Aviation Week

Including Space Technology

5 Cents

A McGraw-Hill Publication

November 2, 1959

Piper Unveils Aztec as Spur To 1960 Sales

Igor Sikorsky Tests S-60 Pod Concept

CL-44 Freighter Aims at Low-Cost Operation

SURVEILLANCE DRONE SYSTEMS BY AEROJET

The Army's AN/USD-2 is today's most advanced drone system for gathering information on enemy battlefields. This high-priority Army program is a major part of Aerojet's acquisition of the Rheem Defense and Technical Products Division at Downey, California. Under the cognizance of Aerojet's Aeronautical Division, the SD-2 project is receiving increased emphasis during its advanced system development stages.

Developed for the Army Signal Corps, the SD-2 is launched from a standard Army trailer and flown by remote control to survey enemy positions. Its sensory compartment accommodates photo transmission systems, infrared, radar or other new electronic devices that transmit or bring back data. Outstanding characteristics of the SD-2 are the stable flight platform, sophisticated navigational system and unique parachute recovery, which make it ideal for a variety of military assignments.

Aerojet-General® CORPORATION

A SUBSIDIARY OF THE GENERAL TIRE AND RUBBER COMPANY

Plants at Azusa, Downey and near Sacramento, California

Engineers, scientists — investigate outstanding opportunities at Aerojet

High temperature regulator and shutoff valve provides proven reliability for the anti-icing system on jet engines.

Still *Another* Hydro-Aire Product for the *Aircraft* and *Missile* Industries

This Hydro-Aire regulator and shutoff valve will be of interest to designers of any system which draws hot air from the compressor bleed. As developed for anti-icing systems of jet engines, it has proven extremely reliable on advanced military and civil aircraft.

Performance and specifications:

Line Size, 2.0″
Operating pressure range, 12 to 275 psig.
Ambient temperature, —65°F to 500°F.
Inlet line temperature, 800°F.

Regulated discharge pressure of 13 psig nominal with an inlet pressure of 220 psig over specified temperature range. Pilot valve for shutoff operated by 400 cycle, 110 volt AC solenoid.

Write for further information or detailed specifications on Part Number 35-265.

Engineers: Several interesting opportunities are available. Please submit your resume to Mr. Nickerson, Chief Engineer, 3000 Winona Avenue, Burbank.

HYDRO-AIRE
BURBANK, CALIFORNIA
Division of CRANE CO.
Developers and producers of reliable control components, sub-systems and systems for aircraft, missiles, electronics, transportation and general industry.

AVIATION CALENDAR

Nov. 2-4—National Midwestern Meeting on New Frontiers in Aviation, Institute of the Aeronautical Sciences, Hotel Lassen, Wichita, Kan.

Nov. 2-5—Fall Meeting, Western States Section, Combustion Institute, Institute of the Aeronautical Sciences Bldg., Los Angeles, Calif. Subject: Equilibria and Performance of High Temperature Systems.

Nov. 3-5—11th Annual Mid-America Electronics Conference, Hotel Muehlebach, Kansas City, Mo. Sponsor: Institute of Radio Engineers' Kansas City Section.

Nov. 4-6—National Automatic Control Conference, Sheraton Hotel, Dallas, Tex. Sponsors: Institute of Radio Engineers; American Institute of Electrical Engineers; Instrument Society of America; American Society of Mechanical Engineers. AIEE is conducting a parallel Control System Components Conference on Nov. 5-6.

Nov. 9-11—Fourth Instrumentation Conference and Exhibit, Biltmore Hotel, Atlanta, Ga. Sponsors: Institute of Radio Engineers' Professional Group on Instrumentation and the Atlanta Section.

Nov. 9-20—13th Annual Air Transportation Institute, American University's School of Business Administration, Washington, D. C.

Nov. 11-13—16th National Meeting, Operations Research Society of America, Huntington-Sheraton Hotel, Pasadena, Calif.

Nov. 12-13—Quarterly Regional Meeting, Assn. of Local Transport Airlines, Marrott Hotel, Indianapolis, Ind.

Nov. 16-19—14th Annual Meeting and Astronautical Exposition, American Rocket Society, Sheraton-Park Hotel, Washington, D. C.

Nov. 16-20—20th Annual Convention, National Aviation Trades Assn., Hotel Montleone, New Orleans, La.

(Continued on page 6)

AVIATION WEEK Including Space Technology

November 2, 1959

Vol. 71, No. 18

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AVIATION CALENDAR

(*Continued from page 5*)

Nov. 17—Fall Meeting, Society of Aircraft Materials and Process Engineers' Eastern Division, Sheraton Carlton Hotel, Washington, D. C.

Nov 17-18—Technical Seminar, American Society of Tool Engineers, Sheraton Hotel, Philadelphia, Pa. Topic: Problems of Machining Space Age Metals.

Nov. 17-18—National Turbine-Powered Air Transportation Meeting, Institute of the Aeronautical Sciences, Fairmont Hotel, San Francisco, Calif.

Nov. 17-19—34th Meeting, Aviation Distributors and Manufacturers Assn., Diplomat Hotel and Country Club, Hollywood, Fla.

Nov. 17-19—1959 Northeast Electronics Research and Engineering Meeting, Institute of Radio Engineers, Boston Commonwealth Armory, Boston, Mass.

Nov. 19-20—Seventh Annual Aircraft and Missile Division Conference, American Society for Quality Control, Sheraton-Dallas Hotel, Dallas, Tex.

Nov. 23-24—Symposium on Solid Facts about Solid State, Instrument Society of America, Ben Franklin Hotel, Philadelphia, Pa.

Nov. 30-Dec. 4—Fourth Annual Naval Air Weapons Meet, Operation "Top Gun," Marine Corps Auxiliary Air Station, Yuma, Ariz.

Nov. 30-Dec. 4—First industry and government-wide training course in Value Engineering & Analysis, Industrial Education Institute, Boston, Mass.

Nov. 30-Dec. 4—Annual Meeting, American Society of Mechanical Engineers, Chalfonte and Haddon Hall Hotels, Atlantic City, N. J.

Dec. 1-3—Eastern Joint Computer Conference, Statler Hilton Hotel, Boston, Mass. Sponsors: Institute of Radio Engineers; American Institute of Electrical Engineers; Association for Computing Machinery.

Dec. 7-8—Classified symposium on "The Plasma Sheath, Its Effect on Communication and Detection," Boston, Mass. Sponsor: Electronics Research Directorate, Air Force Cambridge Research Center.

Dec. 7-11—National Conference on the Application of Electrical Insulation, Sheraton-Park Hotel, Washington, D. C. Sponsors: American Institute of Electrical Engineers; National Electrical Manufacturers Assn.

Dec. 8-9—First Aerospace Finishing Symposium, Hotel Texas, Fort Worth, Tex. Sponsors: Society of Aircraft Materials and Process Engineers; Dallas-Fort Worth Branch of the American Electroplaters Society.

Dec. 17—23rd Wright Brothers Lecture, Natural History Bldg., Smithsonian Institution, Washington, D. C. Dr. Alexander H. Flax, chief Air Force scientist, will speak on "High Temperatures in Hypersonic Flow—Physical Principals and Experimental Techniques." Dr. Flax will repeat his lecture on Dec. 18 before the IAS Cleveland Section, on Dec. 21 before the IAS Los Angeles Section, and again on Dec. 22 before the IAS Texas Section.

"Airline pilots prefer concrete runways because only concrete provides the added safety factors"

Says **CAPT. R. A. STONE,** *veteran airline pilot*

"On take-offs, a level concrete pavement eliminates the disturbed airflow over the wings so frequently caused by a wavy, flexible pavement pitching the airplane nose-up and nose-down. Also, there's no dragging action on the wheels such as flexible pavement has when it softens. On concrete you accelerate to safe flying speed fast and without a lot of bumps and jolts. Furthermore, concrete means cooler temperatures on the runway which in turn mean greater lifting power from the wings and greater horsepower from the engines.

"For landing at night or in fog, we still have to see the runway, even with all our modern electronic aids. Concrete is much more visible under these conditions because it reflects light instead of absorbing it; the concrete runway stands out instead of blending in with the dark background.

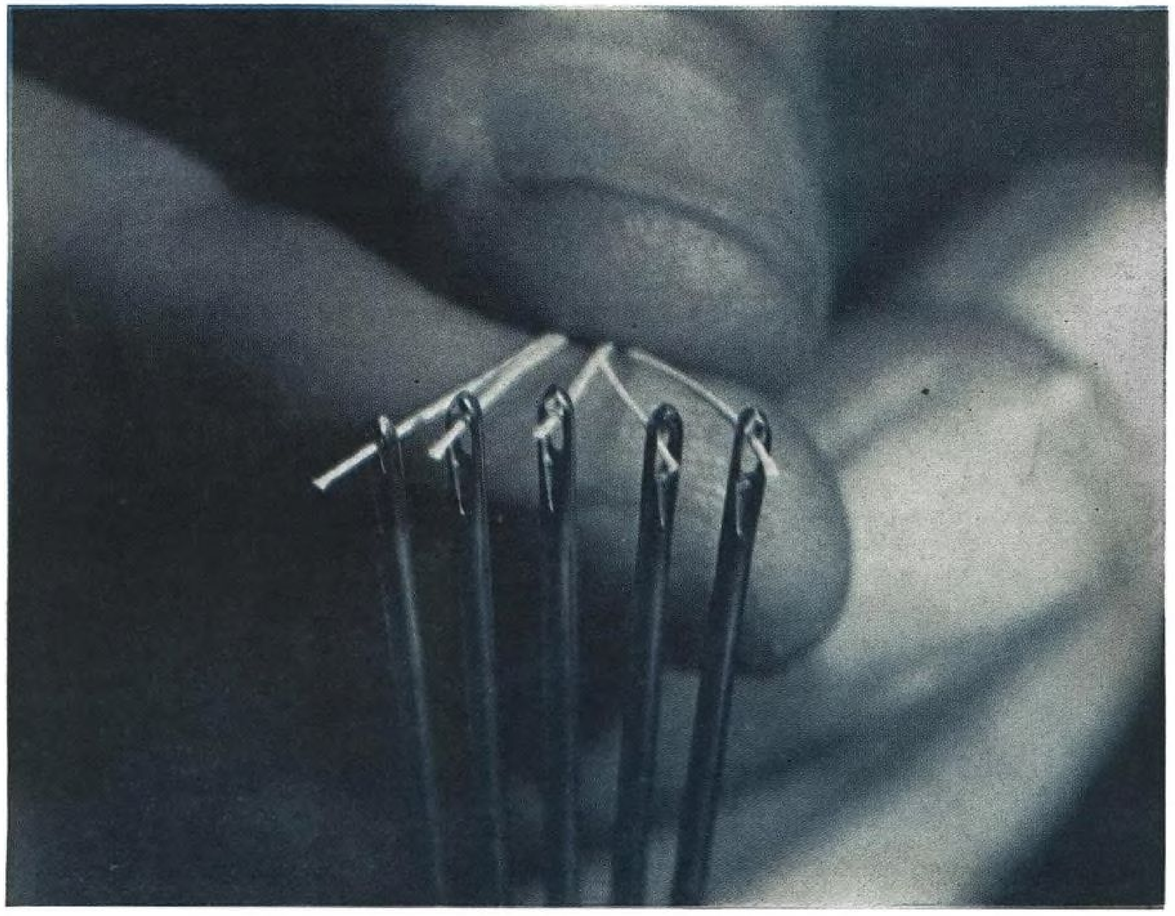
"Better braking is important, especially in wet weather when you're trying to stop 50 tons of airliner that touches down at 125 miles an hour. (The new jets are even heavier and faster.) Tires can always take a good, firm grip on skid-resistant concrete.

"While everybody wants this kind of safety, some people think concrete is too expensive. However, all the figures we've seen show concrete actually saves real money for airports. The airline pilots recommend spending what it takes to get safety now and simultaneously gain the practical, money-saving advantages of concrete throughout the years ahead."

PORTLAND CEMENT ASSOCIATION

A national organization to improve and extend the uses of concrete

Ever try threading five needles at once?



Cubic has, electronically speaking. And far greater precision is required of the five-target Cubic MOPTAR which will be used by the Federal Aviation Agency to evaluate experimental air-traffic-control systems. MOPTAR (Multi-Object Phase Tracking and Ranging), an *omni-directional* system requiring *no moving antennas,* provides startlingly accurate real-time position data. MOPTAR can be expanded to track *hundreds of aircraft* simultaneously with this same accuracy. The FAA installation will monitor other systems in tests at the new National Aviation Facilities Experimental Center near Atlantic City. It's a new use for Cubic's Space Age tracking systems developed under the forward-looking sponsorship of the United States Air Force. Now MOPTAR finds a non-military application in helping solve the problems of air navigation, an application that will lead to greater safety in the traffic lanes of the sky.

MOPTAR

CUBIC CORPORATION

ELECTRONIC ENGINEERING — WITH A DIMENSION FOR THE FUTURE

5575 Kearny Villa Road, San Diego 11, Calif.

Tracking systems by Cubic . . . reliable precision systems with Space Age capability . . . find application in air traffic control and, through the multiple-target potential of MOPTAR, in increasing the fire-power of America's guided missiles.

XXV

This is the twenty-fifth 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.

Thermal Stress-Relieving of Alloy Steels

In the production of alloy steel bars and parts made of alloy steel, stresses are sometimes set up, and these stresses must be relieved before optimum results can be expected. Two general types of stress-relieving are practiced—thermal and mechanical. In this discussion we shall consider only the former.

There are several important reasons for thermal stress-relieving. Among these are the following:

(1) The first and most fundamental purpose is to reduce residual stresses that might prove harmful in actual service. In the production of quenched and tempered alloy steel bars, machine-straightening is necessary. This induces residual stresses in varying degrees. Bars are usually stress-relieved after the straightening operation. When the bars are subjected to later processing that sets up additional stresses, subsequent stress-relieving may be necessary.

(2) A second major purpose of thermal stress-relieving is to improve the dimensional stability of parts requiring close tolerances. For example, in rough-machining, residual stresses are sometimes introduced, and these should be relieved if dimensional stability is to be assured during the finish-machining.

(3) Thermal stress-relieving is also recommended as a means of restoring mechanical properties (especially ductility) after certain types of cold-working. Moreover, it is required by the "safe-welding" grades of alloy steels after a welding operation has been completed.

Alloy bars are commonly stress-relieved in furnaces. Temperatures under the transformation range are employed, and they are usually in the area from 850 deg to 1200 deg F. The amount of time required in the furnace will vary, being influenced by grade of steel, magnitude of residual stresses caused by prior processing, and mass effect of steel being heated. After the bars have been removed from the furnace, they are allowed to cool in still air to room temperature.

In the case of quenched and tempered alloy bars, the stress-relieving temperature should be about 100 deg F less than the tempering temperature. Should the stress-relieving temperature exceed the tempering temperature, the mechanical properties will be altered.

Items other than bars (parts, for example) can be wholly or selectively stress-relieved. If the furnace method is used, the entire piece is of course subjected to the heat; selective relieving is impossible. However, if a liquid salt bath or induction heating is used, the piece can be given overall relief or selective relief, whichever is desired.

Detailed information about stress-relieving is available at all times through Bethlehem's technical staff. Feel free to consult with our metallurgists, who will cooperate fully without cost or obligation on your part. And remember that Bethlehem can furnish the entire range of AISI standard alloy steels, as well as special-analysis steels and all carbon grades.

BETHLEHEM STEEL COMPANY
BETHLEHEM, PA.

Export Distributor:
Bethlehem Steel Export Corporation

BETHLEHEM STEEL

JETLINERS DEMAND JET-AGE BRAKES

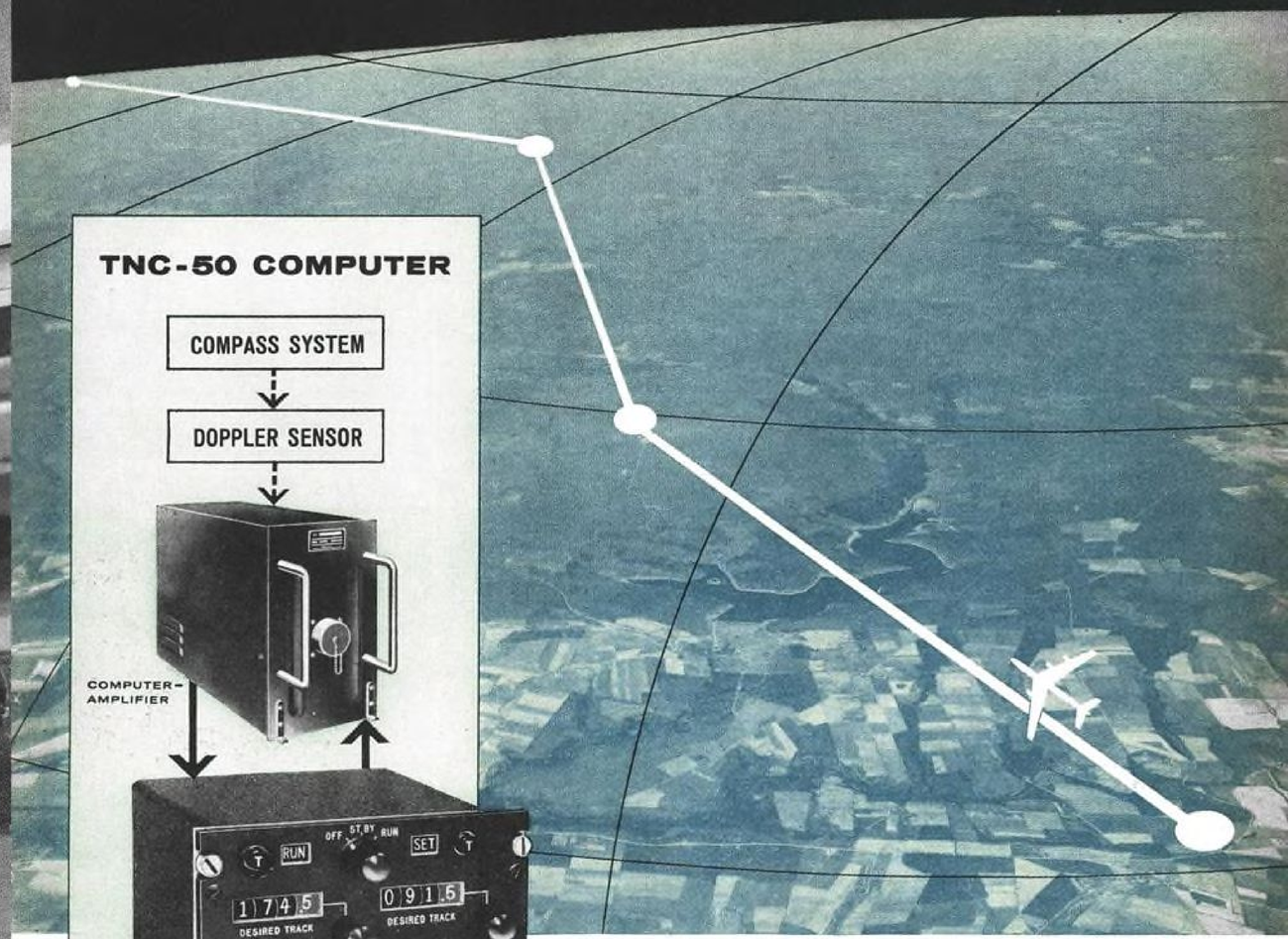
From touch-down to the end of the landing run, Bendix brakes provide smooth and certain ground control for the magnificent new jet airliners . . . To get brakes that measure up to the exacting standards of these swept wing giants, it was entirely logical to look to the world's most experienced supplier . . . For similar reasons, Bendix brakes are regular equipment on the largest and fastest military jets, as well as fully certified by FAA for the new civilian jets . . . BRAKES BY BENDIX is another important reason why you can fly the jetliners with complete assurance.

Bendix PRODUCTS DIVISION South Bend, IND.

Bendix AVIATION CORPORATION

GPL track navigation computer TNC-50

continuous readings of distance to go and distance off track...



TNC-50, GPL's new Track Navigation Computer, provides direct outputs of distance to destination and distance left or right of track. Designed to function with ARINC and other Doppler sensors, and any modern aircraft heading reference, the TNC-50 provides additional outputs for flight directors, autopilots, and attachments.

REALISTIC APPROACH: Utilizing the concept that a flight plan is composed of one or more segments, the TNC-50 provides continuous progress displays of ***distance*** and ***deviation*** along these segments, thereby eliminating complex latitude-longitude instrumentation.

THE RESULT: a compact, accurate computer providing continuous visual and command information to the pilot, and steering information to the automatic flight controls. Write for further data on the TNC-50 and GPL's new ARINC Doppler sensor, RADAN® 500.

APPLICATIONS ENGINEERING

SERVICE FACILITIES

SPARES INVENTORY

GPL — A GENERAL PRECISION COMPANY

GENERAL PRECISION LABORATORY INCORPORATED, Pleasantville, N. Y.

A Subsidiary of General Precision Equipment Corporation

You're in for a Hot Time

but Fenwal's New Miniature

Hermetically Sealed THERMOSWITCH® Unit will control it—precisely!

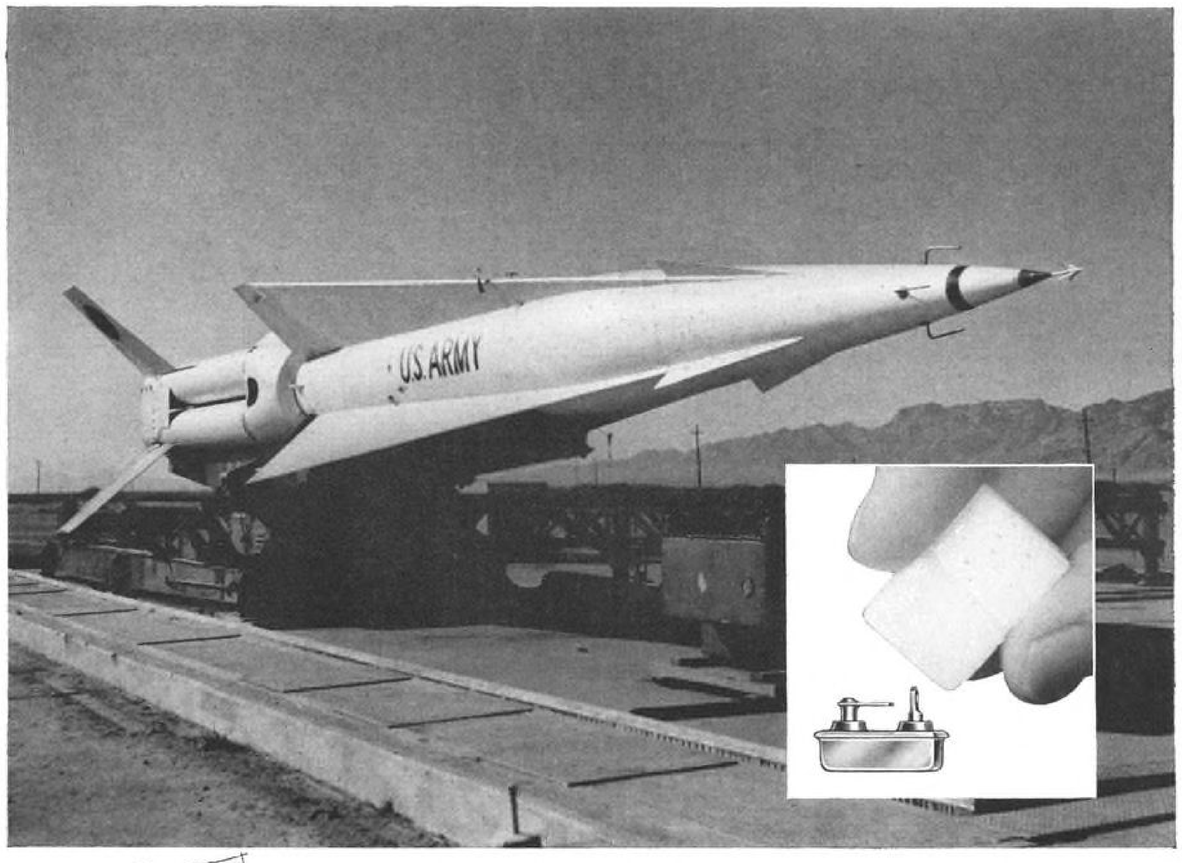
There'll be a hot time in the old ionosphere tonight. But with Fenwal's new Miniature Hermetically Sealed THERMOSWITCH Unit aboard everything will be under control. This tiny Fenwal unit responds quickly and accurately to temperature changes — *it's reliable!*

It's hermetically sealed, yet field adjustable. Even extreme vibration and shock won't upset its control characteristics — *it's built to take it!*

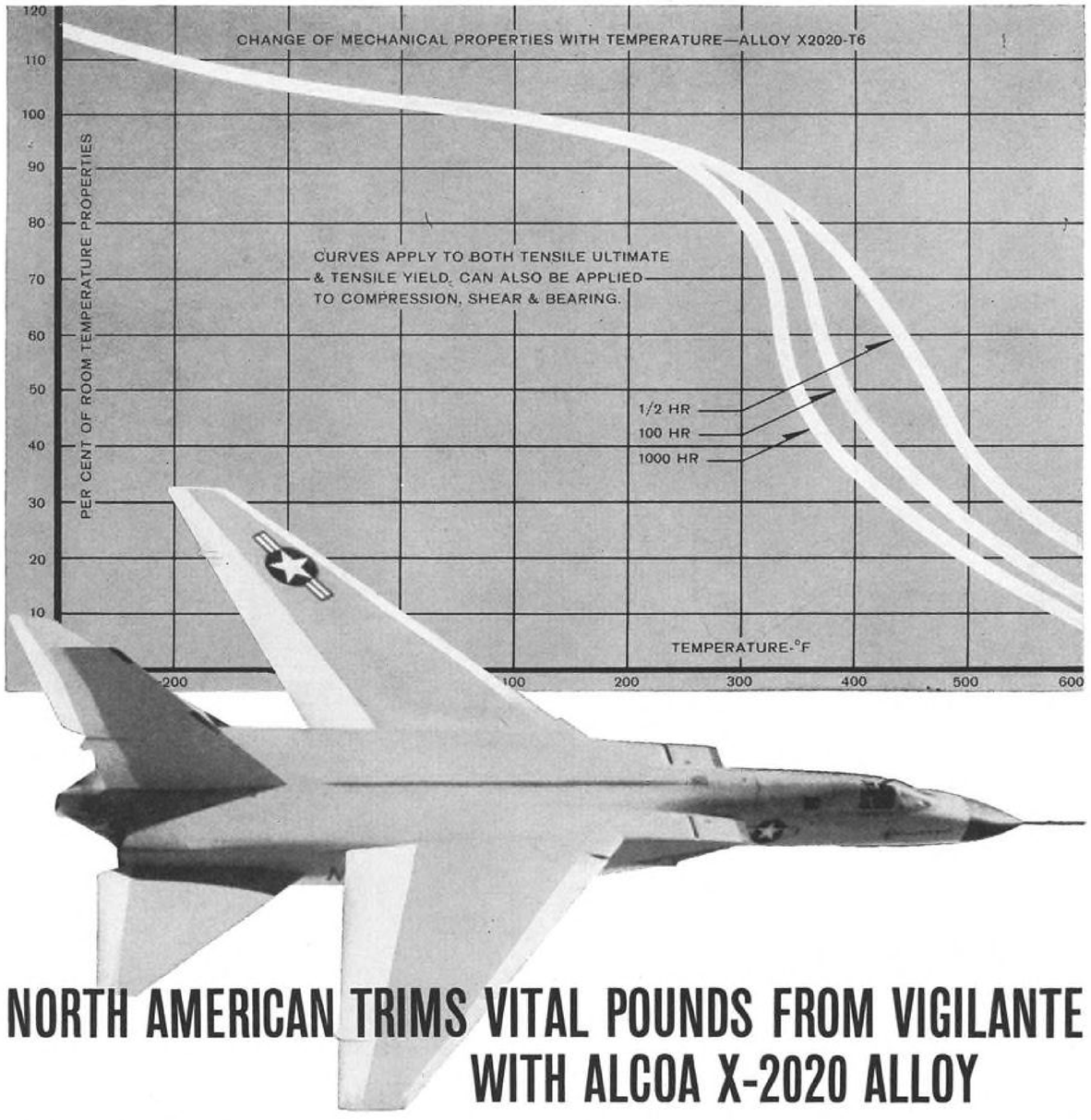
But most of all, this corrosion-resistant Fenwal unit does it all with exacting control of within 1° — in temperatures of −20°F to +200°F (−65°F to +220°F exposure limits). And it's the only unit that has all three features — *small size, ruggedness and precision control!*

If missiles are your business you'll want all the information on this tiny, tough, sensitive and reliable control. For more information on this unit or complete Fenwal temperature control systems, write for our catalog. If you want, we'll send our sales engineer, too. Fenwal Incorporated, 1211 Pleasant Street, Ashland, Massachusetts.

The new Fenwal Miniature THERMOSWITCH Unit (compared here with a lump of sugar) weighs less than ⅛ oz. Its current capacity is 2.5 amps, 115 VAC, 2.0 amps, 28 VDC. Widely used for crystal ovens, tuning forks, gyro assemblies, missile blankets and missile batteries.



ANOTHER EXAMPLE OF HOW **Fenwal** CONTROLS TEMPERATURE . . . PRECISELY



NORTH AMERICAN TRIMS VITAL POUNDS FROM VIGILANTE WITH ALCOA X-2020 ALLOY

THE EXCEPTIONAL high strength and stiffness of Alcoa's new lithium-aluminum alloy permit North American Aviation, Inc., to trim 168 lb from the Navy's A3J *Vigilante* weapon system. Substitution of X-2020 for the alloy previously used allows additional skin milling of the *inboard wings and horizontal stabilizers* to reduce thickness and weight.

ALL THE TENSILE properties of the widely known Alcoa 7075 are combined in this extraordinary new alloy together with three per cent lighter weight and a modulus of elasticity eight per cent higher. The moduli of elasticity in tension and compression at room temperature for X-2020 are 11,100 ksi and 11,400 ksi, respectively. This compares to 10,300 and 10,500 ksi for 7075.

ALTHOUGH THE *Vigilante's* highly supersonic speed does not utilize the high-temperature qualities of X-2020, North American regards the alloy's ability to retain its physical properties at 400°F as an important bonus in the event the aircraft is powered to greater future speeds.

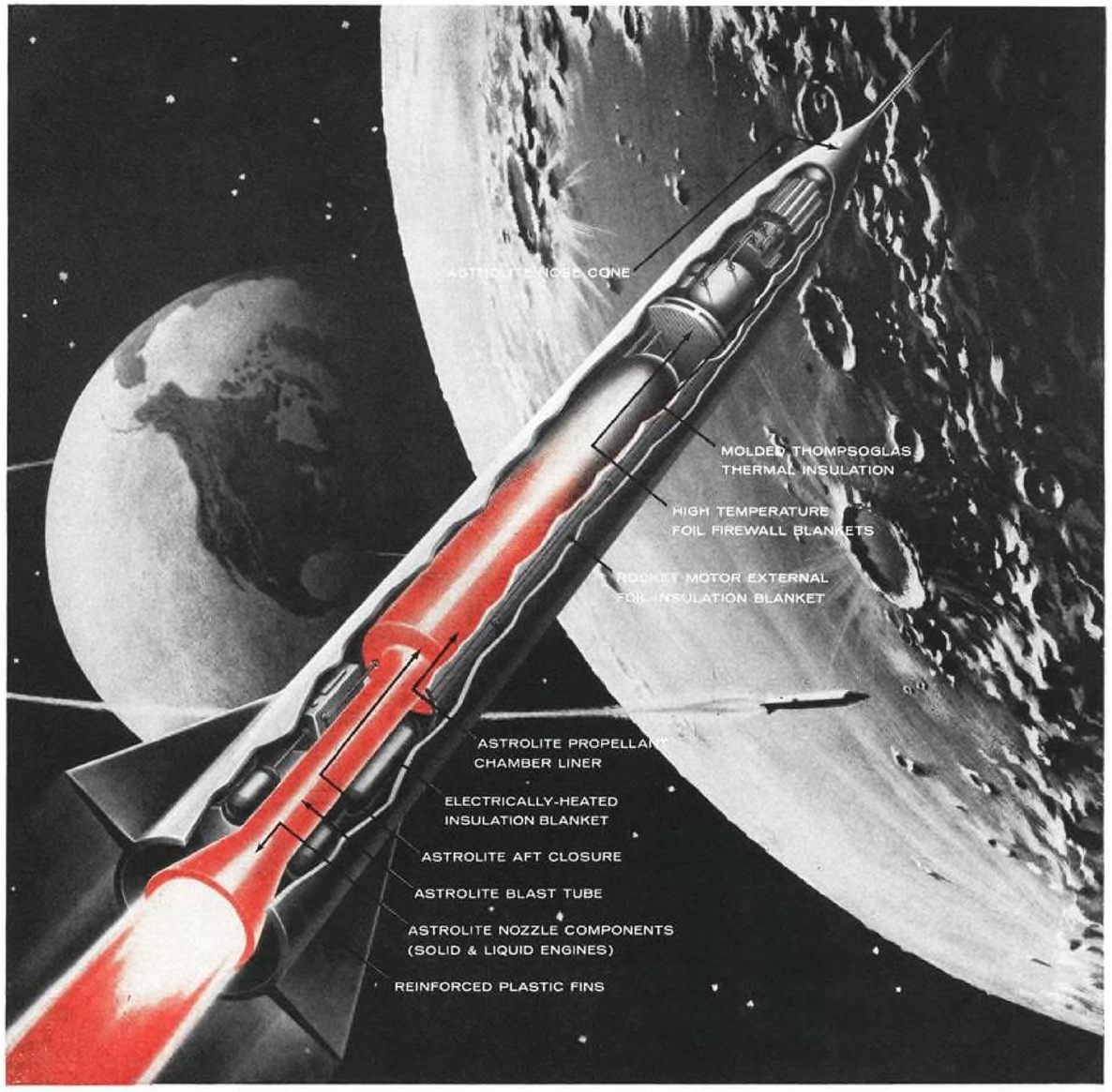
IN ADDITION to its other attributes, North American found that X-2020 machines as readily as other aluminum alloys. X-2020 readily lends itself to the usual aircraft fabrication processes. It is now available in sheet, plate, extrusions, rolled rod and bar from Alcoa. For those pioneering metallurgists who wish to investigate other outstanding qualities of X-2020, Alcoa has facilities for experimental forgings.

FOR COMPLETE, up-to-date technical information and performance data, call your nearest Alcoa sales office or write Aluminum Company of America, 2026-L Alcoa Building, Pittsburgh 19, Pennsylvania.

Your Guide to the Best in Aluminum Value

ALCOA ALUMINUM

For exciting drama watch "Alcoa Presents" every Tuesday, ABC-TV, and the Emmy Award winning "Alcoa Theatre" alternate Mondays, NBC-TV



MISSILE DESIGN WITH HITCO IN MIND

Missile design is probably the world's most exacting technology relative to the need for high temperature insulation materials.

HITCO is one of the world's leading developers and manufacturers of ultra-performance thermal materials capable of resisting extremely high temperatures, even up to 15,000°F. for short duration!

