by Parachutes, Inc., Orange, Mass., formed by Jacques Istel and L. B. Sanborn.

Federal Aviation Agency reports 1959 registration of civil aircraft reached 98,893, a 6% increase over 1958.

Extension of major inspection periods for the Bell 47J Ranger helicopter to 1,200 hr., double the previous period, is being granted to commercial operators, effective today. Major overhaul period for the Ranger's Lycoming VP435 engine remains at 750 hr., extendable to 900 hr. after inspection.

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Bell Helicopter Builds Air Cushion Craft

By Erwin J. Bulban

Hurst, Tex.—Firm interest in air cushion vehicles was demonstrated here recently by Bell Helicopter Corp., with flight demonstrations of a one-man, 160-lb. test vehicle of the plenum chamber configuration.

Although a relative latecomer in the field, indications are that Bell's research program is geared toward developing a well-rounded engineering capability. Behind the little "air scooter" being flown is a considerable amount of model research into varied configurations, including not only the straight plenum chamber type but also the more sophisticated annular jet and a combination of the two.

A series of model tests of one annular-jet configuration, on which flow remains attached to the inner walls, with and without a central interbody, has shown particularly efficient performance, AVIATION WEEK was told. Electrically powered model, weighing approximately 6 lb. and developing some 3 psf. pressure, has lifted 6¾ in. from the floor.

The company plans to build several more "air scooters," which will permit accelerated build-up of data and provide ability to incorporate modifications at a rapid pace with a minimum slow-down in operating time.

Bell, which thus far has financed the air cushion program with its own funds, probably will receive some Office of Naval Research funding shortly, according to informed sources, and the company expects to continue to put its own money into the project.

Air scooter demonstrated is 30 in. high, 53 in. wide, 85 in. long and is powered by a modified 14-hp. Zundapp two-cycle motorcycle engine turning a two-blade wood fan of 30-in. diameter. Plenum chamber develops approximately 11 psf. pressure, which lifts the test vehicle approximately 2½ in. from the ground. Skirt for retaining the air cushion is a hair bristle-brush type.

Indications are that further tests, using a longer skirt, will be made by putting on longer bristles, and will permit a slightly more operational height. The procedure probably will entail installing bristles of yet undetermined length and then cutting them back until sufficient stiffness is retained, despite the outward air blast.

Aluminum Scooter

The tiny scooter, fabricated of aluminum and covered with glass fiber, has picked up a 220-lb. pilot and a 170-lb. passenger and attained approximately one-half inch height off the ground.

Plenum chamber configuration was chosen for the initial large-scale test vehicle because of its comparatively simple control and stability characteristics. Bell air scooter utilizes a simple key starter ignition; throttle is underneath the right hand grip of the motorcycle-type handlebars. Forward acceleration is accomplished by depressing a foot pedal on the right side, which opens louvers in the rear of the vehicle.

Directional control is attained by a combination of turning the handlebars in the desired direction, which directs thrust efflux out of four diagonally-located ports, plus application of "body english" in the same direction. A brief first-hand trial of the air scooter by AVIATION WEEK, following approximately one minute of prior instruction, indicated that the vehicle has considerable maneuverability and can be easily directed over chosen courses, such as ramp markings, with considerable ease.

Stability is good. A series of vanes in the fan downwash is configured to twist the flow so as to cancel out turbulence and torque. Proper trimming of acceleration vanes probably will improve forward thrust, which would permit climbing 15% grades. Currently, the maximum forward speed is on the order of 25 mph.

The project was initiated as a private interest, off-plant study by two 27-yr.-old twin brothers in Bell's engineering department, Ken and Fred Wernicke, who initiated the study a year ago. Starting out with electric-powered model studies, they progressed to a small cardboard vehicle, electrically-powered, which was "test-flown" by Ken Wernicke's four-year-old daughter.

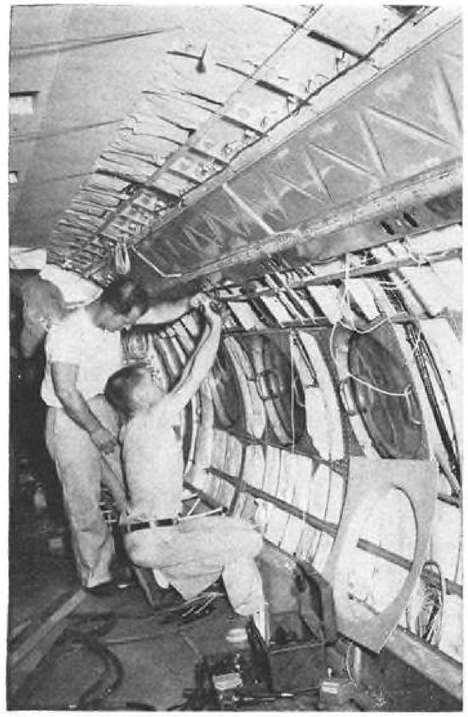
Bell became interested in the experiments last June and, following demonstrations at the plant, authorized the brothers to proceed on the current test vehicle, which was designed, built and first flown in 33 working days.

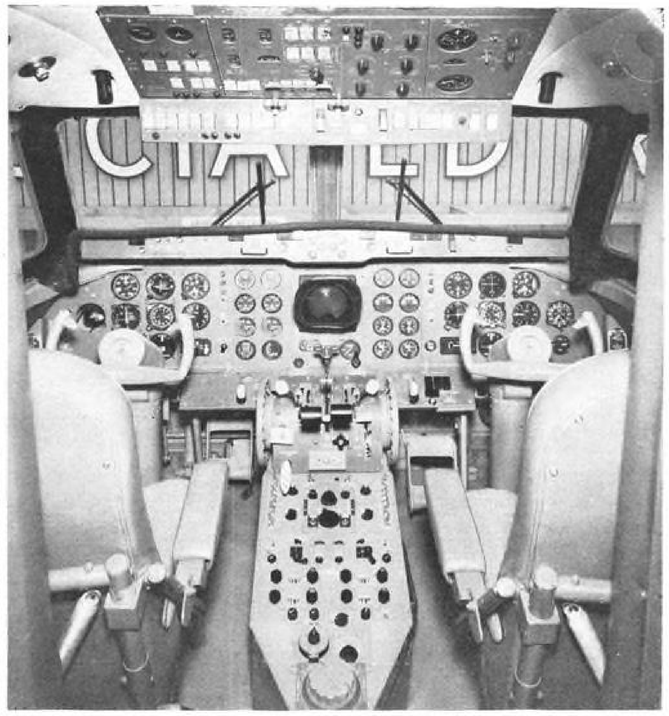
Prime considerations in the development program are future military applications. Although still a test vehicle, the current model probably could be developed easily for civilian applications, including a version that would be a feature at amusement parks, or provide transportation at lakes. Although Bell declined to estimate costs of such a configuration, indications are that a configuration similar to the present one-seat test vehicle might cost somewhere in the neighborhood of $1,500 to produce in lots of approximately 25.

Because of low operating height, overwater flying probably would necessitate installation of some form of planning device to prevent the bow from digging in. Indications are that the evaluation will encompass overwater trials.

Obstable clearance is another factor. Bell says the changes involved with experience will get quite a tryout—scooters will be available to personnel and visitors for plant transportation.

BELL HELICOPTOR'S plenum chamber air scooter is 85 in. long. Powerplant is a modified 14-hp. Zundapp two-cycle motorcycle engine turning a two-blade wood fan.



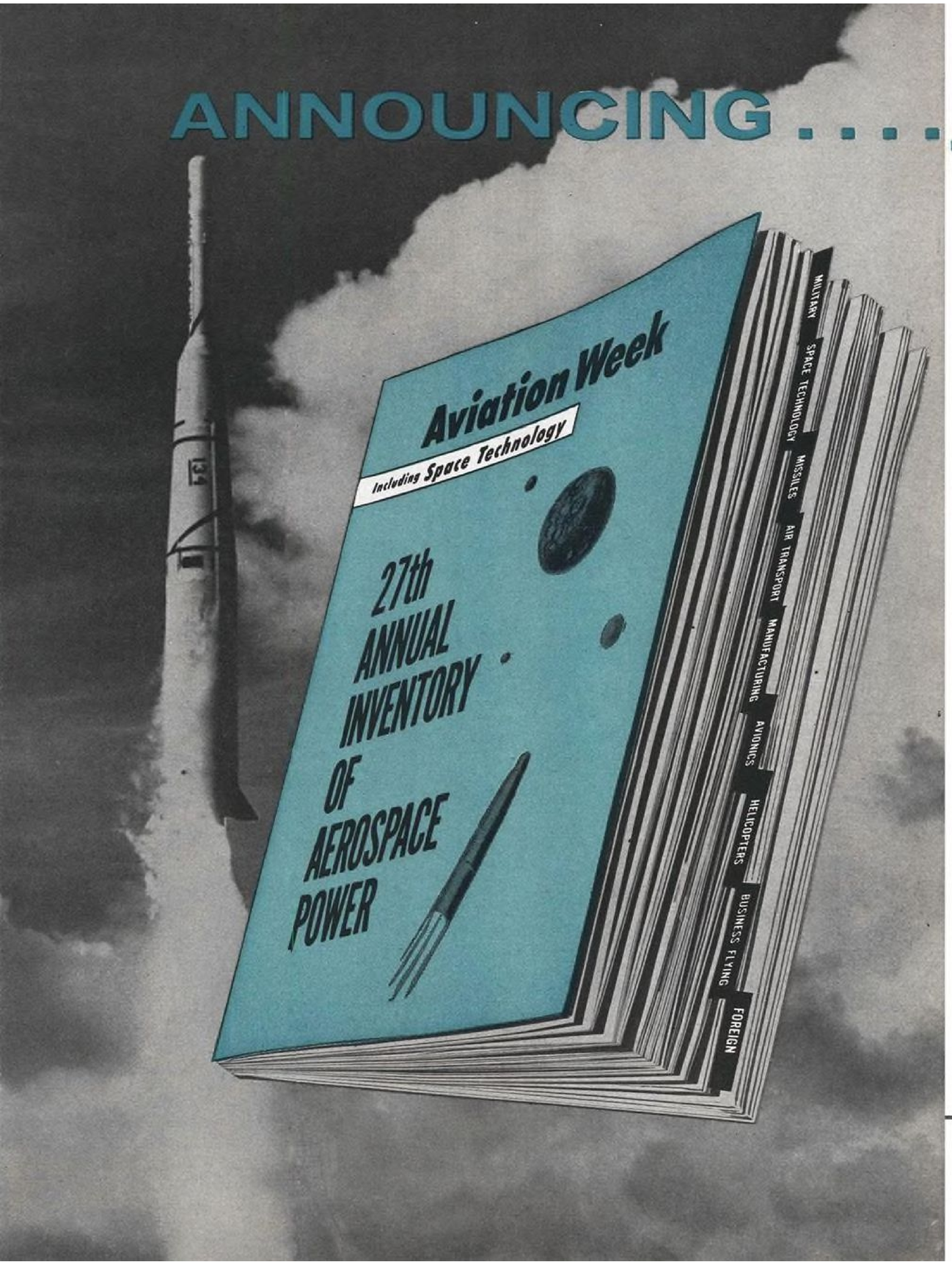


Fiberglas soundproofing material is stripped on Gulfstream hull (left) by Horton & Horton workmen. Note positioning of navigation and communications controls on pedestal aft of engine controls in cockpit customized by Associated Radio Corp.

Texas Firms Customize Newspaper's Gulfstream

Customizing and modification of a Grumman Gulfstream turboprop executive transport, purchased by the Minneapolis (Minn.) Star & Tribune, has been completed at Dallas, Tex., by Southwest Airmotive Corp. and Horton & Horton, interior designers. Initial job was to install Fiberglas soundproofing material to the bare hull interior and then cover it with headliner material. In the meantime, Southwest Airmotive completed manufacturer's modifications, installed an oxygen system and installed a new floor to take an extra set of seat tracks and supporting structures. Completed interior, which cost under $50,000, features a double row of four facing seats on the left side, designed by Horton & Horton to break up the tubular effect of a conventional single seat cabin layout. Cargo net can be slung opposite the couch in the forward cabin (right). Custom cockpit (above, right) was laid out to pilot's requirements. Noteworthy is installation of audio, channel selectors and radar and autopilot controls on a pedestal aft of the engine controls, with conventional factory control heads replaced by special, edge-lighted heads designed by Associated Radio Corp., which completed the cockpit layout. Communications-navigation installation cost under $120,000; future plans call for installation of a Loran navigation system for long overwater flights.

Installation of facing seats on left side of Gulfstream fuselage required installation of extra tracks for aisle seats. Curtain aft of couch provides forward cabin privacy.



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PUBLISHING DATE: MARCH 7, 1960

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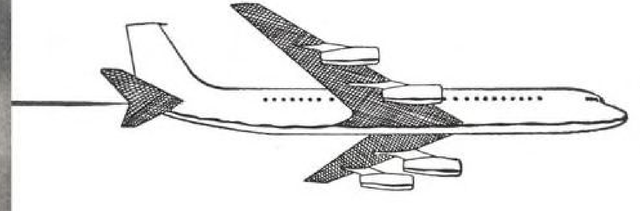

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Army Contracts

Following is a list of unclassified contracts for $25,000 and over as released by U. S. Army contracting offices:

U. S. ARMY ENGINEER DISTRICT, 575 Riverside Drive, Jacksonville, Fla.

Paul Smith Construction Co., Orlando, Fla., reconstruction of Pad 12, Cape Canaveral Missile Test Annex, Patrick AFB, Fla., (ENG-08-123-(ENG-60-6)), $997,859.

Henry C. Beck Co., Palm Beach, Fla., construction of launch facilities, Complex 34 (Saturn), Cape Canaveral Missile Test Annex, Patrick AFB, Fla., (ENG-08-123-60-12), $4,321,658.

DISTRICT ENGINEER, U. S. Army Engineer District, P. O. Box 1538, Albuquerque, N. M.

C. H. Leavell & Co., El Paso, Tex., Nike Zeus facilities, battery control building, White Sands Missile Range, N. M., contract No. DA-29-005-ENG-2453-(IFB ENG-29-005-60-32), $426,000.

H. B. Zachry Co., San Antonio, Tex. Nike Zeus facilities, landing strip and AIL facilities, White Sands Missile Range, N. M., contract No. DA-29-005-ENG-2455 (IFB Eng-29-005-60-36), $30,380.

U. S. ARMY ENGINEER DISTRICT, New York, 111 East 16 St., New York 3, N. Y.

Anderson Construction Co., Inc., Huntington Station, N. Y., construction of maintenance shop, WSE, Suffolk County AFB, Westhampton, L. I., N. Y., contract No. DA-30-075-ENG-9132 (ENG-30-075-60-40), $110,479.