If you are looking for down-to-earth answers for out-of-this-world high temperature problems, keep HITCO in mind in your Missile Design!

- REFRASIL Materials
- HITCO Metal Blankets
- THERMO-COUSTI Materials
- THOMPSOglas Materials
- ASTROLITE Reinforced Plastics
- HITCORE Structural Core Materials

Call or write us for Capabilities Brochure and complete Technical Data on HITCO Products.

H. I. THOMPSON FIBER GLASS CO. HITCO *1733 Cordova Street • Los Angeles 7, Calif. • REpublic 3-9161*

WRITE OR CALL YOUR NEAREST HITCO REPRESENTATIVE: EASTERN: Tom Kimberly, 38 Crescent Circle, Cheshire, Conn., BR. 2-6544; Fred W. Muhlenfeld, 6659 Loch Hill Rd., Baltimore 12, Md., VA. 5-3135 • MIDWEST: Burnie Weddle, 3219 W. 29th St., Indianapolis 22, Ind., WA. 5-8685 • SOUTHWEST: Marshall Morris, 2850A W. Berry, Rm. 7, Fort Worth, Tex., WA. 4-8679 NORTHWEST: J. L. Larsen, 5757 Oaklawn Pl., Seattle, Wash., PA. 5-9311 • CANADIAN PLANT: THE H. I. THOMPSON CO. OF CANADA LTD., 60 Johnston St., Guelph, Ont., TA. 2-6630

B.F.Goodrich

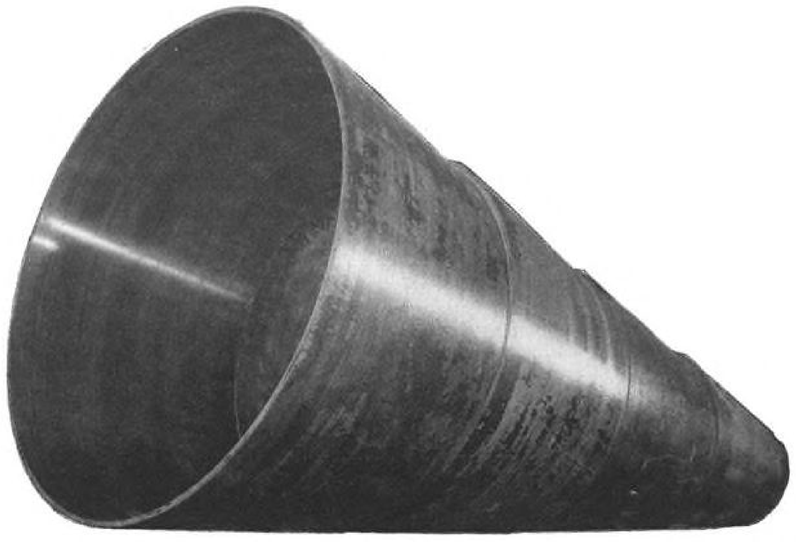
WHAT IS IT? Probably the biggest homogeneous void-free laminate ever built . . . a B. F. Goodrich ablation shield for an experimental re-entry vehicle designed and built by General Electric to be test flown on an Air Force Atlas ICBM.

Fabricated by a special B. F. Goodrich winding technique, the shield contains about five miles of high-temperature resin tape. This fabricating technique, which is also being used for many other specialized B. F. Goodrich products of various types and sizes, completely eliminates precision matched metal molds, cuts tooling costs by hundreds of thousands of dollars, and saves plenty of lead time. Autoclave curing replaces massive high pressure presses.

Throughout the construction of this re-entry vehicle shield, B. F. Goodrich maintains constant quality control of resin content and residual volatiles. Modern radiological facilities are used for final checking.

The fabrication and curing of such huge void-free parts illustrates the advances made by B. F. Goodrich in producing high-temperature, reinforced plastic products. So if you're up in the air and want down-to-earth answers on plastic laminate constructions, contact *B. F. Goodrich Aviation Products, a division of The B. F. Goodrich Company, Dept. AW-119, Akron, Ohio.*

B.F.Goodrich *aviation products*



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EDITORIAL OFFICES: New York 36—330 W. 42nd St., Phone: LOngacre 4-3000 (Nights LO 4-3035) **Washington 4, D. C.**—National Press Bldg., Phones: NAtional 8-3414, REpublic 7-6630 **Los Angeles 17**—1125 West Sixth St., Phone: HUntley 2-5450 **Dallas 1**—1712 Commerce St., Phone: RIverside 7-5117 **European Office**—1 rue du Temple, Geneva, Switzerland, Phone: 32-35-63

COVER: Igor Sikorsky's participation in the S-60 Flying Crane project led to this flight that first indicated the tendency of a sling to damp out helicopter vibration and to the construction of a passenger pod that would take advantage of this characteristic (AW Oct. 19, p. 122). During preparation of the crane for military evaluation last summer, a simple platform was built to carry oil drums, a concrete mixer, etc. Sikorsky himself suggested installing four bucket seats and he, John P. W. Vest, chief of engineering operations, Charles M. Scheverria, S-56 project engineer, and Roderick L. Smith, S-60 project engineer, strapped themselves aboard. After hovering, the crane made a cautious go-around of the field and eventually climbed to 1,500 ft. and 70 kt. forward speed when this photo was taken. Wind force was not excessive because of the protection of the forward cabin, and Sikorsky later unbuckled his seat belt and walked about the platform. For another S-60 concept, see p. 45.

PICTURE CREDITS
Cover—Sikorsky; 26, 27—Tass; 31, 96, 98 (top)—Aviation Week; 33—Martin Co.; 45—Sikorsky; 52, 53, 59, 66—Canadair, Ltd.; 79—International Resistance Corp.; 83—Raytheon; 88, 89, 90, 93—North American; 97, 98 (bottom), 103—NASA; 108, 109, 111—Piper.

79,394 copies of this issue printed

EDITORIAL

Snail's Pace in Space

Despite the one-two punch impact of the Soviet rocket shot to the moon and their more sophisticated lunar orbiting satellite, there is no significant evidence that this country will take any major action to accelerate the current snail's pace of our own space research program. As we have written many times before in the past few years, the biggest drag on our own progress in this field is the lack of top-level leadership in setting unmistakable national goals to achieve superiority in this field. From the first orbit of Sputnik I, the official Administration attitude has been to bury its head deeper in Budget Bureau sand and hope the whole problem of space will evaporate and disappear. As recently as his press conference in Augusta, President Eisenhower indicated he didn't think there was any real competitive problem in the space research field with the Soviet Union. Since Sputnik I went into orbit, there has been no significant action taken by our government in this field that was not a direct reaction to some spectacular Soviet achievement in space research. Each step in the unbroken chain of Soviet space pioneering achievements has indicated that their lead in this field is increasing with the passing of time. Despite all of the official drum beating from the White House, Pentagon and National Aeronautics and Space Administration aimed at convincing the American people that we are catching up with the Soviets, the sad record of achievements indicates we are still losing ground.

Keith Glennan, NASA administrator who was given the admittedly difficult task of getting the U. S. program organized without sufficient top-level or fiscal support, has been waxing irate at the barrage of public criticism leveled at the U. S. space program in view of its rather modest record of achievement in contrast to the spectacular series of Soviet successes. Speaking before the American Bankers Assn. recently, he said:

"Speeches and newspaper articles are not going to provide the greater thrust needed for accurate propulsion of heavy payloads into satellite orbits or on deep space trajectories. I suspect, however, if we were able to contain and use, as a propellant, all the hot air that has been expended on this subject lately, we could have at least one vehicle of really high thrust." Mr. Glennan's remarks on this subject would be in better grace if his agency had not presided over the sale of personal story rights of its seven astronauts for a half million dollars some two years before these gentlemen are expected to achieve their scientific goals or if his own agency and its policy-making superiors had exhibited any enthusiasm for formulating and supporting a program unmistakably aimed at establishing U. S. superiority in this significant field.

In fact, it might seem inappropriate for Mr. Glennan to maintain such a heavy public speaking schedule during a period when his agency has so little genuine achievement to discuss and so many problems in the organization, funding and execution of its program.

We respectfully disagree with Mr. Glennan's thesis expressed to the bankers that public speeches and newspaper articles contribute little to the progress of the space research program. Without the violent public reaction expressed through these media after Sputnik I and the resultant Soviet space achievements, this country would very probably have no space program worthy of the name, and the very agency Mr. Glennan heads would in all probability not even exist. We think that even more public prodding is necessary to stir the very top levels of our government into an understanding of the basic contribution space research can make to humanity and also to the competitive problem we face with the Soviet Union in this respect.

Mr. Glennan had a rather stirring conclusion to his bankers' speech. He said:

"We do not intend to whine or grow hysterical every time the Russians score. We do not intend to rush pell mell into makeshift space spectaculars in hopes of topping each Soviet space success. But I can assure you that we do not intend for long to run second in any phase of space exploration. Time is the key element and in time the United States will prevail over the present challenge in space as it has over equally harsh challenges in the past."

These eloquent phrases would be much more significant to the American people if they were spoken or even echoed by President Eisenhower or some other top-level official of the government. But, with the exception of one San Francisco speech by Vice President Nixon shortly after Sputnik I, no such sentiments have emanated from these lofty levels.

Most of the scientists, engineers, industrialists and military people working in the space research areas agree that NASA has done a fine job in organizing a sound space research program within the limited financial, moral and political support allocated them by the Administration. It is apparent that most of our past failures and the limitations of our current achievements stem from the budgetary blinders, executive indecision and administrative ineptness that has characterized the start and faltering pace of the space program. Mr. Glennan and his cohorts will need far more fiscal, political and public support than they have received in the first year of their agency's existence if they are to make good on his firm public promise that the U.S. will eventually lead this field.

—Robert Hotz

WHO'S WHERE

In the Front Office

Barnet R. Adelman, general manager and a director of United Research Corp., Menlo Park, Calif., a subsidiary of United Aircraft Corp. Mr. Adelman continues as vice president. Also: Vice Presidents **David Altman, Herbert R. Lawrence,** and **Newton V. Turney**, elected directors.

Edwin W. Pauley, industrialist, elected a director of Western Air Lines, Inc.

Maj. Gen. James McCormack (USAF, ret.), a director of Perkin-Elmer Corp., Norwalk, Conn. Gen. McCormack is vice president of Massachusetts Institute of Technology.

Dr. Howard Percy Robertson, a director of Northrop Corp., Beverly Hills, Calif. Dr. Robertson is professor of mathematical physics at California Institute of Technology and a member of President Eisenhower's Scientific Advisory Committee.

W. Hubert Beal, president and chief executive officer, The W. L. Maxson Corp., New York, N. Y., succeeding **Hugo A. Leander**, retiring. Mr. Leander was elected board chairman.

Henry Jacobi, president, Defense Products Division, The Brunswick-Balke-Collender Co., Chicago, Ill.

Richard C. Palmer, a vice president, Stromberg-Carlson Division of General Dynamics Corp. Mr. Palmer will manage Stromberg-Carlson's Washington, D. C., office, succeeding Andrew H. Bergeson, resigned.

Eugene P. Cunningham, senior vice president, Clearing Division of U. S. Industries, Inc., Chicago, Ill.

Kearfott Company, Inc., Little Falls, N. J., a subsidiary of General Precision Equipment Corp., has announced the following elections: **Joseph Heimann**, divisional vice president-avionics, and **Robert E. Ward**, divisional vice president-precision components.

Honors and Elections

The following have been selected the winners of the American Rocket Society's annual awards for outstanding contributions to space flight and rocket propulsion: **Samuel K. Hoffman**, vice president of North American Aviation, Inc. and general manager of the Rocketdyne Division, the **Robert H. Goodard Memorial Award** for outstanding work in liquid rockets. **Dr. Ernest Roberts**, manager of research for Aerojet-General's Solid Rocket Plant, the **C. N. Hickman Award** for outstanding work in solid rockets. **Ali Bulent Cambel**, chairman of the Mechanical Engineering Department of Northwestern University, the **G. Edward Pendray Award** for outstanding contribution to rocket and astronautical literature. **Dr. Walter Dornberger**, vice president-engineering of Bell Aircraft Corp., the **ARS Astronautics Award** for outstanding contribution to the advancement of space flight. **Karel J. Bossart**, assistant to the vice president-engineering at Convair-San Diego, the **James H. Wyld Memorial Award** for outstanding application of rocket power

(Continued on page 119)

INDUSTRY OBSERVER

► Air Force is studying the possibility of buying an interceptor version of the Navy/North American A3J to fill the gap left by the recent cancellation of the Mach 3 F-108 interceptor. Other possibilities under study include the McDonnell F4H. Prospects of an interceptor version of the Convair B-58 are not considered good at the moment because of the relatively high cost per airplane.

► **Air Force has narrowed down the contenders for its Airborne Long-Range Input (ALRI) from the original eight bidders to four companies which have been asked to submit the best price and delivery quotations. The four companies are Burroughs, Hazeltine, Litton Industries and Lockheed.**

► Chrysler is developing a modified version of the Jupiter intermediate range ballistic missile for use as a target in Army's Nike Zeus anti-missile missile tests scheduled to be held in the summer of 1962 in the mid-Pacific (see p. 30).

► **Army has revised its requirements for a supersonic target drone and will hold a new competition within the near future. Competition will be open to all bidders rather than restricted to the five companies that originally submitted proposals.**

► Boeing Airplane Co. is holding its Dyna-Soar project personnel to approximately 40 persons pending a final Air Force decision on the allocation of Phase 2 in the program.

► **Army's Raytheon Hawk low-altitude anti-aircraft missile is scheduled to be fired against Radioplane's RP7D turboprop-powered drone soon.**

► Error in the accuracy of the astronomical unit (mean distance from earth to sun) may be reduced from the estimated 100,000 mi. to as low as 3,000 mi. by radio astronomy, according to Office of Naval Research estimates.

► **Navy has awarded Aerojet-General an $800,000 contract to study the feasibility of a hybrid liquid oxidizer-solid fuel rocket. Such a rocket could give higher performance to a fleet ballistic missile with the size and shape of the Polaris.**

► First manned capsule launch in the Project Mercury program may come as early as April, 1960, if its successive development schedules hold firm.

► **Office of Naval Research hopes to make another balloon flight next January or February to try to determine whether anti-matter exists as a part of cosmic radiation reaching upper levels of the atmosphere. Preliminary flight last Sept. 4 carried an instrument package designed by Dr. Marcel Schein of the University of Chicago and set a balloon altitude record of 154,000 ft. Balloon, made by Raven Industries, was one-half mil thick polyethylene, compared with the usual three-fourths mil thickness, and was the largest ever launched. National Science Foundation is co-sponsoring the research.**

► Pacific Airmotive Corp., Burbank, Calif., will begin overhauling Rolls-Royce turboprop powerplants in February for business and airline aircraft. Initial customers will include West Coast Airlines, Aloha, Northern Consolidated of Anchorage, and possibly Bonanza.

► **Tactical Air Command is considering procurement of about 450 aircraft within the near future for tactical support and fighter-bomber missions. Planes under consideration are the Lockheed F-104, McDonnell F-101 and Republic F-105.**

► General Electric is considering a twin version of its T64 axial flow shaft turbine. Basic T64-2 turboshaft version is tentatively scheduled for a certification model test by the Federal Aviation Agency in late 1961. T64 is in the 2,600 shp. class, embodies a 14-stage compressor and has a pressure ratio of 12.6 to one. Direct drive version weighs 710 lb. without gearbox. The -2 version with turbine shaft gearbox weighs 854 lb.; the -4 turboprop application weighs 1,079 lb.

Washington Roundup

Thrust Proposal

National Aeronautics and Space Administrator **T.** Keith Glennan, speaking into the face of a gale of pioneering Soviet space achievements (see p. 26), said last week that "we do not intend for long to run second in any phase of space exploration." Glennan, who said the U. S. is "two years late already," cautioned, however:

"We do not intend to whine or grow hysterical every time the Russians score. We do not intend to rush pell-mell into makeshift space 'spectaculars' in hopes of topping each Soviet space success."

The NASA administrator also gave controlled vent to his ire over recent criticism of the nation's space program, declaring:

". . . Speeches and newspaper articles are not going to provide the greater thrust needed for accurate propulsion of heavy payloads into satellite orbits or on deep space trajectories. I suspect, however, that if we were able to contain and use as a propellant all the hot air that has been expended on this subject lately, we could have at least one vehicle of really high thrust."

Base Foreclosure

Meanwhile, the Air Force, caught in the throes of one of its tightest fiscal binds in years as it prepares its hold-the-line Fiscal 1961 budget, announced plans last week to deactivate three small air defense squadrons and said the closing of "many more" fields will follow. Each of the bases involved in last week's announcement—Ethan Allen AFB, Vt.; Youngstown, Ohio, and Niagara Falls, N. Y.,—have a complement of approximately 25 jet interceptor aircraft, 1,000 servicemen and 180 civilian employes.

Space Facility Tour

In preparation for Fiscal 1961 budget authorization hearings on Capitol Hill next year, Max Lehrer, a professional staff member of the Senate Space Committee, is currently inspecting major space technology facilities of both the Air Force and National Aeronautics and Space Administration on a coast-to-coast tour. In addition to government facilities, Lehrer also will visit manufacturing plants engaged in space work. Lehrer, a former Defense Department budget expert, is assistant staff director of the NASA Authorization Subcommittee, headed by Sen. John Stennis (D.-Mo.).

Army Aviation Plans

Army does not intend to compartmentalize its aviation activities in a separate "Army Air Corps" nor does it hope to take over the USAF's Tactical Air Command as sometimes rumored, according to Brig. Gen. Clifton F. Von Kann, new director of Army Aviation. Gen. Von Kann says, however, that the Army "views with concern" the type of aircraft which Air Force is buying for TAC. Rather than supersonic aircraft, Army would like to see slower World War II-type piston-engine aircraft that are better suited to close support activities, according to Von Kann.

Army has no present plans to arm its fixed-wing aircraft, as it has done with some helicopters, an action which might conflict with presently assigned roles and missions, Von Kann said. In a speech to the Aviation Writers Assn. here, he also expressed the hope that present 5,000 lb. weight limitations on Army aircraft might be removed completely.

Present Army thinking is to provide a pool of aircraft, helicopters and aviation personnel at the divisional level, but Von Kann expressed the hope that improved aircraft/helicopter reliability and maintenance would permit their assignment at lower organizational levels.

Gen. Von Kann predicted that it probably will be another decade before the aerial jeep will come into operational use, because of problems, such as endurance, which must be solved. He also predicted a bright Army future for ground-effect machines when present problems are solved.

Patent Hearings Postponed

Hearings on patent clauses of the National Aeronautics and Space Act originally scheduled for this month by the House Committee on Science and Astronautics have now been postponed until after Congress reconvenes in January. Rep. Erwin Mitchell (D.-Ga.), chairman of the subcommittee on patents, has been admitted to a Dalton, Ga., hospital for diagnostic studies.

MATS Criticized

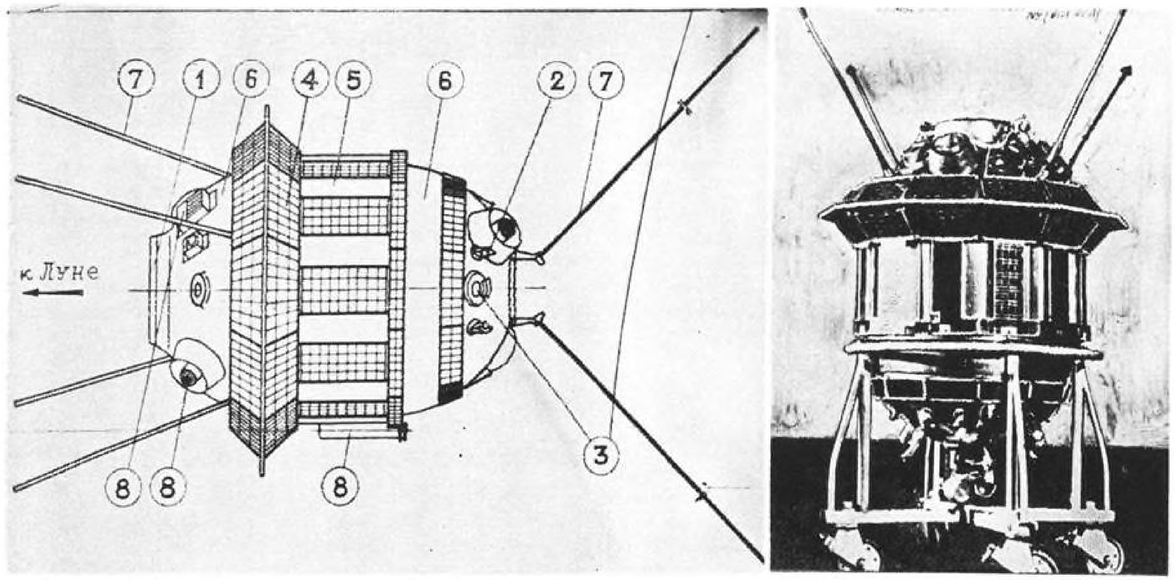
Action by the Defense Department to align the Military Air Transport Service operating policies with those of the Administration was urged last week by Sen. Gordon Allott (R.-Colo.), a member of the Senate Appropriations Committee, in a letter to Defense Secretary Neil McElroy. Allott said he felt it would be in the best interests of the nation to have MATS re-oriented so that it devotes its resources to performing its assigned hard-core missions, leaving the task of maintaining the overseas logistics pipeline to certificated airlines. Allott also charged that the President had asked for a study on the entire MATS problem 18 months ago and that to date there has been no response from the Defense Department.

Union Dispute

AFL-CIO hopes of settling the crew complement issue between its pilot and flight engineer members without government intervention faded last week with the cancellation of a planned meeting of President George Meany with heads of the Air Line Pilots Assn. and the Flight Engineers International Assn. Meany had originally called the meeting for today. ALPA President Clarence Saven, in Europe to attend a Flight Safety Foundation meeting, notified Meany that he would not be able to return in time to attend.

Meany had hoped to discuss ALPA's request that the National Mediation Board rule on a "class and craft" determination at United Air Lines, a ruling that could result in only one union representing the airline's flight crews in contract negotiations. The flight crews are now represented by both ALPA and the Flight Engineers. Meanwhile, the Mediation Board has called a meeting on the issue between the pilots and engineers for tomorrow. Meany, who earlier criticized ALPA's actions as constituting "union raiding," told the two unions he would like to settle the dispute internally without involving a government agency.

—Washington staff



SOVIET PROBE that photographed moon is at right. Equipment in diagram, left, is (1) window for camera (2) orientation system motor (3) solar monitor (4) solar battery section (5) shutters of heat system (6) thermo screens (7) aerials (8) measuring devices.

Space Technology

Soviet Probe Pioneers New Techniques

Complex flight tactics employed as Soviet vehicle photographs moon's far side, transmits results.

By Evert Clark

Washington—Soviet Union pioneered a number of complex space flight techniques in photographing the far side of the moon and transmitting the results over distances of up to 274,000 mi.

Extensive reports in the Soviet press during the past week have described the probe's equipment and techniques in unusual detail and have made much of the fact that the third Russian lunar probe fired in early October (AW Oct. 12, p. 28) accomplished many things that have not been done before.

The probe passed beneath the moon at a distance of about 4,900 mi. from the moon's south pole. When it reached the proper position it stopped spinning and oriented itself on a line between the sun and the moon. It began taking photographs of the far side through 200 and 500 mm. lenses at about 11:30 p.m. EDT Oct. 6 on a signal from the earth. It photographed for some 40 min. as it ranged from 37,284 mi. to 43,498 mi. from the moon's surface.

The special 35-mm. film was protected from cosmic radiation and was suitable for developing at high temperatures. Developing and fixing were carried out aboard the satellite under conditions of weightlessness.

Later, the satellite's orientation equipment restarted the rotation that was necessary to keep its instrumentation cool. Photo signals and other data were relayed at a rapid rate when the probe was close to earth and at a very slow rate when it was far away in order to conserve transmitting power.

Soviet scientists gave place names to prominent lunar surface markings that could be verified in preliminary processing of the many photos, and then set up a special commission under the Academy of Sciences to name other features.

The Soviets claimed some interesting firsts in radio transmission:

"Pictures of the moon were transmitted from the automatic interplanetary station along radio communication lines serving at the same time for measurements of the parameters of movement of the station itself and also for telemetric transmission of results of scientific experiments," official reports said. "Various devices aboard the station were switched on and off and their regimes changed by special orders transmitted from earth over the same radio line.

"Pictures of the moon were transmitted and all other operations on the line of radio communication were carried out by means of continuous radiations of radiowaves, as distinct from impulsive radiation used previously in certain cases," the reports said.

"This is the first time such a combination of functions has been attempted in one radio communication line working under permanent radiation. It ensured reliable radio communications even at maximum distances. . ."

All communication instruments, both aboard the station and on earth, were in duplicate. In one case, a piece of equipment failed and its backup was activated from the ground, the reports said.

The 614-lb. station is a thin-walled, pressurized cylinder with hemispherical ends. Length without aerials is 87 in. and maximum diameter is 47 in. Instrumentation and chemical power sources are mounted on a frame inside the body. Aerials, some instrumentation and sections of the solar batteries are fixed to the outer shell.

The upper end has a window with a lid which opened automatically before photography began. Both upper and lower ends have windows for the solar monitors of the orientation system. Motors to drive this system are fixed to the lower end plate. The orientation system includes optical and gyroscopic pickups, computers and control machines.

Shutters on the outside of the body opened a radiation surface when heat from the instruments brought temperature inside the station to 25C. Power supply included "autonomous blocks of chemical power sources and a centralized block of a buffer chemical battery," Tass news service said. "The energy used from this battery is compensated by solar batteries."

After the orientation system stopped the probe's rotation, its lower end plate was oriented toward the sun with the aid of solar pickups. This pointed the camera end toward the moon. An optical device which sees only the moon and not the earth or sun switched off the orientation system's dependence on the sun and fixed the station on the moon. Once an optical device showed that the moon was in focus, the camera began operation.

Reports indicated that only one camera "having two lenses" was used for "simultaneous two-scale photography." The 200-mm. lens provided an image of the moon that completely filled one frame of film. The other lens provided an image much larger than a frame, giving more detail.

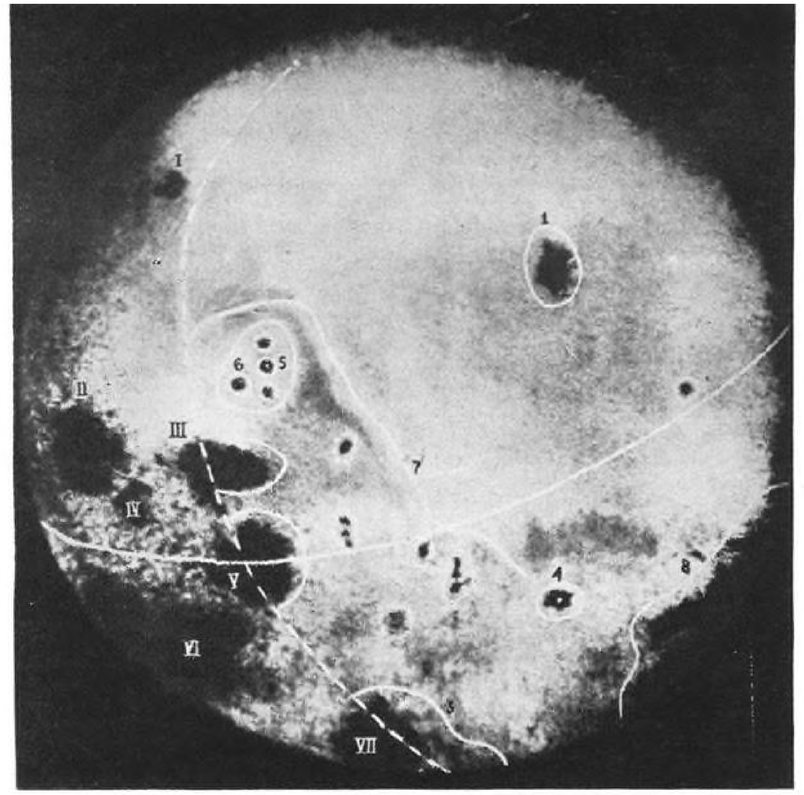
"The photographing was done on a special 35-mm. film with automatically varying exposures," Tass said. This could mean that the exposure speed problem was handled by the film, avoiding the necessity of changing the mechanical setting of the camera.

Film Processing

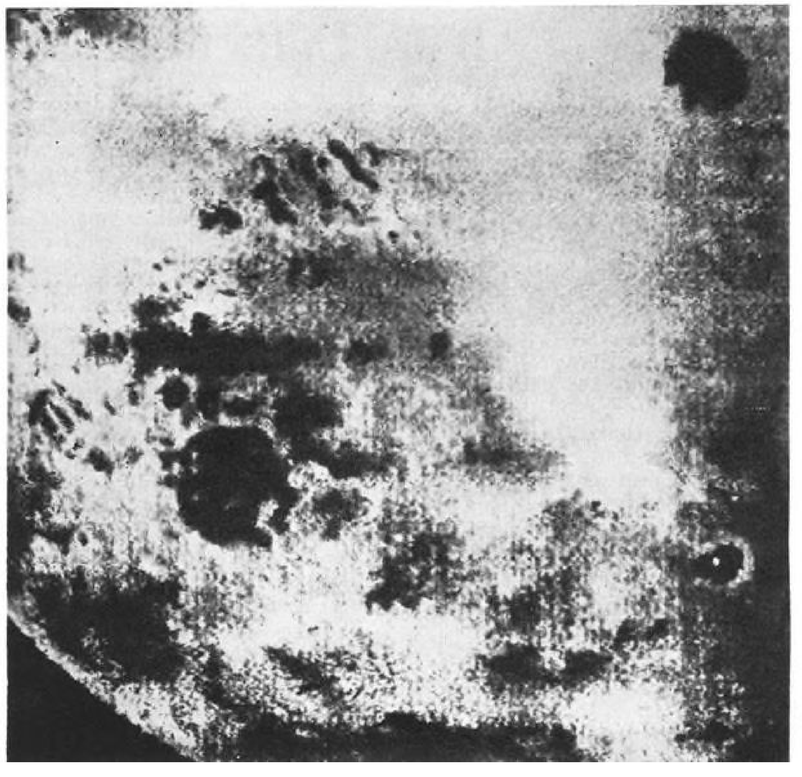
After exposure the film passed into a small automatic developing and fixing device. "Necessary measures were taken to prevent this treating process from being upset by conditions of weightlessness," the Soviet reports said.

Film was dried and moisture absorbed. It then passed into "a special case" and was prepared for transmission. What Soviet reports described as "test marks" apparently were marks at intervals along the film. Similar marks had been made on films on earth. Those on earth apparently were developed simultaneously with development in the satellite. Transmission of a signal to earth when a mark on the satellite's film passed a monitoring device in the satellite apparently "made it possible to control processes of photography treatment and transmission of pictures."

"To transform the image on the negative," an article in Sovetskaya Rossiya said, "a small scanning tube with high resolving capacity and stable photoelectronic multiplier was used. Transmission of pictures to earth was effected in the same way motion picture films



SOVIET PHOTO of moon's far side. Solid line is equator. Dotted line is border between seen and unseen sides. Solid lines around objects show positively established objects. Dotted lines show objects needing clarification. Fine dots show objects now being classified. Arabic numerals show (1) 186-mi. crater, Sea of Moscow (2) Bay of Astronauts (3) part of Southern Sea, which begins on near side (4) 60-mi. wide crater containing Tsiolkovskii Hill (5) crater with Lomonosov Hill (6) Joliot-Curie crater (7) Sovietsky mountain range, over 1,200 mi. long (8) Mechta Sea. Roman numerals show objects on moon's near side (1) Humboldt Sea (II) Sea of Crisis (III) Marginal Sea (IV) Sea of Waves (V) Smyth's Sea (VI) Sea of Fertility (VII) Southern Sea. Closeup, below, shows features including luminescent spot on Tsiolkovskii Hill.



are transmitted by television stations.

"To deflect the ray of the electronic ray tube, economic low frequency scanning devices were used. Magnification and setting of signals of the pictures were effected by a special narrow tape stabilized amplifier which automatically compensated for the influence of changes in the average density of the negative on the outgoing signal. All schemes were carried out in the main with transistors."

Slow transmission was used at long distances and fast transmission at short distances. "The television system made it possible, in accordance with conditions of transmission, to change the number of lines into which the picture was broken up," the magazine said.

The maximum number of lines reached 1,000 per frame, Tass said. "To synchronize transmitting and receiving," Sovetskaya Rossiya said, "a scanning device method was used which ensured high resistance to interference and steady operation of equipment." Tass said the speed of transmitting images over "superlong distances by a radio transmitter of rather low capacity" was "scores of thousands of times lower than that used by conventional television centers."

Images were transmitted over distances of up to 274,000 mi., proving for the first time "that it is possible to transmit halftone images of high clearness in outer space for superlong distances without any substantial specific distortions in the process of propagation of radio waves," Tass agency said.

To ensure high quality transmission of low contrast pictures, "the television apparatus has been provided with automatic adjusting of the scanner tube's brightness," one report said. "Self-adjusting devices have been applied also to ensure reliable faultless operation of the setup in changing (transmission) regimes."

When the pictures were being taken, 70% of the far side of the moon was illuminated. Some 30% of the surface shown in the photographs is area visible at one time or another from the earth. The remainder had not been seen or photographed before.

Russia now predicts that the probe will last for six months from the date of launching last Oct. 4, making 11 or 12 revolutions around the earth, and then burn itself up in the earth's atmosphere. Original Soviet estimates ranged as high as eight years.

Impact of the second lunar probe and its final stage rocket on the moon produced a cloud of dust and gas estimated to be 310 to 560 mi. high, Soviet scientists reported (AW Oct. 26, p. 29). If they struck a dirt layer, diameter of the crater caused by the rocket should have been about 853 ft. and that of the probe about 591 ft. If they struck a rock mass, the craters should have been about 50 ft. and 33 ft. in diameter, respectively, the scientists said. These should be observable through strong telescopes and by photography from future satellites, the Russians said.

Soviets Claim Record

Moscow—Russia has claimed another new altitude record—this time for planes carrying a 10 metric ton (22,046 lb.) payload.

The Soviet press reports that a "four-jet 201M mid-wing monoplane" piloted by Lt. Col. N. I. Goryainov lifted the load to 50,197 ft. on Sept. 16. Horizontal flight at maximum altitude was maintained for 10 min. Besides Goryainov, the crew included a copilot, navigator, radio operator, two engineers and a flight mechanic.

Data on the flight has been sent to the Federation Aeronautique Internationale for certification as a world mark.

The "201M" flight is the fourth altitude record claimed by Soviet air force pilots in recent months. On July 13, a twin-jet "RV" carried a one metric ton payload to 66,600 ft.; on July 14 a single-jet "T-431" reached 94,660 ft. (AW Aug. 3, p. 32), and on Aug. 1 an "RV" carried a two metric ton payload to 66,273 ft.

Senate, House Groups May Probe Transfer of ABMA Units to NASA

By Ford Eastman

Washington—President Eisenhower's decision to transfer Army Ballistic Missile Agency's missile design team to National Aeronautics and Space Administration (AW Oct. 26, p. 28) has touched off a new round of criticism aimed at the "lagging" U. S. space program and promises of a full-scale congressional probe.

While announcement of the proposed transfer provoked only scattered comment from congressional leaders, it did serve as a springboard for strong demands for a more vigorous and coordinated national space program.

Staff members of both the House and Senate investigating committees are studying the transfer proposal, but there is little likelihood that hearings will be scheduled before Congress reconvenes in January because of the difficulty in persuading committee members with previous commitments to return to Washington on short notice. It is also felt that, since many details of the transfer are still to be worked out, hearings at this time would produce little substantial information.

Other reasons for delaying hearings until after the first of the year are that a full and complete report concerning the nature and effect of the proposed transfer, which the President is required by law to submit to Congress, is not expected until January and that details on the funding of a number of projects will not be available until submission of the Fiscal 1961 budget request.

Major congressional interest will center around the functions, facilities and personnel now in ABMA that will be transferred and the amount of money the Administration will ask to fund priority projects.

Sen. Lyndon Johnson (D.-Tex.) chairman of the Senate Space Committee, has asked his staff to analyze the proposal to determine whether the committee should go into this matter further before the next session. Johnson expressed the hope that the move will be an effective one and that it will help preserve the "valuable experience" that has been gained by the Army Ballistic Missile Agency team.

"Our hearings this year have indicated many weaknesses, including the lack of coordinated authority over the space program," he said. "This is one case where we have a team, but I am afraid it lacks a driver."

Sen. Stuart Symington (D.-Mo.), a member of both the Senate Space and Armed Services committees, said he viewed the proposed transfer with doubt. Symington said ABMA has "the finest development team in the space field" and that the working relationship between the Army and the group of scientists under Dr. Wernher von Braun has been unique. He added that this relationship has begun to evaporate with the planned retirement of Maj. Gen. John B. Medaris, commander of the Army Ordnance Missile Command (AW Oct. 26, p. 28).

ALBM Test Equipment

Competition for automatic universal test equipment in Air Force's XGAM-87A air-launched ballistic missile program has been narrowed to Motorola, Inc., Stromberg-Carlson Division of General Dynamics Corp., and Packard Bell Electronics Corp. Almost 40 industry members were originally involved in the competition held by Douglas Aircraft Co., systems manager for the XGAM-87A program. Approximately 30 of the checkout sets may be procured for the testing function.

"It may be further adversely affected by this latest transfer decision," he added, "and that is particularly unfortunate because it is a fact we are behind in the long-range missile race, and far behind in the space field."

Symington also noted that the 1.5 million lb. thrust Saturn cluster under development at ABMA is the only super booster program that could become available in the near future and that the program had been cut by 40% in Fiscal 1960. He said the only possible gain in the transfer is that NASA, through the Space Council, may be able to prevent further reductions in the Saturn project. Symington has asked the chairmen of both the Senate Space and Armed Services Committee to investigate the matter.

Rep. Chet Holifield (D.-Calif.) chairman of the Military Operations Subcommittee of the House Government Operations Committee, also instructed his staff to conduct a preliminary review to determine if a full inquiry by his committee is required.

In another move, Rep. Overton Brooks (D.-La.), chairman of the House Committee on Science and Astronautics, announced plans to begin extensive hearings on the nation's space program when Congress reconvenes to determine "why this nation is lagging behind in the exploration of space and what steps can be taken to place the U.S. where it belongs, in the forefront."

Brooks said it is imperative to make a new and thorough evaluation of just what the U.S. is doing and in the space technology field what it intends to do in the future. Witnesses scheduled to appear include representatives of NASA, the National Aeronautics and Space Council, the Office of Secretary of Defense, Air Force, Army, Navy, Advanced Research Projects Agency and private agencies.

Brooks said the committee intends to seek answers to a number of questions, including:

- **"Does the U.S. have** (an over-all) national space program?
- **"To what extent do military** and the civil agencies engaged in space activities correlate their work?
- **"What does the Administration** plan to do with the Saturn program?
- **"What will become of** the Army Ballistic Missile Agency . . . now that the scientific team headed by von Braun has been transferred to NASA?
- **"Exactly what will be** the future missions of the Air Force, Army, Navy and ARPA in the exploration of space?
- **"Does the Administration** plan to subordinate either the civilian space activities or those of the military?
- **"Are sufficient funds** being allotted to both the military and civilian space programs?"

NASA Wants Fiscal 1960 Fund Boost

Washington—National Aeronautics and Space Administration is expected to ask Congress for a supplemental Fiscal 1960 appropriation. Increased responsibilities, higher development costs and the fact that Congress cut $29.725 million from the combined Fiscal 1959 supplemental and Fiscal 1960 request are forcing the agency to consider such a move.

NASA expects to defend the 1.5 million lb. thrust first-stage engine for the Saturn vehicle in its Fiscal 1961 budget, probably at about the $135-$140 million budget, planned for next year before the transfer of the project from Advanced Research Projects Agency's jurisdiction to NASA's was announced (AW Oct. 26, p. 28).

Transfer of Saturn and of the Army Ballistic Missile Agency team was originated in Defense Department and was not requested by NASA, according to Richard E. Horner, NASA's associate administrator.

It was made because "there is no clear military need for Saturn" now, according to Defense Director of Research and Engineering Herbert F. York. "On the other hand," York said, "the people in Defense regard it as probable that a need will develop, may develop, over the next few years." York said a major consideration in transferring the booster was "if Defense lets this go, will there be a big booster? We are satisfied that there will be."

York said the merits of going ahead with Saturn as compared with a four-engine Martin "Super-Titan" were explored thoroughly and "we concluded that the Saturn was the one that we should be going ahead with."

Horner said Saturn will have "a very high priority" under NASA's direction and that the "earliest apparent requirement for boosters of the Saturn size is for advanced manned space flight." Probable use in this regard, he indicated, would be for a multi-manned scientific space laboratory.

Details of the transfer are just beginning to be worked out. Horner said NASA's acquisition of this in-house capability is not expected to decrease the percentage of NASA's work that is done by industry. In addition to Saturn, the Army missile group now has some 18-to-20 months more work programed for NASA on Redstone and Juno II boosters.

The Army group will continue to work on Army's Pershing missile guidance after the transfer and is expected to continue on some ARPA contracts. The team, headed by Dr. Wernher von Braun, also will ultimately be given "responsibility for the big engine development and subsequently whatever happens in the Nova program," Horner said. Basic engine for the projected Nova vehicle is a single-chamber 1.5-million lb. thrust engine now under development for NASA by Rocketdyne Division of North American Aviation.

Meanwhile, Army named Maj. Gen. August Schomburg to take over the Army Ordnance Missile Command when Maj. Gen. John B. Medaris retires next Jan. 31. Gen. Schomburg, now deputy chief of ordnance, will begin immediately to devote most of his time to AOMC to ensure continuity of operations before and during the transfer. Schomburg took part in last year's discussions over transfer of the missile team and the Jet Propulsion Laboratory to NASA. He is a graduate of the U. S. Military Academy and the Massachusetts Institute of Technology and has considerable experience in ordnance research and development work.

Hughes Gets GAR-9 Prime Contract

Washington—Air Force has awarded Hughes Aircraft Co. prime contracts for continued development of its AN/ASG-18 fire control system and GAR-9 nuclear-tipped air-to-air missile, both of which formerly were being developed under subcontracts in North American Aviation's now-canceled F-108 long-range interceptor program.

Indications are that the fire control system may be tagged specifically for the Air Force-Convair B-58. Convair is pushing the B-58 to fill the gap left by cancellation of the F-108, although the Mach 2 performance of the B-58 will not meet the Mach 3 interceptor role for which the F-108 was projected.

One Air Force bailment B-58 is now at Hughes' Culver City, Calif., plant for use in evaluating the company's fire control system development. A second bailment B-58 is scheduled to be given to Hughes shortly. Now being fitted with this equipment, the first bailed B-58 is scheduled to begin flight tests with the system in January, 1960. The Hughes system, a complex development, is designed to control various flight regimes as well as fire control job.

Application of the GAR-9 has not yet been specifically determined. Indications are that it could not be adapted to the B-58 without considerable conversion. The missile is farther along the development timetable than the fire control system and may have been continued by the Air Force for this reason.

Defense Group Evaluates Zeus Potential

By Philip J. Klass

Washington—Defense Department decision on whether to seek an extra billion dollars in Fiscal 1961 to begin production of the Nike Zeus anti-missile missile will largely depend upon the results of a year-long technical evaluation scheduled to go to Defense Secretary Neil McElroy within the next few weeks.

The technical evaluation is the work of a group of 10 top 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.

The report is expected to recommend continuation of the Zeus research and development program through 1962 when full-scale tests against ballistic missiles are scheduled to be held near Kwajalein Island in the Pacific. Approximately $500 million already has been spent or authorized through Fiscal 1960 for research and development work and another $750 million reportedly would carry the program through the Kwajalein tests.

Fund Needs

The thorny question is whether to proceed now with production tooling and procurement of long leadtime items. Congress appropriated $137 million as a starter in the Fiscal 1960 budget, and the Army estimates that another billion dollars would be needed next year.

The question would be difficult to resolve even if the Defense Department were not already sorely squeezed for funds for other important programs and even if it did not involve a measure of interservice rivalry between the Air Force and Army over air defense and space missions.

Zeus supporters are in favor of taking the calculated risk of starting Zeus production before the research and development phase is completed, a practice that paid off in the ballistic missile program. But there also are effective arguments against committing the nation to production of a not-yet-proven weapon whose ultimate cost may run from $10 billion to $20 billion or more, depending upon the scale of deployment.

Since the additional billion dollars required to start Zeus production would mean a cutback on other important defense programs or an increase in the defense budget, the final decision is expected to go to the President. This is why his scientific adviser is a member of the technical evaluation group.

With current tax revenues down because of the steel strike coupled with the Administration's hope of presenting a balanced budget during the election year, the prospect of an increase in the defense budget appears slim.

Some observers feel, however, that the Administration, faced with the prospect of being accused by the Democrats of slighting defense for the sake of a balanced budget and already sensitive to recent Soviet space achievements, may decide that an unbalanced budget is the lesser political liability.

If the billion dollars of production funds for Zeus must be found within the present $41 billion budget figure, the Zeus must compete against strategic weapons for funds rather than against other alternative active ICBM defense systems since there are none on the immediate horizon.

Bitter arguments can be expected over the question of whether the billion dollars could buy more national security if it were spent for additional ballistic missiles, additional Polaris submarines, additional hardening of ICBM sites, and/or mobile launching platforms for ICBMs.

It will not be possible to make a direct comparison of the merits of similar weapons, as in the case of the Nike Hercules versus the Bomarc or the Jupiter versus the Thor. The arguments will be far more abstract, less susceptible to scientific or other clear-cut resolution.

The battle will be joined by Air Force and Army partisans who see the Zeus as a "re-entry vehicle" for getting the Army back into the space business. A weapon system designed to knock out a ballistic missile nose cone in space is a logical contender for action against unfriendly satellites.

Defense vs. Deterrence

Zeus supporters say that complete reliance upon strategic deterrence is both militarily and psychologically unsound, particularly for a nation whose military policy is based on not striking the first blow.

If deterrence alone is an adequate air defense, why did the nation spend billions for air defense missiles, interceptors and SAGE at a time when it had a sharp margin of superiority over the Soviets in bomber retaliatory capability? Zeus supporters ask. If strategic deterrence was not sufficient in the past under these favorable terms, they say, why should it be more adequate today when the Soviet's ballistic missile retaliatory capability matches or exceeds that of the U. S., and thermonuclear warheads make each weapon carrier a greater threat?

The Zeus supporters do not deny the importance of deterrence but contend that the ability of a Zeus installation to protect bomber bases and missile sites, making them more difficult to knock out, actually strengthens the nation's deterrent hand. These supporters also contend that, if strategic deterrence fails to keep the peace and the Soviet Union launches an all-out attack which is detected in time for the U. S. to launch its retaliatory strike, the country with the most effective active defense for minimizing the effect of enemy missiles is the most likely victor.

Critics of the Zeus do not deny the value of an active defense if it provides a reasonable degree of effectiveness for the investment. They seriously question whether the Zeus is able to cope with ballistic missile warheads equipped with sophisticated decoys which the U. S. is now developing and which the Soviets must be assumed to be developing.

Any active defense system capable of providing a reasonable return on its investment must be able to discriminate between the actual warhead and decoys spewed out intentionally to fool an active defense system.

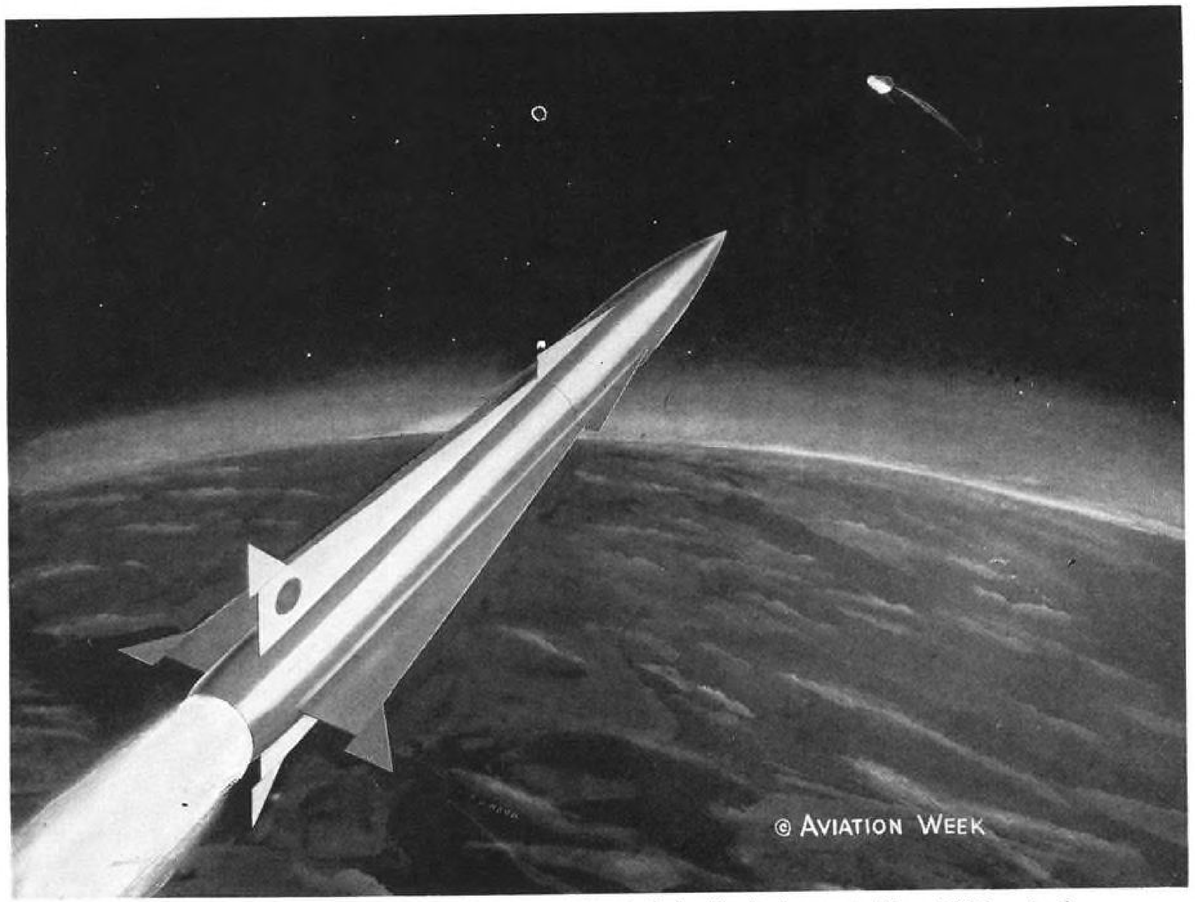
With the extremely powerful rocket boosters the Soviets now have, it would be easy for them to saturate an area with several dozen warheads intermixed with hundreds of decoys. Unless the Zeus system radars and/or computers can discriminate between the decoys and the actual warheads, enough missiles must be fired either to knock down or neutralize every target. Another possibility is to dispense a number of small active nuclear warheads, designed to strike a wide area from a single nose cone which might require a separate Zeus for each of the warheads.

Unless the country builds an extremely large number of Zeus missiles at a cost of many tens of billions of dollars, Zeus critics claim, it will be comparatively easy to saturate such an active defense system and render it practically useless.

Far better use can be made of far less money, they say, by hardening and dispersing missile sites and by providing mobile launching platforms—submarines, railroad cars, ships—whose position is constantly changing and impossible to predict in advance.

Zeus critics argue that for a smaller investment in hardening, dispersal and mobility, an enemy is confronted with a situation that makes it impossible to be sure of completely knocking out our deterrent capability in the first blow.

Insofar as protecting cities and other targets that cannot be hardened, the critics point out that even the most ardent Zeus supporters don't claim



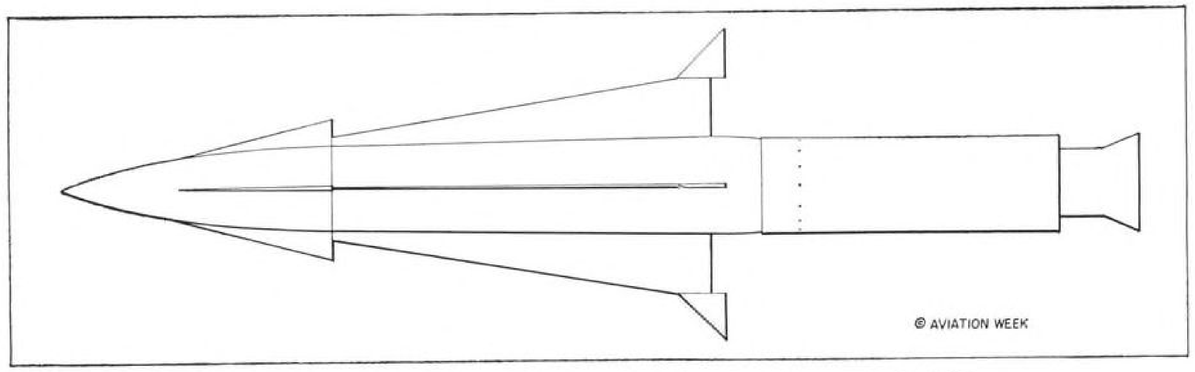
AVIATION WEEK artist's conception depicts a Nike Zeus anti-missile missile heading for intercept with an ICBM warhead.

100% kill potential and that a single bomb which gets through can wipe out a city. Nor does Zeus offer protection from fall-out from warheads that land outside of the protected area.

In answer to the decoy problem, Zeus supporters point out that the system is designed to discriminate between warheads and lightweight decoys such as metal balloons or tankage fragments which could be produced in large quantities. The heavy warhead will have a different trajectory from the lightweight decoys. By analyzing the trajectories of each object under Zeus radar surveillance, high speed computers will be able to discriminate between warheads and decoys, its supporters claim. The Kwajalein tests will include runs against decoys.

However, Zeus critics point out that with rocket boosters more powerful than those required for just the warhead, an enemy can develop more sophisticated decoys. These might be small decoys designed to have the same weight-to-drag ratio as the warhead and equipped with radar augmentation devices to produce as strong a radar signal as the warhead itself. This would give the decoys a trajectory which could not be distinguished from that of the warhead.

Zeus supporters cite this as an example of what they term "what-if-it-is." They say they're always being asked: "What if the enemy does this, or that?" They concede that Zeus in its present design cannot always cope with every threat conjured up by the opposition, particularly if it seems unlikely to be an operational reality for at least



AVIATION WEEK artist's conception shows Nike Zeus two-stage missile configuration. Nose cone is detachable.

Nike Zeus

The Nike Zeus anti-ICBM missile is a two-stage missile with detachable nose cone equipped with reaction controls to permit small last-second corrections in its intercept path. Zeus is being developed by Western Electric, Bell Telephone Laboratories and Douglas Aircraft Co. under Army Rocket and Guided Missile Agency, Huntsville, Ala.

Powered by a 450,000 lb. thrust solid-propellant booster, the largest ever built in the U. S., the Zeus is designed to reach intercept altitude of 200-250 mi. in less than two minutes.

Zeus may have the provision for a number of warhead types: thermonuclear for extremely high altitude intercepts where radiation is the kill mechanism; nuclear warhead for last-ditch low-altitude strikes where blast is the kill mechanism.

Present flight test configuration, an interim design, bears a resemblance to other members of the Nike family. Most noticeable difference between Zeus and Hercules configuration is the shift of the control surfaces to the outboard tips of the Delta stabilizers.

Second stage and nose cone measure about 30 ft. long; the first-stage booster measures about 20 ft.

Booster is made by Thiokol Chemical Co. Second stage sustainer engine is produced by Grand Central Rocket Co.

Zeus, like other members of the Nike family, employs ground-based command guidance by means of a radio-radar link between missile and guidance computers on the ground. Because of the need for a greater detection range, tracking accuracy and higher computation speed, entirely new radars and computers have been developed for the Zeus.

The specific number of radars and computers required for a Zeus installation will depend upon the size and nature of the target area to be defended. However, each installation will include one or more of the following types of radar:

- Forward acquisition radar, extremely powerful, long-range detection sets, will be located a considerable distance away from the Zeus missile batteries for early warning and target acquisition. Radar is expected to have a detection range of 1,500 mi. or more. Associated computers will determine missile's intended target area.
- Local acquisition radar, similar to forward radar, will be located near the Zeus batteries. Forward acquisition computer will assign targets automatically to appropriate acquisition radar and its tracking computers.
- Target track radar and computer will track individual nose cones prior to launching Zeus missiles and during the missile intercept phase, feeding information on target position to local guidance computers. Each radar computer can handle three targets simultaneously.
- Zeus tracking radar will simultaneously track several Zeus missiles, comparing their actual intercept course with the desired course as determined by digital guidance computers, then relay corrective steering signals to the missiles.

Zeus warhead may be detonated by a self-contained proximity mechanism or from the ground guidance computer.

Novel feature of the acquisition radars is the use of separate antennas for the powerful transmitter and the extremely sensitive receiver. Receiving antenna is equipped with a parametric amplifier or Maser to provide maximum possible sensitivity.

Missiles will be launched from underground silos to permit some degree of base hardening.

Based upon the very preliminary deployment studies conducted thus far, it has been estimated that 60 Nike Zeus batteries, each equipped with 50 missiles, sufficient to protect major cities and military installations, would cost about $10 billion. Cost of 120 Zeus batteries, sufficient to protect cities over 100,000 population plus major military and industrial targets, is estimated at around $15 billion.

However, judging these figures on the basis of the history of original estimates of the deployment cost of earlier Nike and Bomarc missiles, and SAGE, some observers believe the ultimate cost of Zeus deployment will be at least twice the figures cited above.

Nike Zeus is an outgrowth of a study of advanced air defense systems conducted during 1956 by Western Electric, Bell Telephone Laboratories and Douglas Aircraft Co. Actual development program was initiated by the Army in the spring of 1957, aimed at providing a defense system against both hypersonic aircraft and missiles.

About a year ago, decision was made to place primary emphasis on ballistic missile defense. Army officials say that Zeus has "rigorously adhered" to the development timetable drawn up more than two years ago.

another decade or perhaps longer.

When confronted with a difficult "What if . . ." question, Zeus supporters sometimes counter with the statement that Zeus has the growth potential of meeting the proposed threat with suitable modification and additional equipment.

The critics of Zeus, on the other hand, claim its supporters are being unrealistic in dealing with the decoy problem.

The Air Force already has ICBM decoys under development in rather sophisticated versions.

The basic problem for any active defense system, the Zeus critics say, is that small, inexpensive, quickly-made modifications in the ICBM nose cone can create complex, difficult-to-solve problems for the defense system which are costly in time and dollars to counter.

It is generally agreed that the crux of the ICBM active defense problem is the matter of being able to discriminate between decoys and warheads. Some observers, while not opposing the continuation of Zeus research and development, say that it is premature to start moving into production because too little is known about the basic physics of re-entry bodies. They point out that our basic knowledge of how a re-entry body looks to radar and infrared detectors is far too meager to warrant costly moves into production at this time.

The Advanced Research Projects Agency has a program under way to make radar and infrared measurements on missiles fired from the Atlantic Missile Range during launch, mid-course and re-entry. As one Defense official says, however: "We're getting radar and infrared signals, but at the moment we don't know whether they're coming from the warhead, the tankage, the ionized trail or something else."

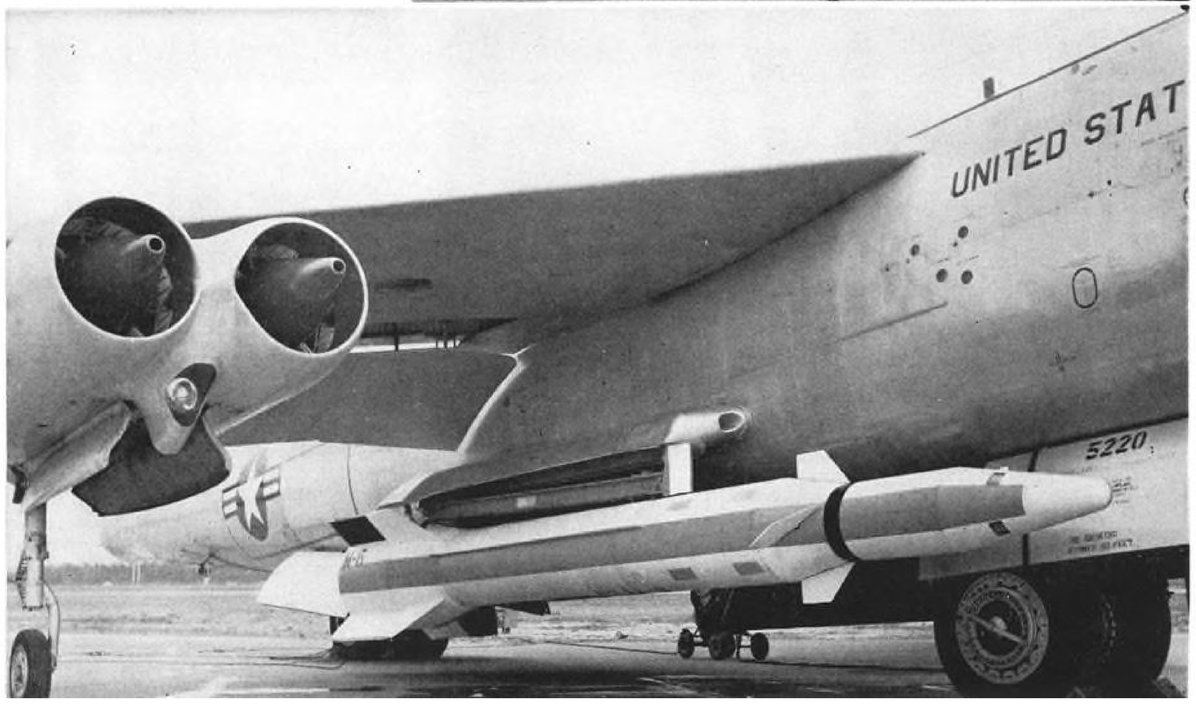
But other observers believe the only hope for an active defense against ICBMs in the next decade will be a system which employs a high-speed intercept missile, radars and computers—in other words, a "Zeus-type" system. Any exotic defense, such as "death rays," is at least a decade or more away, they believe.

Since Zeus is the only anti-ICBM missile program under way at present, these observers believe that we should proceed post haste with Zeus production, taking the calculated risk in order to obtain earliest possible advantage and maximum life from the weapon. When new techniques for target/decoy discrimination are developed, these can be introduced into the Zeus design. This may require costly modification, perhaps even some scrappage, but this is the price for survival in a ballistic missile-nuclear age, they say.

Martin Co. air-launched missile is now being proposed to USAF as satellite surveillance vehicle.

Martin Proposes ALBM Satellite Monitor

Two-stage solid propellant missile launched at 35,000 ft. from a Boeing B-47 came within four miles of Explorer VI satellite which was orbiting at 26,000 mph. at 160 mi. altitude (AW Oct. 19, p. 34). Martin proposes similar vehicles to reconnoiter unknown satellites, and produce data applicable to satellite rendezvous and refueling techniques. Windows at front of vehicle (right and below) indicates Martin-developed Domar doppler guidance system may use infrared homing for final run on target. Other components are off-the-shelf hardware. Mounting pylon (below) is similar to that used in test firings of the Bell Rascal air-to-ground missile. The B-47 may be one of those modified for the Rascal program.



Liquid Engines Upgrade Sparrow, Bullpup

By Michael Yaffee

Bristol, Pa.—Development of prepackaged, liquid propellant rocket engines, in production at Thiokol Chemical Corp.'s new plant here, was sponsored by the Navy to upgrade performance of solid-powered Sparrow III and Bullpup missiles.

The prepackaged engines, which answered specific needs of the Navy, are being groomed by the company's Reaction Motors Division for other uses. At the moment, however, the new engines have no other definite applications and are not scheduled to supplant solid propellant powerplants in other missile applications at the present.

Production of the Guardian I engine for the Sparrow III air-to-air missile has been under way here since last December (AW Nov. 10, 1958, p. 33); Guardian II engine for the Bullpup air-to-surface missile has been in production since August, 1959. Thiokol currently holds Navy Bureau of Aeronautics contracts of $1,800,000 for the Guardian I and $3,800,000 for the Guardian II, plus an undisclosed amount for the development of a somewhat different type of storable liquid propellant engine for the Corvus air-to-surface missile.

Under management of Thiokol's Reaction Motors Division, the plant here is the only facility that produces complete liquid propellant propulsion packages. When the engines leave the plant, they contain everything required for rocket propulsion—from hermetically sealed propellants to exit nozzles. On board an aircraft carrier, the Guardian I propulsion package is taken from a storage magazine to an assembly area and simply screwed into the aft end of the Sparrow III.

Principal advantage of the Guardian I and II engines over the solid propellant powerplants they are replacing is the better temperature cycling characteristic of the liquid propellants.

At the time the Guardian program first started, wide temperature variations significantly altered the burning rate and, hence, the performance of available solid propellants. Military specifications required missiles to operate over the temperature range from −65F to 160F. The first Sparrow IIIs which were to be carried by the McDonnell F3H-2 Demon were able to meet this requirement with a solid propellant engine. But on McDonnell's Mach 2 successor to the F3H-2, the F4H-1, operating requirements for the Sparrow III call for a top temperature capability somewhere near 225F.

Storable Liquid Powerplant

The only way to accomplish this, at the time, seemed to be with the less temperature-sensitive liquid propellants. Because the missile had to be carried on ships and because its design was already established, the Navy had to have a storable liquid powerplant with the same dimensions, simplicity, performance and safety as the solid motor it was to replace. The answer was Reaction Motors' prepackaged unit.

The solid propellant grains also were subject to cracks from the thermal cycling which could cause the propellant to detonate instead of burn. Detection of these cracks on board ship would require extensive X-ray inspection equipment and time. H. R. Ferguson, Thiokol executive vice president, noted that temperature considerations no longer are valid reasons for choosing the prepackaged liquid unit over a solid propellant engine. Improvements in the temperature characteristics of today's solid propellants make them the equal of the liquids, he added. The choice between the solid and the packaged unit, if made today, would center primarily on cost.

Higher specific impulse and, hence, greater range for the missile was another advantage given for the prepackaged liquid propellants. But, again, Thiokol officials feel that current solid propellants could match the prepackaged liquids which, in the case of the Guardian engines, are mixed amine fuels and inhibited red fuming nitric acid oxidizer.

At the same time, Aviation Week learned, Reaction Motors is continuing its work on the development of more powerful propellants for the prepackaged powerplants (AW June 15, p. 37) and expects to switch the engines to these propellants as soon as they are proven. One possible combination, hydrazine and chlorine trifluoride, would match operational solids in density impulse and outdo them in specific impulse.

Prepackaged liquids also appear to be at a standoff with solids, in regard to simplicity. The present Guardian engines have only one moving part. Like all liquid engines, they theoretically lend themselves to thrust control more readily than solids. But the addition of thrust control mechanisms to the Guardian would both complicate the engine and make it more expensive.

Besides being in competition with solid propellants, the prepackaged liquids are, to a degree, also in competition with monopropellants. Rear Adm. Robert E. Dixon, chief of the Navy's Bureau of Aeronautics, said the acceptance of the Guardian engines will not affect the Navy's program on the development of high energy monopropellants. He believes the competition will prove beneficial to the Navy and compared it with the earlier competition between liquid-cooled and air-cooled aircraft engines.

Scalability was another advantage given for the prepackaged engines. To get more powerful engines than the 8,000-lb.-thrust Guardian I and 12,000-lb.-thrust Guardian II, Thiokol said it would simply fabricate a larger engine of the same design and would not, as with solids, have to design a new engine. The company already has built and fired a prepackaged engine with 50,000-60,000 lb. thrust.

Large prepackaged engines, Navy officials said, would be suitable and, owing to their low thermal sensitivity, desirable for the Polaris as well for air-launched ballistic missiles. Adm. Dixon stressed that the Navy has no immediate applications for the prepackaged engines, other than the Sparrow and Bullpup. The engine for BuAer's Corvus missile, it was disclosed, will use storable liquid propellants, but it was described as being "not precisely prepackaged" and as not belonging to the Guardian series. Shelf life of the Guardian engines is believed to be 3-5 years.

Navy also considers that the prepackaged engines have a slight edge on solids in safety and resistance to battle damage. The Guardian engines, it was brought out, can be dropped six feet or so safely. When a solid propellant engine is dropped, a BuAer engineer said, it is almost impossible to determine without a detailed inspection whether the propellant has cracked and spilled. Ignition of a damaged grain could blow the wing off the carrier aircraft, he added.

Another advantage listed for the prepackaged liquid propellant engines over the solid propellant engines they are replacing is diminished exhaust smoke. This is particularly important in the case of the Bullpup, which is tracked and radio-controlled by the pilot who tries to keep the two flares in the tail of the Bullpup superimposed on his target sight. Exhaust smoke, however, often obscured the flares, making it difficult for the pilot to correct the course of the missile. The range increase afforded by the prepackaged engine also is expected to count for more in the case of the Bullpup. From data gathered in Korea, the Navy found that 40% of its aircraft losses on close support missions were caused by small arms ground fire.

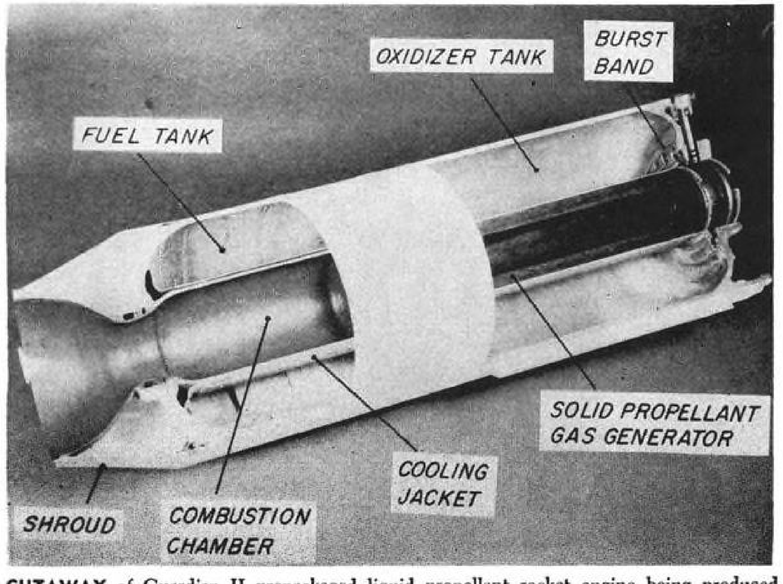
Official designations for the Guardian I and Guardian II are, respectively, LR44-RM-2 and LR58-RM-2. Both engines are approximately 98% aluminum. The Guardian I, used in Sparrow III, has a regeneratively cooled aluminum nozzle. Exit cone in the Bullpup's Guardian II engine is made of copper and is uncooled. Combustion chamber and exit cone of the Guardian II are flame-sprayed with zirconium dioxide.