U. S. ARMY ENGINEER DISTRICT, Omaha, 1709 Jackson St., Omaha, Neb.

Leavell-Scott & Associates, El Paso, Tex., construction of WS-107A-2 technical facilities, Complexes 1A, 1B and 1C, Ellsworth AFB, Rapid City, S. D., Contractor's No. DA-25-006-ENG-5919 (IFB ENG-25-006-60-1), $28,587,945.

LOX Equipment Co., Oakland, Calif., furnishing standardized equipment for WS-107A-2 technical facilities, Base T-2, Group I propellant loading system equipment (cryogenic vessels), (IFB ENG-26-006-60-35), Subschedule B(1) Ellsworth AFB, Rapid City, S. D., Contract No. DA-25-066-ENG-5923, $827,595—Subschedule B(2) Moses Lake, Wash., Contract No. DA-25-006-ENG-5924, $270,765—Subschedule B(3) Warden, Wash., Contract No. DA-25-006-ENG-5925, $270,765—Subschedule B(4) Othello, Wash., Contract No. DA-25-006-ENG-5926, $270,765—Subschedule B(5) Beale AFB, Sacramento, Calif., Contract No. DA-25-006-ENG-5927, $794,529—Subschedule B(6) Mountain Home AFB, Mountain Home, Idaho, Contract No. DA-25-006-ENG-5928, $811,800.

The Trane Co., LaCrosse, Wis., furnishing standardized equipment for WS-107A-2 technical facilities, Base T-2, Group IV, air conditioning and refrigeration equipment (IFB 60-35), Subschedule G(1), Ellsworth AFB, Rapid City, S. D., Contract No. DA-25-006-ENG-5929, $142,842—Subschedule G(2), Moses Lake, Wash., Contract No. DA-25-006-ENG-5920, $49,022 — Subschedule G(3), Warden, Wash., Contract No. DA-25-006-ENG-5931, $49,022—Subschedule G(4), Othello, Wash., Contract No. DA-25-006-ENG-5932, $49,002—Subschedule G(5), Beale AFB, Sacramento, Calif., Contract No. DA-25-006-ENG-5933, $147,516—Subschedule G(6), Mountain Home AFB, Mountain Home, Idaho, Contract No. DA-25-006-ENG-5934, $146,598.

Joy Manufacturing Co., Chicago, Ill., furnishing standardized equipment for WS-107A-2 technical facilities, Base T-2, Group V, air compressors, Subschedule H(1), Ellsworth AFB, Rapid City, S. D. Contract DA-25-006-ENG-5935, $91,811—Subschedule H(2), Moses Lake, Wash., Contract No. DA-25-006-ENG-5936, $31,245—Subschedule H(3), Warden, Wash., Contract No. DA-25-066-ENG-5927, $31,245—Subschedule H(4), Othello, Wash., Contract No. DA-25-066-ENG-5938, $31,245—Subschedule H(5), Beale AFB, Sacramento, Calif., Contract No. DA-25-066-ENG-5939, $93,120—Subschedule H(6), Mountain Home AFB, Mountain Home, Idaho, Contract No. DA-25-066-ENG-5940, $92,861.

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group VI and VII alarm system equipment (damage control and annunciator), Subschedule I(1), Ellsworth AFB, Rapid City, S. D., Contract No. DA-25-066-ENG-5941, $88,170—Subschedule I(2), Moses Lake, Wash., Contract No. DA-25-066-ENG-5942, $29,390—Subschedule I(3), Warden, Wash., Contract No. DA-25-066-ENG-5943, $29,390—Subschedule I(4), Othello, Wash., Contract No. DA-25-066-ENG-5944, $29,390—Subschedule I(5), Beale AFB, Sacramento, Calif., Contract No. DA-25-066-ENG-5945, $88,170—Subschedule I(6), Mountain Home AFB, Mountain Home, Idaho, Contract No. DA-25-066-ENG-5946, $88,170.

G. M. Wallace & Co., Denver, Colo., Group VIII pumps, Subschedule J(1), Ellsworth AFB, Rapid City, S. D., Contract No. DA-25-066-ENG-5947, $86,815—Subschedule J(2), Moses Lake, Wash., Contract No. DA-25-066-ENG-5948, $29,225 — Subschedule J(3), Warden, Wash., Contract No. DA-25-066-ENG-5949, $29,225—Subschedule J(4), Othello, Wash., Contract No. DA-25-066-ENG-5950, $29,225—Subschedule J(5), Beale AFB, Sacramento, Calif., Contract No. DA-25-066-ENG-5951, $87,700—Subschedule J(6), Mountain Home AFB, Mountain Home, Idaho, Contract No. DA-25-066-ENG-5952, $87,450.

Riedesel-Lowe Co., Cheyenne, Wyo., construction of headquarters wing (rehab), Building 1200, F. E. Warren AFB, Cheyenne, Wyo., Contract No. DA-25-066-ENG-5954 (IFB-ENG-25-066-60-58), $124,850.

Federal Pacific Electric Co., Scranton, Pa., furnishing standardized equipment for WS-107A-2 technical facilities, Base T-2, Group III, 2.4 k.v. switch gear, Subschedule F(1), Ellsworth AFB, Rapid City, S. D., Contract No. DA-25-066-ENG-5957, $277,965—Subschedule F(2), Moses Lake, Wash., Contract No. DA-25-066-ENG-5958, $92,655—Subschedule F(3), Warden, Wash., Contract No. DA-25-066-ENG-5959, $92,655—Subschedule F(4), Othello, Wash., Contract No. DA-25-066-ENG-5960, $92,655—Subschedule F(5), Beale AFB, Sacramento, Calif., Contract No. DA-25-066-ENG-5961, $277,965—Subschedule F(6), Mountain Home AFB, Mountain Home, Idaho, Contract No. DA-25-066-ENG-5962, $277,965.

Nordberg Manufacturing Co., Milwaukee, Wis., furnishing standardized equipment for WS-107A-2 technical facilities, Base T-2, Group II, electrical generating equipment (IFB-ENG-25-066-60-35), Subschedule E(1), Ellsworth AFB, Rapid City, S. D., Contract No. DA-25-066-ENG-5963, $1,152,566—Subschedule E(2), Moses Lake, Wash., Contract No. DA-25-066-ENG-5964, $397,602—Subschedule E(3), Warden, Wash., Contract No. DA-25-066-ENG-5965, $387,602—Subschedule E(4), Othello, Wash., Contract No. DA-25-066-ENG-5966, $387,602—Subschedule E(5), Beale AFB, Sacramento, Calif., Contract No. DA-25-066-ENG-5967, $1,098,726—Subschedule E(6), Mountain Home AFB, Mountain Home, Idaho, Contract No. DA-25-066-ENG-5968, $1,162,566.

Navy Contracts

Washington—Following is a list of unclassified contracts for $25,000 and over as released by Department of the Navy, Bureau of Aeronautics:

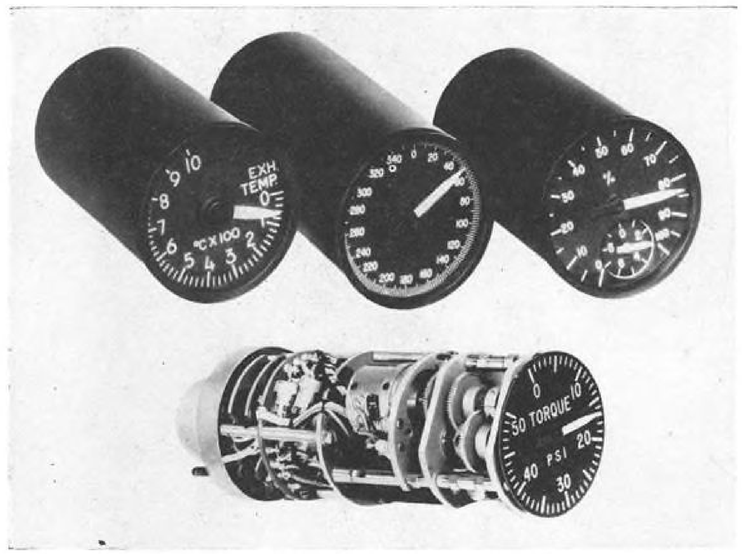
Crescent Communication Corp., New London, Conn., (6,500) PP-2100/ARC power supply in accordance with specification MIL-P-8010-a(PD-31-5812-9), Inv. No. IFB 600-2054-59-A, $1,171,000.

Packard Bell Electronics Corp., Los Angeles, Calif., APX-7 radar recognition sets, NOas 59-0320-r(PD-31-1840-59), $1,235,173.

Van Zelm Associates, Inc., Baltimore, Md., design components and provide change kits for outfitting three Mark 2 Model 0 bridle arresters, NOas 60-6023-c, (SI-32-2767-0), $34,392.

Armour Research Laboratories, Illinois Institute of Technology, Chicago, Ill., conduct an investigation to develop ductile beryllium composites and determine the mechanical properties of materials produced, NOas 60-6036c(AE-41-4788-9), $30,000.

NEW AVIATION PRODUCTS



Servo Indicators Utilize Modular Construction

Servo indicators, utilizing modular construction, are available in integrally lighted, vernier pointer and dial presentation, and high input impedance transistorized instruments, according to Servo Development Corp., Westbury, N. Y. The basic module is the gear box in which up to seven .0937 diameter shafts are mounted in ABEC-7 ball bearings. Gear ratios up to 65,000 to 1 are obtainable using precision 2 stock gears. The component module utilizes standard plates for mounting size 8 or size 10 rotating components. The dial section, another module, also utilizes standard parts. Dials are accurate to 6 min. of arc. Silicon transistors and diodes, and high temperature tantalum capacitors are used to meet MIL-E-5272 environment. Hermetically sealed case measures 2 in. in diameter.

Infrared Detector Coolers

Four types of infrared detector cooling systems all use liquid nitrogen as the cooling agent. The cooling systems, designed to increase efficiency of infrared detectors, include: integrally mounted cell; liquid feed—vacuum insulated line; liquid to high pressure gas generator; and liquid feed—uninsulated line.

Detector cells are cooled by heat exchange with liquid nitrogen at −320F. The integrally mounted cell (right) utilizes a conducting material to take heat from the detector. Space limitations may require the insulated or uninsulated (left) lines. The liquid to high pressure gas generator is a miniature cryostat.

Linde Co., 420 Lexington Ave., New York 17, N. Y.

Refueling Truck

Aircraft refueling truck is engineered for underwing fueling of turbojet and turboprop aircraft. The front-fueling truck has a 600 gpm. fueling rate.

The one-man cab of the refueler opens onto the fueling platform. A glass roof in the cab allows the driver to check his overhead clearance. The rear-mounted engine eliminates the drive line, providing more tank room. Tandem front steering is provided. The truck has an automatic transmission; a split-shaft Chelsea transfer case provides full engine torque power takeoff for driving the Gorman Rupp Model 66C-G pump.

KW-Dart Co., 1301 North Manchester Trafficway, Kansas City, Mo.

Radiation Fuel Gage

Transistorized radiation fuel gage for aircraft and missiles is designed for greater accuracy and reliability than conventional fuel quantity gages. The indicator, developed for the Navy, performed accurately in tests in a jet aircraft from 0 to 38,000 ft.

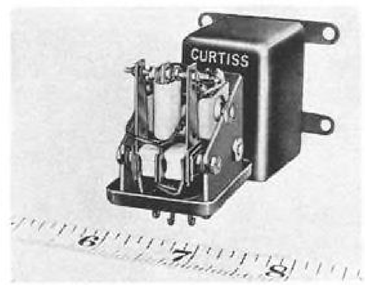
The radiation gage consists of gamma radiation sources, such as cobalt 60, scintillation detectors containing a ratemeter and pulse amplifier, a power supply and an indicator. Radiation sources and detectors are mounted in the fuel cells. Gamma rays given off decrease in intensity as they pass through the fuel. Fuel quantity is determined by the intensity of the gamma rays. Ratemeters convert gamma pulses into d.c. voltage and fuel is indicated in pounds.

Atomics International, division of North American Aviation, Inc., Canoga Park, Calif.

Time Delay Relay

Hermetically sealed time delay relay for aircraft and missiles will reset the instant it is de-energized, providing the same time delay period for each succeeding cycle.

The STR relay employs a thermal element in conjunction with a pair of magnetic relays. This component combination utilized the heating and cooling intervals to obtain the total time delay period. Voltage compensation is provided for 22 to 32 v.d.c. operation. Temperature range is from −65 to 125C. Power drain is less than 3 w. after timing; 10 w. during timing. Contact rating 2 amp. at 28 v.d.c. resistive load. Dimensions are 1⅝ x 1⅞ x 1¼ in.



Curtiss-Wright Electronics Division, 620 Passaic Ave., West Caldwell, N. J.

Sayen Describes ALPA Air Safety Stand

(Clarence N. Sayen, president of the Air Line Pilots Assn., recently presented a detailed documentation of the pilots' stand on air safety in a statement before the Senate Aviation Subcommittee, which is investigating airline safety needs. Because of its general interest and the importance of the problems involved, AVIATION WEEK *is reprinting his statement below.)*

We would like to point out that we were roundly condemned by public officials, certain segments of the press and others, when we were critical and insisted that the following items be added or changes be made over the years:

- **Full feathering propellers.**
- **Reversible propellers.**
- **Approach lights.**
- **Improvements in air traffic control** in the early 1950's. (We were told that we were alarmists and that the system was fine.)
- **Temperature accountability.**
- **Removal of CAA** from the Department of Commerce.
- **Standardization of the location** of basic flight instruments.
- **FAA approval** of training programs.
- **Airborne radar.**
- **Increased requirements for copilots,** and many others.

Our statement, therefore, will be critical and will point out deficiencies and hazards. This does not mean that it is not meant to be constructive or that we feel air transportation is not a safe, comfortable way to travel. We merely want to keep it that way and to accomplish this we have found we must be aggressively critical and occasionally hurt someone's feelings.

The committee has available to it the statistical record on air safety during 1959. We will merely summarize our view of it briefly. The safety record for 1959 is not good. ALPA records show that during the calendar year 1959, 16 fatal accidents involving United States carriers occurred in which 271 passengers and 60 crew members were killed. These accidents may be categorized as follows: 7—on approach to airport; 8—en route (mechanical, weather, flight controls, fire, etc.); 1—during takeoff (engine failure).

Of these 16 fatal accidents, 10 involved trunk carriers, three involved local service carriers, two involved certificated cargo carriers, and one territorial carrier.