Basically, each prepackaged Guardian engine consists of the following sections: nozzle, combustion chamber, cooling jacket, injector and mixer, two burst bands, solid propellant gas generator, initiator, fuel tank, oxidizer tank and gas deflectors. The oxidizer tank, slightly larger than the fuel tank, is at the head end of the engine. The two tanks are separated by the mixer and injection head. The gas generator cylinder runs down through the center of the oxidizer tank while the combustion chamber with its cooling jacket occupies the center of the fuel tank.

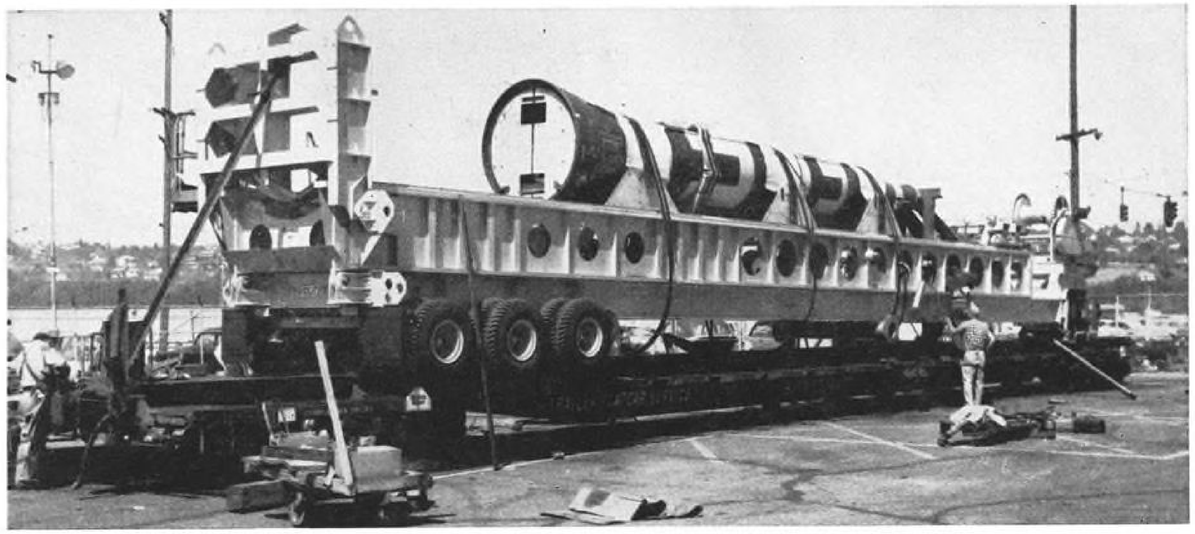
To fire the unit, an electrical signal is transmitted to the initiator. The initiator ignites the solid propellant gas generator. The gas forces its way through the burst bands located at each end of the generator cylinder, one at the head of the oxidizer tank and one at the head of the fuel tank.

In the oxidizer tank, the deflector at the head end forces the pressurizing gas rearward so that it pushes the oxidizer into the mixer at the back end of the tank. The deflector in the fuel tank also forces the pressurizing gas and the fuel toward the rear. At the back end of the fuel tank, however, the fuel enters the cooling jacket and, reversing itself, flows forward into the mixer that separates the fuel and oxidizer tanks. Fuel and oxidizer mix and are injected into the combustion chamber where hypergolic propellants ignite spontaneously.

For most of the aluminum forgings and extrusions in the Guardian engines, a weldable aluminum alloy (6066 T-4) is used. More than 60 separate steps are involved in the fabrication of each engine with a long list of quality control checks that must be made along the way. Thiokol keeps each engine's quality control check list for seven years.

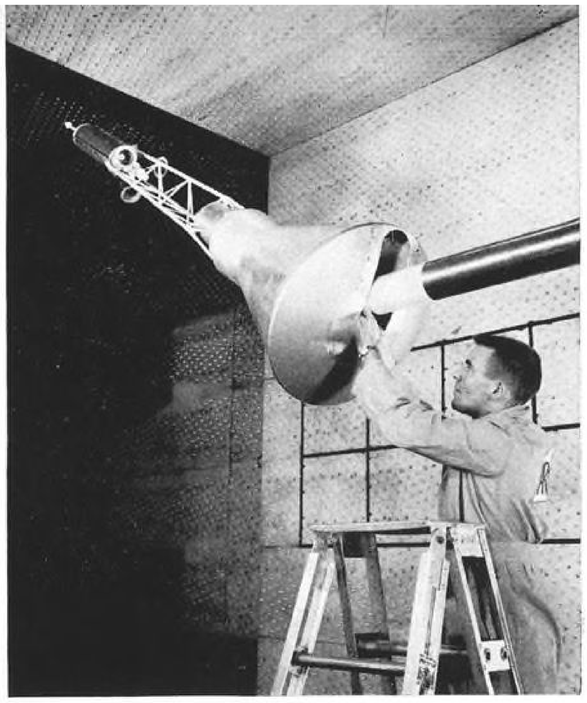


CUTAWAY of Guardian II prepackaged liquid propellant rocket engine being produced for the Bullpup missile shows nozzle, shroud, combustion chamber and jacket, fuel tank, oxidizer tank, solid propellant gas generator and oxidizer burst band. Hidden from view by the center band are the mixer and injector section and fuel burst band.



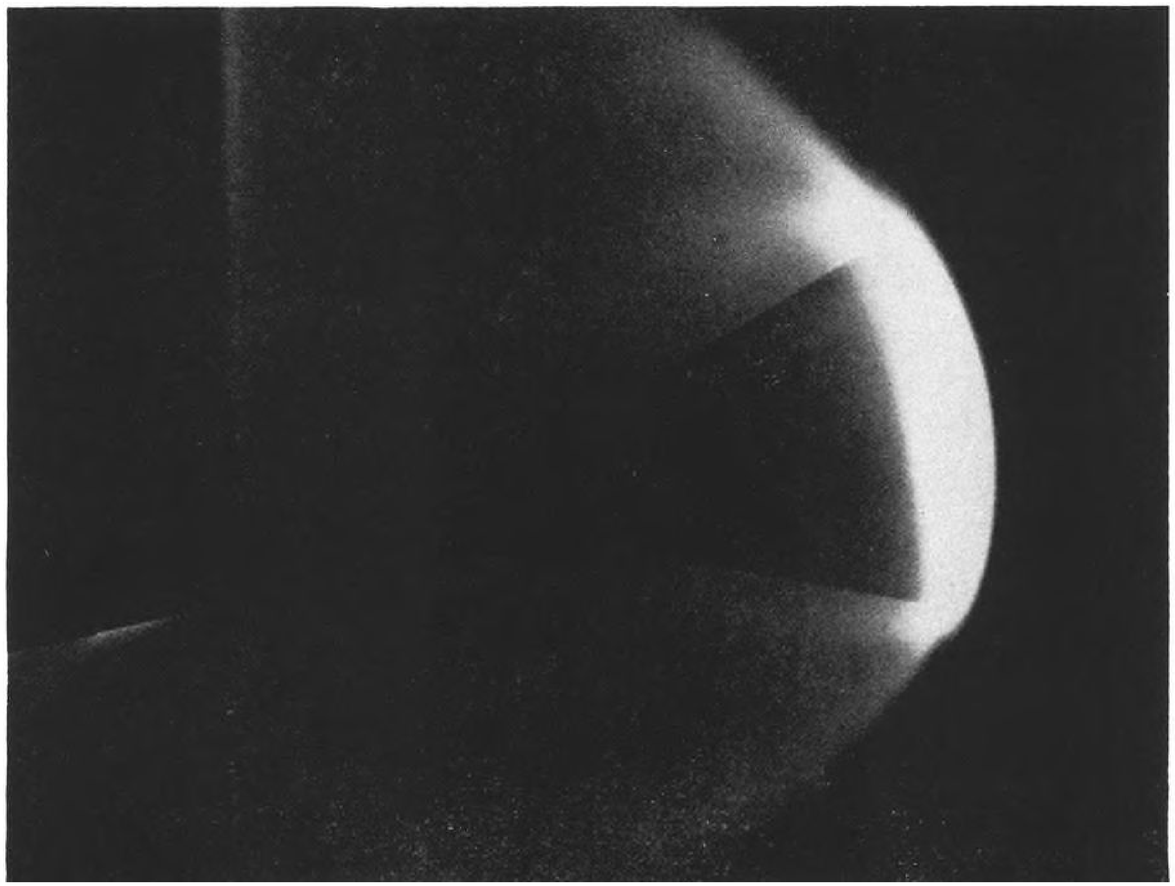
Minuteman Dummy Stage Used in Firing Test

Dummy upper stage for full-scale model of Minuteman solid-propellant intercontinental ballistic missile used in underground silo environmental test firings at Edwards AFB, Calif., is carried on a flatbed trailer loaded on a railroad flatcar for transportation from the assembly and test contractor, Boeing Airplane Co. at Seattle, to Edwards. Dummy upper portion consists of second and third stages, guidance section, and nose cone. Fitted to partially loaded, live first stage, the upper section completes the model missile to give a realistic configuration embodying true size (about 65 ft.) and weight. In silo tests, the missile model is fired to about 1,000 ft. altitude by first stage. Yoke-type tether on missile nose prevents escape from the prescribed area (AW Oct. 12, p. 33). Three firings already have been made from Edwards test silos in a continuing series projected to reveal environmental factors. Meanwhile, Air Force's Ballistic Missile Division is going ahead to establish silo design criteria as well as follow-on design for hardened silos.



Deflection Plate Tested for Mercury

Deflection plate (top left) may be used on the small end of the Mercury manned space capsule to turn it around if it re-enters the earth's atmosphere backward. Research has shown that the capsule is stable at angles of attack from about 176 to 184 deg. Capsule model recently was tested at Mach 0.7 to 1.5 range in the 16-ft. transonic section of propulsion wind tunnel at Air Research and Development Command's Arnold Engineering Development Center, Tullahoma, Tenn., with escape tower attached (top right). McDonnell Aircraft Corp., capsule manufacturer, and ARO, Inc., contract operator of AEDC, also have studied heat transfer, pressure distribution and stability in hypervelocity high-altitude tests in the Hotshot 2 tunnel (at Mach 20, below).



France to Develop IRBM With U.S. Aid

Paris—France will depend for its atomic strike force on an intermediate range ballistic missile developed with U. S. technical aid and armed with a French warhead.

Jean Blancard, French Air Secretary, disclosed that the French IRBM would be in the 1,500 to 2,500 mi. range and probably would be fueled by solid propellants. French Defense Ministry is hoping to have the missile ready by the mid-1960s.

Blancard said there was no question of France independently building the missile. He indicated French aircraft companies would work closely with U. S. firms on development of the delivery system. The atomic warhead would be developed by the French, at least as long as U. S. legislation prohibited Franco-American cooperation in this field.

Blancard also confirmed reports that the French Defense Ministry had abandoned its project of developing a long-range bomber strike force (AW Sept. 7, p. 31). The project, announced earlier this year, involved building of a larger version Dassault Mirage 4 attack bomber to be powered by two Pratt & Whitney J75 turbojets. Idea behind the project was for the French to use the long-range bomber as a vehicle for French-developed nuclear weapons until the mid-1960s, when a French IRBM would be operational.

Such an undertaking, Blancard said, would have been too expensive. Figures he quoted indicated each Mirage 4 strategic bomber, slated to weigh roughly 60 tons, would have cost about $6 million. Development costs would add another $40 million Blancard said. Faced with these cost estimates, French Defense Ministry apparently has decided to stay with its smaller Mirage 4 attack bomber, now flying in prototype version, until the French IRBM is operational. Mirage 4, which weighs about 25 tons and is powered by two Snecma Atar 9 turbojets, could carry an atomic payload into Russian territory but only on a one-way basis.

Blancard said that responsibility for developing the French IRBM rests with a new combine set up several months ago. The group, (AW Aug. 10, p. 28) called Societe pour les Etudes et Realisation de Engins Ballistiques (SEREB), is composed of most French aircraft companies plus several government agencies. SEREB's main task will be to coordinate efforts of various French companies in building the IRBM as well as dealing with American companies which will participate in the program. Top man in SEREB is Charles Cristofini, former government official. Technical director is Fernand Vinsonneau, formerly technical director for Sud Aviation's military division. It is expected that Vinsonneau's technical staff will consist of some 50 engineers drawn from industry and government ranks.

Three Airlines Cite New Revenue Gains

Washington—Traffic diversion from strikebound Eastern Air Lines plus the benefits of a 10% interim fare increase are credited for much of the heavy gains in passenger revenues experienced by National and Delta airlines during Fiscal 1959.

Delta recorded a net profit of $4,062,222 for a 17.26% gain in passenger revenues over Fiscal 1958, while National earned a net profit of $2,379,128 with a gain of more than 32% in passenger revenues for the same period.

Delta's net income, as a per cent of revenue, was 3.91% as compared with 1.06% for Fiscal 1958 when the airline made a profit of little more than $1 million. Earnings per share of stock were $3.62 as compared with 95 cents for the previous year.

Total operating revenues of the airline reached $103.8 million, a $15 million gain over Fiscal 1958. Most of the increase was accounted for by increased passenger revenues, although Delta's cargo revenues were up 26.90% over the previous year and amounted to more than $7.2 million.

Operating expenses totaled $94.4 million for the year, reflecting a gain of 10.26% over Fiscal 1958. Gain in dollar expense by $5.4 million was largely attributed to the staffing of new cities added to the Delta system, which required the hiring of 665 new employes.

National's Fiscal 1959 profit is based on operating revenues of $70.8 million as compared with the previous year when the airline experienced a net loss of $605,316 based on operating revenues of $53.8 million and total operating expenses of $54.7 million.

Expenses for the airline reached $64.4 million in Fiscal 1959, a 16.1% gain over the previous year. Cost per available seat mile increased to 3.28 cents as compared with 3.23 cents for Fiscal 1958 but still fell below the industry average of 3.56 cents.

At Pittsburgh, Pa., Donald W. Nyrop, Northwest Orient Airlines chief, last week predicted to the Society of Financial Analysts that Northwest's 1963 revenues will be 75% greater than 1958's, for an annual increase of 13%.

In 1958, he noted, Northwest realized almost $102 million in gross revenues, for a net profit of $5.6 million. The airline's growth, he said, is pointed up in the net income for the first nine months of 1959, up 54.6% over the same 1958 period, for a total of $4,850,826, against $3,138,104 a year ago.

Total revenues for this period were $94,278,331, up 28.2%, of which $77,444,680 came from passenger revenue. Expenses for the first nine months were $85,246,393, up from $67,028,942 reported in that period a year ago. Nyrop attributed the rises to cost control, modern equipment, acquisition of a Florida route, and service and merchandising factors.

News Digest

National Aeronautics and Space Administration last week successfully launched and inflated a 100-ft. diameter aluminized plastic sphere which is a forerunner to a passive communications satellite that will be put into an earth orbit. Launch was made from NASA's Wallops Island Station, Va., using a Thiokol Sergeant and two Recruits for the first rocket stage and an Allegany Ballistic Laboratory X-248 for the second stage. Water, boiling off into steam at the low pressure of some 220 naut. mi., inflated the sphere. It was seen as far away as 300 mi. and tracked by radar for more than 20 min.

First prototype of Navy's McDonnell F4H all-weather fighter crashed recently during a routine test flight from Edwards AFB, Calif., killing McDonnell engineering test pilot Gerald Huelsbeck, 31. Cause of the crash is under investigation by a Navy board of inquiry. The wreckage was found in a field approximately 17 mi. from the air base. The F4H test program is being continued by a number of other aircraft now at Edwards.

Commercial turbine-powered helicopter service began at San Diego, Calif., last week with the arrival of two Republic Allouette IIs. Coast Rotors, Inc., will operate the five passenger aircraft from Montgomery Field and has four more Allouettes on order from Republic Aviation, which so far has sold 17. Plans are to operate regular shuttles from neighboring cities around San Diego, provide interplant travel for aircraft and electronics industries and to offer a variety of agricultural, conservation, photographic and other services.

U. S. Army will activate three more Martin Lacrosse surface-to-surface missile battalions at Ft. Sill, Okla., early next year, bringing the total to seven battalions, with an eighth to be added before June 30, 1960.

IATA Airlines Gird for Passenger Battle

Fringe benefits designed to lure traffic may be first result of international open-rate fare structure.

By L. L. Doty

Tokyo—A rush to fringe benefits designed to lure passenger traffic in the competitive jet race on international routes is now expected to be the first direct result of the open-rate situation created by the recent breakdown of the International Air Transport Assn. traffic conference (AW Oct. 19, p. 38).

Failure to reach an agreement on almost all major issues forced the IATA traffic conference to adjourn last month in Honolulu in a complete stalemate. Only passenger fares in the Middle East and Europe and between North and South America, as well as cargo rates on all routes, were closed at the conference.

Current fares on all other international routes will remain in effect until Mar. 31 after which an open-rate situation will exist. Here is the latest summary of the fare crisis as it now stands:

• **British Overseas Airways Corp.** apparently has no intention of wavering in its demands for a reduction of fares on Far Eastern and African routes, nor is it willing to consider dropping the tourist configuration to allow for an expansion of economy class seating. BOAC wants a fare slice 20% below current tourist rates.

• **Other IATA carriers** are equally determined to forestall any drive toward fare cuts in certain areas on grounds that the high cost of operation coupled with low market development potential does not justify any drastic rate adjustments at this time. These carriers are willing to risk a complete disintegration of the IATA traffic conference rather than face conference domination by a single carrier.

• **Chances are strong that** the individual governments will take over rate negotiations for the carriers unless some agreement is reached before the Mar. 31 deadline. IATA members still here are firmly convinced that such agreement is very unlikely. One remote possibility for settlement exists. Carriers could negotiate through IATA Director General, Sir William Hildred, in attempts to reach a compromise agreement and then cast votes by mail thus avoiding reconvening of the traffic conference.

Most IATA members who attended the annual general meeting here now feel that a price-cut war can be averted at least temporarily despite the open rates. They are, however, almost certain that a majority of international carriers will take full advantage of the lifting of all controls—caused by the open-rate situation—and increase give-aways to passengers or adjust seating configurations to any desired pattern.

No one is discounting entirely the fact that a price-cut war could eventually come about as a competitive weapon if load factors begin to drop sharply as seating capacity in jet aircraft begins to climb. Such battles could be settled by the governments involved since all air transport bilateral pacts call for mutual agreement on tariff issues.

Nevertheless, there is always the possibility of one government siding with a second against a third as a means of helping its flag carrier attract traffic with reduced rates. Highly subsidized flag carriers are in a position to absorb any resultant losses in gross revenues in such cases.

Slash Fares

It is almost certain that British Overseas Airways Corp. will slash its fares on its cabotage London-Hong Kong and other colonial routes to the Far East and Africa by 20% to compete with independent carriers which have requested the British government to permit fare cuts by as much as 50%. In the past, British state carriers have always held to standard IATA fares on such routes although the association holds no jurisdiction over any nation's cabotage routes.

If the British government grants the BOAC request to cut fares on the London-Hong Kong route, other airlines will be forced to follow suit since competition on most cabotage routes is highly intensified by the relatively light traffic volume traveling over these routes. It was the demand by BOAC for the cut to 20% below current tourist rates on fares from Europe to the Far East and to Africa that started the deadlock in the traffic conference and created the complexities that tied delegates into knots during the talks.

Beyond these routes, however, most delegates to the annual general meeting held the view that rate cuts would be slow in making an appearance and that bilateral agreements in the Pacific and Atlantic regions between individual carriers outside of the mechanism of the traffic conference would arrest any trend toward uncontrolled price-cutting.

Several delegates suggested to AVIATION WEEK that public opinion may force fare reductions. They were particularly resentful that BOAC, by spearheading the drive for universally low fares, had conveyed the impression that it stood alone in its demands for lower fares.

These delegates were then quick to point out that the majority of IATA members are strong proponents of reduced fares but that they favor a conservative progressive reduction as the only means of keeping revenues alive in line with the unknown costs of jet operations and the low air travel market potential in many areas throughout the world.

Prospects of reopening traffic conference talks on the fare issue have grown dim since BOAC took the stand that threw the conference into a stalemate. One IATA member told AVIATION WEEK that "we have no intention of spending another three or four weeks talking in circles on a subject that could be settled in two or three hours." BOAC Managing Director Basil Smallpeice had this to say during his visit here during the annual meeting:

"We had certainly hoped for a decision which would have enabled us to offer on our routes south and east of the United Kingdom a fare which would have been some 20% lower than the current tourist rates on most of our routes throughout the world. BOAC has for long been in the forefront of the movement for cheaper air fares and we shall not relax our efforts to convince other airlines belonging to IATA that it is sound policy to introduce cheaper fares on routes where they are not at present applicable."

BOAC also noted that it had ". . . clearly stated its main objective prior to the Honolulu traffic conference of IATA" and added that "it will now be necessary for BOAC and for that matter presumably other carriers as well to take stock of the situation thus created."

Pan American World Airways prior to the traffic conference launched a publicity campaign designed to create a favorable atmosphere for lower fares and arrived at the conference with the announced intention of widening the use of the economy fare plan. Although on the suface these two carriers joined in negotiations with apparent unanimity of opinion, a wide split, hidden by the complexities of the issues at stake, developed between the two companies almost as soon as negotiations began.

As talks developed, it became obvious that BOAC, while fighting for an extension of economy fares, also wanted to retain de luxe, first class and tourist configurations on all routes. These demands were reportedly made because BOAC's combined fleet of de Havilland Comet 4s and Bristol Britannias are particularly suited to a combination of the four classes of service.

Other IATA carriers are ready to drop the tourist configuration on all routes where the economy plan is used since the popularity of the latter has almost eliminated the demand for tourist class seats. These carriers, however, want to retain tourist class configurations and delay the introduction of economy plans on routes which still do not indicate a healthy market potential.

Thus, the issue that did more toward creating the conference deadlock was clouded by the drive for lower fares which, in turn, was not necessarily the real stumbling block in negotiations. Lord Douglas of Kirtleside, chairman of British European Airways, said that "the executive committee has unanimously agreed in principle that the lower we can get fares the better."

Lord Douglas, in this statement, echoed the feeling of most delegates to the annual general meeting and voiced the general sense of conferees to the traffic conference when he forecast that fares will be lowered eventually on a regional basis.

Recommendations by the Civil Aeronautics Board, issued to the traffic conference in September, the more round trip excursion fares applicable to off-peak directions and seasonal off-peak periods be introduced were sidetracked by the conference stalemate. Jet surcharges, which is no longer a controversial issue and which most carriers are ready to drop, also was omitted from the negotiations by the deadlock.

As matters now stand, transatlantic and transpacific routes will be without a standardized fare structure beginning Apr. 1. Feeling is strong that rates on these routes will not change initially but that passengers will be showered with give-aways, fringe benefits, special foods and liquors all of which have been rigidly controlled under the terms of traffic conference rulings.

Passengers also will have a large selection of seating configurations to chose from since agreement on this matter is not likely to be reached for some time to come. Pitch of aircraft seats was a thorny issue that served to block several moves to compromise on rates. BOAC, eager to keep its Comet 4s competitive with the larger Boeing 707s and Douglas DC-8s, insisted that a 54-in. pitch should be adopted for first class Comet flights instead of the 42-in. pitch proposed for all turbojet transport seating configurations. Attempts to compromise this issue by permitting a 47-in. pitch on Comets were turned down by the British. Strong disagreement on a proposed 34-in. pitch for tourist service ran throughout the conference.

As demonstrated by the "sandwich war," (AW Apr. 28, 1958, p. 39) international airlines have historically found it difficult to refrain from granting passengers every practical type of gift and benefit imagineable as a means of capturing new customers. The open-rate situation will prove a bonanza for the traveler until rates on these two routes are closed.

On the Far East route and routes to Africa, fares will likely be lowered in a price-cut war. At the same time, fringe benefits on these routes will virtually disappear and passengers will be handled with austerity.

Cargo rates will remain the same on all routes although some shippers will gain by drastic reductions, approved by the conference, in specific commodity rates on transatlantic routes.

CAB Ruling in Viscount Accident Disputed by Capital, Dispatchers

By Robert H. Cook

Washington—Extreme weather turbulence that forced a Capital Airlines Vickers Viscount turboprop transport into an out-of-control 9,000 ft. dive was cited by the Civil Aeronautics Board last week as the probable cause of the in-flight disintegration of the aircraft on May 12 near Baltimore, Md. All 31 persons aboard the New York-Atlanta flight were killed.

At the same time, the Board laid heavy emphasis on testimony that although the aircraft, Capital Flight 75, had an inoperative airborne radar, the company's flight dispatch section failed to inform the pilot of an additional weather report indicating an increase in the severity of en route thunderstorms and, therefore, failed to assist the pilot to the "ultimate of its capability." Had the airborne radar been working, the Board said, the flight may have avoided the area of turbulence.

CAB's criticism of Capital's dispatch duties, brought immediate protests from both the company and the Air Line Dispatchers Assn.

The airline said that weather information given to the flight prior to a New York departure "specifically pointed out the possibility of encountering 'extreme' turbulence and a solid squall line on the flight."

Capital contended that a later "flash" weather advisory, which CAB said indicated worsening weather conditions, actually indicated improved conditions since it stated that the turbulence had been reduced from "extreme" to "severe" and that the possibility of a solid squall line had been reduced to scattered thunderstorms. The company said it agreed with its dispatcher's judgment that, in view of the unsettled weather conditions, the advisory should not have been transmitted.

The Air Line Dispatchers Assn. concurred that the actions of the dispatcher, a trained meteorologist, were in complete accord with company policy.

In reviewing the accident, the Board said that Flight 75 departed from New York bound for Washington at 3:29 p.m. under instrument flight rules and proceeded to its assigned cruise altitude of 14,000 ft. At 4:02 p.m., the flight contacted the Washington traffic control center asking permission to alter course to avoid a "pretty good string of thunderstorms" to the west. Permission was granted and last contact from the flight came eight minutes later when the aircraft reported passing over a checkpoint and advised that cruise speed was being reduced to 170 kt. on "account of rough air."

The CAB reported that an analysis of its findings indicated that the aircraft caught in extreme turbulence went out of control, dove 9,000 ft. in three minutes or less at a speed of 335 kt. and broke up in less than one second during an attempted recovery.

Initial failure in the aircraft's destruction sequence, as determined by CAB accident investigators, was the nearly simultaneous downward failure of the horizontal stabilizers at the No. 2 hinge point. Violent downward pitch of the plane then caused all four engine nacelles to break upward. Immediately afterward, the right wing separated from the fuselage. Drag induced by the remaining left wing then caused the fuselage to yaw to the left, tearing off the vertical fin along with portions of the fuselage. The left wing and the remaining fuselage portions then tore off and fuel cells located in the wing ripped open causing a brief flash fire, the Board said.

CAB's Expanded Mail Program Tentatively Approved by American

Washington—American Airlines notified the Civil Aeronautics Board last week that it would be willing to accept under certain conditions the rates proposed by the Board for the expanded movement of first-class mail by air (AW Oct. 26, p. 38). Conditions American attached to the acceptance are that the Board:

- **On or before the date** the rates are to become effective, issue regulations prohibiting any air carrier from transporting such mail on any basis other than that described in the CAB order—namely as non-priority, space-available traffic.
- **Issue regulations prohibiting** any air carrier from accepting or storing such mail in excess of the quantities that can be accommodated by the carrier within a reasonable period of time.

The rates proposed by the Board in a show cause order are 50% of what airlines now receive for transportation of air mail and about the same as those they receive for first-class mail under the limited experimental program now in effect. Deadline for filing objections to the rates is Nov. 5.

Other major airlines that had not filed notice of intention with the CAB by late last week said the proposed rates are still under study.

If the mail is offered under conditions asked by American, the other major carriers generally agreed that the proposed rates would seem "fair and reasonable." If, however, the airlines must accept the mail on any basis other than space-available, the airlines say the proposed rates would not be high enough to cover the additional cost.

The airlines said that, under an experimental program first begun in 1956, a large portion of this mail moved on night flights, which was convenient to the Post Office Department, since there was more available space for the mail. With the increase in jet service, the trend is now toward more day flights and less night service, creating a larger problem in transporting the mail because of limited space available, the airlines said.

While the Board awaited answers from other airlines involved, the Railway Express Agency, Inc., petitioned for leave to intervene in the case. The Agency said that since it is engaged in small package transportation by both surface and air in competition with the Post Office's parcel post service, it has a direct interest in the case insofar as it relates to the transportation of fourth-class mail.

In its petition, the Railway Express said that under the Board order it would face a possible diversion of 24,396,000 packages each year, amounting to more than 299 million lb. and revenue of $56,939,000. Such a diversion, it contended, would require the agency to change the nature of its operation to the detriment of the shipping public.

During congressional hearings on expanding the non-priority mail program, the Post Office Department said that the program initially would involve only a portion of the available first-class mail but that it eventually could be expanded to include all mail except air mail and air parcel post.

Delta Pilots Dispute Seniority Listings

Washington—Mounting resentment among Delta Air Lines' pilots over the seniority listing formulated in 1952 when the carrier merged with Chicago and Southern Airways is endangering cockpit safety in the airline's Douglas DC-8 jet transports, a group of 232 Delta pilots charged last week in a complaint to the Civil Aeronautics Board.

"Bitterness, constant tension, frequent arguments and threats of fights" are increasing among the 435 pilots directly affected by the merger, the complaining pilots said in asking the Board to reconsider a recent order refusing to investigate or hold a public hearing on the disputed seniority list. Delta has a total of more than 700 pilots.

CAB dismissed the original request of the pilots on grounds that it is not equipped to undertake such a task and that neither Delta nor the Air Line Pilots Assn. chapter which compiled the list had acted in bad faith. The dissenters, most of whom are former Chicago and Southern employes, claimed that the listing has not placed them in proper order according to their dates of employment and has injured their seniority bidding power for more advanced flight equipment which offers higher pay scales. They say the problem is now being aggravated by competition between pilots for DC-8 jet berths.

Delta attorneys have termed the safety charges unfounded, "spurious, unjustified and bordering on being irresponsible." The airline says pilot contentions of financial losses as a result of the merger are also unfounded and that no claims for pay losses have been filed with the company.

In addition, the attorneys pointed out that three new pilot contracts have been negotiated since the merger took place and said that the integrated seniority list has never been injected into the discussions, although some of the representatives on the pilot bargaining team were affected by the merger.

Attorneys for the dissenting pilots, who say they are prepared to seek legal action should CAB dismiss the second request, said their clients are now suffering heavy financial losses as a result of the use of the disputed seniority list in bidding for DC-8 jet berths.

The pilot attorneys contend that many Delta pilots who are senior in terms of employment dates have been below other pilots on the seniority list so that they often find themselves flying copilot to captains who joined Delta after they did. These junior pilots, the attorneys say, were placed higher on the list by the ALPA Seniority Board. Aside from financial losses, the complaining pilots say they are also being "bumped" from desirable flights and stations.

Attorneys cited the case of one Delta pilot who, they say, successfully bid a DC-8 schedule at a total monthly pay of $2,391, while another pilot employed a month earlier but placed lower on the disputed seniority scale was forced to settle for a DC-7 schedule paying $1,845 a month.

PanAm Objects To Transpacific Proposal

Washington—Recommendation by a Civil Aeronautics Board hearing examiner that Northwest Airlines be given sole operating authority over the Pacific Northwest-Hawaii route (AW Sept. 21, p. 37) drew heated protests last week from both Pan American World Airways and a group of its pilots.

Management spokesmen for Pan American said Examiner Ferdinand D. Moran's initial decision would grant a "monopoly" to Northwest at a time when the competitive service of the past 11 years is needed to cope with expected traffic gains over the route.

Pan American pilots, filing as the airline's "System Route Committee," labeled Moran's recommendation a continuation of CAB "hostility" toward the airline's growth. This "administrative campaign" against Pan American, the group said, has resulted in heavy financial losses by the company and complete "stagnation" of advancement opportunities for the pilots.

Referring to the examiner's statement that the route could not support the increased seat capacity that would result from jet operations by both Pan American and Northwest in 1961, spokesmen for Pan American said there is no basis for such a "shroud of pessimism" since the airline's own traffic studies indicate a potential of 100,000 passengers per year by 1962.

U.S. Jets Set Service, Reliability Records

New Orleans—U. S.-built jet transports have set new precedents for reliability and serviceability during their first year of airline service, according to the men in charge of maintaining them. Here are the records of four jet transports manufactured in the U. S. that are now in scheduled service:

• **Boeing 707 turbojet.** Average daily utilization for five 707 operators is above 8 hr. per aircraft. Total of 73,500 flying hours were accumulated as of Oct. 16 by these carriers, with more than 90% of the flights being dispatched without a mechanical delay.

• **Lockheed Electra turboprop.** Total flying hours accumulated by eight operators was over 90,000 hr. as of Oct. 1 with an average daily utilization rate between seven and eight hours. Over 300 departures per day are being made by these airlines with a delay rate due to mechanical causes of about 5%.

• **Fairchild F-27 turboprop.** Twelve airlines have operated the F-27 during the past year for a total of about 50,000 hr., with an average daily utilization rate of more than seven hours.

• **Douglas DC-8 turbojet.** The DC-8 went into service on Sept. 18 and, during the first month, six aircraft flew approximately 1,000 hr. There were 26 delays of more than 15 min. due to mechanical trouble during this period. This low number of flight hours has little significance statistically, but, if the aircraft can maintain this mechanical delay rate per 1,000 flight hours over the next year, it will have one of the best records of any aircraft in this respect.

Engine Performance

U.S. jet engine performance during the first year of airline use has exceeded all predictions. Pratt & Whitney Aircraft Division of United Aircraft Corp. reports that its JT3 engine—civil version of the Air Force J57—has far outperformed the R-2800 piston engine during the first 12 months of commercial service. The rate of engine failures per 1,000 hr. of operation for the R-2800-CA was almost three, while that for the JT3C-6 has been about 1.25.

Airline maintenance officials, manufacturers' service representatives and Federal Aviation Agency and Air Transport Assn. officials who attended the annual Air Transport Assn. Engineering and Maintenance Conference here all expressed satisfaction with the operation of the jet equipment to date. In general, the average utilization rates of about eight hours per day for the new aircraft are now equal to those for piston engine aircraft which have been in service for a number of years. The Douglas DC-6, for instance, has an average rate of about eight hours per day for all operators and the DC-7 figure is approximately nine.

It was predicted at the maintenance conference last year, however, that jet utilization rates would have to be between 10 and 11 hr. per day if they were to prove profitable. The fact that the jets have been very profitable during the operations thus far is explained by the fact that their load factors have stayed much higher than expected. The Boeing 707, for example, still has an average load factor of better than 90% after one year of operation and with 67 aircraft in scheduled operations.

Future profits from jet operations are expected to depend upon an increase in utilization and operational efficiency to counteract an almost certain drop in load factor as more jet aircraft enter service.

Maintenance Improvement

Improvement in maintenance operations is expected to come in three broad areas—revised maintenance plans and schedules, more realistic information on parts life and increased personnel training and experience.

Most airlines have gone to some type of continuous maintenance for their jet equipment (AW Feb. 23, p. 39) so that a little overhaul work is done each day with no aircraft remaining in the shop for more than 24 hr. at a time. This is in contrast to older schedules which allowed up to a month for major overhaul.

Continuous maintenance apparently is becoming more and more attractive to all airlines, with major improvements becoming obvious in existing programs.

Something approaching continuous maintenance for turbojet engines also is being advocated by some engine manufacturers. This involves a sectionalized method that removes the necessity of overhauling the entire engine at the same time after a specified number of running hours. The hot parts of the engine which have the lowest life would be replaced as a complete section, while the "cold" compressor section would remain on the engine for a much longer period before removal. Federal Aviation Agency officials are now studying these proposals.

More realistic information on parts life is being collected as rapidly as possible by all of the manufacturers with the assistance of the airlines. Several systems have been devised for reporting parts failure, the circumstances under which the failure occurred and the exact type of loadings and use the part had received during its life.

Ultimate Goal

The ultimate goal of the airlines is to have a single system that will allow an operator to send reports on failures to all manufacturers that are clear and concise and will permit the development of usable statistics on the expected life of all aircraft parts. Such a system also would allow trouble areas to be located and remedied more quickly than at present. The ATA has had a committee organized for the past two years that has the responsibility of establishing a number code for use in digital computers that will completely identify the aircraft, its operator, the type of failure, the parts involved, where they are located, remedial action taken, etc. Three digits of this code have been agreed upon by the manufacturers and operators but at least six digits will be needed to identify a generator, for example, and four more would be necessary to specify its parts. Final completion of this numbering system is undoubtedly years away, but major improvements in maintenance costs are expected after it has been in operation for a number of years.

Elaborate data on failures and service efficiency of parts will make the determination of safe overhaul periods more exact and will undoubtedly extend the allowable life of parts.

Personnel operating experience is being augmented by training programs and a number of maintenance managers feel that this training will pay the large dividends in improving the efficiency of their organizations.

Most serious mechanical trouble encountered with any of the new jet aircraft has been on the Electra (AW May 4, p. 47). A severe noise and vibration condition developed on the aircraft at high cruise speeds and at relatively low altitudes. The cause was determined to be an assymetrical loading condition on the propeller that had not shown up during wind tunnel test-

PanAm Jets Use Orly

Paris—Pan American jet operations into Paris will switch from Le Bourget back to Orly Airport on Nov. 5. Pan American has been using Le Bourget while construction work on Orly's east-west runway was pushed to completion. Orly jet traffic will now use east-west Runway 8-26 which is 10,827 ft. in length. At Le Bourget, PanAm 707s have been using the north-south runway which is 8,760 ft. long.

Sikorsky Envisions Future S-60 Passenger Pod

Sketch prepared by Sikorsky Aircraft designers shows configuration of a future passenger pod for the S-60 flying crane turbine helicopter. Aft section has been streamlined and front end of the pod is attached to the cockpit cabin. Designers said provisions will be made to keep the pod dynamically isolated from the airframe despite closer connections, to keep vibration at a minimum.

ing and flight tests. Modifications involved in correcting this condition were "staggering," according to Lockheed. They involved raising the center line of thrust of all four nacelles by three degrees. Lockheed developed Quick Engine Change assemblies that required approximately five days to install on an aircraft.

Fifty-eight aircraft already in service required this fix, and they all received it between June 9 and Oct. 10.

Operational troubles experienced with other aircraft included:

• **Boeing 707.** Hydraulic pump failures that were remedied by installing a bypass line to protect the pump from high transient pressures. An example of the problems that can be caused by small parts was the fact that many of the aircraft delays due to the hydraulic system were brought on by a faulty batch of "B" nuts that were not discovered until they were in service.

• **Boeing 707 and DC-8.** Acoustic loads from the engines resulted in minor cracking of the skin in several aft sections on these aircraft.

• **Boeing 707.** Lavatory water drains were found to be freezing over. Boeing is conducting "a considerable amount of enginering testing" to ensure that the cabin air bleed orifice to the lavatory drain is large enough to prevent freezing.

• **DC-8.** Toilets on this aircraft have caused trouble because of an inadequate filter in the system that tends to clog, causing a shearing of the filter's universal drive pins and burning out the motor. This failure has caused a number of delays and in-flight difficulties.

• **DC-8.** Windshield cracks and bulging have occurred in a number of instances on both service and test aircraft. This has been corrected by providing additional clearance to avoid any preload on the windshield. The amount of rain removal heat also has been restricted on the dry windshield, and the operating temperature reduced.

Los Angeles Airways Plans S-61 Service

New York—Los Angeles Airways has ordered five Sikorsky S-61 turbine-powered helicopters for delivery in late 1960. Equipped with two General Electric T-58 gas turbine engines developing 1,050 eshp. each (AW Apr. 27, p. 50), the S-61s will carry 28 passengers and 1,200 lb. of mail and express.

Present Los Angeles Airways fleet includes five Sikorsky S-55s and two Sikorsky S-51s. The S-61s are expected to go into service in 1960 and 1961. Price was reported "in the neighborhood of $650,000."

Los Angeles Airways previously had announced plans to buy two Sikorsky S-62 helicopters as interim equipment until the S-61 was available.

However, the earlier than expected availability of the Sikorsky S-61 has eliminated this step.

HOT GAS SYSTEM COMPONENTS NOW AVAILABLE FROM CHANDLER EVANS

CECO SYSTEMS CONTROLS

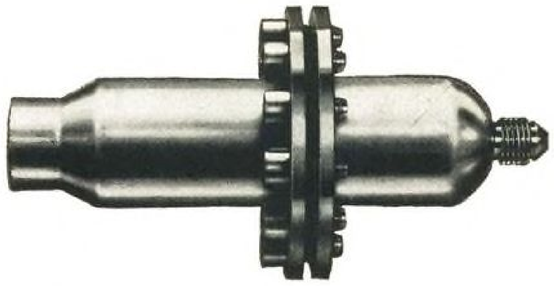
As by-products of extensive development work in the field of high-pressure pneumatics, Chandler Evans has—over the past several years—designed, developed, tested and produced a number of hot gas servo system components, some of which are presented here.

The products shown and described were developed for use with high-pressure hot gas generated from liquid or solid propellants, and are suitable to such applications as auxiliary and control power systems for guided missiles and space vehicles.

All the components shown are developed items, ready for use. However, because they have been fabricated to meet the requirements of particular applications, the specifications presented should be considered only representative. Design modifications can readily be made to adapt these devices to *your* requirements.

If you, too, are engaged in hot gas systems work and want to save considerable time and money in development, by using proven components not heretofore available, CECO will be happy to afford you its traditional cooperation.

For detailed information on these and other components, or for data on CECO's hot gas servo *systems*, contact any of the Field Engineering Offices listed at the right.

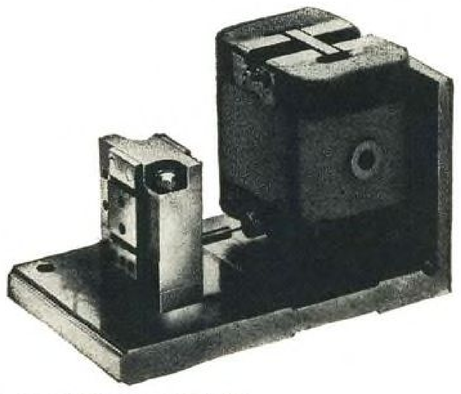


LIGHTWEIGHT HYDRAZINE REACTION CHAMBER

This reaction chamber, containing a suitable catalyst bed and injection nozzle, is used to generate hot gas. When hydrazine from a pressurized source is introduced, the catalyst immediately initiates a chemical reaction which continues until the fuel supply is exhausted.

Representative specification:

Operating temperature	to 1800°F.
Operating pressure	to 2000 psi
Flow capacity	.10 lb./sec.
Operating time	in excess of 5 hrs.
Weight (including catalyst)	1.27 lbs.
Size	1.50″ O.D. x 5.00″



REED-SUSPENDED, CLOSED CENTER SERVO VALVE

Developed for use with hot gas produced by decomposition of liquid propellants, the servo valve shown here is currently available in a variety of sizes to accommodate the requirements of individual applications.

Representative specification:

Inlet gas supply pressure	to 2000 psi
Inlet gas supply temperature	to 1500°F.
Operating temperature (ambient)	to 350°F.*
Valve stroke	±.004″
Flow capacity (total gas flow)	.01 lb./sec. air @ 1500°F., 2000 psi
Overboard leakage (valve at null position)	10% of total flow
Power input (maximum)	2 watts
Natural frequency	430 cps
Weight	1.00 lb.
Size	1.75″ x 2.75″ x 1.75″

** With additional torque-motor cooling, ambients to 1200°F. can be tolerated.*

PROPELLANT FLOW MODULATING AND PRESSURE REGULATING VALVE

The problem of operating hot gas generators at a specified constant pressure level led to the design, test and development of the liquid fuel regulating valve pictured here.

This valve may be described as a spring-loaded, spool-type throttling valve. Full open when the pressure at its outlet port (gas generator pressure) is low, it progressively closes off as the outlet pressure increases.

With minimum leakage an important objective, the valve shown meets the following specification:

Flow (hydrazine)	.002 to .02 lb./sec.
Upstream pressure	500 to 3000 psi
Regulated pressure	500 to 2000 psi
Temperature	0° to 200°F.
Weight	.38 lb.
Size	1.75″ O.D. x 3.00″

Limited changes in regulated pressure can readily be accomplished by means of a simple adjustment screw. Broader changes in regulated pressure or in flow capacity can be accomplished through slight re-design of the spool or spring elements.

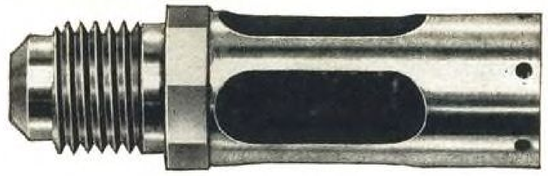
SOLID PROPELLANT HOT GAS FILTER

Since small-orifice areas of servo valves cannot tolerate contaminants produced by combustion of solid propellants, CECO found it necessary to develop the special hot gas filter shown here. Unlike those heretofore available, this filter can easily be cleaned for re-use and has amply demonstrated its ability to withstand the temperatures and pressures encountered in hot gas systems.

It operates as follows: hot gas flows into an annulus between the filter element and housing, then diffuses through to the outer surface of the element, depositing solid particles as it goes. With gas flow at .015 lb./sec., this filter operates for several minutes, with average contamination, filtering out particles as fine as 10 microns.

Representative specification:

Operating temperature	to 1800°F.
Operating pressure	to 2000 psi
Initial pressure drop at .015 lb./sec.	2 psi @ 1000 psi
Filter housing size	1.38 O.D.″ x 5.00″
Weight	.88 lb.

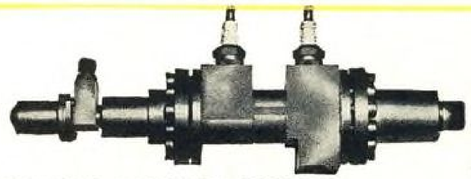


HOT GAS PRESSURE RELIEF VALVE

Typical of component hardware developed by CECO in its work with hot gas servo actuation and reaction systems is the valve pictured here. While it can easily be modified to satisfy other requirements, specification for the valve shown is as follows:

Relief pressure	1000 psi*
Reseat pressure	950 psi
Flow	.02 lb./sec. @ 1000 psi
Temperature	1800°F.
Weight	.032 lb.

** Adjustable from 800 to 1200 psi.*



HOT GAS REACTION CHAMBER FOR LABORATORY USE

This unit is used as a "workhorse" hydrazine reaction chamber to provide clean, hot, high-pressure gas for test purposes.

Ideal for laboratory use, its flow rates range between .001 and .1 lb. sec., and may be extended in either direction by changing nozzle and load orifice sizes. Operating temperatures are between 1200°F. and 1800°F. with pressures to 2000 psi.

The chamber is preheated by an electrical coil, a feature which facilitates repetitive starting without need for disassembly between test runs to renew the catalyst.

The above picture shows CECO's generator with the pressure regulating and flow modulating valve in position. For those who require a complete, "packaged" system for providing a continuous supply of hot gas, Chandler Evans can supply a complete laboratory model hot gas generator system including the fuel storage, pressurizing, purging and pressure regulating elements in addition to the gas generator reaction chamber described above.

CECO SYSTEMS CONTROLS

CECO FIELD ENGINEERING OFFICES:

WEST COAST
WILLIAM B. GURNEY
7046 Hollywood Boulevard
Hollywood 28, California

MID-WEST
KENNETH L. MOAN
Room 305, Spitzer Building
Toledo 4, Ohio

EAST COAST
ROBERT M. CAMPBELL
Chandler Evans Corporation
Charter Oak Boulevard
West Hartford 1, Connecticut

CHANDLER EVANS CORPORATION

Literature, including a reprint of this ad, available by request to Department 69.

American Predicts Reasonable Gain In Airfreight, But No 'Bonanza'

New York—Air cargo will show a reasonable, modest growth, American Airlines President C. R. Smith told the New York Society of Security Analysts, but it will be a long, slow pull and not the bonanza some have made it to be.

"There are more false prophets in the area of freight than in any other phase of aviation today," he said in response to a question. "It's not some bonanza where everybody will get rich. We don't expect any boom in the freight business until we get an airplane where the costs are considerably less than today. We all expect acceleration—but reasonably modest growth."

He described as possibly optimistic estimates that cargo planes now on order might cut costs 40-50%.

Pointing out the dangers of buying such an airplane now at $4-5 million each when the economics of piston vs. turboprop vs. turbojet powerplants for air freight are still to be demonstrated, he said that when American bought a cargo airplane it would be one the airline would operate 10 years.

On this basis the importance of making the right choice is apparent, he said, indicating American does not greatly fear competitive pressure in this type of equipment. "Nobody is going to get very far ahead," he said. "These days you can get delivery on an airplane in a reasonably fast time."

Was American interested in the swing-tail Boeing 735 cargo plane, unvailed a few days before the Analysts' meeting, Smith was asked?

"I don't know whether we can make any money now with those swing-tail airplanes or not," he replied. "Besides, we don't have the $5 million now to buy them."

Discussing various turbine-powered aircraft, Smith had the following to say:

• **Boeing 707.** This is the most dependable airplane American has ever operated and has caused less difficulty than any other airplane for the carrier. The problems that have occurred have had considerably less serious implications than others in the past.

• **Lockheed Electra.** Experience with this airplane and its Allison 501D turboprop engine has not been greatly different from that with the 707 and its engine.

• **Douglas DC-8.** Based on American's experience with Douglas, this should be a very fine airplane. But if American had it to do all over again, it would still order the 707. The 707 is faster—considerably more than the 10 mph. Douglas will concede. This is explainable because the DC-8 is a little larger (though carrying no more passengers), weighs a little more, has a little less wing sweepback. Given comparable powerplants, the 707 always will be the faster.

• **Sud Caravelle.** This also is a fine airplane. On non-competitive routes it should do very well, but since it cruises at less than 500 mph. it might not work out as well on competitive routes.

• **Convair 600.** With the Boeing 720, which is due sooner, it will replace Lockheed Electras on some routes.

Load Factors

Load factors for the 707 have fallen off from the averages in the 90s recorded in the first six months of jet operations, Smith said. They are now around 80%. Compared with initial DC-7 load factors, which averaged 76% in the first six months, the passenger appeal of the jets is impressive. Electra load factors averaged 80% or better in the first six months.

"Utilization is not setting any records," he said. The figures are 7.48 hr. for the 707 (8.22 hr. ramp-to-ramp, showing the effect of taxi times) and 6.5 hr. for the Electra. "We expect to get all our airplanes above 8 hr.," Smith added, "and we got accustomed to 10 hr. with the DC-7."

Quoting from a Pratt & Whitney report, Smith said that in 250,000 hr. of 707 operation there have been 38 premature removals of the JT3 powerplant —or a ratio of 1.2 per 10,000 hr. The ratio for the P&W R2800 piston engine, which Smith said American considered a very satisfactory engine, was 2-2.9. Overhaul time on the JT3 is now 900 hr. and will go to 1,000 hr. soon.

Despite the engine's fine performance, he said, there have been problems with accessories, including starting system, water system, fire warning system and lubrication system. One example is the water pump. Spares were ordered on an estimated life of 1,000 hr. Instead, eight or nine were replaced in the first 100 hr. in one instance.

Operating costs are higher now than American would like, Smith said. "With the load factors we are showing today," he said, "we should be making more money. But we believe costs will come down later on."

A big airplane like the 707 can make a lot of money if used properly, Smith added, but there is danger some carriers for competitive reasons may try to use jets on routes with marginal traffic potential. In this case, he warned, it may be shown that a big airplane can also lose a lot of money when it's empty.

Risk in Mergers

Mergers are a preferable alternative to return to subsidy if excessive competition forces some carriers into the red, C. R. Smith believes. But a merger now, he said, can be a risky thing.

If the Civil Aeronautics Board would say it favors mergers, they would work themselves out, Smith told the New York Society of Security Analysts. There would be no need to force mergers; if the Board simply would not pay subsidy, the laws of economics would take care of the situation.

Delay of two or three years, which could be expected now, creates the risky situation because of personnel problems, loss of morale and other reasons, Smith said. Unless steps are taken by CAB to reduce this delay by providing an indication of what the government wants, Smith doubts if potentially logical mergers will actually take place.

American's Earnings Rise

New York—American Airlines earned $16,091,000 net during the first nine months of 1959, up from $13,325,000 in the like period of last year despite a pilots' strike in January that resulted in a first-quarter loss of $278,000. The carrier's third quarter 1959 net earnings totaled $7,264,000 compared with $6,123,000 during the third quarter of 1958.

Revenues for the nine months of this year were $274,117,000, a gain of 15%. Third quarter revenues totaled $107,211,000, a 26% increase. The third quarter 1959 results included a net of $424,000 from sale of property, compared with $840,000 from this source during third quarter 1958.

American carried 5,990,000 passengers some 4,207,500,000 revenue passenger miles during the nine-month 1959 period.

Airfreight ton miles were up 6% to 69,723,000 for the period.

Continental Reports Revenue Increase

Washington — Continental Airlines showed a third quarter total operating revenue of $14,306,000, a gain of 79% over the 1958 period, and a net operating income of $1,887,000 as compared with $224,000 for the third quarter of 1958.

The airline's operating income was $31,772,000 during the first nine months of 1959, 57% above the comparable period of last year. Net income after taxes was $1,621,000 as compared with a net loss of $444,000 in the nine month period of 1958.

Airline Aid Pact Extended by CAB

Washington—Civil Aeronautics Board last week again approved a one-year extension of the six-member airline mutual aid pact in the wake of strong criticism from G. Joseph Minetti, the only Board member to object to the plan originally approved in May (AW May 25, p. 39).

Minetti's second dissent followed CAB's earlier rejection of a petition filed by the International Assn. of Machinists and the Brotherhood of Railway and Steamship Clerks seeking disapproval of the pact signed by American, Capital, Eastern, Pan American, Trans World and United airlines. The Board's refusal to change its original decision and its subsequent approval of an extension permits the plan to remain in effect until Oct. 20, 1960. Terms and conditions of the extension amendment are the same as those of the original pact agreement.

Grounds for its refusal to reconsider, the Board said, were that no further examination of facts was necessary since none of the parties involved had requested an evidentiary hearing; that the original approval was based upon a full record which indicated the pact would not be adverse to the public interest, and that the Railway Labor Act forbids government interference in labor-management disputes and allows the parties to "engage in reciprocal tests of economical strength" through collective bargaining.

In his rebuttal, Minetti replied that even though no request for an evidentiary hearing had been made, "facts of which we are currently aware . . . should prod the board" into exploring possible violations of the Railway Labor Act. Minetti said that, "if stripped of presumption," all that remained of the majority decision was a "see-no-evil neutrality." Board interpretation of the Railway Labor Act, he added, failed to recognize that it had given the airlines an anti-trust immunity and possible Railway Labor Act immunity. The approval, Minetti said, also placed the "considerable weight of the United States government on the side of management."

Pointing out that approval of the pact had resulted in a counter measure by the unions which have formed a similar pact, Minetti said the Board's action has increased the possibility of future airline strikes. Both the airline pact members and CAB, he said, have done a disservice to the remaining carriers whose reluctance to join the pact indicates that the mutual aid plan is not an effective means of settling management-labor disputes.

COCKPIT VIEWPOINT

By Capt. R. C. Robson

The Spoken Word—Part II

Our air traffic control system will continue, for many years to come, to depend on voice communications. The total of all work done in the past decade to supplant voice communications with something better can be summed up by saying that we now use radar in certain locations (when it works). The necessity for automatic communications, visual displays, data links and other sophisticated protuberances apparently are destined to remain forever merely wishful thinking and not to become actualities. It may not be generally realized how vital a part hand microphone techniques play in the over-all aeronautical structure nor the many ramifications they produce.

The recent edict of FAA Administrator E. R. Quesada regarding the vigilant presence of pilots in the cockpit touched off a small explosion which can still be noted on the Letters page of this magazine. From the pilot's viewpoint there appears an ever growing list of violation reports for failure to observe other traffic. The legal people of FAA reached such a pitch at one point in their zeal to prosecute that it was only with considerable reluctance that they were persuaded to drop charges against a pilot for NOT taking evasive action when another plane passed his vicinity.

Recent Flight Record

But what do we really do about this situation? Here is the record of a recent flight of a Lockheed Electra from Washington, D. C., to Chicago. It was a routine operation. There were no altitude changes, no unnecessary calls for weather or miscellaneous information—all transmissions were required. The flying time was 1 hr. 46 min. In this period there were 49 radio reports using a total of 19 different frequencies (two were airline company channels). This averages one transmission every two minutes and one frequency change every five minutes.

Doesn't sound too bad does it? But let's dig a little further. Most of these contacts were position reports. These required the tuning of other radios to navigational frequencies, the reading of charts to ascertain published bearings and frequencies, the calculation of estimated time of arrival at subsequent check points, notations on the flight log, cross-checking and liaison between pilots to verify all information, an occasional nod to passenger relations and of course, flying the airplane.

Obsolete Communications System

Were these pilots goofing off? Doubtful. The simple, routine flight chores required by our obsolete communications system do a good job of keeping heads and eyes in the cockpit. Yet the lawyers prosecute the pilot who is caught up in this merry whirl and is doing his best to keep his cash customers right side up.

Is it fair to say that the pilot is lax if he fails to note an oncoming jet with a closure speed 1,000 mph. plus when he is required to shift his Mark I eyeball from myopic to hypermetropic sight every 60 sec. or so? The situation borders the ridiculous. Surely it would be wrong to lay all of our troubles at the door of communications—yet who can fail to note their influence?

So we too will underscore the need for automatic methods for the future but first we must emphasize the necessity for immediate action on voice communications. We can improve these, we can reduce their numbers, we can find new ways of phrasing in order to convey more intelligence per syllable. This will ease frequency congestion and speed traffic with greater safety.

AIRLINE OBSERVER

►Watch for the airline industry to renew its attack on a White House proposal to increase the "users tax" by two and one-half cents for aviation gasoline and by four cents for jet fuel. Shelved during the last session of Congress, the proposal is expected to reappear at the next session and is a part of the transportation study being conducted by the Department of Commerce. Airline spokesmen say the hoped-for profits, which could be obtained with an expected raise in air fares under the pending General Passenger Fare Investigation Case, could be wiped out by the tax increase which would hit hardest at jet operators. Eastern Air Lines estimates that the four-cent boost would cost the company $6.8 million for 270 million gal. of jet fuel in 1960. Estimates submitted more than a year ago on the financial impact of the increase indicate that 1960 operating costs would jump by $6.6 million for United; $8.8 million for American, and $7.6 million for Trans World Airlines domestic operations.

►U. S. airlines also are searching for a means to combat any further boost in aviation insurance rates, which they feel are already too high. British insurers, who underwrite a large percentage of the policies held by American carriers, recently told delegates to the International Union of Aviation Insurers that, while several airlines complained that rates for jet aircraft were unreasonable, premiums charged were justified in view of relatively heavy jet losses thus far and the increasing cost of partial losses. The insurers say that jet claims already paid raise the question as to whether the current premium rates are satisfactory.

►Douglas Aircraft Co., is working to eliminate an unexpected 3-to-10 kt. drag penalty on Pratt & Whitney J57-powered models of the DC-8 operating under normal cruise conditions. Design change on engine pylon contour is the expected fix, but the manufacturer also will try upper wing surface vortex generators, which gave a 7 kt. gain to the Boeing 707 clean-up program. Douglas, however, has little hope that generators will solve the problem, since tests do not show an air flow disturbance problem at that location.

►Philippine Airlines will make a bid next year for bilateral rights to serve all routes between the Philippine Islands and the U. S. mainland that are now served by Pan American and Northwest on their Pacific routes.

►Iraqi Airways is shopping for a $7 million purchase of jet or turboprop airliners. A joint committee of technicians from the government-owned carrier and the Iraqi air force are reportedly studying offers from aircraft manufacturers in Britain, Holland, East Germany and the Soviet Union. New equipment would be used on planned routes from Baghdad to Moscow and Peiping as well as to North Africa via Beirut, Rome and Madrid.

►Seventh air transport union may be included in the mutual aid pact proposed last month by the International Assn. of Machinists, the Air Line Pilots Assn., Flight Engineers International Assn., Air Line Dispatchers Assn., Transport Workers Union and Brotherhood of Railway Clerks (AW Sept. 28, p. 47). Request for membership has been submitted to pact members by the Hotel and Restaurant Employes and Bartenders International Union. Large percentage of this union's 450,000 membership is employed by airline food departments and catering services.

►Eastern Air Lines is spending $6 million for spare parts and support equipment for its Douglas DC-8 jet transport fleet. Breakdown shows costs of $1.75 million for airframe parts; $1.5 million for engine parts and accessories, and $1 million for instruments and electrical items. Ground support equipment will cost approximately $368,000. The airline also is spending an additional $7 million for 34 spare Pratt & Whitney JT3C engines at a cost of $210,000 each.

►Watch for a second revision by the Civil Aeronautics Board of its report on the TWA Martin 404 accident which occurred at Albuquerque, New Mexico, on Feb. 19, 1955. First amendment of the initial report was issued in 1957.

SHORTLINES

►**Bonanza Air Lines** reports a 46.6% increase in revenue passenger miles in September over the same month of 1958. The local carrier attributes the greatest gains in traffic to its Fairchild F-27 turboprop transports. The carrier now has its full order of six F-27s in operation.

►**Capital Airlines** is adding Washington, Atlanta, Buffalo, Cleveland, Detroit, New York and Pittsburgh to its commuter ticket plan beginning this week. Capital has been using the plan between Minneapolis/St. Paul and Chicago since Aug. 2. Under the plan, passengers holding commuter tickets can call the nearest Capital office, reserve their space and fill in the ticket themselves by marking the appropriate embarkation and debarkation cities, class of service, flight number, date and the number of the reservation agent.

►**Delta Air Lines** airfreight volumes for September rose 20% above September, 1958, to a total of 4,958,172 lb. The airline says this is the highest figure for a single month that it has recorded.

►**Empire of Ethiopia** plans to construct or improve five airports within the country at Addis Ababa, Asmera, Dire Dawa, Jimma and Bahar Dar. Improvements at 29 other internal airports are also included in the $24 million line of credit granted by the Export-Import Bank in Washington. A portion of the loan was allocated to Ethiopian Airlines for three Douglas DC-6 aircraft.

►**MacRobertson Miller Airlines** of Australia expects to take delivery of a Fokker F-27 turboprop transport sometime in late November and is scheduling flight operations of the aircraft before Christmas.

►**Northwest Airlines** is now operating Lockheed Electra turboprop schedules on its Chicago, Atlanta, Tampa/St. Petersburg and Miami route, flying two round trips daily in first class, air coach and night coach configurations.

►**Portland International Airport** reports that 653,544 passengers were handled during the first nine months of 1959 as compared with 565,217 handled in the same period of 1958.

►**Western Air Lines** plans a 25-cent quarterly dividend payable on Nov. 20 to stockholders of record on Nov. 6. The carrier's estimated level of operating revenues for September is $5.9 million, with a per share earning for the first eight months of the year of $3.10.

PROTOTYPE Canadair CL-44D-4 turbine-powered cargo-troop transport, one of 12 CC-106s ordered by the Royal Canadian Air Force, is scheduled to make its first flight this month. This aircraft is a side-loading version; the first swing-tail will be No. 9 aircraft.

CL-44D Seeks to Tap All-Cargo Market

By Robert I. Stanfield

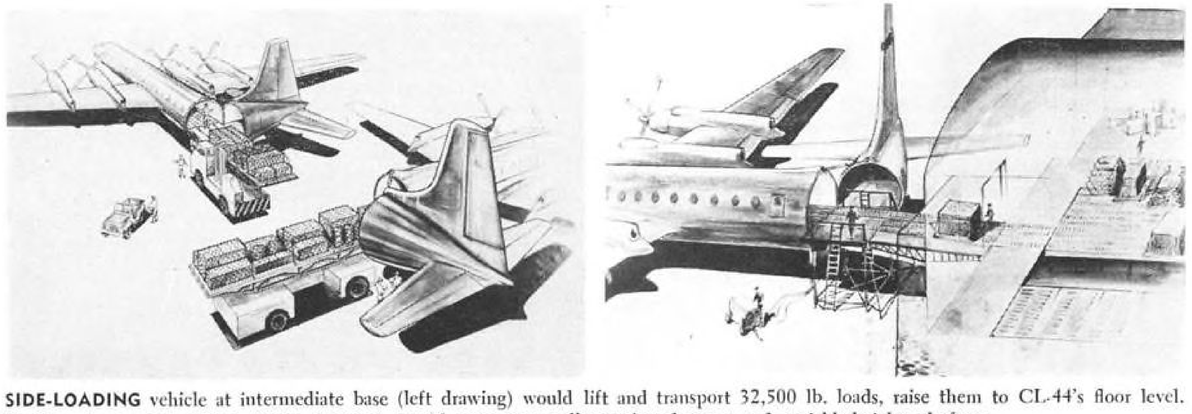
Montreal—Tailored to the cargo market, both international and domestic, the swing-tail version of Canadair's long-range, multi-turbine-powered CL-44D-4 is geared to the rapid movement of freight, via straight-in loading, at a minimum ton-mile cost. The air conditioned and pressurized turboprop is also available in convertible cargo-passenger and all-passenger versions.

Aircraft is powered by four Rolls-Royce Tyne 12 Mark 515/10 engines, each generating 5,305 eshp. at sea-level takeoff. Engines cost approximately $140,000 each. Four-bladed propellers, made by de Havilland, are 16 ft. in diameter. Total fuel capacity is 12,180 gal. (kerosene or JP-4).

Basic price of complete aircraft is $3,690,000, not including 12.5% duty. American components—in excess of $350,000 value—are not applicable to duty charges. Recent Canadair contracts with Seaboard & Western, for five convertible aircraft, and Flying Tiger Line, for five convertibles and five all-cargo, total $70 million, including spares and support equipment. Loans covering purchase will be insured up to 85% of 80% (the unpaid balance of total) by the Canadian government (AW May 18, p. 41).

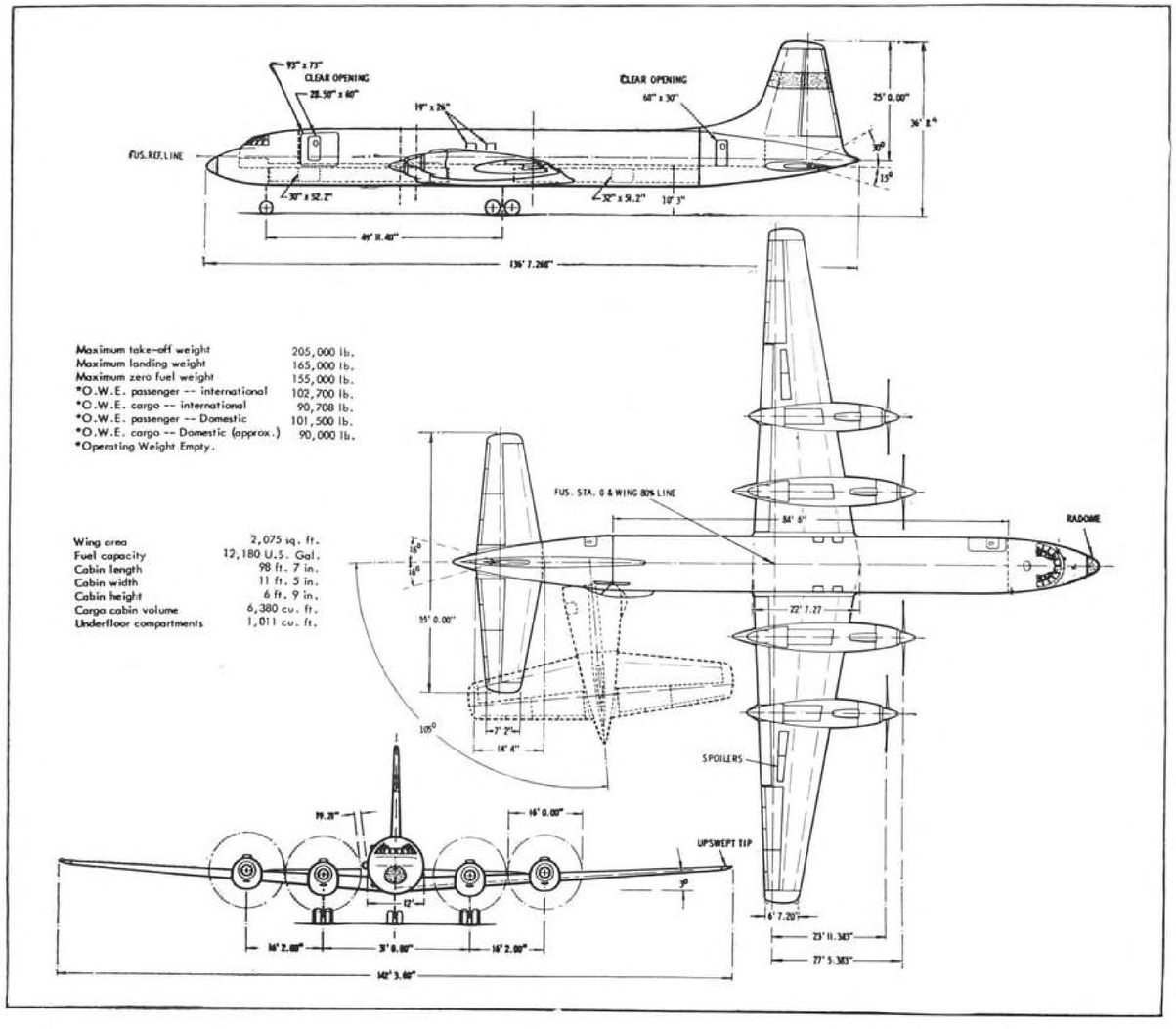
First swing-tail version, No. 9 off the production line, will be delivered to Seaboard early in 1961, following its participation in flight test program. Second swing-tail version will be delivered to Flying Tiger during the same period. Last commercial deliveries to these two companies will have been completed by mid-1961.