While 1959 was the first year of operation of straight jet aircraft and there were a number of near accidents, no major accident occurred in passenger service. There were, however, two major training accidents in which two aircraft were destroyed and nine crew members were killed.

Three major accidents in passenger service involved turbine-powered, propeller-driven aircraft. Two involved the Electra which was introduced into service in 1959 and one involved the Viscount. There were no fatal accidents involving the turboprop F-27 which was introduced into service in considerable numbers in 1959.

While there is no single cause or trend to which these fatal accidents may be attributed, they may be grouped roughly into two major categories (1) those occurring during the approach to an airport and (2) those occurring due to the disintegration of the aircraft in flight. One occurred during takeoff due to engine failure.

In addition to the foregoing, there were a number of very serious accidents which, fortunately, did not result in fatalities. Our records show at least 23 more serious accidents that had fatal potential. Of these, ALPA records reveal that all but three were associated with the approach or landing. Of the remaining three, two involved fire in flight and one a control problem.

Any review of an accident record must have a primary purpose . . . to determine whether there are dangerous areas of deficiency which require remedial action in order to prevent similar accidents in the future. We believe that there is much to be learned from the record of the past year and the following discussion will cover areas in which we feel considerable improvement in aviation safety is possible. Many of these areas are familiar and will be recognized as problems with which the pilots have been concerned for a number of years.

Previous Sessions

Previous sessions of Congress have been greatly concerned with the air traffic separation system provided by the federal government and the accidents and near accidents which were stemming from its inadequacies. This was one of the important problems which motivated Congress to enact the Federal Aviation Act of 1958. Whenever this matter has been discussed, we have attempted to point out that a safe and efficient air traffic system must encompass more than the airspace from airport to airport but must, in fact, stretch from the ramp of the departure airport to the ramp of the destination airport. There is not much logic in building an efficient air traffic separation system between two airports and leaving a bottleneck at both ends.

Clarence N. Sayen, president of the Air Line Pilots Assn. since 1950, served as a Braniff Airways' copilot between 1944 and 1949 and is a graduate of Northern State College of Michigan. He holds a master of arts degree in geography and economics from Southern Methodist College. In addition to heading an organization of more than 18,000 active and inactive pilots employed by approximately 49 airlines, Mr. Sayen is a member of the Committee on Aircraft Operating Problems of the National Aeronautics and Space Administration and the executive committee of the National Air Transport Coordinating Committee.

We believe that one of the most critical problem areas in aviation today is the inadequacy of the terminal area facilities. By terminal area facilities, we mean the navigation, communication, traffic separation, visual aid, and airport facilities by which the pilot takes his aircraft from the en route system, makes an approach to the airport, lands, and guides his aircraft safely to the ramp. These facilities have lagged badly behind the development of the aircraft and the growth of air traffic and the accident record for 1959 and previous years bears this out. An examination of the major and minor accident record for prior years will also reveal the large number of accidents occurring in the terminal area with approach and landing accidents predominating.

ALPA's records of serious fatal and nonfatal air carrier accidents (domestic and international) during 1959 indicate that of 39 accidents, 14 occurred during the approach or landing (terminal area). This accounted for 36% of the 1959 air carrier accidents and 37% of the total 1959 fatalities. From our analysis these accidents resulted, in whole or part, from a lack of landing aids and airport safety.

In our opinion, no single category of preventable accidents has caused so much loss of life, injury, delay and substandard air service, destroyed and damaged aircraft, and adversely affected the growth of the aviation industry than the continued lack of known and obtainable landing aids and airport safety standards.

This is a difficult area in which to secure improvements since there is usually overlapping jurisdiction between the federal government and municipalities. We believe, however, that it is a fundamental responsibility of the federal government to provide the air traffic system of the country and any air traffic system can only be as safe and efficient as the capability of the airport and terminal area permits. The federal government must, therefore, provide leadership, prescribe standards, and make available funds for this purpose.

For many years and currently, modern instrument approach facilities have been installed on only one runway in one direction at a few airports. We now have 569 airline airports in the United States and U. S. carriers operate into 157 foreign airports. We do not have at hand the exact figures for installed facilities but FAA planning figures indicated for the fiscal year 1959 there would be 210 air traffic control tower services, 75 airport surveillance radar, 122 secondary radar, 65 long range radar, 30 radar centers, 185 instrument landing systems, 53 approach light systems (of various kinds), and 23 sequenced flashing light systems. The FAA has indicated that, for planning purposes, we can only expect 235 instrument landing systems installed by 1963, 100 radar surveillance plus beacon systems, and 30 ground radars for taxiing.

As the foregoing figures indicate, there are a large number of our airline airports that do not now have modern approach facilities and cannot expect to have them by 1963. As a result, airline operations at many airports and many runways must be conducted with obsolete terminal area navigational and approach facilities, without approach lighting, adequate runway lighting and other necessary facilities.

With modern aircraft requiring longer runways, many of our airports have become, for all practical purposes, single runway airports.

Even our best equipped airports usually only have straight in, full instrument approach capability in one direction on one runway.

Circling Approach

One of the most critical operating conditions which faces the airline pilot is the circling approach under low ceiling and visibility conditions. With smaller aircraft, this procedure is undesirable but has some measure of practicality. However, with larger, high speed aircraft this maneuver is extremely marginal during normal operation and critical during an emergency. Without modern approach and landing aids at airports and in more than one direction, operations must be conducted with what is available.

Some low density traffic airports into which the Civil Aeronautics Board has certificated airline service have virtually no terminal area navigation, communication, or landing aid facilities owned or operated by the government, or, for that matter, by anyone else. Some have radio beacons installed by the air line. Some have low frequency ranges and VOR facilities without any additional approach aids such as the instrument landing system, approach lights, runway lighting, etc.

Fortunately most of the research and development needed to provide the necessary terminal area facilities has been completed and the equipment is available for purchase. While the Administrator has initiated certain research programs in this area, we believe that most of the necessary information is available on which to base any remaining decisions and that no further delay should be countenanced because of lack of decision by the government agencies concerned.

Short Runways

The runways on many of our airports are too short for the jet aircraft. Operations may only be conducted by substantial operating compromises both in runway selection with regard to weight, wind direction, runway condition, etc., and with regard to flight planning because of restrictions as to fuel weight which may be carried. Under any runway condition, except that of smooth, dry runways, the performance standards established for the aircraft make the operation marginal. Runway length requirements often leave the pilot with a single runway around which to plan his flight regardless of weather and runway conditions. The same situation applies at other airports for aircraft other than jets.

Another serious problem threatens to compromise the safe and efficient use of commercial airports through the adoption of operating restrictions designed to minimize the noise nuisance for airport neighbors.

In making this statement, we want it clearly understood that the airline pilots are sympathetic to the legitimate noise complaints of the airport neighbor and have cooperated and will continue to cooperate in any rational program designed to minimize the noise nuisance that is not an unreasonable compromise with safe operation.

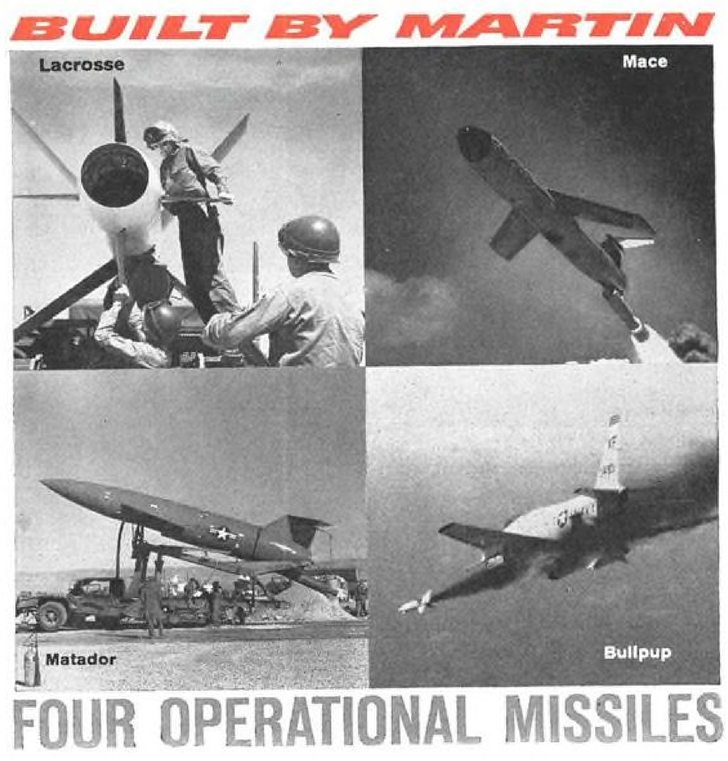
However, transport aircraft today are operated under a rigid set of airplane performance requirements which permit little deviation without compromising the safety of the operation. Noise regulations which represent a further compromise with present minimum standards for safety will not help the airport neighbor, the traveling public, or the aviation industry. Noise restrictions which restrict the right of the pilot to exercise his best judgment in the interest of safe operation and noise alleviation are not practical.

We believe that the federal government possesses the exclusive right to regulate interstate air commerce including the adoption of any regulations establishing methods of alleviating the noise problem. However, we feel strongly that any regulation adopted for the purpose of noise alleviation must be completely consistent with safe standards of operation and should not represent a further compromise of minimum standards of safety. Any such compromise will result in further deterioration of the utility of our airports and may be the cause of serious accidents in the terminal area. Most certainly any such regulations adopted must first be predicated upon a national standard establishing minimum safety standards which may not be compromised.

Operational regulations may only move the noise laterally or vertically and the eventual solution to the noise problem must come from adequate zoning of the approach and departure zones from airports and a further reduction of noise at the source.

Airport Zoning

In 1952, following a series of disastrous air crashes in the vicinity of airports and continued public complaints over aircraft noise, President Truman created a commission consisting of J. H. Doolittle, chairman, C. F. Horne, and J. C. Hunsaker. The task of the commission, known as the President's Airport Commission, was to consider means to safeguard the lives of people living in the vicinity of airports and to alleviate for them, as far as possible, the disturbance that arises from the operation of aircraft. The report contained many excellent recommendations both for improvement of existing airports and criteria for any future construction of airports. The commission stressed the urgent need for adherence to their suggestions. The following is a partial list of some of the recommendations which are as applicable today as in 1952



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and, where followed, have contributed greatly to aviation safety:

• **Support required airport development.** New airports will be needed and present airports must be improved. State, county and municipal governments should be prepared to assume their proper share of this expense.

• **Expand Federal-Aid Airport Program.** Authorization of matching funds for federal aid to airports should be implemented by adequate appropriations. Highest priority in the application of federal aid should be given to runways and their protective extensions incorporated into the airport, to bring major municipal airports up to standards recommended in this report.

• **Integrate municipal and airport planning.** Airports should be made a part of community master plans completely integrated with transportation requirements for passenger, express, freight and postal services. Particular attention should be paid to limited access highways and other transportation facilities to reduce time to the airport from sources of air transport business.

• **Incorporate cleared runway extension** areas into airports. The dominant runways of new airport projects should be protected by cleared extensions at each end at least one-half mile in length and 1,000 ft. wide. This area should be completely free from housing or any other form of obstruction. Such extensions should be considered an integral part of the airport.

• **Establish effective zoning laws.** A fan-shaped zone, beyond the half-mile cleared extension described above, at least two miles long and 6,000 ft. wide at its outer limits should be established at new airports by zoning law, air easement or land purchase at each end of dominant runways. In this area, the height of buildings and also the use of the land should be controlled to eliminate the erection of places of public assembly, churches, hospitals, schools, etc., and to restrict residences to the more distant locations within the zone.

• **Improve existing airports.** Existing airports must continue to serve their communities. However, cities should go as far as is practical toward developing the cleared areas and zoned runway approaches recommended for new airports. No further building should be permitted on runway extensions and, wherever possible, objectionable structures should be removed. Operating procedures should be modified in line with commission recommendations for minimizing hazards and nuisance to persons living in the vicinity of such airports.

• **Clarify laws and regulations** governing use of airspace. Authority of the federal, state or municipal governments with respect to the regulation of the use of airspace should be clarified to avoid conflicting regulation and laws.

• **Extend Civil Aeronautics Act to certificate** airports. The Civil Aeronautics Act should be amended to require certification of airports necessary for interstate commerce and to specify the terms and conditions under which airports so certified shall be operated. Certificates should be revoked if minimum standards for safety are not maintained. Closing or abandonment of an airport should be ordered or allowed only if clearly in the public interest.

• **Maintain positive air traffic control.** Certain air traffic control zones in areas of high air traffic density should be made the subject of special regulations to ensure that all aircraft within the zone are under positive air traffic control at all times regardless of weather.

• **Accelerate installation** of aids to air navigation. Research and development programs and installation projects designed to improve aids to **navigation** and traffic control in the vicinity of airports, especially in congested areas, should be accelerated. Installation and adequate manning of radar traffic control systems should be given high priority.

• **Meet standard requirements** for runway length. For each category of airport a standard runway length has been established consistent with its future planned use. Airports should bring their runways up to the standard. For intercontinental or transcontinental airports, the length of the dominant runways should be 8,400 ft. with possibility of expansion to 10,000 ft. if later required and with clear approaches as per recommendations above. (Longer runways are required today at many airports.)

• **Accelerate ground noise reduction** programs. Engine run-up schedules and run-up locations should be adjusted to minimize noise near airports. Adequate acoustical treatment in run-up areas and at test stands should be provided.

• **Arrange flight patterns** to reduce ground noise. Airways and flight patterns near airports should be arranged to avoid unnecessary flight over thickly settled areas to minimize noise, but only within the limits of safe flight practice.

• **Minimize training flights** at congested airports. Flight crew training should be conducted, as far as practicable, away from thickly settled areas and with a minimum number of flights into and out of busy airports.

• **Separate military and civil flying** at congested airports. Military aircraft should not be based on congested civil airports except when it is not economically or otherwise feasible to provide separate facilities for them nor should commercial aircraft operate regularly from busy military airports.

Same Problems

Unfortunately, little attention has been paid to many of the recommendations and consequently many of the same problems exist today which caused the commission to be appointed almost eight years ago. Citizens are still permitted to construct residential housing a few feet from active runways. Aircraft landing a few feet short of the runway or over-running the runway a few feet are involved in disastrous accidents. No provision is made in the performance standards for aircraft for any form of moisture on the runway, or any variation in piloting technique. We seem to be capable of constructing thousands of miles of super highways in the country but find it impossible to secure another 1,000 ft. of concrete on marginal airport runways.

Conflicts and overlapping of authority continue to exist and, as a result, no standards exist in a number of vital areas.