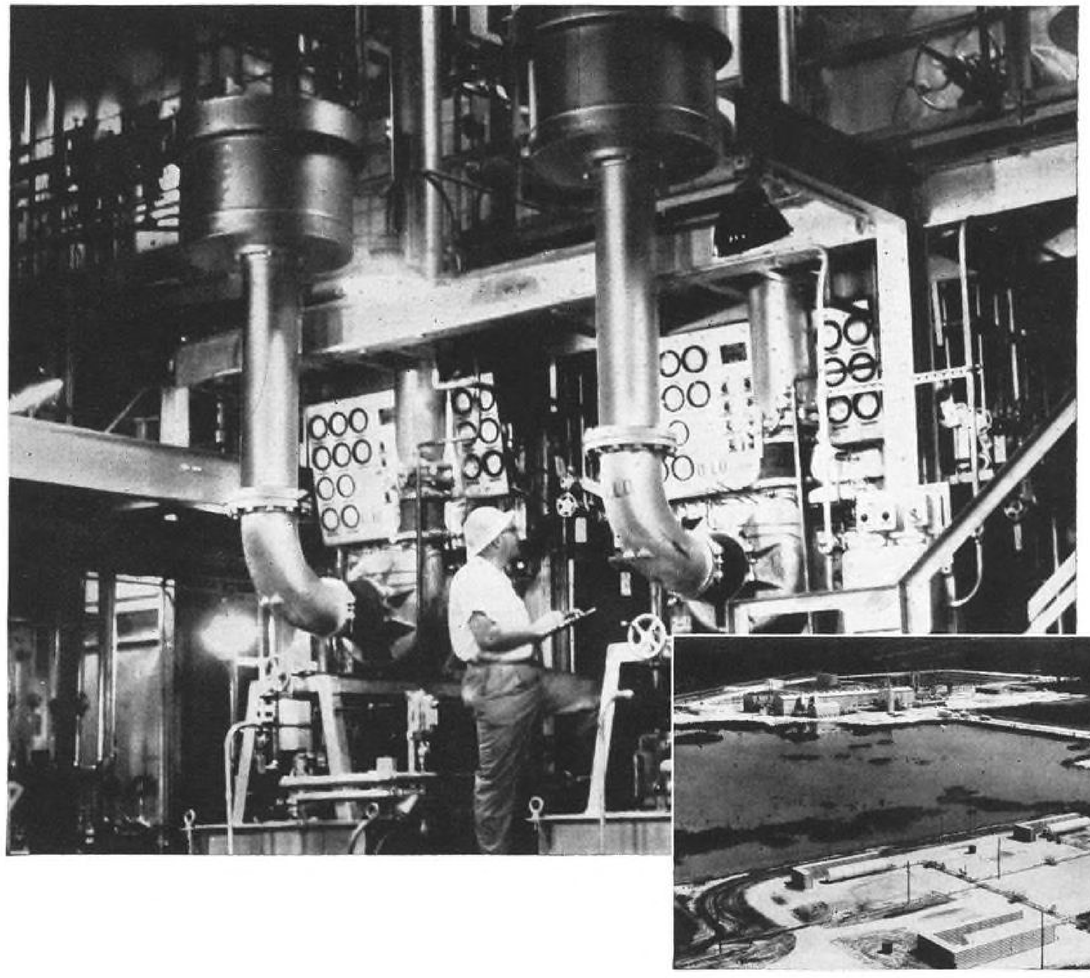
First CL-44 prototype, one of 12 cargo-troop transports ordered by the Royal Canadian Air Force and designated the CC-106 (all of which will be conventional side-loading versions, minus the swing-tail) was rolled out Aug. 31. First flight is scheduled for this month. First three of the RCAF order,

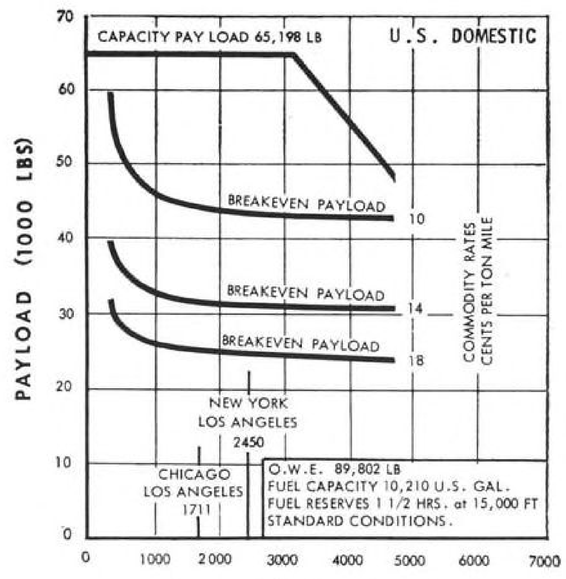


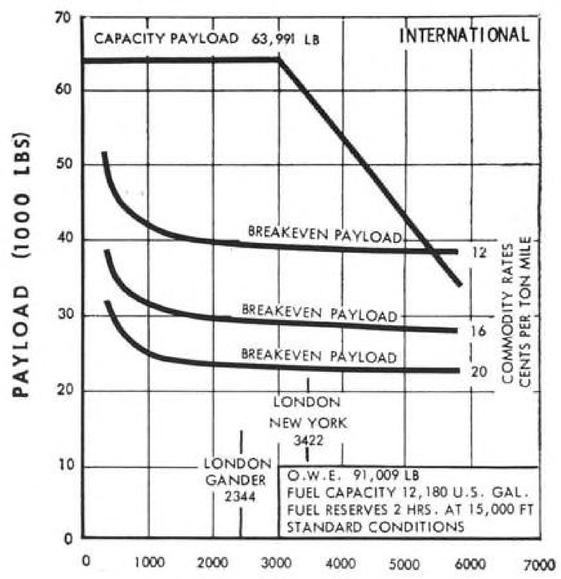
SIDE-LOADING vehicle at intermediate base (left drawing) would lift and transport 32,500 lb. loads, raise them to CL-44's floor level. Trolley at permanent base (right drawing) would pass over roller-equipped ramp and variable-height platform.

ROLLS-ROYCE Tyne 12 Mark 515/10 turbine engines power the CL-44D-4. Each engine generates 5,305 eshp. at sea-level takeoff. Three-view below shows sweep of swing-tail. The CL-44 is a cantilever low-wing airplane of two-spar box wing structure.









CHARTS show distances to which payloads can be carried with reserves, and the break-even payload required at several rates.

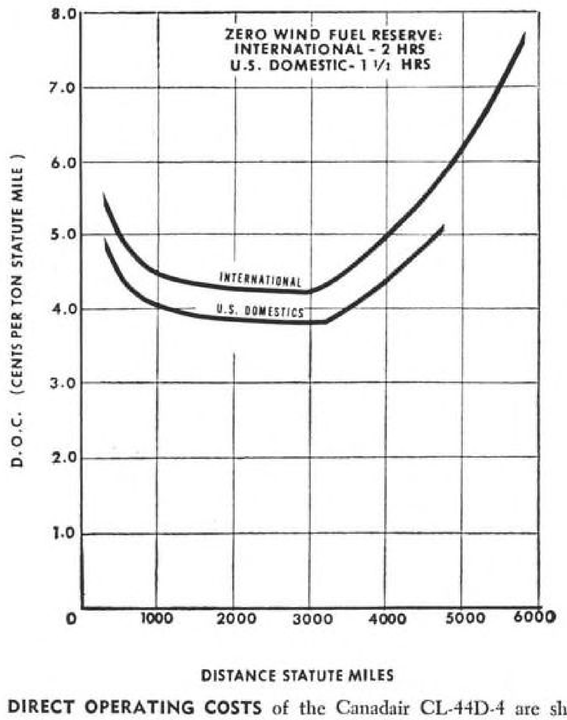
along with the first swing-tail version, will be used in the flight test program. Certification of the CL-44 is expected to occur about 15 months following first flight.

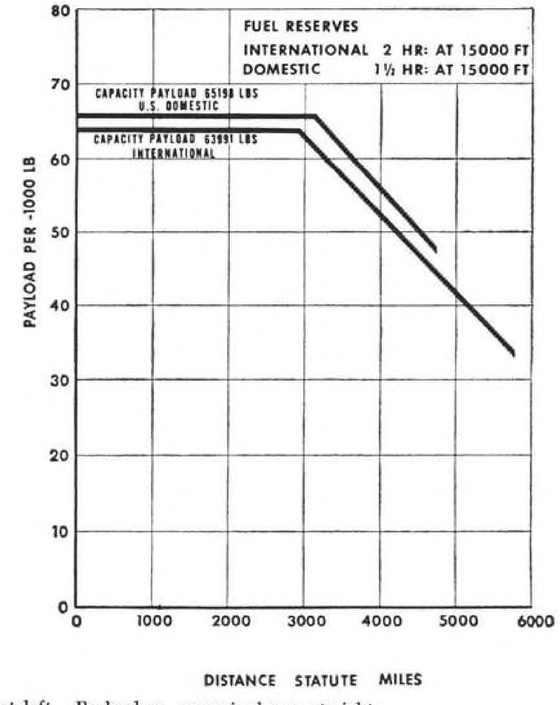
Four aircraft—No. 2 through 5—are currently on the production line. No. 2 is scheduled to fly in February.

CL-44 is a derivative of the Bristol Britannia, but with a lengthened fuselage (an extra 12 ft. 4 in.), higher gross weight (a 25,000 lb. increase) and more power (additional 1,285 eshp. per engine). Designed progressively through the piston-engined CL-28 Argus by Canadair, Ltd., a subsidiary of General Dynamics, it will carry a maximum payload of cargo—63,991 lb.—2,500 naut. mi. with 2 hr. fuel reserve.

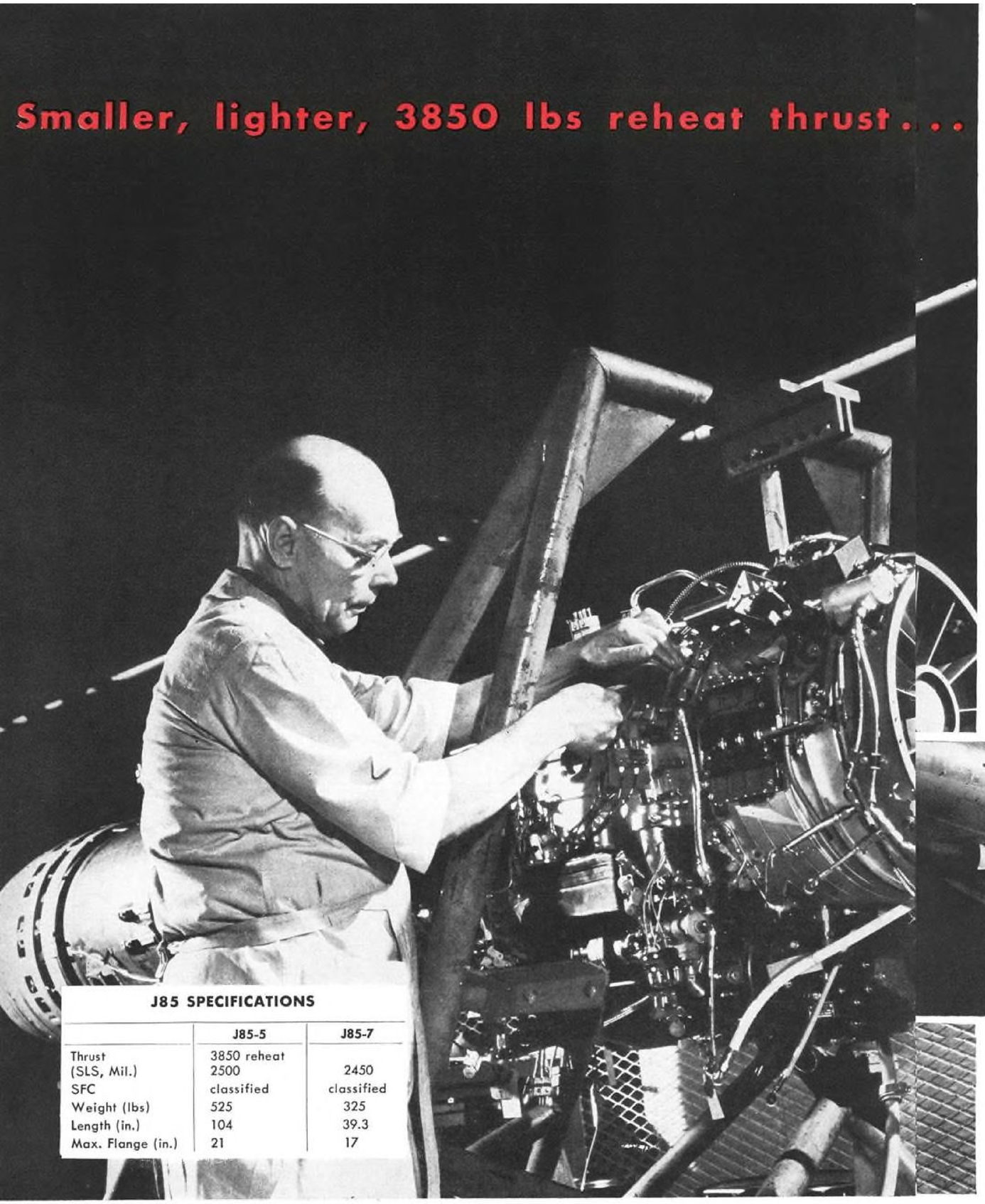
It will carry 172 economy-class passengers—37,630 lb.—3,500 naut. mi. with the same reserve. Range with maximum fuel is 4,910 naut. mi., plus 2 hr. holding at 15,000 ft.

A Canadair study indicates that the CL-44D-4 is capable of carrying an average 28.67 ton payload between New York and London at an average direct operating cost of 5.42¢ a ton mile (nautical). On a Gander-Shannon stage the direct operating cost per ton mile averages out to 4.91¢. With the airplane's growth capacity, Canadair says,





DIRECT OPERATING COSTS of the Canadair CL-44D-4 are shown at left. Payload vs. range is shown at right.



J85 SPECIFICATIONS

	J85-5	J85-7
Thrust	3850 reheat	
(SLS, Mil.)	2500	2450
SFC	classified	classified
Weight (lbs)	525	325
Length (in.)	104	39.3
Max. Flange (in.)	21	17

General Electric J85 engines are now in production at the Company's Small Aircraft Engine Dept., Lynn, Mass.

NEW

General Electric J85 turbojet helps reduce airframe size, weight, cost... boosts mission performance

SMALLER AND LIGHTER than comparable turbojets, General Electric's new J85 reduces airframe size, makes possible significant savings in airframe weight . . . corresponding reductions in airframe costs.

RATED AT 3850 LBS REHEAT THRUST, and 2500 lbs dry thrust, the J85-5 weighs only 525 lbs. Its missile counterpart, the J85-7, delivers 2450 lbs thrust . . . weighs only 325 lbs.

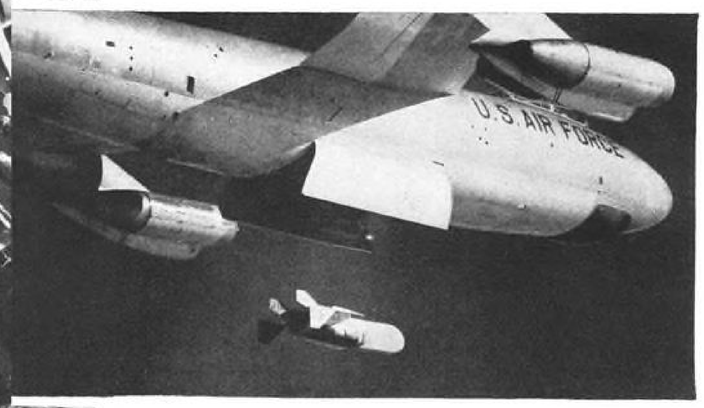
SHORT AND COMPACT, with a better than 7 to 1 thrust-to-weight ratio and low SFC, the J85 makes possible greater mission capabilities.

PERFORMANCE PROVEN, the J85 has accumulated more than 6000 test hours. On North American's T-39 utility transport, individual prototype (50-hr) YJ85's have logged over 85 hours of engine flight time before overhaul.

DURING ALTITUDE TESTS at Arnold Engineering Development Center, the J85 has exceeded thrust and SFC guarantees. At Wright Air Development Center rugged environmental tests have demonstrated the J85's low temperature starting and accelerating characteristics.

THESE EXAMPLES are typical of the rigorous flight, field and factory tests that have verified J85 ruggedness, reliability and safety margins.
The J85 has been developed under USAF contract and is now in production.

A NEW ILLUSTRATED BROCHURE *that describes* **General Electric's J85 engine is now available. For your copy, write Section 233-23, General Electric Company, Schenectady, N. Y.**

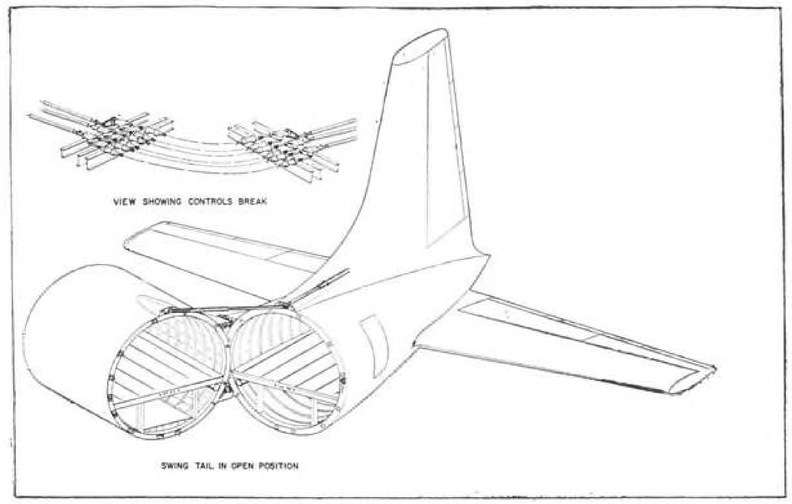


McDONNELL'S GAM-72 DECOY MISSILE, powered by General Electric's J85, will give the U.S. one of today's most effective diversionary weapons. The GAM-72 is shown above being air dropped from a B-47 during flight test.

NORTHROP'S N-156F "FREEDOM FIGHTER" AND T-38 "TALON" TRAINER—With lightweight, compact General Electric J85 engines, these high performance, low cost aircraft offer significant airframe size and weight savings.

Progress Is Our Most Important Product

GENERAL ELECTRIC



DETAIL DRAWING shows how controls break when CL-44D-4 tail section is swung open.

over 75,000 lb. of payload ultimately could be carried on this stage with a resultant cost decrease.

Maximum payload, carried on a New York-Los Angeles route segment, would result in an average direct operating cost of 4.41¢ per ton nautical mile, Canadair reports.

Operating weight empty of the CL-44D-4 is 91,728 lb. Maximum for take-off is 205,000 lb.; for landing, 165,000 lb. Wing span is 142 ft. 3.6 in. Over-all length is 136 ft. 8 in. Main cabin floor area is 1,080 sq. ft. Cabin volume is 6,380 cu. ft.; lower (underfloor) compartment volume is 1,011 cu. ft. Fuselage structure is designed for a maximum working differential pressure of 8.33 psi. and a minimum ultimate differential of 16.67 psi. Main cabin length is 98 ft. 7 in.; front bulkhead to swing-tail joint is 84 ft. 6 in.

Swing Tail

Swing tail allows for cargo to be loaded directly into the full cross-section of the main cargo compartment, the tail area and the aft belly compartment. In addition, cargo may be loaded through the hydraulically operated 6 ft.

Route Cost Breakdown

(Based on Seaboard & Western System)

	Cost per Hour	Trip Cost New York-Frankfurt & Return Gander Stop Westbound	Trip Cost New York-Frankfurt & Return NonStop Shannon-New York
Crew Salaries	76	1,830	1,842
Crew Travel, per diem		96	96
Crew Transportation	1.50	36.10	36.40
Fuel & Taxes		3,010.20	2,787.20
Oil		50.50	50.90
Landing Fees		1,729.50	1,406.65
Flight Communication		75	75
Miscellaneous Crew Costs	1.50	36.10	36.40
Employe Insurance & Taxes	2.28	54.90	55.30
Training & Non Revenue Flying	10.00	240.70	242.40
TOTAL (Flying Operations) ($)		7,159.00	6,628.25
Trip Time (OFF/ON) (hours)		22.57	22.91
Cost/Hour*, Maintenance ($)		200	200
Trip Cost, Maintenance ($)		4,514	4,582
TOTAL TRIP COST for Flying Operations & Maintenance ($)		11,673	11,210

* Maintenance Cost per hour is based on OFF/ON time, and includes maintenance overhead.

Canadair CL-44D-4 Performance

Maximum level speed (135,000 lb.):	
V_{mo}	306 kt. EAS
M_{mo} (above 16,200 ft.)	Mach .63
Maximum level speed (155,000 lb.):	
V_{mo}	278 kt. EAS
M_{mo} (above 20,600 ft.)	Mach .63
Economical cruise (135,000 lb.):	
V_{mo}	275 kt. EAS
M_{mo} (above 21,400 ft.)	Mach .63
Economical cruise (155,000 lb.):	
V_{mo}	250 kt. EAS
M_{mo} (above 25,000 ft.)	Mach .63
Stall speed (165,000 lb., 45 deg. flaps)	95.5 kt. EAS
Initial rate of climb (205,000 lb., 13,500 rpm.)	1,190 fpm.
Time to climb to 20,000 ft. (max. takeoff weight)	45 min.
Takeoff distance over 35 ft. (205,000 lb.)	7,660 ft.
Landing distance over 50 ft. (165,000 lb.)	6,780 ft.
Range, max. fuel, 2 hr. holding, at 15,000 ft.:	
Cargo	4,910 naut. mi.
Passenger	4,910 naut. mi.
Range, max. payload, 2 hr. holding, at 15,000 ft.:	
Cargo	2,500 naut. mi.
Passenger	3,500 naut. mi.
Service ceiling	30,000 ft.

1 in. x 7 ft. 9 in. forward cargo door. Forward belly compartment is loaded through a 2 ft. 6 in. x 4 ft. 4 in. door on the starboard side. Hinged tail swings to right, permitting loading and unloading of 32.5 tons of cargo in 19 min. Usable volume will accommodate heavy trucks, pipes and missiles such as the Bocing Bomarc or the Nike ground-to-air weapon systems.

The tail itself is hydraulically operated from power supplied by the auxiliary power unit. Tail is positively locked and requires no manual disconnects of flight controls, hydraulic lines or electrical cables. Hinges and actuator are designed to withstand wind conditions up to 60 mph. Safety system prevents operation of actuator if any one of the eight door latches is engaged. Engines cannot be operated above a predetermined power setting unless all latches are engaged and locked.

Inflatable seal at fuselage break prevents loss of cabin pressure. In addition to the inflated seal there is a tubular seal, a secondary weather seal for rain and water.

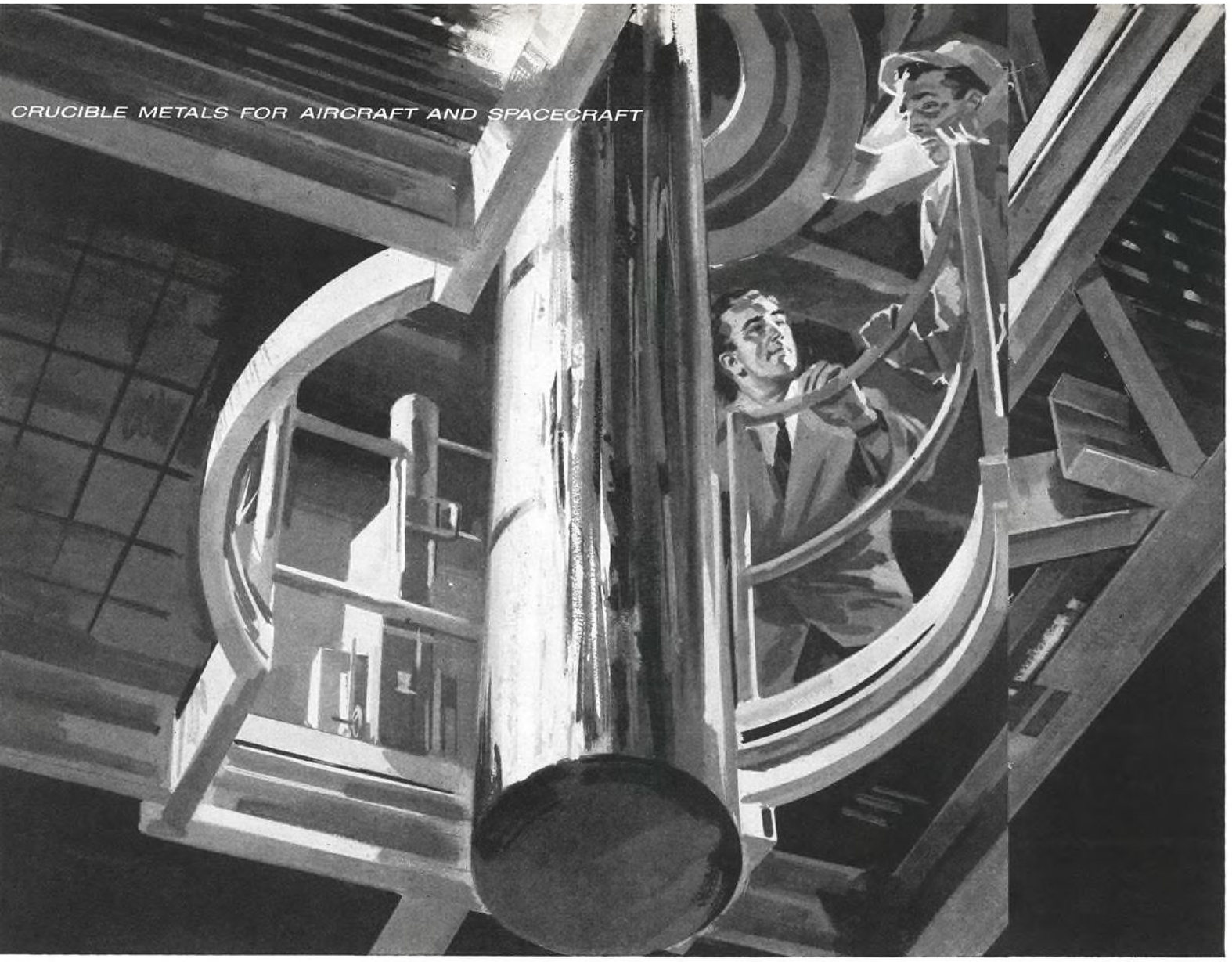
Rudder, elevator and elevator trim control is transmitted through the fuselage break by a system of bevel gears, levers and push rods, providing a positive self-centering interface. Control connections are recessed to prevent damage occurring when fuselage is open. Pressure for hydraulic locking of the control surfaces is transmitted by flexible hoses which require no disconnect.

Method of latching the swinging rear fuselage (which will be interchangeable and which will hold 3,000 lb. of cargo) to the forward fuselage is by means of hydraulically actuated pins located in the box frame of the rear portion. Pins, with the fuselage closed, join with a tongue fitting in the forward fuselage. Each pin, at the end of its extended stroke, operates a microswitch. When all pins are fully home, pilot indication is available on the flight deck.

Jacks operating the latching pins have internal hydraulic locks which engage when the jacks are fully extended. To ensure that unlatching cannot be selected in flight, Canadair intends to provide a hydraulic-lines disconnect and stowage facility on the exterior of the airplane to be operable by ground crew member only, and then only if all latching pins are fully home.

This disconnect will isolate the fluid in the pin jacks and in the main operating jack, switch off pilot visual indication, and disconnect the throttle lock so that engines can be fully operated. Physical location of the rear part onto the forward fuselage is maintained by torsional shear carrying attachments in the form of tapers and internal cones, located centrally between each pair of latching pins.

Swing-tail hinge fittings are fabricated from steel forgings and high-strength steel sheet. Tail structure is beefed up at the break, including a heavy extruded frame, a multiple web frame either side of the break with machined 70 to 75ST extruded caps. The eight shear pins take



a.

b.

c.

a. Lowering a consumable electrode into a vacuum arc furnace. Metals produced by vacuum melting are "cleaner" and therefore offer improved strength, ductility and longer fatigue life.

***b. Titanium,** more than 1000 lbs. of it, saves 800 lbs. in Convair 880 because of metal's high strength/weight ratio. Principal use is in jet engine pods, aileron, stabilizer, and tail assembly.*

***c. Crucible Vacuum-Melted Bearing Steel** makes stronger, longer-lasting bearings. Rejects during manufacture and early failures are virtually eliminated.*

***d. Vacuum-Melted 4340** was specified for hook pivot pin of bomb rack and rocket launcher when air melted steels failed to withstand 4½ hour destructive vibration tests.*

d.

NEW TITANIUM ALLOYS, HIGH PURITY METALS PROVIDE IMPROVED PROPERTIES FOR MISSILE DESIGNERS

Several new titanium alloys may prove to be the answer to designers' needs for improved tensile and fatigue strength, ductility and corrosion resistance in aircraft and spacecraft materials.

One of the alloys is Crucible B-120VCA. This new, weldable alloy has the highest strength/weight values of any structural material available. At 220,000 psi, its strength/weight ratio is equivalent to that of steel at 360,000 psi. And it maintains its strength/weight advantage for short times at temperatures up to 1400° F. Furthermore, B-120VCA is "Formageable"® (readily formed in the "soft" solution annealed condition and then strengthened by age-hardening).

As this is written, about 50 aircraft and missile manufacturers are testing Crucible B-120VCA samples. They're reporting: (1) it's easier to fabricate than any other titanium alloy; (2) it seems ideal for rocket motor cases, structural members, rivets and other components.

Several other critical design problems are being solved by Crucible vacuum-melted steels and superalloys. Some Crucible alloy and tool steels, for example, possess tensile strengths in the 280,000/300,000 psi range and even higher. Up to now, getting uniform transverse ductility at this strength level has been a problem. Crucible solved it through vacuum melting.

These developments are typical of Crucible advances in specialty steelmaking. They're possible because Crucible is completely integrated—and because Crucible pioneered in the development of titanium, the high temperature alloys, and in vacuum induction melting and vacuum arc remelting techniques.

Today, Crucible's experience—and newly-increased capacity for vacuum arc remelting of its own special air melted and vacuum induction melted electrodes—provides industry with a complete range of High Purity Metals at lowest cost.

If you'd like to know more about this work, read: "Titanium for Aircraft and Spacecraft" and "Quality Aspects and Engineering Properties of Vacuum Melted Super Alloys and Steels". Write: *Crucible Steel Company of America, Dept. AK-17. The Oliver Bldg., Mellon Square, Pittsburgh 22, Pa.*

CRUCIBLE STEEL COMPANY OF AMERICA

fore and aft loads; wedges take care of torsional loads.

Canadair is building a full-size functional mockup of 100 in. of structure either side of the break-line, including all latching mechanisms and control breaks, which can be loaded to the limit loads for the actual airplane.

Main cargo floor consists of plywood panels ½ in. thick, except in the area above the wing where ⅝ in. plywood panels are installed. Panels are flush with six floor tracks. Cargo compartment extends from the front edge of the front cargo floor (Station 233) to the rear pressure bulkhead (Station 1406). Tracks provide 5,000-lb. cargo tie-down points on a 20-in. grid; two outboard tracks provide for 10,000-lb. tie-down points 40 in. apart.

Allowable unit floor loading, from Station 233 to 1237 (hinge) is 300 lb./sq. ft.; from Station 1237 to 1406, 150 lb./sq. ft.

The CL-44 has been designed to operate from permanent bases with specialized equipment and a large volume of cargo, from fixed intermediate bases with simple cargo handling facilities, and from isolated unequipped bases. In all cases, the company feels, mechanical loading times are consistent with aircraft refueling times.

Mechanical loading system is based on a terminal building consisting of receiving and distributing docks, loading and unloading areas and a 90 x 20 ft. trolley mounted on flanged wheels. The trolley, large enough to carry two complete aircraft pallet loads, traverses sideways between the loading-unloading areas. Preloaded pallets are moved from the loading area to one side of the trolley; cargo to be unloaded is winched off the aircraft to the vacant side of trolley, which then traverses sideways, bringing outgoing cargo in line with aircraft and incoming cargo against unloading area.

A roller equipped ramp and variable height platform joins the trolley to the aircraft and allows adjustment for any change in height of the aircraft floor.

For intermediate bases, use would be made of a sideloading vehicle capable of lifting and transporting 32,500 lb. loads. With the hinged tail open, the vehicle would carry a 40-ft. roller equipped master pallet to the airplane, raising it to floor level. Pallets from the aircraft load would be pulled out via portable winch. Airplane would be loaded by reversing this procedure. Canadair feels that with two loading vehicles and four men, the airplane could be completely loaded or unloaded in about eight minutes.

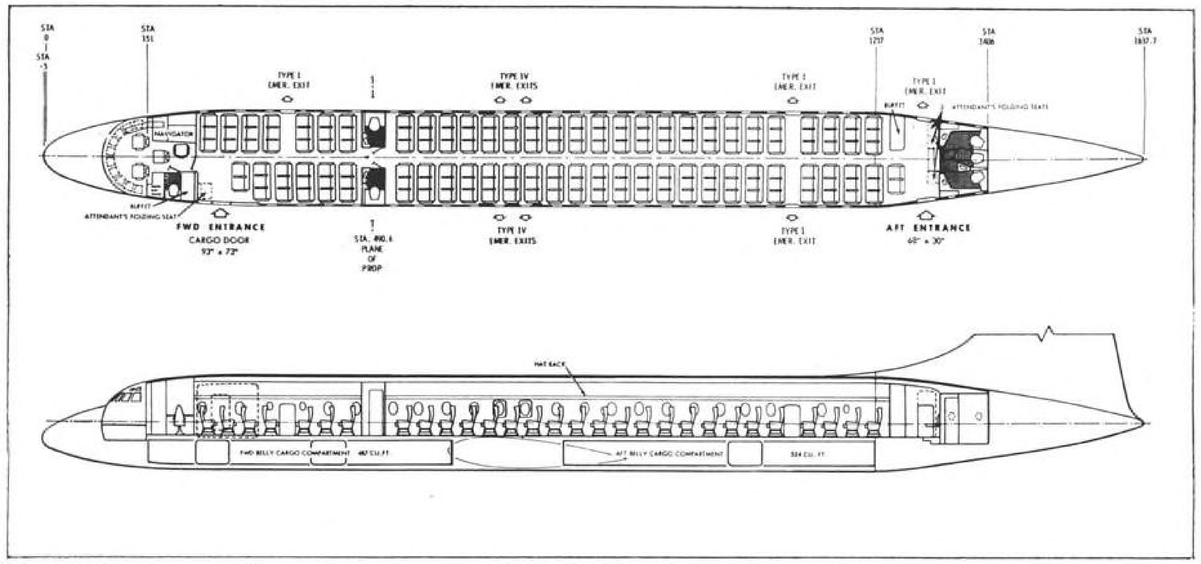
Isolated Base System

For isolated bases, a Canadair designed system utilizes a three-way ramp constructed of magnesium alloy in sections 10 ft. long with tracks 2 ft. wide and an over-all width of 8 ft. Disassembled, the system can be stowed in the aft belly compartment together with cross members, the hydraulically operated self-compensating jacks and the cargo handling dolly.