An example of lack of standards and overlapping authority in airport facilities lies in the area of the fire fighting and rescue facilities maintained on our airports. No federal requirement for such facilities exists and, to the best of our knowledge, the federal government is not even prepared to recommend to an airport operator the type and amount of fire fighting and rescue facilities that should be maintained. There is no published information available to the pilot as to the facilities of this type maintained by an airport.

A pilot faced with an emergency which may require the emergency landing of an aircraft carrying 125 passengers and 100,000 lb. of inflammable fuel has no information available to him as to the type or amount of fire fighting and rescue equipment necessary for his particular aircraft or the equipment available at nearby airports. Efforts by ALPA to resolve this problem have been met by the usual difficulties attendant to the divided authority present in dealing with airport problems and the reluctance or failure of the federal agencies to provide the necessary leadership.

We feel strongly that the critical problems of the terminal area require immediate attention from the federal aviation agencies and the Congress. The Doolittle Committee report should be reviewed, and concrete and specific action taken on the recommendations. We are indebted to this committee for the leadership that has been provided in these areas and for its strong sponsorship of additional federal aid for the solution of these problems. We are in agreement with the Administrator that airport aid should be expended primarily for safety features but we cannot agree with his position on reducing expenditures in this area and feel that the problem and the need has been badly underestimated. Anyone who does not agree should try making an approach into some of our airports on a dark, stormy night.

Air Traffic Control

Fortunately, there was not a collision accident involving airline aircraft during 1959. Near misses, however, continue to be reported to ALPA and we have no reason to believe that the number has been reduced from previous years. You probably have not seen as many near miss reports as in past years since the near miss reporting program of the government has been discontinued by the Administrator and any near miss report received by the FAA under present procedures is, as we have been informed of the policy, automatically reason for beginning an enforcement action against the pilot involved by the Administrator. The net result is that pilots have ceased reporting near misses to the FAA. We believe that this policy of FAA is fallacious and should be reversed immediately. It may make the record look good but it deprives interested and necessary parties of vital information.

Our air traffic is increasing. Our system of air traffic control is essentially the same as it has been during recent years although its capacity has been increased somewhat. New personnel have been added, some additional radar has been added, and several new airways have been designated. Research has been started which will partially automate the work of the ground controller, and hopefully, expedite communications. Insofar as the pilot is concerned, he is still not provided with the positive separation he feels is required in many areas, his workload in dealing with traffic control has been mounting steadily, and air traffic control delays are long and frequent. The main dependence is still on the "see and be seen" philosophy which practically everyone agrees has not afforded positive separation for many years.

The FAA is continuing efforts toward establishing airways affording positive separation, however, these airways presently are a very small part of the airspace between 17,000 and 24,000 ft. on some special airways.

On high altitude jet airways above 24,000 ft., we were hopeful that high speed jet transports would be provided positive separation. This is accomplished, in part, by radar tracking and by the installation of transponders on the aircraft. We find, however, that the available surveillance radar does not cover the area adequately and that other aircraft are permitted to operate in the area under Visual Flight Rules. These aircraft do not have operative transponders on occasion, do not appear on the radar screens at times, and, therefore, are not reported to the airline aircraft.

Pilot Reports

Pilots report traffic on these airways on occasion which evidently provide too difficult a problem for the radar operator to interpret for traffic reporting purposes. As an example, one pilot reported hearing the radar operator start a transmission, hesitate, and try it another way about the time a jet airplane passed in front and another behind within one or two miles. Evidently the radar operator was unable to detect the aircraft in time and provide a proper warning to the pilot. The traffic advisories while not providing positive separation, have increased the communications workload considerably. Net result of the foregoing is that while some additional assistance is being provided by radar on high altitude jet routes, controlled and uncontrolled traffic is being mixed and a radar advisory service is being provided. "See and be seen" is still the prime system with all its acknowledged deficiencies especially in high speed jet aircraft and is the legal philosophy on which the regulations are based. This is far from being a satisfactory situation.

The pilots of aircraft flying under 24,000 ft. continue to report near misses. Under 17,000 ft., there are no positively controlled airways. ALPA, however, in conjunction with the Air Transport Assn., has established a procedure under which our members will not accept Visual Flight Rule clearances above 10,000 ft. Again, however, this only provides protection against other airline flights and non-airline aircraft may and do operate VFR. We continue to urge that FAA extend positive separation procedures to all aircraft operating above 10,000 ft. as soon as possible.

The FAA has embarked upon a number of long-term research projects which, hopefully, will provide some relief from the present reliance upon an obsolete "see and be seen" philosophy for the maintenance of separation between air traffic. Relief is also badly needed from the cockpit workload engendered by the present cumbersome communication and traffic control procedures. For the immediate future, however, we see some automation of the ground controllers function but little relief for the pilot. Radar advisories provide some assist-

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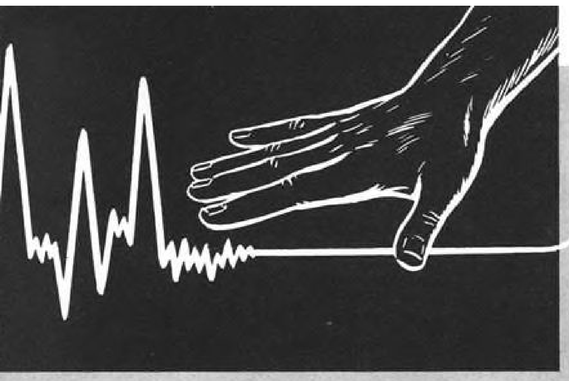

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ance but still leave the pilot with primary reliance upon the inadequate "see and be seen" concept.

Insofar as federal regulations are concerned, when you board an airline aircraft today, you may find the following situation. The pilot-in-command will be qualified to operate the particular aircraft and will be so certified by the FAA, the copilot is not required to be qualified to operate the particular aircraft on which he is serving as copilot, and the third crew member is not required to be able to fly, navigate, communicate, or assist with traffic control at all. In the event of incapacity of the pilot-in-command for any reason, there is no requirement that anyone be qualified to relieve him.

The modern transport aircraft cannot be flown under complex flight conditions by a single pilot. It is imperative that he have well qualified and carefully coordinated assistants and that any incapacitation of a crew member leave at least a minimum crew in control. Yet there is no requirement that any crew member be fully qualified to relieve any other crew member. The "fail-safe" concept applied to other components of the aircraft is not applied to the crew. By "fail-safe" we mean that a single failure will not result in a major emergency (if one engine fails, flight must be sustained by the remaining engine or engines. If the gear will not lower by normal means, an alternate is provided.) Any concept under which only one crew member can perform particular functions is unsafe.

Fortunately, many air carriers maintain a level of training well in excess of federal requirements. In addition, ALPA has successfully worked with the management of many carriers through collective bargaining or other processes to provide a higher level of qualification.

Airline flying is a highly skilled profession in an industry of constant technological change. It is imperative, therefore, that adequate and practical opportunity for periodic refresher training in problems not possible of performance in passenger operation be available and that any transition to new aircraft or new devices be accompanied by adequate training.

We have, in addition to our normal programs, conducted a number of industry surveys and detailed studies on these subjects over the years and have had many conferences with the CAB, CAA, and more recently with FAA on the subject.

We have strongly urged regulatory action in these areas to bring the standards of all carriers to a basic minimum. FAA recently acted on one of our recommendations to require air carriers to submit their training programs to FAA for approval. While the regulation adopted establishes no standard for such programs, we are hopeful that such standards will be developed and that improvements will be made in deficient areas. The results, of course, will also depend on the capabilities of the individuals working with the carriers in the establishment of the programs and the subsequent monitoring of them. It is unfortunate, however, that despite our repeated urgings this subject has been permitted to drift without any affirmative action by the aviation agencies for many years.

We also urged very strongly that licensing standards for copilots be raised, that copilots be required to possess a type rating on the aircraft on which they are to serve as copilot, and that copilots take proficiency checks each six months. (Under the present regulations, an individual may be employed with a commercial license and instrument rating on a light aircraft, assigned as copilot with minimum training on the aircraft, and receive no periodic training or proficiency checks.)

The Administrator issued Draft Release 59-3 in June, 1959, which proposed that the copilot be required to possess a type rating and to demonstrate his proficiency each six months. We strongly supported this proposal although we pointed out the deficiency in experience requirements for copilot licensing and urged licensing requirements be increased as we had recommended. We commented that the day when pilots could operate their aircraft with minimum assistance and do on-the-job training simultaneously had passed.

Regulatory Situation

The regulations as adopted leave the regulatory situation as follows: (1) they fail to ensure that copilots will be fully qualified on the aircraft on which they are serving as copilot since no requirement is made that they possess a type rating on such aircraft; (2) the proficiency of the copilot is checked only once per year and only one such check every two years needs to be made in the aircraft (alternate years may be given in the simulator); (3) the foregoing requirements are not effective until Jan. 1, 1961; (4) the third crew member is not required to be qualified to assist the pilot in flying, navigation, communication, traffic management, or other essential flight operational duties. Licensing requirements for copilots have not been altered in any way and the fail-safe crew is not provided.

We have lost 23 crew members in 13 training accidents over the past 10 years. We believe that the use of simulators for initial and refresher training, particularly during familarization with a new aircraft and emergency procedures training can provide a higher level of proficiency and lower casualty levels. Before a pilot is brought down to low altitudes to practice certain dangerous maneuvers, he should have been thoroughly trained in such procedures in the simulator and at high altitudes.

We recommend maximum use of flight simulators as a training device whenever possible. More training can be provided in a simulator at less cost. A simulator may be employed for training in many problems which are hazardous in the aircraft. The result is an increase in the level of proficiency and a reduction in the number of training accidents which, in our opinion, claim too many lives.

There is no substitute for adequate training. Some people may be under the impression that you can fly airplanes safely by piling regulation on top of regulation and then having a strict enforcement of the regulations. This is nonsense and can only prove that you can be killed legally. Regulations are necessary in some areas and

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particularly when they require the installation of minimum necessary equipment, personnel, training, etc., to do a job. But when desk-bound personnel attempt to set up a rigid pattern and division of duties for the operation of aircraft under all circumstances and the anticipation of all emergencies, we are flirting with death.

When the pilot becomes convinced that he must follow "the book" under all circumstances even though such action may destroy him and all his passengers, we are flirting with death. When we set up a rigid division of duties in the cockpit based on some preconception, we are flirting with death. The man in control of the aircraft, if well-qualified and adequately trained, is the best judge of the proper course of action to be taken in a given circumstance. The secret lies in such training and not in regimentation.

We have succeeded in making air transportation one of the safest means of travel. This has been accomplished despite the fact that this is potentially an extremely hazardous business. Accidents have disastrous consequences, and the high safety record can only be maintained by constant exercise of the highest degree of care. The exercise of such care must be based on knowledge backed with sound judgment. Any action which interferes with that exercise of judgment constitutes a hazard in this business.

We want to make it very clear at the beginning of this discussion that we are not opposed in any way to enforcement of the regulations. Without enforcement there would be very little purpose in having regulations. We urge, therefore, an effective, rational enforcement program having as its purpose the promotion of high standards of safety in aviation.

We believe very strongly, however, that any enforcement program must be very carefully planned around the primary purpose of the promotion of safety and that each enforcement action must be examined very carefully to determine the over-all safety implications of the action. If the result of the action is to convey false information or impressions to the individual affected and his associates that will jeopardize safe operation, these objectives are not being met.

The Federal Aviation Agency has embarked upon an enforcement philosophy during the last year which, while undoubtedly well-meant, is not, in our opinion, achieving its over-all safety objective. Rather, it has resulted in resentment and anxiety among the pilot group and others who now feel they are being influenced to a greater level of concern as to whether they are "legal" than whether they are operating safely and within their good judgment.

The federal regulations governing the operation of an aircraft are very extensive and detailed. Many of them were written originally as guides to good practice under normal conditions. Many were never intended to be arbitrary laws. With the extensiveness of these regulations, and the extent to which decisions remain a matter of judgment, a flight assignment will seldom be completed without deviation from some rule . . . if the rule is interpreted arbitrarily or by someone not experienced in the business. In addition, there are numerous rules which are very general and alleged violations are filed under such general charges as "careless and reckless operation." The net result is that there is a saying in the aviation fraternity that "it is impossible to fly a trip without violating a half dozen regulations." Therefore, if there is to be an arbitrary application of rules as written, the pilots would have no alternative but to insist that many of them be deleted or rewritten.

FAA Expansion

FAA has expanded very rapidly in recent years and many new people have been employed. There is limited opportunity within the Federal Aviation Agency to qualify flight operations personnel in airline type operations. It is only normal, therefore, that personnel errors will occur and this is recognized. However, the over-all enforcement program and philosophy should be such that adequate checks and balances will counteract for personnel errors and that the enforcement philosophy stresses the promotion of safety. This is much too important a subject to be entrusted to new employes without previous civil aviation experience.

We do not believe that it is fair to this committee to take their time to air individual grievances against the enforcement program and we will not do so. Unfortunately, more than half of a statement delivered before this committee was devoted to an attempt to paint certain groups as undisciplined and irresponsible, and many statements from which erroneous conclusions could be drawn were made. No use-

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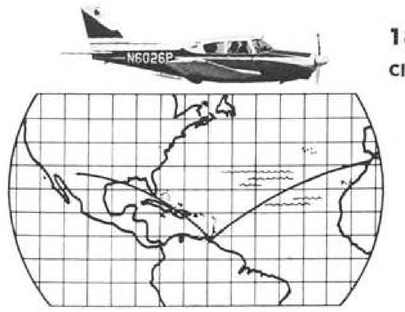

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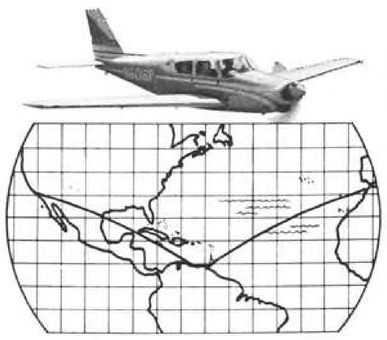

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ful purpose would be served by tediously going into each case and allegation and pointing out the errors, the erroneous assumptions, and the obvious fact that many of the complaints of FAA originated within FAA itself. Nor will we recite the series of incidents during the past year which have caused airline pilots to be extremely critical of the inspection and enforcement policies of FAA.

However, several points must be made. In recent months, the Federal Aviation Agency has embarked on a program of widely publicizing in the press every minor action which is taken against an airline, airman, or others. This is evidently to convey to the public the impression that this agency is the sole protector of the public interest in all matters of air safety against the "irresponsible" airlines, pilots, and other employes. The pilots and the rest of the industry are probably expected to absorb this type of treatment without comment since any criticism of the agency is met with tirades to the public press spread throughout the country by a large public relations staff at public expense. If the day has come, under our form of government, when individuals or organizations are to be intimidated from making proper criticisms of public officials and their actions, then the cause of safety will suffer badly.

There is no one protector of the public interest in air safety matters. The Congress has imposed a high degree of responsibility for air safety upon the airline companies in granting them their public franchises. A high degree of public responsibility has been placed on the airline pilot and other licensed airmen, and this individual responsibility cannot be delegated to the employer, to the government, or anyone else. ALPA has taken the lead in air safety matters since the inception of commercial aviation in this country and we intend to continue to do so. We are accustomed to public criticism when we champion causes of air safety which may be in controversy. We have learned, however, that the cause of progress is not always a popular one.

Near-Miss Reporting

We have mentioned previously that the elimination of the near-miss reporting procedure and substitution of enforcement action has eliminated the reporting of near-misses. It has not, unfortunately, eliminated the near-miss. It has only deprived the government and others of valuable information. It would be easy to say that people should still report but impractical to get them to do so.

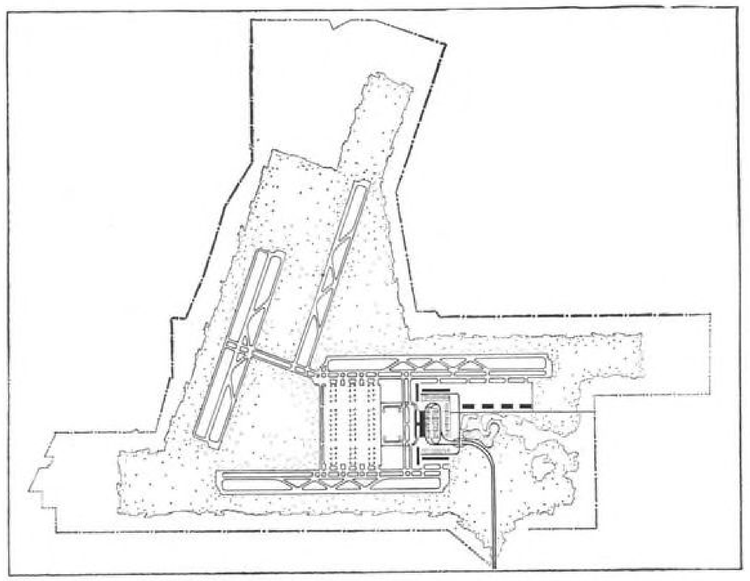
The following is an excerpt from an Air Safety Bulletin published by one of our Central Air Safety committees recently which indicates the attitude toward the present FAA program.

> "The Central Safety Committee provides every pilot with an easy way to report 'near-misses' without the possibility of ending up in an FAA interrogation. Just a note to your Local Safety Chairman stating that a 'near-miss' was experienced and the date is all that is required. This way we can show the industry what the 'near-miss' score is on at least one airline and maybe jar some people who think everything is fine on the airways. The results to date, thanks to the cooperation of all pilots, show that in the past ten weeks, our airline has experienced 14 'near-misses.' Included in the tabulation is one report from a DC-8. Let's hope you don't have a 'near-miss,' but if you do, let your Local Safety Chairman know about it."

An enforcement program which shuts off the flow of incident reporting and other vital information constitutes a serious hazard. A pattern of incidents, correctly reported and analyzed, will often reveal a serious accident potential. However, safety experts have recognized for many years that an incident reporting program must be fostered carefully and that it may easily be destroyed. We have been through this several times in civil aviation.

We urge immediate reinstatement of the near-miss reporting program and the development of an over-all program that will encourage the maximum of incident reporting of all kinds in the interest of early discovery of potential hazards. Unless the Federal Aviation Agency plans to grow to a force of hundreds of thousands of employes and inspectors, it cannot substitute itself for the honest and conscientious performance of work and reporting of incidents by the licensed airmen, maintenance personnel and others in aviation. This is a fundamental source of air safety information and any program of the federal government which discourages incident reporting and shuts off the flow of vital information to the government, the airlines, and organizations, constitutes a positive hazard.

In this connection, we have also urged FAA to establish a requirement for the submission of Daily Mechanical Irregularity Reports (DMIR's) to FAA and to establish an automated system of analysis of such reports. Presently the submission of such reports is voluntary and they are only analyzed by personal inspection. Under this system, incidents or irregularities to the same aircraft or component may be occurring at a dangerous level but on different carriers and much time may elapse or an accident occur before it is caught. For example, when the Electra crash at La Guardia occurred last year and raised the problem of altimeter irregularity, it was discovered that 21 irregularities with this particular altimeter installation had occurred at various times prior to the accident. The altimeters were subsequently removed.



Dulles International Airport Runway Layout

Design of Dulles International Airport shows two parallel north-south runways each 11,500 ft. long. Construction has begun on this and a west northwest-east southeast runway 10,000 ft. long. An additional runway to parallel the latter will be constructed when required by traffic. Airport is approximately 23 mi. due west of Washington and will cover 9,800 acres in Virginia (AW Feb. 1, p. 29).

Cockpit Absence

During 1959, the Administrator announced that pilots must remain in their seats at all times and enforcement action was taken against several pilots. Such a rule had been part of the regulations for many years and had been applied by the pilots based on their judgment. Now the Administrator was, in an arbitrary manner, to employ an apparently totally different interpretation, but no one has been able to determine what it is. Evidently, whether a pilot exercised good judgment in leaving the cockpit is presently to be subject to someone else's subjective judgment at a later date. This entire subject would appear ridiculous if it did not reveal a lack of understanding of the entire problem and of the serious safety problems connected with it.

Presumably the rule is to guarantee that there will be two pilots at the controls at all times. ALPA has strongly advocated for many years that this be done. Unfortunately, adopting the Administrator's interpretation of the rule will not accomplish it and merely creates other hazards and restricts the pilot's judgment.

As a practical matter, pilots must leave the cockpit to attend to their other statutory responsibilities aboard the aircraft, to make equipment and passenger compartment inspections, to maintain order, to navigate, etc. In addition, the sensible pilot makes a practice of leaving his seat periodically to stretch, restore circulation, and maintain alertness, and, of course, the lavatory facilities (which usually have a waiting line these days) are in the passenger cabin.

Under FAA regulations covering domestic flying, a pilot may be scheduled for eight hours of flying during an on-duty period of indefinite duration. Since the rule only encompasses scheduled work, the actual day with weather and delays may run 10 hr. or more of flying and 16 or more on-duty at the end of which the pilot may encounter flight conditions requiring his highest degree of skill and alertness.

Situation Exists

Under the FAA regulations covering international flying, a situation exists that we have been trying to remedy for many years.

It is still possible to schedule a flight crew for international operations composed of only one qualified pilot-in-command, assisted by a copilot, and a non-pilot third crew member to fly for 12 hr. Should there be adverse weather or other delays, the pilot may actually fly 14 or 15 hr. during a period of 20 to 24 hr. on duty. For example, the pilot may be scheduled for a flight of 11:30 with two intermediate stops of one hour each. He reports to prepare for the flight two hours before departure. The flight departs and one hour out develops mechanical trouble and returns to base. Three hours later the aircraft is repaired and the trip departs. Headwinds stretch the flight time to 12:45. On arrival at destination, the pilots have flown 14:45 and have been on duty continuously for 19:45. All perfectly proper under the regulations. This problem has been under consideration by CAB and now FAA for four or five years with no relief. In a jet, 14:45 is over 7,000 mi. of flying.

It appears that this rule applies only if FAA has not approved an operation to the contrary. On certain operations being conducted today, and which have been approved by the Federal Aviation Agency, one member of a two-pilot crew is required to leave his seat in order to perform en route navigation and is, therefore, absent from his flight station approximately 40% of the time. This has been brought to the attention of the Federal Aviation Agency but evidently this is an exception to the rule.

Now pilots with 20 and 30 years' airline experience and spotless flying records are being threatened with violations for, in their exercise of good judgment, leaving the cockpit for a few minutes. This, in light of ALPA's position for many years that it was imperative there be two pilots on the flight deck at all times and the recognition that this is only practical with the fail-safe crew previously described in this statement, will make it clear why pilots sharply resent the arbitrary rule.

Much has been made of the dive of a 707 aircraft over the North Atlantic last year which began during the time the pilot-in-command was absent from the cockpit. The FAA has publicized their action in this incident widely. We would like to point out several facts that were not publicized. At the time this incident occurred, the pilots of this airline, pursuing the policies of ALPA, had refused to operate the airline aircraft under the conditions approved by the Federal Aviation Agency and the airline because provision had not been made for manning the aircraft in such a manner that two pilots could be at the controls at all times. The aircraft was being flown by management personnel of the company. Their actions were contrary to the policies of ALPA and ALPA disciplinary action was taken against them for operating the aircraft under such conditions. When agreements were worked out between ALPA and the company providing for proper manning of the aircraft by fully qualified three-pilot crews and under conditions under which two pilots could be at the controls at all times, the pilots returned to the operation.

It is obvious that the captain could have been absent from the cockpit and his position unprotected as readily under the present interpretation of the rule as formerly. The fine imposed accomplished nothing except possibly to impress the public that FAA was protecting them. How they were being protected is not clear to us.

We recently received a telegram from one of our councils which read as follows: "Pilot grounded for refusing to crack-up." Subsequent investigation revealed that the pilot, during takeoff of a jet aircraft loaded with 125 passengers, suffered an engine failure at a critical point during the takeoff. Employing sound judgment, the pilot elected to continue his takeoff, successfully did so, and the engine was restarted in the air. In our opinion, and the record of operation with this type aircraft, had he elected to discontinue the takeoff and attempt to stop on the runway in question, the aircraft and its occupants would probably have been destroyed. On return to base, the pilot found that the FAA agent, who was riding his first check ride on a 707 airplane, had ordered the company to remove him from schedule and to retrain him.

The impression was therefore conveyed to this pilot, and all the other pilots operating this particular aircraft, that it was more important to follow a rule, dependent on judgment, arbitrarily than to employ sound piloting judgment of an individual experienced in the opertion of this aircraft. The company refused the retraining as unnecessary.

The company and ALPA intervened, the problem was resolved, and the pilot was returned to schedule.

We are wondering, however, how this pilot and other pilots similarly affected will react in the next such instance when conflict between sound, experienced judgment and a blind following of "the book" is involved. This is one of a number of similar incidents. We realized that these may occur with experienced personnel, however, we recommend that procedures be

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established under which an inexperienced or newly-employed inspector be required to discuss fully any complaint or incident which comes to his attention with a competent and experienced supervisor, the individual involved, and other affected parties, before hasty action is initiated and in order that the over-all safety ramifications may be properly evaluated.

We also urge government aviation inspectors be provided with proper qualifications in order that they are competent to evaluate the over-all safety significance of a particular problem. In this regard, maximum use should be made of the experienced, competent, and currently qualified inspectors and check pilots of the airlines whose work can be standardized by cooperation with the Federal Aviation Agency. This is the system of inspection, training and standardization that has been most successfully employed in the past. For the FAA to attempt to acquire, train, and keep currently competent sufficient personnel to duplicate the air carriers' supervisory staffs is an unwarranted and unnecessary expenditure of public funds that could better be employed elsewhere.

In a number of recent incident where an aircraft has experienced an obvious mechanical failure, the pilot of the aircraft has been subjected to flight tests. This is similar to becoming angry with your wife and kicking the dog. It serves no safety purpose. This should be immediately discontinued.

Rule-Making

The Federal Aviation Act of 1958 transferred complete authority for rule-making to the Administrator of the Federal Aviation Agency. No appeal from the actions of the Administrator is provided except the limited appeal provided under the Administrative Procedures Act. This Act does not permit review of the Administrator's "interpretation" of rules already in effect, in consequence "new rules" may be written in the guise of "interpretations" from which no right of review exists.

The Administrator may arbitrarily make any rule he desires, and his only obligation is to provide notice and to give the parties the opportunity to submit written comment. Hearings may be provided at the discretion of the Administrator and, when provided, may only provide the parties an opportunity to voice their views and are not for the purpose of developing evidence in the normal legal process. In effect, the Administrator becomes a complete czar over the entire aviation industry and may make any rule he desires subject only to compliance with the time limits of the Administrative Procedures Act, and that may only occur in those cases where the Administrator determines that the particular rule is not merely an interpretation of a previous rule.

We urged before Congress when the Federal Aviation Act was being considered that, while the Administrator should have rule-making authority, an appeal from his decisions should be provided. Experience under the Act to date has not altered our view but rather has strengthened it.

We believe that it was the clear intent of Congress to preserve the right of any airman or air carrier, to appeal to the Civil Aeronautics Board in any case where their in-

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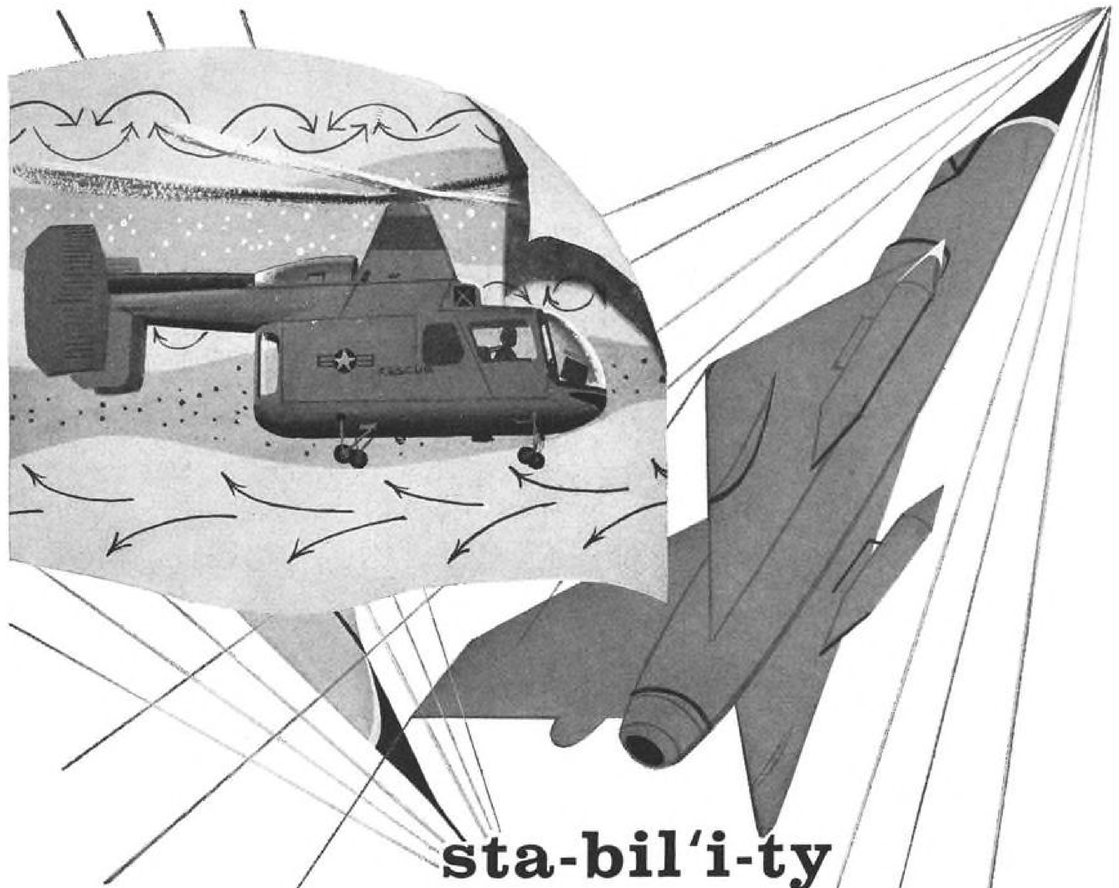

sta-bil'i-ty

World's Record #1

Bloomfield, Conn. — Air Force established new world record by flying Kaman H43-B turbine helicopter to 30,100 ft.