Either surface of the ramp can be used for cargo handling. One side consists of tracks which are wide enough to carry a truck or provide a walkway for manual loading-unloading. Inboard section is channeled to accommodate the four wheels of a cargo dolly, operated by means of the portable winch. Use of a portable gantry, capable of lifting 8,000 lb., is proposed for handling crated loads (engines, aircraft components, etc.). The gantry also can be stowed in the aircraft.

The CL-44 is a cantilever low-wing airplane of two-spar box wing structure. It has a minimum number of chordwise ribs. Stress-carrying upper and lower skins are stiffened by spanwise stringers. Material in general is 7075 aluminum alloy except for the main wing undersurface, which is of 2024-T3 clad sheet.

Primary wing structure consists of a tapered box-spar in which bending loads are distributed between the skin and closely spaced stringers. Major fatigue advantages are lack of large cutouts in the lower skin inboard of the



INTERNATIONAL convertible passenger-cargo version of the Canadair CL-44 accommodates 72 passengers.

outer auxiliary fuel tank, lack of transport joints and no change in direction of many major structural members. Metal-bonded laminations at chordwise joints aim at reducing stress concentration. The structure is scaled to form integral fuel tanks.

Fuselage Structure

Fuselage is semi-monocoque and of circular cross section. Loads are distributed between skin made from 2024-T3 alclad, continuous longitudinal stringers and ring frames made from 7075-T6 material. Crew and aft entrance doors open inward and slide longitudinally on tracks. Hinged, inward-opening hatch sits in the roof of the crew compartment and four over-wing emergency ground exits and two baggage doors are provided.

Ailerons are made with two separate spanwise sections of aluminum alloy skins stiffened by riveted and bonded stringers and ribs. Aileron control surfaces are free-floating, and control is effected by operation of trailing edge servo-tabs. Aileron movement from neutral is 21 deg. up, 15 deg. down. Flaps are double-slatted Fowler type, consisting of four sections of aluminum alloy stressed skin construction mounted on load carrying rollers which move on curved tracks. Maximum deflection is 45 deg.

Spoilers—hinged slats on the upper wing surface—are electrically actuated and synchronized with aileron servo-tab movement. The spoiler system is inoperative at speeds exceeding 200 kt. Travel is from zero to 48 deg.

Horizontal stabilizer is of aluminum alloy stressed-skin construction. Removable, it is bolted to the aft portion of fuselage. Elevators are made in two separate spanwise sections, of aluminum alloy with metal skins stiffened by riveted and bonded stringers and ribs. Each is supported from the horizontal stabilizer rear spar by four hinge ribs. Travel limits are 30 deg. up; 15 deg. down.

Three outer tabs act as servo tabs; the inner tab as a trim tab.

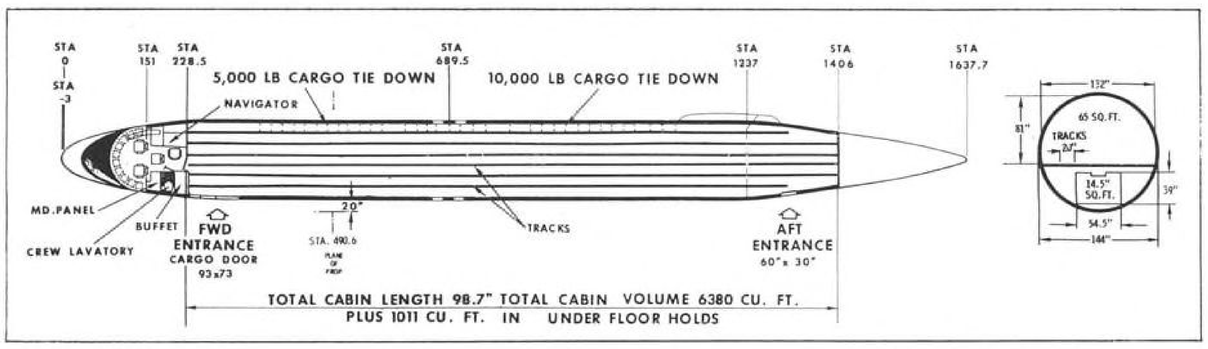
Fin also is aluminum alloy stressed skin. Rudder, made in two separate portions, is supported from the fin rear spar by four hinge ribs. Four servo tabs are installed along the trailing edge. Rudder movement from neutral is 18 deg.

Landing gear is hydraulically actuated. Each main gear leg consists of a heavy forked aluminum alloy forging attached by two pins to the main gear pivot fittings mounted on the rear spar. Leg houses an oleo-pneumatic telescopic shock strut and a bogie beam is attached to the lower end.

Main Gear

Main gear incorporates eight wheels and brake assemblies, four to each gear. Wheels on each side are mounted in tandem pairs. Each wheel incorporates an individual brake assembly. Wheels are mounted on axles inserted in a beam which is suspended in a fitting integral with the shock strut piston. Truck thus formed can rock fore and aft. An anti-skid system is included. Nose gear incorporates a dual wheel; steering angle is 50 deg. left or right.

Main gear retracts aft into the nacelles; nose gear retraction is forward into the fuselage. Main gear takes tubeless tires 40 x 12, of 20-ply rating. Nose



CARGO tracks provide 5,000 lb. tiedown points on 20-in. grid; two outboard tracks provide 10,000 lb. points 40 in. apart.

ATLAS utilizes a radio-command guidance system provided by the Defense Systems Department. Depicted here is the dramatic blastoff of the ATLAS which — under radio-command guidance — produced a successful earthly orbit as part of project SCORE.

GENERAL ELECTRIC'S DEFENSE ELECTRONICS DIVISION

Organized for a Full Range of Systems Requirements

DEFENSE SYSTEMS DEPARTMENT

The Defense Systems Department, Syracuse, N. Y. — newest of the Division's five functionally organized departments — is the focal point of those integrating capabilities so vital to major prime and support systems for national defense. Made up of the Company's top systems management and technical talents, DSD is G.E.'s single point of authority and responsibility for major, long-range defense programs.

ORDNANCE DEPARTMENT

POLARIS
. . . whose inertial guidance and fire control equipments will be provided by the Ordnance Department, Pittsfield, Mass. — center of the Division's capabilities in precision electro-mechanical elements of sea and land-based weapons systems. In addition to POLARIS equipments, the Department produces radar antennas, directors, launching and handling equipment and underwater ordnance.

LIGHT MILITARY ELECTRONICS DEPARTMENT

SIDEWINDER
. . . the deadly air to air missile whose infrared guidance and control units are provided by the Light Military Electronics Department, Utica, N. Y., is representative of its capabilities for military electronic subsystems and equipments contained in, or launched from, air vehicles. Its additional contributions range from electronics countermeasures to integrated avionic systems.

HEAVY MILITARY ELECTRONICS DEPARTMENT

DATA PROCESSING AND DISPLAY EQUIPMENT
. . . for air space management is being developed and produced by the Heavy Military Electronics Department, Syracuse, N. Y. — center of the Division's capabilities for the design, production and installation of land-based and sea-borne detection, guidance and control equipment. Major contributions of this Department range from long-range sonar to the largest known radar systems.

MISSILE AND SPACE VEHICLE DEPARTMENT

RE-ENTRY/RECOVERY VEHICLES
. . . such as the ATLAS experimental nosecone — largest re-entry vehicle ever recovered from space — are designed and built by the Missile and Space Vehicle Department, Philadelphia, Penna. Experienced in space technology, MSVD developed operational ATLAS and THOR re-entry vehicles. Other responsibilities range from certain missile arming and fuzing projects to the re-entry/recovery vehicle of the DISCOVERER satellite.

226-3

Copies of this illustration, in full color and suitable for framing, may be obtained by writing the Defense Systems Department, P. O. Box 457, Syracuse, N. Y.

DEFENSE ELECTRONICS DIVISION

GENERAL ELECTRIC

SYRACUSE, NEW YORK

gear wheel takes 32 x 8.8 12-ply tubeless tires.

Canadair has been running static tests on the rear fuselage structure of the CL-44, investigating symmetrical heavy-landing on the main gear, which is the critical case for vertical bending of the rear fuselage, and the engine-out case, which produces a sudden side-load on the fin, inducing high torsion loads with lateral bending of the rear fuselage.

Canadair plans to redesign completely its commercial cockpit from that of the military, and is working on a mockup of the new version of the cockpit.

This is necessary for compliance with latest Federal Aviation Agency requirements relative to vision.

FAA came to the conclusion that vision afforded by the military version—which is the same as that of the Britannia—was inadequate.

Present military windshield consists of 10 panels, of which the forward six are electrically heated flat shatterproof laminated glass capable of withstanding bird impact.

Small circular windows, about six

Canadair CL-44D-4 Specifications

Wings:	
Span	142 ft. 3.6 in.
Area	2,075 sq. ft.
Airfoil section, root	NACA 25017
Airfoil section, tip	NACA 4413 (modified)
Aspect ratio	9.76
Incidence at root	3 deg.
Incidence at tip	6 deg.
Sweepback at 80% chord	0 deg.
Length	136 ft. 8 in.
Height, over-all	38 ft. 7 in.
Fuselage outside diameter (constant section)	12 ft.
Main cabin length	98 ft. 7 in.
Front bulkhead to swing-tail joint	84 ft. 6 in.
Main cabin width at floor (constant section)	11 ft.
Cabin height	6 ft. 10.6 in.
Main cabin volume	6,380 cu. ft.
Underfloor compartment volume	1,011 cu. ft.
Total cargo volume	7,391 cu. ft.
Areas:	
Fin	264.2 sq. ft.
Rudder	92.2 sq. ft.
Elevators	85 sq. ft.
Horizontal stabilizer	586 sq. ft.
Ailerons (including tabs)	70.2 sq. ft.
Flaps	410 sq. ft.
Main gear track	31 ft.
Wheel base	49.95 ft.
Turning circle:	
Wing tip	226 ft.
Pavement	117 ft.
Total fuel capacity	12,180 gal.
Oil capacity	54.6 gal.
Operating weight empty:	
Cargo version	91,009 lb.
Passenger version	104,252 lb.
Maximum payload:	
Cargo	63,991 lb.
Passengers (172, economy class)	37,630 lb.
Maximum takeoff weight	205,000 lb.
Maximum zero fuel weight	155,000 lb.
Maximum landing weight	165,000 lb.
Wing loading	99 psf.
Power loading	8.95 lb./ehp.

Engines: Four Rolls-Royce Tyne 12 Mark 515/10

Rating	Altitude	Rpm.	Shp.	Tehp.	Sec. lb./tehp./hr.
Takeoff	sea level	15,250	5,305	5,730	.449
Max. cont.	sea level	14,500	4,850	5,230	.46
Max cruise	25,000 ft.	13,500	2,820	3,040	.395

Propellers: de Havilland, 4-bladed, solid dural of 16 ft. diameter

inches in diameter, are provided in each entrance door. Six cabin windows are utilized, four of these in each of the overwing emergency exits. Windows, of 19 in. height by 14 in. width, comprise two panels of craze-resistant colorless acrylic plastic, each pane capable of retaining cabin pressure.

CL-44 fuel system comprises two port and two starboard main tanks, plus port and starboard outboard and center section auxiliary tanks. Each tank holds a submerged a.c. motor-driven booster pump. Main-tank pumps supply fuel to either the corresponding engine or to the manifold system. Auxiliary tank pumps connect to the manifold system for distribution from any tank or combination of tanks to any engine or combination of engines. System also permits transfer between tanks.

Each inboard and outboard main tank is of integral construction. Inboard auxiliary tank comprises six interconnected cells of non-metallic, flexible construction. Each tank expansion space comprises 2% of its total volume.

Total fuel quantity of 12,180 gal. is distributed as follows: inboard main tanks, 4,584 gal.; outboard main tanks, 4,528 gal. Inboard auxiliary tank holds 1,968 gal. Outboard auxiliary tanks hold 1,100 gal.

All tanks can be filled by either pressure refueling or overwing (gravity) refueling. Single adapter on the underside of the right outboard nacelle is connected to a manifold which distributes fuel to all tanks. Pressure refueling flow rate is 600 gal. per min. at 50 psi. During refueling, control valves reduce flow to 150 gal. per min. when 80% tank capacity is reached and shut off fuel flow at 98% tank capacity. Fueling sequence is main tanks then auxiliary.

All fuel in main tanks in excess of 1,560 gal. can be jettisoned at a rate of not less than 294 gal. per min. Fuel is jettisoned through a dump chute; installations are identical in each wing and have separate switches allowing fuel to be jettisoned from either side or simultaneously. Fuel from auxiliary tanks is transferred to main tanks for jettisoning.

Hydraulic System

Operating pressure of the CL-44's main hydraulic system is 3,000 psi. Accumulator is of 200 cu. in. capacity, initially charged with air at 2,000 psi. Pressure for the main system is provided by two constant delivery pumps, mounted on constant speed units installed on the port engines, an electric motor driven pump and a hand pump.

Main hydraulic system actuates the gear, nose wheel steering, brakes, control surface ground locks, front cargo door operation, swing tail operation, propeller brake and windshield wipers. Emergency extension of main and nose gear is pneumatic, via 3,000-psi. air bottles. A hand pump also is available.

Power for aircraft's electrical system is supplied by three systems: a primary 200/115-v., 400-cycle, three-phase constant frequency a.c. system, a variable frequency 200/115-v. a.c. system, and a 28-v. d.c. system. First two systems are supplied by engine-driven a.c. generators. The secondary d.c. system is supplied from transformer rectifiers powered by primary constant frequency a.c. system.

Heating and cooling is provided via a gear-driven, positive-displacement type air compressor mounted on each engine. Compressor draws air through a cowl-mounted, anti-iced ram air intake, compresses the air and delivers it to a temperature control system.

During flight, cargo and crew compartments can maintain 70F with outside air at minus 40F. At sea level and 100F outside air, cabin can be held to 80F with relative humidity no higher than 73%. Ground heating and ventilation is via an eight-inch connection on the starboard side of the fuselage. Air conditioning system provides limited ground heating-cooling with one or both inboard engines operating.

Sea level pressure is provided up to 19,000 ft. Working differential pressure of 6.55 psi. corresponds to a cabin altitude of 8,000 ft. at an airplane alti-

tude of 30,000 ft. Wing anti-icing is provided by ram air passing over the engine tail pipes and ducted into the leading edges.

Empennage anti-icing is obtained from a dual heater system installed in the tail of the aircraft.

Propellers, nose cowls, windshields, pitot heads, elevator horn balances and the main air intakes for cabin pressurizing, heat exchanger cowling and tail pipe muffs are electrically anti-iced.

San Francisco Area Air Traffic Analyzed

Under a Federal Aviation Agency study project, a Convair Pomona Division task force recently counted airplanes over the San Francisco Bay area in an effort to gain first-hand knowledge of the dimensions of the air traffic control problem. Data was collected on movement of military, commercial and private aircraft operating on instrument flight plans within the area by the Oakland Traffic Control Center. Airspace covers much of the western United States, from the Oregon border south to Bakersfield, Calif., and from central Nevada to 800 mi. out in the Pacific Ocean.

As part of the San Francisco project, Convair Pomona engineers analyzed data on actual position of IFR aircraft en route from city to city and their reported positions based on direct radio contacts between pilots and traffic controllers at Oakland Control Center.

A camera was mounted over a monitor scope of the long-range radar installed at the center which automatically recorded, at 30-sec. intervals, positions of aircraft within a 100-mi. radius of the bay.

Pictures were then correlated with hand-written slips prepared by air traffic controllers on progress of aircraft through their control sectors. A detailed examination of all traffic in the air during several VFR days also was conducted and pilots taking off or landing at every field, including military, in the area were interviewed as to their routes and destinations.

Aeronutronic to Study Air-Cushion Vehicles

Army Transportation Research and Engineering Command, Ft. Eustis, Va., awarded Aeronutronic Division of Ford Motor Co. a contract to investigate feasibility of air-cushion vehicles for Army applications. Aeronutronic study will include delineation of stability and control aspects and performance characteristics when vehicles such as these are operated over unimproved terrain and water.

WHAT'S NEW

Reports Available:

The following reports were sponsored by the Office of Technical Services, United States Department of Commerce, Washington 25, D. C.

Impact and Shock Resistance of Plastics: Final Report—North Carolina State College for Bureau of Ships, U. S. Navy. December, 1957. $1.25; 35 pp. (PB 151729)

Tensile Properties for Three Thermoplastics Over Six Decades of Rate—by R. E. Ely, Redstone Arsenal, U.S. Army Ordnance Corps. October, 1957. $2.00; 75 pp. (PB 151573)

Papers From Image Intensifier Symposium Released by Army—U.S. Army Engineer Research & Development Laboratories. Oct. 6-7, 1958. $5.00; 310 pp. (PB 151813)

Micro Determination of Carbon and Hydrogen In Organic Compounds—E. M. Bens, U. S. Naval Ordnance Test Station, China Lake. January, 1958. $1.00; 33 pp. (PB 151570)

Study of Limited Type Ice Removal and Prevention Systems, Chemical Phase—by R. A. Budenholzer, F. J. Olmer and T. E. Waterman, Armour Research Foundation for Wright Air Development Center, U.S. Air Force. June, 1955. $2.75; 141 pp. (PB 151293)

Telling the Market

Technical Data on **precision wire wound and composition variable resistors,** engineering catalog, Reon Resistor Corp., 155 Saw Mill River Rd., Yonkers, N. Y. . . . Outline of engineering services and products for **automatic measurements and control of processes by electronic and electromechanical techniques,** brochure, Chicago Division, American Bosch Arma Corp., 5857 West 95th St., Oak Lawn, Ill.

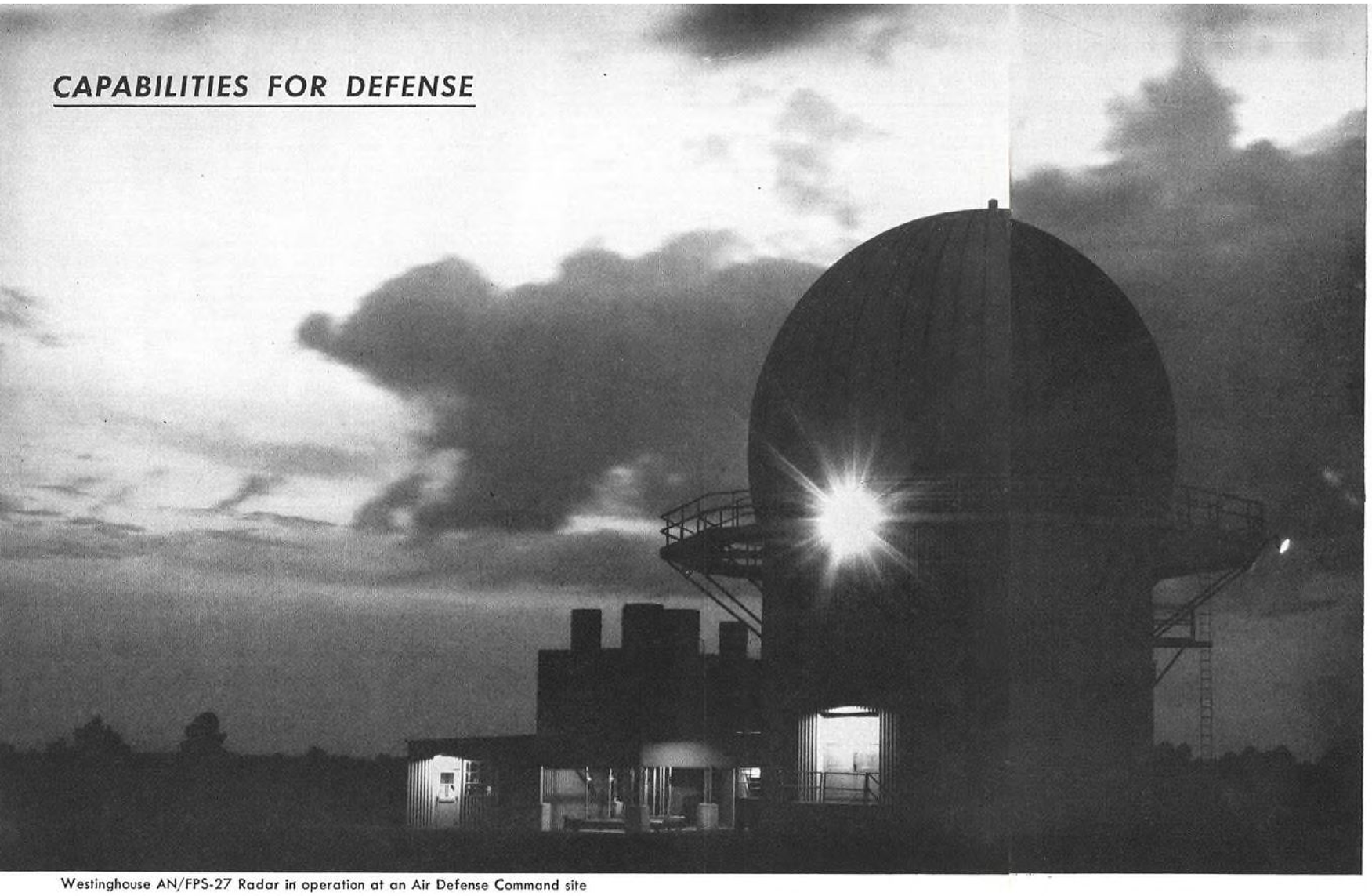
Pneumatic Controls Bulletin PC1.20, presentation of pneumatic system controls for aircraft and missile applications, Whittaker Controls Division of Telecomputing Corp., 915 North Citrus Ave., Los Angeles, Calif. . . . Illustrated description and specifications of **scientific and test instruments,** Catalog G-10, Minneapolis-Honeywell Regulator Co., Station M-321, Wayne and Windrim Avenues, Philadelphia 44, Pa.

Performance chart, nomograph for approximating weights of pressure vessels in various materials and illustrated description of **techniques for making titanium, stainless steel and alloy steel pressure vessels for missiles,** Bulletin No. 141, Airite Products, Inc., 3516 East Olympic Blvd., Los Angeles 23, Calif. . . . Illustrated brochure of the **engineering, research and development, production and testing facilities** of Horkey-Moore Associates, 24660 Crenshaw Blvd., Torrance, Calif.

Ready-reference chart-fold bulletin of **threaded fasteners for aerospace use,** Form 2529, A. W. Scott, Advertising Dept., Box 566, Standard Pressed Steel Co., Jenkintown, Pa. . . . Operating principles, performance characteristics and applications for **Series 19 acceleration switching servovalves,** Product Bulletin 106, Moog Servocontrols, Inc., East Aurora, N. Y. . . . Description, specifications and applications of 50-amp. and 100-amp. models of **line impedance stabilization networks,** bulletin, Stoddart Aircraft Radio Co., Inc., 6644 Santa Monica Blvd., Hollywood 38, Calif.

General Electric CT58—Gas Turbine Power for the New Age in Helicopters, Bulletin GED-3987, General Electric Co., Schenectady 5, N. Y. . . . Information on **bonding rubber to metal, vibration mounts, molded rubber and silicone modified rubber,** catalog, Stoner Rubber Co., Inc., 10792 Knott Ave., Anaheim, Calif.

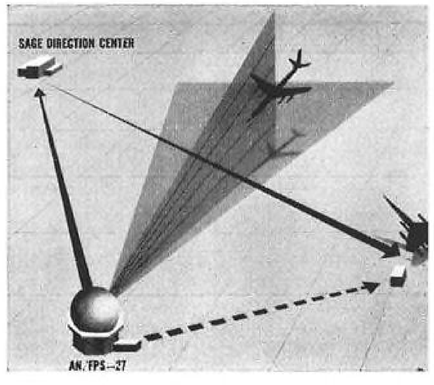
CAPABILITIES FOR DEFENSE



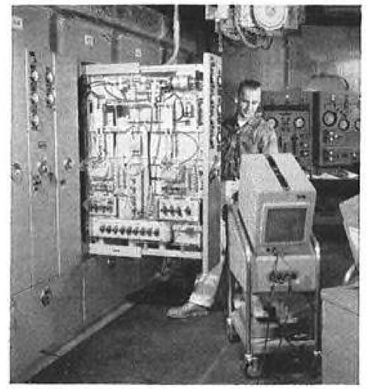
Westinghouse AN/FPS-27 Radar in operation at an Air Defense Command site

A single Westinghouse radar gets a 3-D fix on the enemy...dilutes his jamming ability

The AN/FPS-27, versatile 3-D radar designed by the Westinghouse Electronics Division for the Air Force's Rome Air Development Center, is achieving new standards of performance, reliability . . . and economy. Now under contract from the Rome Air Materiel Area, this high-power, stacked beam radar gathers range, azimuth and height data quickly and accurately while eliminating unwanted signals. These comprehensive functions in a single radar represent the application of the latest state of the art radar techniques to our nation's early warning defense.

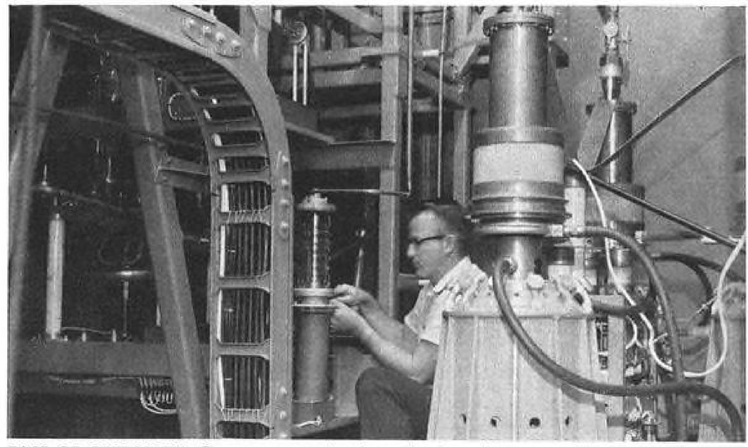


Here is the management team responsible for the development of the AN/FPS-27—within budget and on schedule. This team is typical of the Westinghouse practice of matching talent to the job.

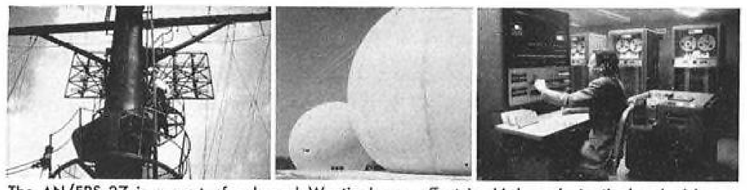


MAINTENANCE EASE: AN/FPS-27 design stresses reliability and maintenance accessibility. A separate monitor console calibrates the receivers remotely. Equipment troubles are automatically indicated. Sub-assemblies can be replaced rapidly in case of circuit malfunction.

UNIQUE CONSTRUCTION DESIGN of the antenna system permits the inclusion of the latest 3-D height-finding techniques. Range, azimuth and height data can be automatically fed to a computer to form a composite picture of the air defense sector.



EASE OF OPERATION: One man operates the entire transmitter room. This is typical of the operational ease of the Westinghouse designed AN/FPS-27. A minimum team of six specially trained men can handle the operation and maintenance of the entire facility.



The AN/FPS-27 is a part of a broad Westinghouse effort in shipboard, tactical and airborne radar. Current simulation studies at the Air Arm Division, utilizing the latest digital computer facilities (at right), hold promise for new approaches to the problem of long-range detection and tracking of aircraft and ICBM's.

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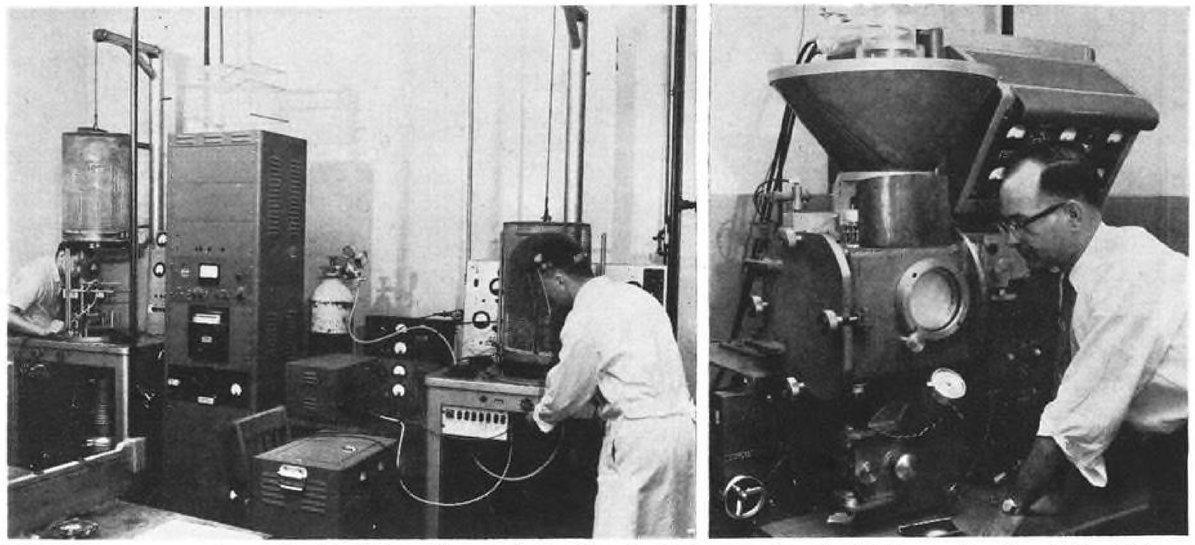


RESEARCH program at International Resistance Corp. seeks to determine basic properties of materials as a function of film thickness and deposition process used. At left are two of more than dozen vacuum chambers used in laboratory. Device at right is combination vacuum chamber, electron diffraction instrument which permits analysis of crystalline structure without removing specimen from chamber.

Component Firm Develops Microcircuitry

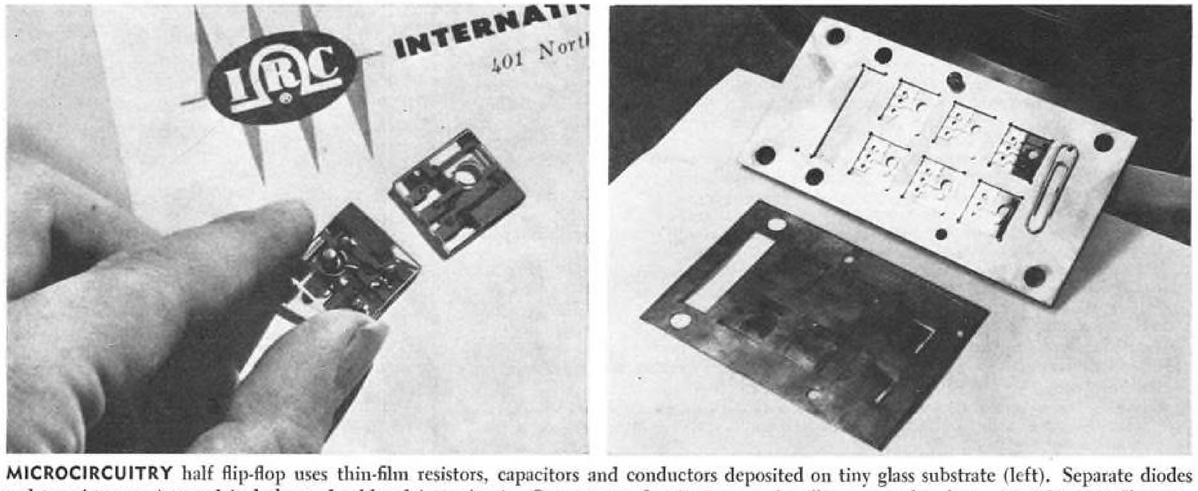
By Philip J. Klass

Philadelphia — Microcircuitry with component densities of several million per cubic foot, using deposited thin-film resistors, capacitors and conductors, has been developed here by International Resistance Corp. (IRC).

The company has produced a number of half flip-flop circuits, each consisting of three resistors, two capacitors, three diodes and one transistor with associated interconnections, on a thin glass substrate measuring only ⅝ in. square. The diodes and transistor are separate (non-deposited) components which are installed in small holes in the glass substrate and soldered in place.

The program is the first to be disclosed by a company that is solely a component producer. The bulk of the activity reported in microcircuitry and molecular electronics is taking place at avionic equipment manufacturers with the exception of Texas Instruments, Inc., which makes both avionic equipment and components (AW Sept. 28, p. 73).

IRC, which says it produces 25% of the resistors made in the United States, launched its microcircuitry program about a year ago with its own funds, although basic research in thin films had been under way at IRC for nearly 10 years. The microcircuitry effort reflects IRC's belief that separate components will be replaced by integral or lumped circuits in many applications, particularly for military and space use,



MICROCIRCUITRY half flip-flop uses thin-film resistors, capacitors and conductors deposited on tiny glass substrate (left). Separate diodes and transistor are inserted in holes and soldered into circuit. Component density is several million per cubic foot. At right, thin-film passive components are deposited in required pattern in vacuum chamber using thin metal masks like one shown at foreground. Six substrates are prepared in a single operation. Microcircuitry was developed by International Resistance Corp.

according to Dr. John Bohrer, director of research.

With techniques and materials already developed, Dr. Bohrer says IRC can produce vacuum-deposited circuit elements with the following:

• **Resistors** with resistances of up to 1,000 ohms per square to tolerances of plus 5%. This is approximately twice the maximum resistivity reported by D. A. McLean of Bell Telephone Laboratories at the recent Western Electronic Convention (AW Sept. 28, p. 79).

• **Capacitors** with values as high as 0.1 mfd. per square inch to tolerances of plus 10%. At upper limit of capacitance value, loss figure is about 2%, dropping off at lower values. Breakdown voltage is approximately 50 v.

• **Conductors** with a width of only 0.002 are easily obtained and 0.001 is possible with some difficulty. Same dimensional control for deposited resistors permits construction of high resistance values in a small substrate area.

Dr. Bohrer says the tolerances cited above can be achieved "a reasonable percentage of the time in the laboratory without post-deposition trimming or adjustment."

The company has fabricated several hundred microcircuits to date, some of which have been purchased for evaluation by American Bosch Arma and by an undisclosed government agency. IRC also has made proposals to several equipment manufacturers.

For the present, IRC has no plans to market standardized microcircuits. It prefers to work with equipment manufacturers in applying the technique to their specific circuit designs.

Thin Film Anomalies

When IRC began its thin film research 10 years ago, for application to conventional resistors, it found that the properties of thin films did not follow predicted theory. Theory indicated that resistance temperature coefficient should fall off and approach zero as film thickness was reduced. IRC found that it reached zero and crossed over from positive to a negative temperature coefficient. By controlling the thickness and deposition process, IRC discovered it could obtain a positive, negative or zero temperature coefficient.