World's Record #2

Edwards AFB, Calif. — Air Force established new world record by flying Convair F-106 over an 18 km course twice, averaging 1,525.9 mph.

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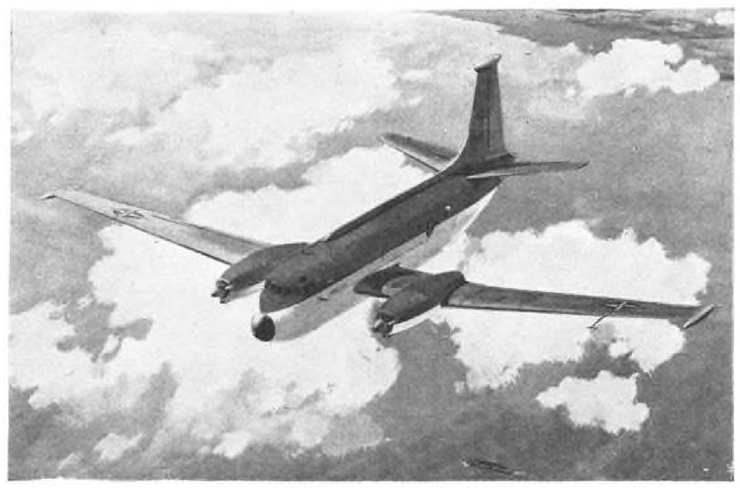

First Drawing Shows Breguet 1150

First drawing of the Breguet 1150 Atlantic shows the configuration of the anti-submarine warfare turboprop aircraft (AW Jan. 25, p. 35). Cruising speed is about 375 mph. The Atlantic is expected to be capable of 10-12 hr. of patrol work. Only the upper portion of the fuselage will be pressurized. First prototype is scheduled to fly in November, 1961.

dividual certificate was effected. We pointed out, at that time, and experience has confirmed, that providing the Administrator with arbitrary rule-making on one hand would give him the power to negate the appeal provisions of the Act on the other. For example, the Administrator may promulgate a rule which places a limitation on an airman's certificate and since this is accomplished under the rule-making authority of the Administrator, he may contend that the appeal provisions do not apply. On the other hand, an individual who has been affected by a rule of the Administrator and makes an appeal under the existing rule to the Civil Aeronautics Board may find that, while the appeal is pending, the rule has been changed and even if his appeal is successful, his case is lost.

Arbitrary Authority

We feel, therefore, that providing arbitrary authority to the Administrator on the one hand and attempting to maintain the right of appeal on the other is a most difficult if not an impossible undertaking, and that it would be more practical if the right of appeal was preserved in all such matters. As we contended during the consideration of the Federal Aviation Act, this would not hamper the efficient functioning of the Federal Aviation Agency but would serve to maintain the checks and balances necessary to preserve individual rights and avoid possible abuses.

We will comment briefly at this time on the rule-making during 1959, and since the FAA was created and return to these subjects in detail at a later time.

On Jan. 4, 1960, the Federal Aviation Agency issued a press release listing what they considered their major accomplishments during 1959. The following rules were listed:

1. Mandatory retirement age for air line pilots. FAA characterized this as "the most significant" of a number of changes in rules and regulations affecting air carrier operations. The rule effective Mar. 15, 1960, provides that "no individual who has reached this 60th birthday shall be utilized or serve as a pilot on any aircraft while engaged in air carrier operations."

We are unable to find any air safety justification for this rule. No accident or incident occurred during 1959 or any other year which has been attributed to the age of a pilot. The only pilots who could be affected are those who have been certificated as healthy and competent by the Federal Aviation Agency and their employer. No accident has ever been attributed to the chronological age or the physical breakdown of a pilot. The only individual affected would be one who has met all of the requirements laid down by the government for his license and who has met all of the requirements of his employer.

The Administrator freely admits in the notice adopting the rule that there is no evidence on which to base the rule.

Pilot's License

The rule does not revoke or suspend the pilot's license. The rule is directed at the air carrier and merely prohibits the carrier from utilizing the pilot. It is, therefore, an arbitrary order from the Administrator to the operator to discharge a competent, healthy, and fully licensed pilot. The rule applies only to carriers operating under Parts 40, 41 and 42 of the Civil Air Regulations. The same pilot, therefore, is fully licensed to operate any type of aircraft in general aviation and to fly passengers such as corporation executives, the President, senators, or anyone else.

In adopting this rule, the Administrator has made no attempt to provide for the individuals affected. Some pilots will be forcibly retired by the rule without any retirement income. Some will have a retirement income approximating 5 to 10% of their final earnings. Social Security is not

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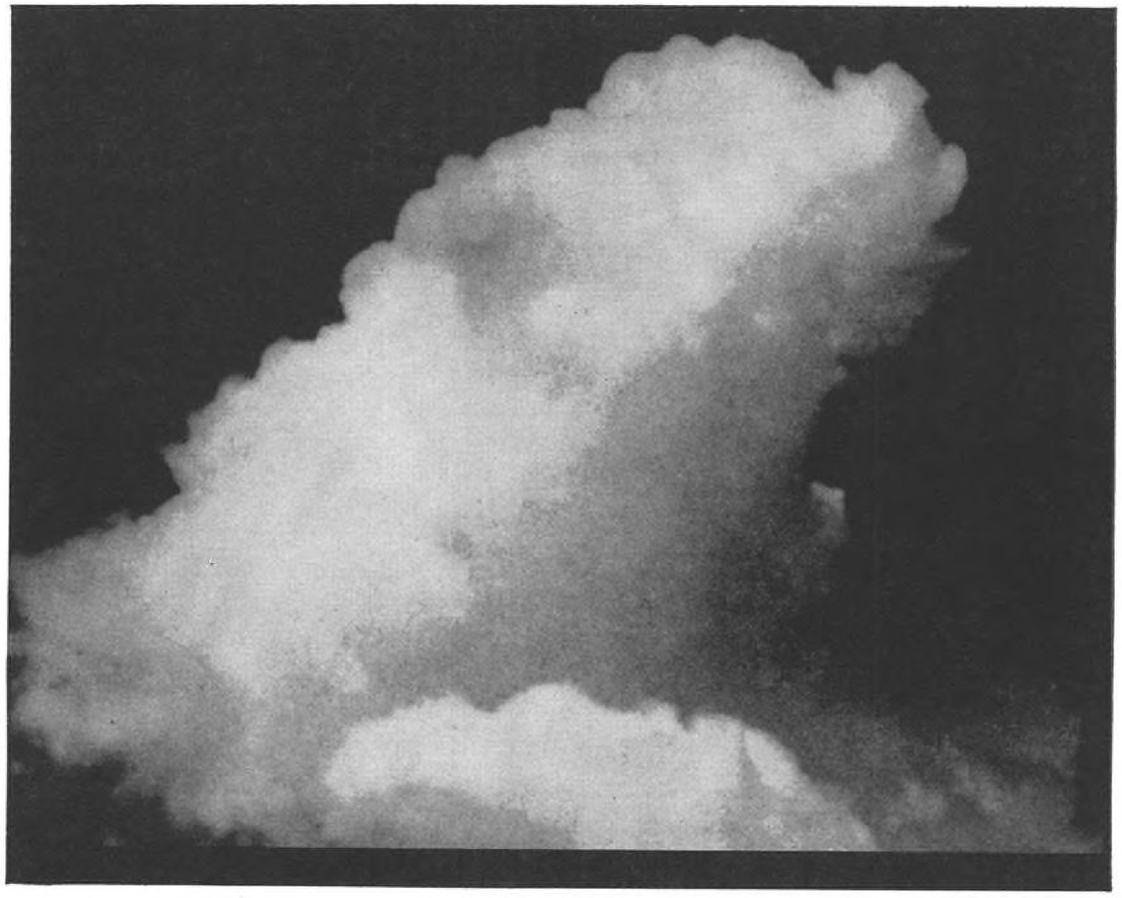

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available until age 65. To this date, the Administrator has not recommended to the Congress that the Social Security age for pilots be revised, or to the Civil Aeronautics Board that air carriers be required to provide minimum pensions.

There is no precedent in our government for this action. For that matter, the Congress and various agencies of the government have very active programs to preserve and utilize the skills of the older competent worker.

Appeal Rights

This rule, since it does not deprive the pilot of his license, has the effect of placing a limitation on his license. We believe it was the clear intent of Congress that a limitation may be placed on a pilot's license only by individual hearing under Section 609 of the Act and with full preservation of the individual's appeal rights. We believe that this is an instance of the Administrator using the rule-making procedure to take to himself authority which was reserved to the Civil Aeronautics Board, and to circumvent the clear intent of Congress to preserve individual rights of appeal in any case affecting an individual's certificate.

The air carriers and eventually, of course, the traveling public, must pay for this arbitrary action of the Administrator by losing the services of trained, experienced, competent pilots and having to train replacements and by replacing the income of the individuals affected.

From statements issued by the Administrator in the adoption of this rule, presumably his concern stems from the increased danger of in-flight incapacitation of the older pilot. To the best of our knowledge, we have conducted the only detailed study made in this industry on pilot incapacitation, and the results of our study show that in-flight incapacitations of pilots are a very real problem and occur frequently. However, they occur most frequently from such everyday causes as food poisoning and diarrhea which are not related to the age of the pilot.

However, even if we take coronary failure as the measurement, we find, for example, that there will be five times as many coronary failures among pilots in the 45-49 age bracket as in all pilots over age 60 in 1962. It is obvious, therefore, that the rule of the Administrator will do nothing to provide against the very serious problem of in-flight incapacitation of a crew member.

There is, however, a very real and practical way of providing against in-flight incapacitation and we have previously discussed in this statement the concept of the "fail-safe crew" in which each flight crew position is capable of being filled by more than one flight crew member.

No contribution to air safety has been made by his rule and no accident which occurred in 1959, or for that matter in any previous year, would have been prevented by it.

2. Copilot qualifications. As discussed previously, the rule, as adopted by the Administrator, fell far short of his proposal. A type rating is not required and a proficiency check is only necessary once every two years in an aircraft providing, during the intervening year, such a check is given in a simulator. We are hopeful that the Administrator will see fit to return to his original proposal since the rule adopted will not provide the level of training and qualifications necessary, the fail-safe crew is not provided, no protection is provided against incapacitation, and the qualified pilot is not guaranteed adequate assistance to do his job.

3. Approval of carrier training programs. We have previously discussed this rule. No curriculum or standards of training have been specified as yet but we hope to work with the Administrator to make this rule meaningful.

4. Medical revisions regarding diabetes mellitus, coronary heart disease, psychosis, etc. As far as we know, this rule would not have prevented any air carrier accident which has occurred in commercial air transportation in 1959 or any previous year.

5. Airborne radar. We have been strong advocates of this rule and welcome its adoption although we regret that time limits were were not stringent and hope that it will soon be extended to accommodate cargo aircraft, C-46 and DC-3 aircraft. Many models of cargo aircraft are now operating, and will be operating, on the nation's airways, and this essential protection for the crew, the airframe, and people on the ground should be provided. We have never been able to see the justification for differentiation between the airworthiness standards applied to passenger aircraft and cargo aircraft for any purpose and can see no justification for this differentiation. Similarly, the DC-3 and C-46 operate under conditions where airborne radar is very badly needed and these aircraft will be utilized in such operations for many years in the future.

Radar Policy

Airborne radar has been a policy objective of ALPA for many years and we urged the Civil Aeronautics Board and later the Federal Aviation Agency to propose and adopt this rule. It is our intention to monitor very carefully the operational rules which are to be established under the regulation for the use of this device which is probably one of the most important contributions to air safety in recent years and which, had it been in operation during the past six years, would have, according to our files, prevented seven accidents, 187 fatalities, and millions of dollars of cost in aircraft damage and deviations from planned flight routes.

6. Consumption of alcoholic beverages. The Administrator has adopted a rule which provides "(a) No person shall drink any alcoholic beverage aboard an air carrier aircraft unless such beverage has been served to him by the air carrier operating the aircraft. (b) No air carrier shall serve any alcoholic beverage to any person aboard an air carrier if such person appears to be intoxicated." We do not believe that this rule, as adopted, will contribute to air safety. It condones the consumption of alcoholic beverages on aircraft and goes so far as to provide that the passenger may bring his own liquor supply on board and have it served to him by the flight attendants. The determination of intoxication has always been a very complex legal problem and the judgment as to whether an indi-

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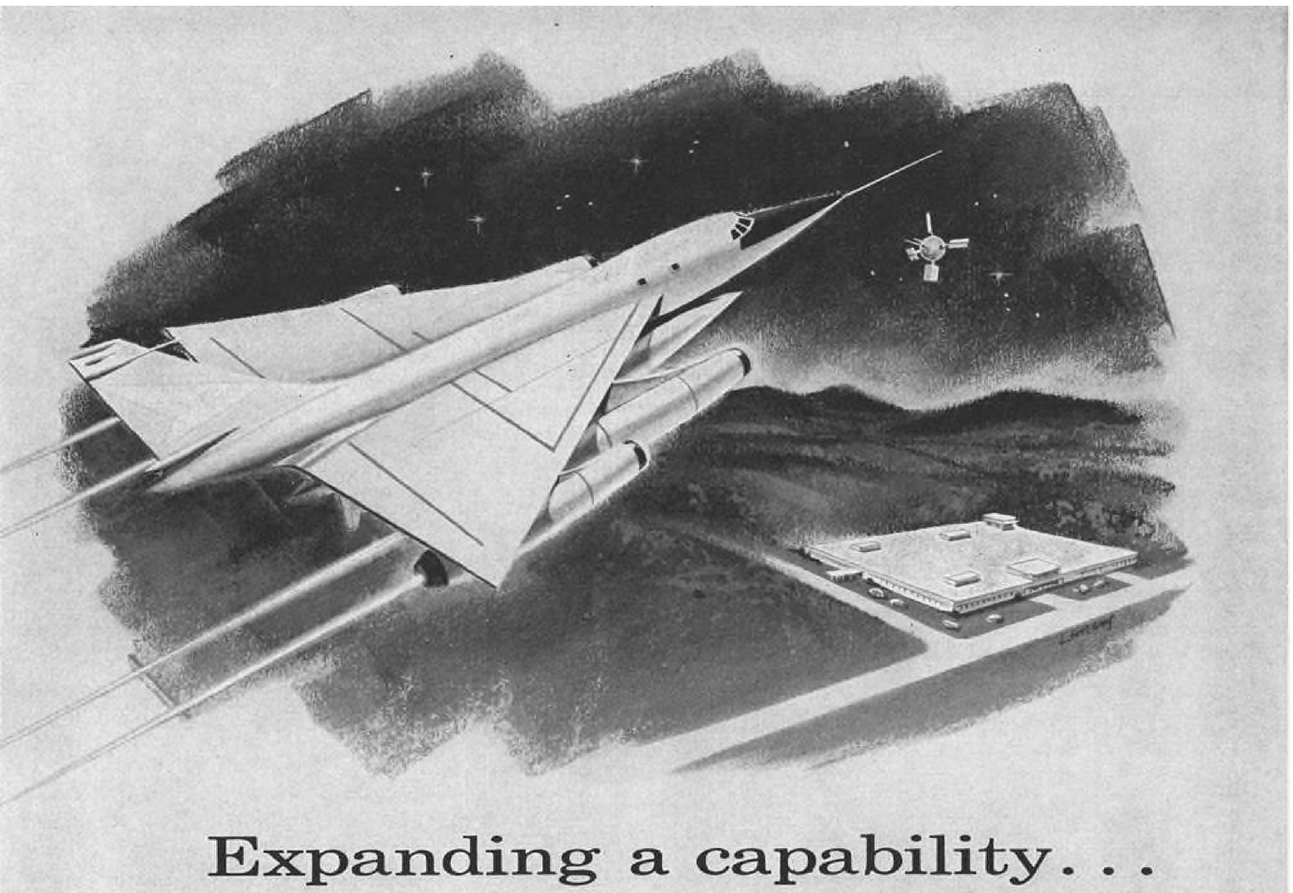

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Like the B-58's sophisticated search and Doppler radars, the systems, subsystems or equipments developed will find application in manned aircraft, missiles, drones, and a variety of space carriers.

To engineers and scientists with particular interest in this work, the new laboratory offers complete professional satisfaction in an academic environment. For immediate information on select staff appointments, write Mr. Donald H. Sweet, Engineering & Executive Placement, Raytheon, 624 O Worcester Road, Framingham, Mass. (suburban Boston).

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vidual has achieved this state is now placed entirely on the flight crews. Presumably if the flight crews do not carry out this responsibility, they are subject to violations. If they do carry out their responsibility, they must file the complaints against the individual affected (who may be one of the airline's best customers), and appear in the legal proceedings against the individual.

Regulation Weakened

It is obvious to us that this method of enforcement is completely impractical and the regulation merely indicates that the consumption of alcoholic beverages on board aircraft will now be condoned and that there is no effective method of preventing it. In our view, this regulation weakens the previous regulation which provided that ". . . A pilot shall not permit any person to be carried in the aircraft who is obviously under the influence of intoxicating liquor or drugs, except a medical patient under proper care or in case of emergency."

We cannot view this rule as any addition to safety.

It does, however, place the FAA in the position of having a regulation on the books in the event a disastrous accident results from the consumption of alcoholic beverages. Obviously, the person who became intoxicated and interfered with the safety of the flight had been doing so contrary to the regulations and the flight crew had not been carrying out their assigned responsibilities to prevent intoxication. An accident arising from alcoholic consumption will obviously be attributable to flight crew error.

In summary of the rule-making record in 1959, we must conclude that excluding the rule on airborne radar and the possibility of some help from the requirement that training programs be approved by the FAA, the Agency in its rule-making seems not to have diagnosed the needs of the industry during its first year of operation. Rather than coming to grips with the basic immediate needs of air safety, the emphasis seems to be on long-term research programs which hopefully will produce some result in the indeterminate future and an enforcement program which hopefully, in some way, will compensate for some of the inadequacies without removing the basic problems. Excluding the rule requiring airborne radar at a future date, none of the rules adopted would have prevented any of the accidents which occurred in 1959.

Needed Facilities

The installation of needed aviation facilities flowing from increased appropriations by Congress and the activity of some communities will be very helpful but should be greatly accelerated.

We would like to make a number of specific recommendations at this time.

1. We have noted with interest other specific recommendations made by the Air Transport Assn., on pages 17, 18, 19, and 20 of a statement made before this committee by Mr. Tipton. We endorse these recommendations and some of the following will be a repetition or re-emphasis of some of them.

2. We believe that a major effort should be made to improve the airport and terminal area facilities of this country without any further delay. This is, in our opinion, an emergency project without which the safety and efficiency of our air transportation system will be very severely handicapped. Without such an accelerated program, the tremendous investment that we are making in air traffic control facilities and new aircraft will be badly handicapped.

Necessary Projects

Among the varied projects necessary immediately to move this program are the following:

- **Immediate decisions** on standards for approach lighting and runway lighting.
- **Immediate research** and decisions on standards for airport fire-fighting and rescue equipment.
- **Immediate decisions on standards** for airport zoning and clearways along the line recommended by the Doolittle Commission.
- **Immediate steps to certificate** airports in line with the report of the Doolittle Commission.
- **Immediate installation** of known aids to navigation, such as (1) The establishment of control zones at all airports which are provided with instrument approach procedures; (2) The establishment of control towers at all airline airports; (3) The installation of standard approach lighting on all major instrument runways; (4) The installation of instrument landing systems on all major instrument runways; (5) An early decision on standards and installation of

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visual glide path equipment wherever necessary.

5. Extend the positive separation of aircraft under the air traffic control system to all operations above 10,000 ft. as quickly as possible.

4. Expedite the implementation of the standard short-range navigation aids to replace older and less reliable and efficient aids as soon as possible.

5. Improve the measurement of weather in the terminal area in order that the pilot will be in possession of more precise weather data.

6. Expedite a program of direct communication between the pilot and air traffic controller and take all possible steps to reduce the cockpit communications workload.

7. Immediately reinstate a positive system of near-miss and incident reporting that will encourage the maximum flow of such information to the federal government and aviation organizations.

8. Initiate immediate rule-making that will provide the traveling public with a fail-safe flight crew providing the same protection in the flight crew that is afforded in the other components of the aircraft.

9. Expedite research in every possible way for an airborne anti-collosion device that will restore the see-and-be-seen capabilities to the cockpit.

10. Amend the Federal Aviation Act of 1958 so as to provide that rule-making actions of the Administrator are subject to review by the Civil Aeronautics Board.

11. Amend the Federal Aviation Act of 1958 so that any doubt is removed that any action against a certificate of a carrier or airman is subject to the appeal provisions of the Act.

RAF Is Installing Runway Barriers

London—All Royal Air Force fighter and training stations are to be equipped with the Swedish-designed Safeland runway barriers at a total cost of approximately $2.24 million.

By 1961, about 40 RAF air bases will be equipped with the device.

It is estimated that half the cost of Safeland systems already has been saved by the first few installations, which are mainly in Germany, through stops made with the barriers. There have been 20 engagements with the net so far.

Safeland is a net of suspended nylon cords. When an aircraft engages the net, the vehicle's momentum drags coiled wire from drums, and the progressive braking force normally stops the aircraft in about 750 ft. The nets are not designed to stop propeller aircraft. Maximum aircraft weight that can be stopped with the system is 40,000 lb. The English Electric P.1 can be stopped from 85 mph. and the Hawker Hunter from 110 mph. Each barrier system costs about $50,400 and is operated electrically from the control tower. Erection time is 10 sec.

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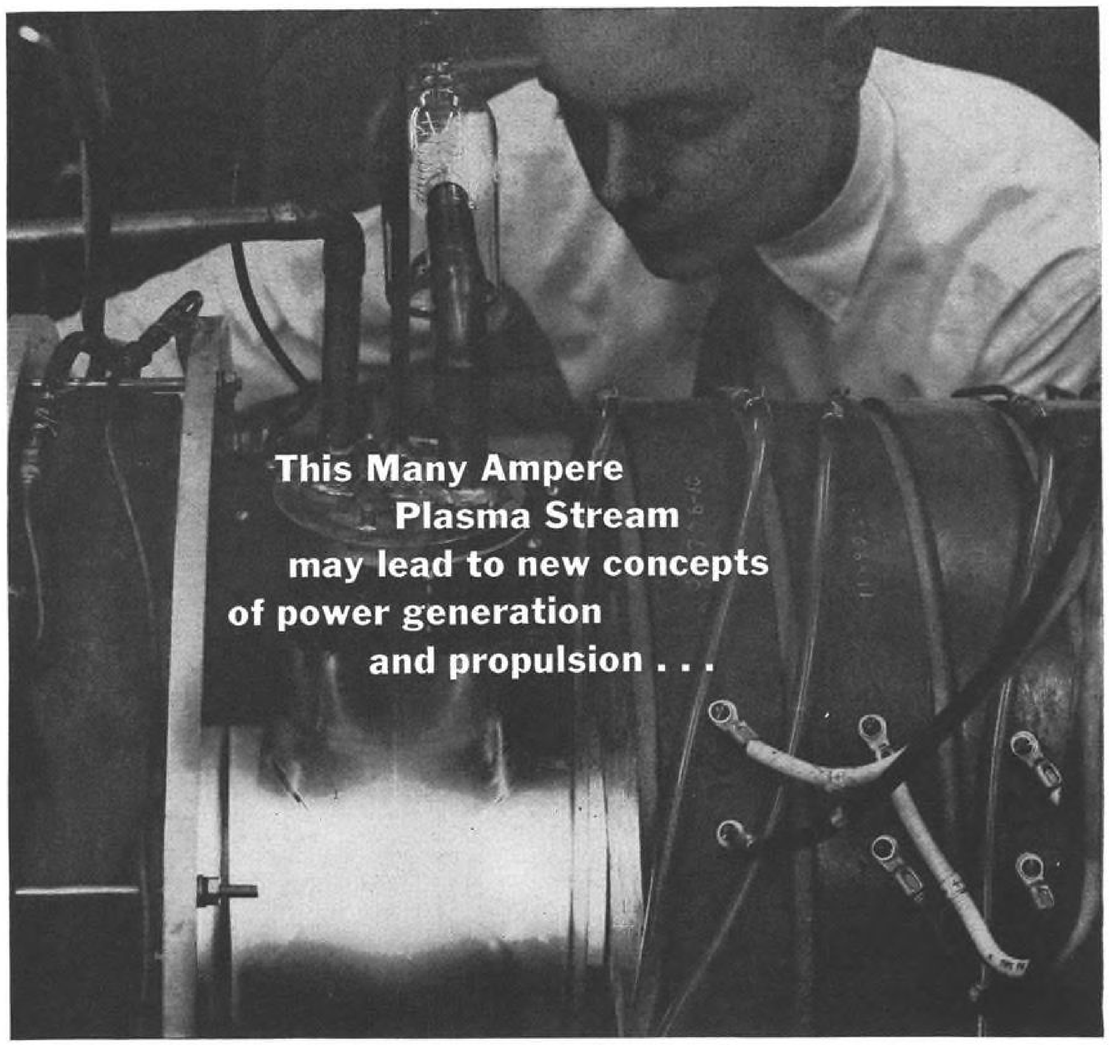

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WHO'S WHERE

(*Continued from page 23*)

Honors and Elections

Henry T. Harrison, director of meteorology for United Air Lines, has received the Applied Meteorology Award from the American Meteorological Society for his work in the field of aviation weather. Also, on behalf of AVIATION WEEK magazine, Flight Safety Foundation presented Mr. Harrison with an award for "distinguished service in achieving safer utilization of aircraft."

Dr. Paul Garber, head curator and historian of the National Air Museum, a unit of Smithsonian Institution, has been named recipient of the National Aeronautic Association's 1959 Frank G. Brewer Trophy in recognition of outstanding activity in the field of aviation education.

Okanagan Helicopters, Ltd., has been named the first recipient of the Lawrence D. Bell Helicopter Pioneer Award. Also: **Carl C. Agar,** one of the founders of Okanagan, has received the McKee Trophy of Canada and the Captain W. J. Kossler Award for his "contribution to the practical application and operation of rotary-wing aircraft."

Changes

Keith K. McDaniel, assistant chief of systems test-field operations, Aero-Space Division of Boeing Airplane Co., Seattle, Wash.

George V. Woodrow, Jr., director of weapon systems engineering, Philco Corp.'s Government and Industrial Group, Philadelphia, Pa.

Morgan E. McMahon, manager, and **Elmo E. Maiden,** assistant manager, Engineering Department of Pacific Semiconductors, Inc., Culver City, Calif., a subsidiary of Thompson Ramo Wooldridge, Inc.

K. P. Dowell will direct a new department covering large radar systems for defense and civil air traffic control for the Apparatus Division of Texas Instruments, Inc., Dallas, Tex. **A. L. Coulson** succeeds Mr. Dowell as manager of the division's Service Engineering Department, and he also will direct marketing activities.

R. W. Harbison, general manager of the newly established Service Division, Lear, Inc., Santa Monica, Calif. Also: **R. W. Richardson,** contracts division manager of Lear's Instrument Division, Grand Rapids.

T. C. Pitts, manufacturing manager, Boeing Airplane Co., Wichita, Kan. Also: **Verne Hudson,** head of an engineering department design study special task force for a carrier-based aircraft equipped to carry air-to-air missiles; **Robert Sivley** has been appointed assistant to Mr. Hudson.

Robert H. Cranshaw, manager-advanced space projects, Light Military Electronics Department, General Electric Co., Utica, N. Y. Also: **J. L. Comer,** manager of the newly formed Product Information subsection of LMED.

Paul W. Crapuchettes, technical director, Litton Industries Electron Tube Division, San Carlos, Calif. Also: **William F. Boyd,** general manager of Litton's Airtron Division, Morris Plains, N. J.

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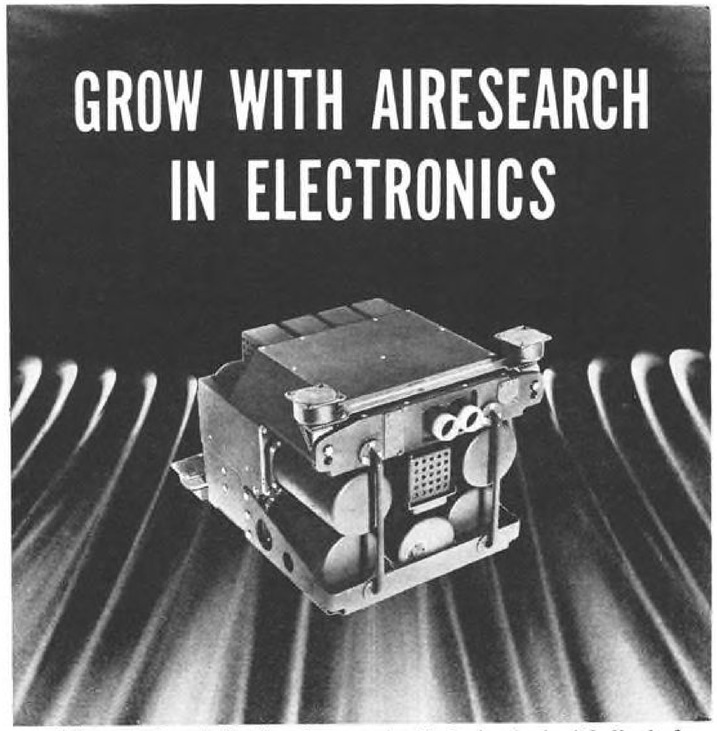

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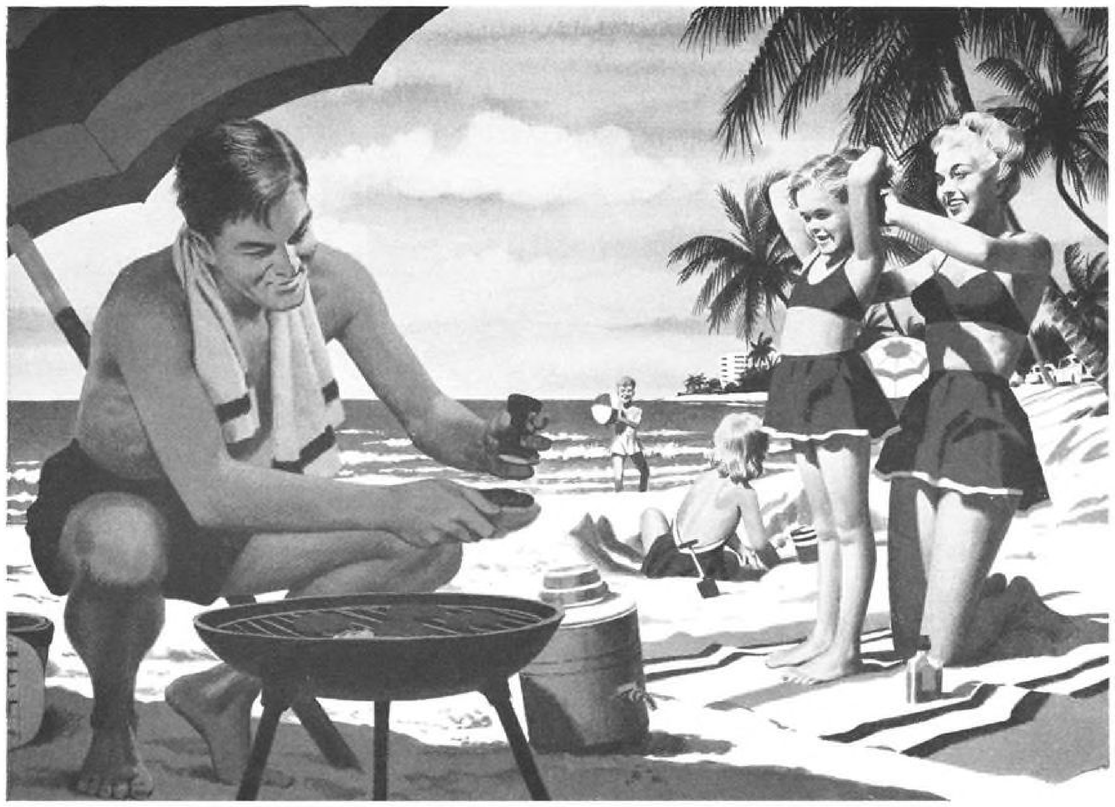

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LETTERS

Decca System

I refer to the news item "FAA Raps Decca" in your Jan. 4 issue (p. 27), and also to an article in the British Daily Telegraph containing a synopsis of the FAA report press release. I cannot comment fully until the actual report is available, but as a practicing airline pilot with considerable experience on Decca Mark 10 I would like to make the following observations:

(1) Within the normal rated coverage of the European Decca chains, i.e. 220-250 naut. mi. by day and 200 naut. mi. by night, I personally have not encountered deviations of the tracking pen on the log chart.

(2) I cannot understand the criticism relating to difficulties encountered due to lack of a preprinted course. It is the normal practice to have tracks printed on the flight log charts for en route navigation in accordance with the ATC rountings which are predetermined, anyway. However, Decca is used without difficulty in the London Control Zone every day without a preprinted course being incorporated on the flight log chart, and, in fact, one of the big advantages of the Decca system with its pictorial presentation is that one can see at all times one's position relative to holding areas, runway extensions, etc.; and on the subject of holding areas, one of the major advantages of Decca over other systems is that the captain can see exactly where he is in the holding area and is able to stay precisely within the holding area regardless of the wind position. This results in minimum workload and consequently far less strain on the pilot.

(3) I do not understand the criticism relative to performance at intermediate ranges. I have experienced satisfactory operation on European Decca Chains up to the ranges quoted above, and frequently ranges in excess of these figures are encountered.

(4) Decca is not, of course, an instrument approach aid but it does prove extremely useful for lining up with the ILS localizer and also for break-cloud procedures to runways not equipped with a precision approach aid.

(5) I would not agree that manipulation of the Decca controls is "relatively cumbersome." The initial setting-up is perfectly straightforward and during flight little manipulation is required.

J. Monro (Captain)
"Alsterlea"
Eghams Wood Road
Beaconsfield, Bucks
England

Rhyme Author

With reference to your Nov. 30 issue, on p. 110 you published the Range Rhyme, "Medaris, von Braun and Me."

The author of this is Ivan Hirshburg, a member of the test lab group at ABMA.

So many have enjoyed his verse he should get due credit for his effort.

Eugene C. Hadley
Garden Grove, Calif.

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.

Human Factors

The report of the British aircraft accident investigation of the Juliett Echo, contained in your issue of Dec. 14 (p. 119), is most interesting. The investigator has a very pleasing way of expressing himself. His slight trace of pique lends a further touch of intrigue as to whose toes he stomped on and caused him to become defensive. With very little imagination, the report could be woven into a novel to rival "The Wreck of the Mary Deare."

But of much greater interest to me is that this British aircraft accident investigation seems to highlight a fundamental difference in approach. In this report, the investigator places great emphasis on the human factors involved. As in so many accidents, this one was caused by a failure in the cockpit.

The investigator, therefore sets out to ascertain "why the pilot failed." He retraced the lives of the crew for the period immediately preceding the accident and developed a rather seamy picture of an aircraft charter company trying to operate on a shoestring and on the verge of panic to avoid impending bankruptcy. "Why the pilot failed" is clearly revealed.

Contrast this British accident report to that by our own CAB as illustrated in your issue of Jan. 11 (p. 127) covering the accident involving a DC-3 aircraft at Kerrville, Tex. The CAB report makes only the briefest reference to the human factors involved. It cites the probable cause as simply "the captain's poor judgment in continuing into known and dangerous icing conditions."

Why an experienced plane captain failed is not explained. In this case Capt. Epps' "poor judgment" is the "effect" rather than the "cause."

The cause is really the physical and mental fatigue of more than 25 hr. flying within a 40-hr. period—McGuire AFB to Boise, Idaho (14 hr.?) to Pueblo (5 + 28) to Kerrville (5 + 37).

All of this correlates to your editorial of Jan. 11 entitled "The Safety Problem." There is a great deal of emphasis on mechanical means to achieve safety—both in aircraft equipment and in air traffic control techniques. This is certainly important, but ultimately everything rests on the individual operators of the equipment and who must make the system work. This, in turn, presupposes we have financially healthy and competitive aviation companies which are capable of exercising sound personnel programing and management techniques.

David G. Cogswell
Lt. Col., USA
Springfield, Va.

Bombs on Airliners

The problem of bombs planted aboard commercial aircraft has resulted in several impractical or impossible suggestions for detecting such bombs. X-ray, fluoroscope, or visual inspection of the baggage is suggested most frequently. Aside from the real significance of the delay and inconvenience entailed by these methods of inspection, it has been entirely overlooked that a passenger may very easily carry a bomb on his person. Preliminary evidence concerning the crash involving the National Airlines DC-6 indicates that if a passenger did set off a bomb he was carrying it on his person.

Thus, if inspections were initiated, it would be necessary to examine the passengers as well as the baggage.

The application of X-rays or fluoroscopy to passengers is out of the question for obvious reasons.

And how many passengers would consent to a visual inspection of their persons each time they boarded a plane?

The dilemma might seem insoluble in a practical manner. However, if one considers the intent of the bombings, there remains at least one simple, painless, and possibly even successful, solution to the problem; namely publicize the capabilities of the aircraft accident investigation branch of the Federal Aviation Agency in the same manner that the FBI is publicized.

In all aircraft bombing plots there appears to be one desired result in addition to destroying the aircraft. The crash must appear to be accidental, otherwise, the ultimate purpose of the plot is likely to be discovered.

To the bomber, planting a bomb on a commercial aircraft seems like an obvious way to avoid detection of the plot. The aircraft wreckage is likely to be scattered widely in many pieces. Moreover, many people will be involved in the crash thus obscuring the criminal and his intent. Unfortunately, the criminal probably has never heard of the accident investigation teams of the FAA. These extremely able teams, as Aviation Week readers should be aware, have had remarkable success in identifying the cause of numerous crashes where the cause was considerably more obscure than a bomb.

However, their work has gone unnoticed by the general public because, unlike the FBI, they are concerned primarily with aircraft rather than people. The combination of the FAA and FBI teams makes concealment of an aircraft bombing extremely difficult.

The advertising of this fact and its realization by the general public might well serve to discourage further bombing attempts.

Walton Howes
Euclid, Ohio

(CAB now assigns a "Human Factors Team" to each fatal accident investigation as a routine procedure. Since last October, the team has participated in six investigations involving fatalities.—Ed.)

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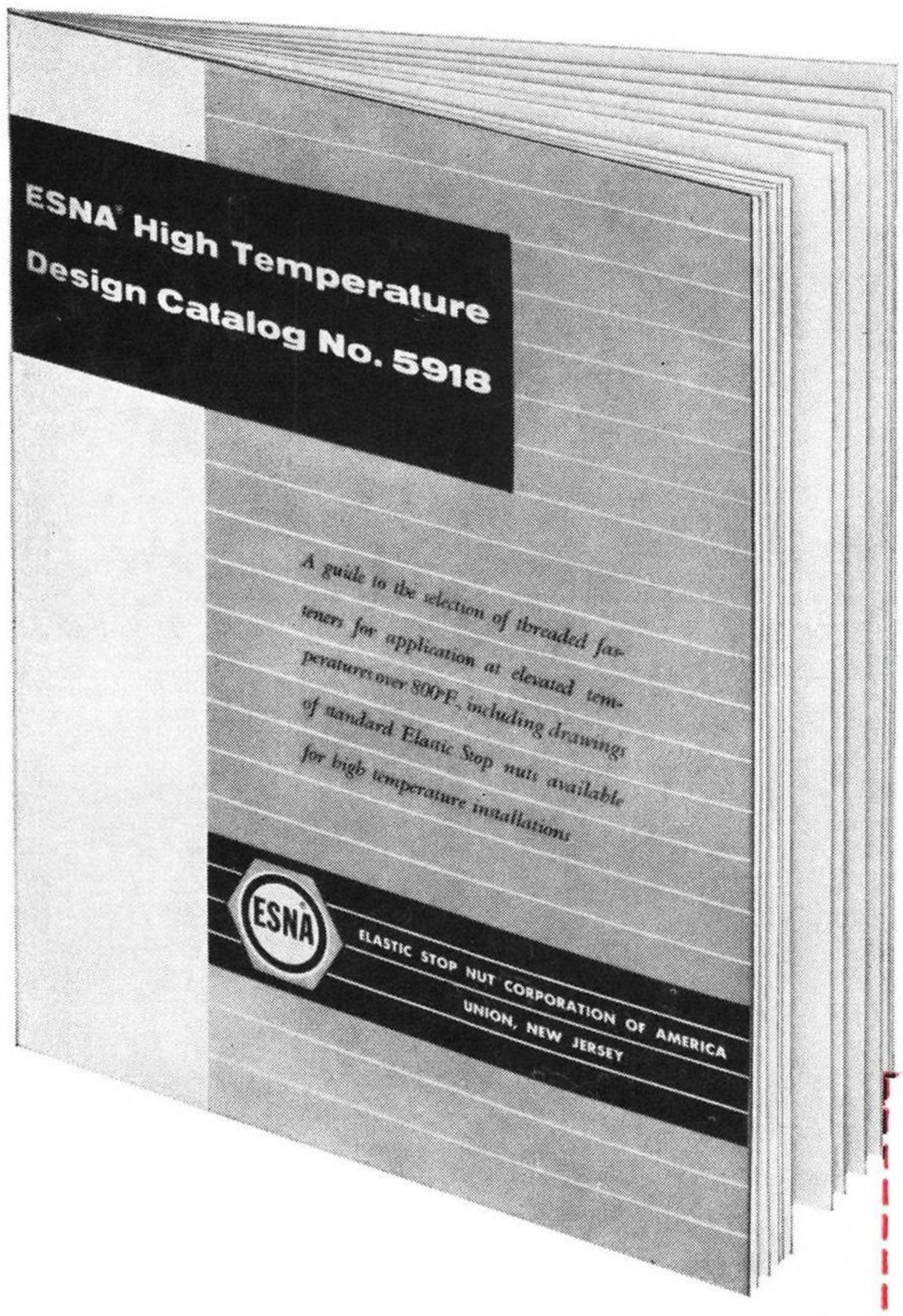

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