Subsequently IRC turned its research attention to dielectric materials. Here it found that the dielectric constant of a material was not constant, but varied with the thickness of the film. As the film thickness decreased, the effective dielectric constant increased.

With this background in thin film characteristics, and the experience gained from producing deposited film resistors, IRC decided early this year to attempt microcircuits employing resistors, capacitors and conductors. Because of its very modest background in semiconductors, company decided to use existing transistors and diodes fabricated by outside manufacturers rather than attempt thin-film active elements at the start.

More recently, IRC has launched an investigation of the thin film properties of semiconductor materials such as germanium and silicon to find out how such properties differ from those of the bulk material. Long-range objective is deposited thin-film active elements.

IRC is close-lipped about the materials it employs in its microcircuitry work except to say that it uses pure metals and alloys for resistors and conductors, while for dielectrics it generally employs mixtures of metallic oxides.

Present technique for depositing the thin films is thermal evaporation in a vacuum chamber. However, the company also is investigating other deposition techniques, such as sputtering, for handling materials with high melting point. Thin films which IRC employs range in thickness from approximately 50 to 1,000 angstroms.

To lay thin films in desired patterns, IRC employs series of thin metal masks. These can be fabricated to required dimensions by using photo-etching, engraving or precision machining techniques. In present laboratory facilities, IRC deposits on six substrates simultaneously in a single operation.

One of the most difficult problems which had to be solved, according to Dr. Bohrer, was to develop techniques for soldering input-output connections to the thin films. This has been accomplished by using multi-layer deposited conductors.

Since the properties of a thin film depend both upon the material used and upon its thickness, there are an almost infinite number of combinations and permutations which scientists can investigate. IRC's own research laboratory, with about 35 professional scientists (six with Ph.Ds, 10 with masters' degrees), are heavily engaged in materials research.

A key device in this effort is a combination electron diffraction instrument and vacuum chamber. This permits a scientist to deposit a thin film of a new material, then analyze its crystalline structure without removing it from the vacuum chamber or exposing it to contamination or change of structure. There are only two instruments of this type in this country, according to Dr. Bohrer.

An IRC official says the company is anxious to work with equipment manufacturers that have specific hardware or circuits which require microminiaturization.

Company's address is: 401 North Broad St., Philadelphia, Pa.

Tests Set for SAGE Antenna

System tests of this 50-ton radar antenna, designed by Raytheon Co. for the U. S. SAGE (Semi-Automatic Ground Environment) system, are scheduled to get under way at Houma, La., Air Force Station. Antenna is 104 ft. long.

FILTER CENTER

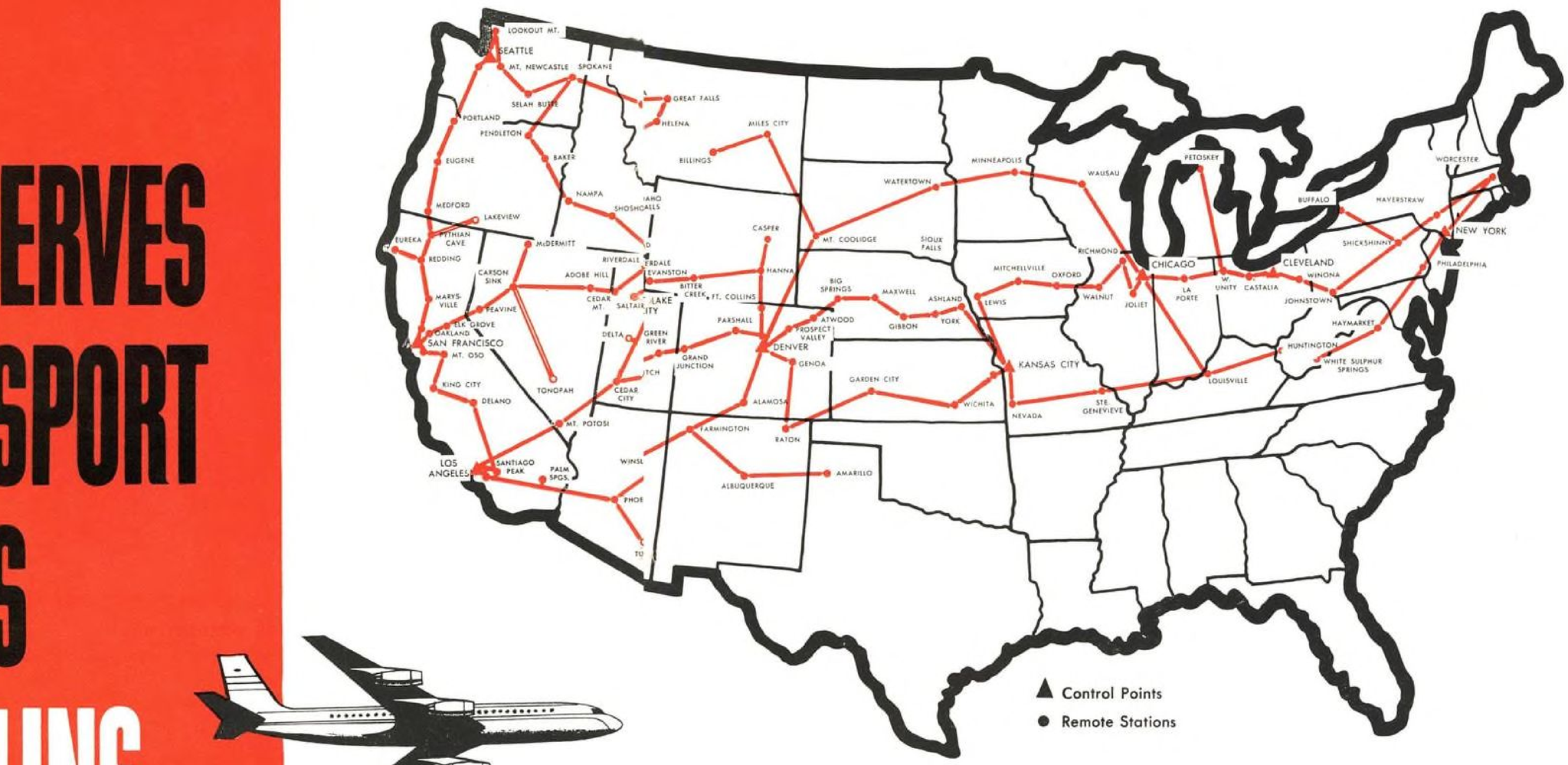
(Ed. Note: The following Filter Center column highlights points of avionic interest from the recent National Electronics Conference in Chicago.)

► **Monopulse Radar Has Slight Edge**—Naval Research Laboratory study indicates that monopulse radar has better target resolution characteristics and greater angle-error sensitivity than conical scan or sequential lobing types of radar, NRL's Samuel F. George and Arthur S. Zamanakos reported. When radar return is too weak for good automatic gain control operation, monopulse exhibits an angle-error sensitivity that is 40% better than sequential lobing radars, 70% better than conical scan, for antennas of identical gain, authors reported. However, they conclude that other factors, such as scan loss, range sensitivity, system complexity and jamming vulnerability may prove equally significant in determining which technique is best for a specific application.

► **Direct Current "Transformer"**—A single transistor circuit which can be used to step up and control a d.c. voltage over a 10:1 range, and which can handle 200 watts output, was described by R. E. Morgan, General Electric Co., Schenectady, N. Y. Circuit can provide output voltage as high as 10,000 v.

► **Electron Beam Par-Amp Gains**—Zenith recently has achieved a noise figure of only 0.6 db. with its electron beam parametric amplifier (AW Sept. 1, 1958, p. 64), two-thirds of the previous noise figure, at an operating frequency of 425 mc., Robert Adler reported. He said that about half of this new noise figure was due to losses in the input coupler. Bandwidths of about 40 mc. currently are being achieved, but Adler predicts it may be possible to triple this figure. Company now has electron beam parametric amplifiers operating at frequency of 1,300 mc. and within a year hopes to have an X-band tube in operation. Zenith has constructed experimental electron beam parametric amplifiers in which the idler frequency is five times the input signal frequency, but has not yet achieved the low noise figures obtained in tubes where idler and signal frequencies are approximately the same.

ARINC SERVES AIR TRANSPORT ROUTES WITH COLLINS VHF SYSTEMS



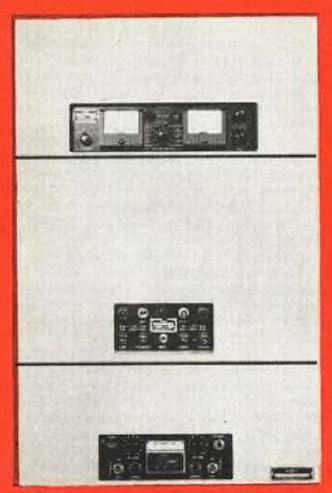
A vast expansion of ARINC's coast-to-coast VHF communication network is now providing ground-to-air service for jet fleets and other air transports flying a variety of trans-continental, border-to-border and intermediate stop routes across the nation.

Selected by ARINC to meet specific operational and reliability requirements of the extended system were Collins 242F-5CL Transmitters and 51M-8 Receivers. Most of the stations on the network are unattended. Operational control is effected with ARINC-designed remote control systems.

Minor modification of existing Collins systems shortened development time and allowed completion of the networks as jet service was being inaugurated along the routes.

Collins 242F-5CL VHF Transmitter is designed for use in network communication systems involving unattended stations. Automatic control of power output maintains a nearly constant carrier level with normal variations in primary source voltage. All major functions, including VOX (voice actuated transmission) are remotely controled over wire lines. Power output level, transmission line SWR and percentage modulation will be remotely metered. The compressor type modulation limiter has an extremely fast attack time and holds modulation rise in audio input level. An ARINC-designed high stability oscillator, used in conjunction with the 242F-5CL, enables the aircraft to be in continuous station-to-station communication over entire segments of the network without retuning the aircraft receiver.

The associated 51M-8 Receiver employs high selectivity in the RF circuits to reduce cross modulation effects to a very low level and prevent signal blocking in terminal areas where channel frequencies are closely spaced. For information and literature on the 242F-5CL and 51M-8, write Collins Radio Company, Cedar Rapids, Iowa.



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► **Communication Satellite Tests**—Tests conducted by Bell Telephone Laboratories using a high-gain horn-reflector antenna and a traveling-wave type ruby Maser, prototype of the antenna which will be used in passive communication satellite experiments, have achieved over-all system noise temperatures as low as 17.2 deg. Kelvin, with a mean figure of 18.5K for 25 runs. By reducing input waveguide losses, and through other improvements, it appears possible to reduce over-all system noise temperature to 10K at the zenith and 24K when antenna is pointed 10 deg. above the horizon, Dr. R. W. DeGrasse reported. The traveling-wave Maser employed in BTL tests operated in the C-band (5.5 kmc.), had a bandwidth of about 30 mc. and achieved a gain of about 30 to 40 db.

► **High-Speed Digital Encoder**—Transistorized analog-to-digital converter, which converts analog voltages to an 8-4-2-1 binary coded decimal output at a rate of one bit every four microseconds was described by R. C. Platzek, H. F. Lewis and J. J. Mielke of North American's Autonetics Division. Readout is a parallel presentation, with symmetry preserved for both positive and negative input voltage polarities except for sign bit changes. Converter has a resolution of one part in 2,000 and an accuracy of 0.1% of full scale.

► **New Radar Angle-Noise Concept**—Angle-noise, the random motion of the apparent target position about its physical center as seen by a radar, is the distortion of the echo signal phase front resulting from multiple reflecting sources of the target, according to Dean D. Howard, Naval Research Laboratory. The apparent location of a complex-structure target, as seen by radar or other target locating devices, is in a direction normal to the echo signal phase front. Howard said the new concept aids in visualizing the source of target angle noise and in assessing its affect on radar or other target locating devices.

► **Molectronic Element Described**—Molectronic light telemetry system, consisting of a tiny wafer of germanium or silicon which oscillates at a frequency that varies directly with the intensity of the light to which it is exposed, was described by Gene Strull, of Westinghouse Electric. The molectronic device, developed as part of the Air Force-sponsored molectronics program (AW Apr. 27, p. 54), can be constructed with a dark frequency as low as several kilocycles or as high as several megacycles. Westinghouse can construct the element with either a positive or negative temperature coefficient, Strull said.

HOUND DOG air-launched missile, powered by 7,500-lb.-thrust Pratt & Whitney J52 turbojet engines, is fired at Eglin AFB.

Hound Dog Support Tailored for Weapon

Los Angeles—Ground support equipment for North American Aviation's Hound Dog missile is designed around a modular concept and was developed from the beginning to fit operational needs.

Cost of the ground support equipment for the GAM-77 Hound Dog air-to-surface missile will amount to about 20% of the weapon system with up to 70% of the total system cost for some other missiles, E. B. Price, chief of the Support Equipment Section of North American's Missile Division, told a recent Society of Automotive Engineers National Aeronautic Meeting here.

Price said that designing the ground support equipment to the operational configuration precluded the creation of experimental or prototype configurations which would subsequently receive major redesign for production. It also made possible the utilization of equipment designed to the operational configuration in field test programs at Eglin AFB, Fla., and at a plant in Downey, Calif. Some items are being used in factory final assembly and testing departments. "As a result, the earlier use of operational equipment and, consequently, earlier product improvement, will minimize field retrofit for changes," he said.

Price noted that Hound Dog ground support totals approximately 95 different end items of equipment peculiar to the weapon system which are furnished by North American. In addition, many items of standard equipment are government furnished. Breakdown of contractor furnished equipment shows that 40 items are for checkout and control, 20 for servicing and 15 for handling. In addition, there are 20 items classified as auxiliary equipment.

Support requirements for an air-launched missile vary greatly from those required for ground launched vehicles. In the case of Hound Dog, the Boeing B-52G serves as the launching platform and the missiles carried and launched from the bomber are considered solely as an adjunct to the B-52 weapon system. Price said only the modifications required to carry Hound Dog are chargeable to the missile's system.

Modifications to the B-52 include the pylon attaching structure, missile release system, and control and monitoring stations for missile operation prior to release for free flight. He said that unlike ground launchings the air launches must be accomplished without the protection of a blockhouse and necessitate much more detailed development and testing to assure safety of flight during takeoff, cruise with captive missiles operating and launch operations.

Price noted that one item in the inventory of Hound Dog ground support equipment which posed a challenge is the ground checkout equipment for those airborne support equipments in the carrier aircraft. A missile/pylon simulator tests the missile operator's panel in the B-52 and also tests the tie-in systems between the missile and the bomber. This checkout console, trailer mounted, is used in B-52 maintenance areas for periodic testing prior to attaching the GAM-77 missiles for operational readiness.

Most complex and costly items of ground support equipment are the checkout and ground control units, and the servicing equipment provided for adequate maintenance of the missile. Price said modular construction was used for these units in order to produce simpler, less expensive hardware. The basic console configuration was established by Wright Air Development Center and North American with the result that each end item is composed of two, three, or four standard bays mounted on a standard mobile base. Each bay has provisions for mounting standard 19-in. panels or modular drawers. Bays are two feet wide resulting in assembled console dimensions of four, six or eight feet in length. Configuration is suitable for test equipment incorporating electronic packages, standard power supplies, blowers, instrumentation, and handbook storage.

Price defined servicing equipment as equipment required to transfer fluids needed for the missile's mission, and equipment required to properly place the missile systems in a state of readiness and environment for ground checkout. Typical of the latter are servicing units for electrical and hydraulic ground power, pneumatic pressurization, ground temperature control, etc. Modular concept has been used in the packaging of fluid systems servicing equipment for the GAM-77 program. Previously, the number of personnel fabricating a unit was seriously limited by the manner in which tubing and components were installed in the console.

Modular Advantages

Modular concept provides these advantages:

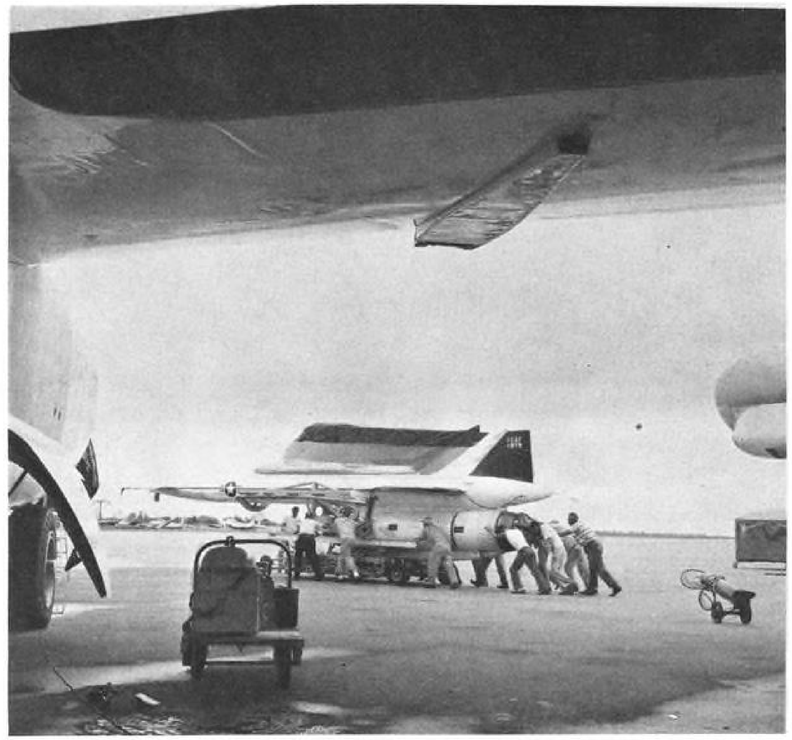
- **Subsystems may be mounted** in one drawer and will be complete with electrical controls.
- **Maintenance is simplified** by providing access to a drawer which may be easily removed from the console.
- **Drawers may be completed** and checked to applicable process specifications prior to installation in the console assembly.

Tow bars are not attached to the consoles because towing at unsafe operating speeds might possibly result in damage to the delicate instruments mounted within the consoles. Price said they are designed for hand movement only within the immediate areas of usage but may be fork-lifted onto a flat bed trailer for transportation between checkout and servicing areas.

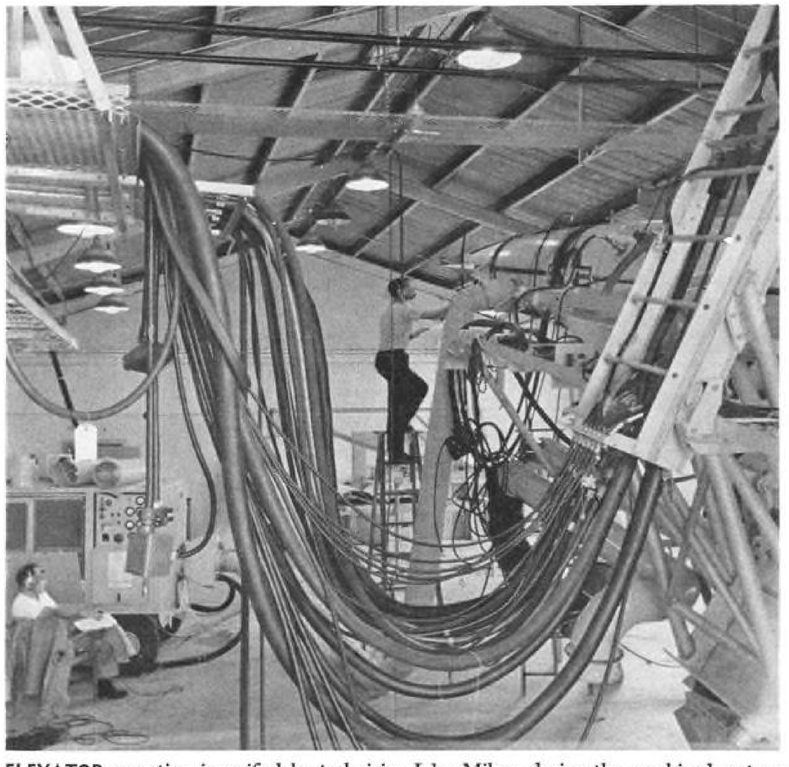
Acceptable degree of reliability, Price said, is assured by the use of a combined systems checkout concept which is conducted in the missile runup area provided in the maintenance cycle for the missile at the squadron level. The combined systems checkout will be principally engaged in determining the airworthiness of assembled missiles by a comprehensive check of system interactions under simulated flight conditions. Checkout program is sequenced, tests are selected and test results are evaluated and displayed by means of automatic equipment.

Equipment is packaged in the standard console configuration and includes consoles for checkout control, checkout circuit distribution, flight attitude control, hydraulic power, electrical power, pneumatic pressurization, and pitot-static flight environment simulation. Units, comprising 26 bays of equipment (approximately 52 ft. of consoles) are enclosed in a control room adjacent to runup position of missile.

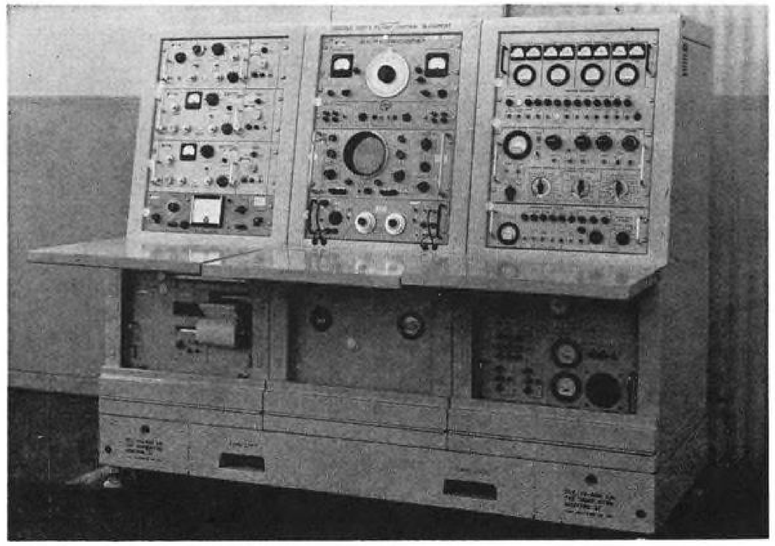
Price said that such automatic equipment is more complex than manually



GAM-77 missile is pushed on ground transporter to combined systems checkout area after being unloaded from a Douglas C-124 which flew the missile from Downey, Calif., to Eglin AFB, Fla. Fitting on B-52 wing (above) is for the air-launch pylon.



ELEVATOR operation is verified by technician John Milnor during the combined systems checkout procedure. One series of tests is aimed at proving out the compatibility of the missile-pylon combination; another is to check instrumentation.



CHECKOUT console for the GAM-77 Hound Dog missile utilizes modular type construction and can be shifted to other control locations in sections. Complete checkout system consists of 26 bays measuring 52 ft. in length.

operated equipment and therefore requires higher skill levels for its own maintenance and repair. However, a built-in, self-check capability automatically isolates malfunctions in this checkout equipment to a desirable degree, greatly facilitating trouble shooting and easing maintenance personnel requirements. A crew of three is required to automatically perform the operations of missile/pylon combined systems checkout.

Using the same equipment, and performing the operations semiautomatically, a crew of seven with additional training can accomplish the same tests. The additional personnel are required for manual operation of the servicing units, which are capable of either type of operation. Manual operator capabilities in equipment normally controlled automatically are provided to facilitate basic checkout of the servicing units without requiring a tape programer. Therefore, checkout can be accomplished in either the missile runup area or a hangar maintenance area with a minimum amount of additional standard test equipment.

Checkout Program

Price recounted the North American Missile Division development program of fully automatic checkout equipment several years ago. Development entailed design, fabrication, and testing of prototype consoles which automatically performed variable programs with circuit selection; first, by punched cards, later by punched tape. Both types provided for analog measurements converted to digital information for evaluation and readout. Mechanical switching in early models has been replaced by solid state logic. Readout consisted of a "low-go-high" display, supported by printed digital tabulation. This equipment was evaluated in terms of requirements for Hound Dog. Many design parameters were considered in the selection of automatic checkout and control equipment including performance requirements, human factors, reliability, accuracy, flexibility, speed, cost, and the availability of developed components. Design objective was the utilization of automation to the degree that it best combined these considerations in order to give results compatible with available skills. Fully automatic equipment was selected for the checkout of mated missiles and pylons in the missile runup area. Complement of equipment in this area is devised to automatically check 90% of each complete missile/pylon combination. Automation of the checkout affords stringent and repetitive verification of operating parameters. Electronic programer controlled by a punched tape is used to obtain checkout with speed and reliability. Solid state elements such as transistors and diodes enhance reliability. The design thus achieved enables the checkout equipment to perform individual system verification as progressive commands and decisions are accomplished electronically by means of logic and digital techniques.

Price disclosed that automatic checkout of the Hound Dog flight control system presented an interesting and challenging design problem since the Hound Dog is completely assembled and in a closed configuration during these tests. Acceptable degree of system activation and interrogation requires that the missile airframe be displaced in order to determine the behavior of the flight control system. Although not a new technique, it is normally limited in use to relatively small missiles. Conventional method of flight control system checkout wherein gyros are removed and placed on a displacement table is not used. Rather, North American undertook to design a device identified as a flight attitude positioner. It is capable of displacing the entire assembly of missile and attaching pylon in pitch, roll, and yaw axes, maintaining a constant displacement rate when the airframe passes through zero displacement. This approach to flight control system checkout is compatible with the use of automatic equipment.

Price said the positioner is operated by a control console which is, in turn, controlled by the automatic control console. The missile is maneuvered with its systems energized and the engine operating during the test. Flight control system checkout has been accomplished satisfactorily using this flight attitude positioner. It weighs approximately 6,000 lb. and may be disassembled for air transport.

For guidance system components checkout, a complete airborne guidance system is included as part of the ground support equipment utilized in the bench maintenance area. This enables the entire system to be aligned and checked to verify system performanc.

Price described one of the big problems confronting the ground support equipment engineer as being that of designing satisfactory simulators for electro-explosive devices such as explosive bolts, destruct packages and thrustors (explosive units which generate gas to actuate mechanical releases) which are detonated with an electrical signal. Power is applied to energize these circuits intentionally but they are sometimes energized accidentally by pickup of stray voltages (noise). During checkout of these circuits, simulators are utilized to avoid danger to personnel or equipment which would exist if live explosive devices were used. Circuit checkout consists of checking for proper operation and monitoring for dangerous levels of noise pickup.

Simulators which provide the elements to perform the required circuit checkout impose a load equal in amplitude and duration to the load imposed by the actual device. To monitor this circuit for noise pickup, the simulator contains a detector which produces a visual and audible warning signal when a dangerous noise level is picked up.

Although the portion of the simulator which checks for proper circuit operation presented no particular problem, a rather unique circuit is used. A single shot transistorized multivibrator with

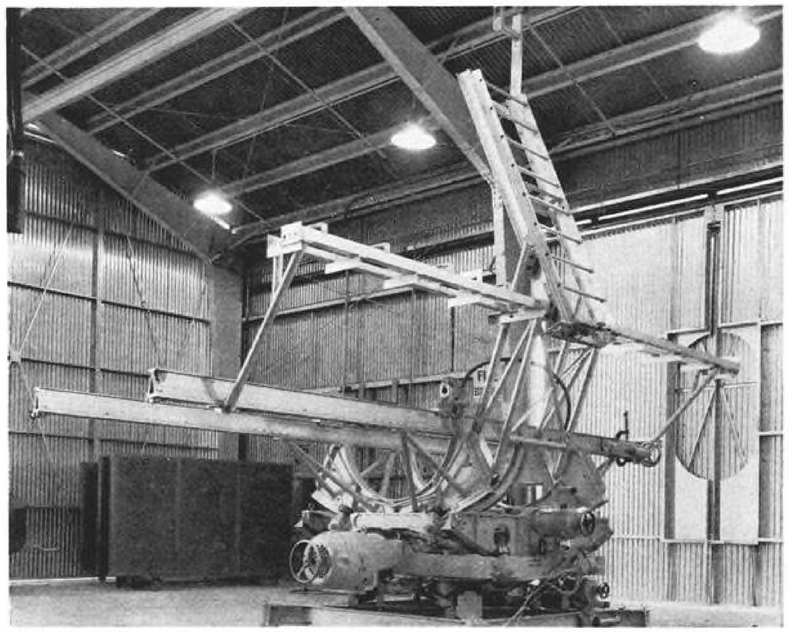
suitable loading resistor establishes the amplitude of current. The duration is established with a resistor-capacitor network which generates the cutoff signal to the multivibrator. Cutoff signal must reach a minimum specified level in order to act upon the multivibrator. Level of the cutoff signal is a reciprocal function of the circuit resistance being checked. When the multivibrator cuts off, it produces a "go" signal verifying proper circuit operation. Any circuit malfunction will not permit the multivibrator to cut off; therefore, the multivibrator will not produce a "go" signal.

The real problem is that portion of the simulator which monitors the circuit for noise because of some of the properties of noise. Pickup of noise in a circuit is dependent upon the impedance of the circuit. The electro-explosive devices have impedance ranging from .1 to .2 ohms. Noise also exists at any and all frequencies in a very broad range, from d.c. to RF of thousands of megacycles. To be adequate, the noise detector must emit a usable signal while simultaneously exhibiting identical characteristics of the electro-explosive device. Most important characteristics are impedance, frequency response, and RF shunting effects. The present state of the art provides only one possible device that may serve as the noise detector. This device is an RF meter thermal element which is a thermocouple attached to a resistive wire in such a manner that the thermocouple output is a measure of power dissipated in the resistive wire. This thermal element however, did not satisfy the requirement for the monitor detector because, when measure of impedance was correct, the thermocouple output was too low to be usable, and vice versa.

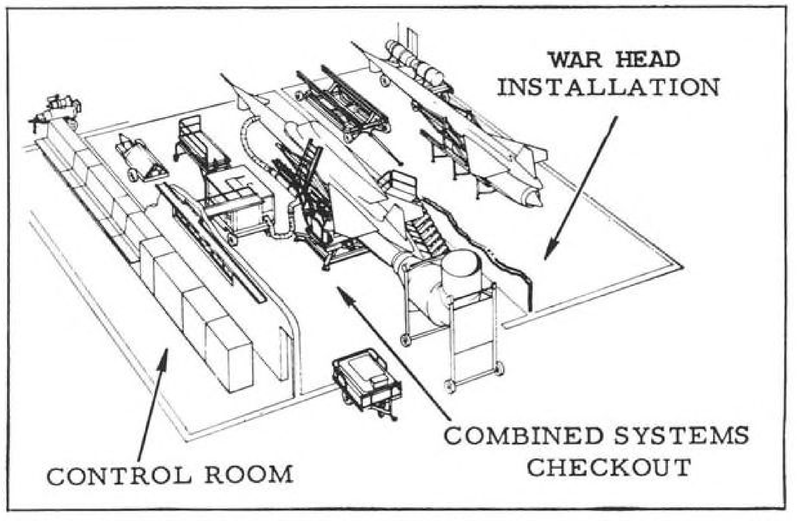
Solution to the problem was reached by a combination of existing unrelated elements. The squib wire from the electro-explosive device was placed in an evacuated capsule with an infrared, four-leg bolometer bridge. All noise reaching the squib wire is dissipated as heat, thus producing infrared radiations. Opposite legs of the bolometer bridge are exposed to these radiations, thus unbalancing the bridge. Since the bolometer bridge is excited with an external power source, the output signal from the unbalanced bridge exceeds that of a self-generating thermocouple. This now becomes a very usable signal which is used to actuate audible and visual indicators signifying that dangerous noise levels exist in the circuit which may detonate the electro-explosive device when installed. Thus, corrective action to avert a possible accident may be initiated.

Although weight of the GAM-77 in the fully fueled configuration is in excess of 12,000 lb., an available trailer capable of assuming loads only up to 12,000 lb. was used in the research and development program.

The result was that mobility was restricted to approximately 3 mph. It became evident that a handling system capable of approximately 15,000 lb. capacity was needed and the Air Force authorized the development of such a handling system consisting of a positioning trailer, work stand and air transport trailer. Complete ground support equipment hardware for GAM-77 has not been determined as yet with a few new items still being evaluated. Occasionally an item of equipment will be deleted by the elimination of the existing requirement even though initial periods of Strategic Air Command operations may commence. Proportion of ground support equipment cost in some weapon systems has been estimated to be as high as 70% of the total weapon system cost. However, Price concluded the figure for the GAM-77 Hound Dog will probably not exceed 20% of the total weapon system cost.

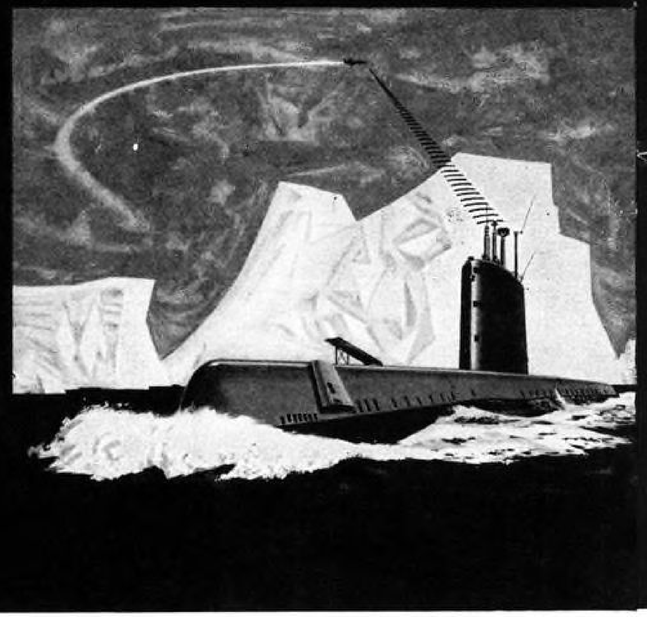


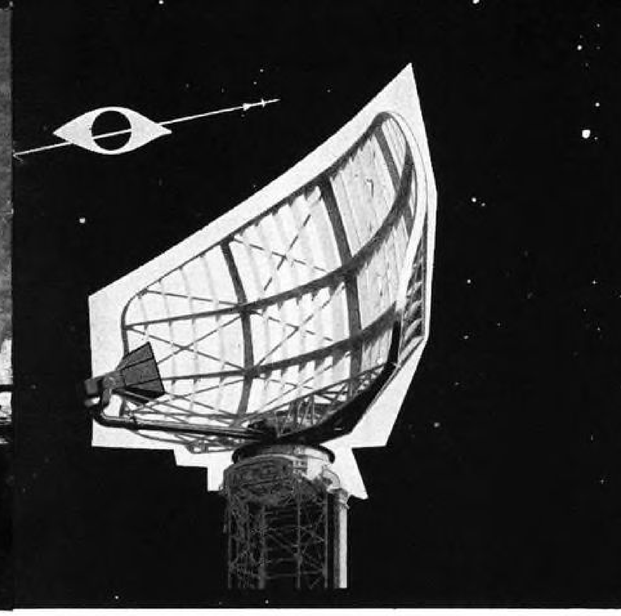
FLIGHT attitude positioner is designed to hold the Hound Dog with its engine operating and control systems energized; unit can displace the missile in pitch, roll and yaw attitudes. Positioner weighs 6,000 lb. and can be dismantled for air transport. Missile is fitted with its flight pylon at North American's Missile Division.



DRAWING shows layout of the missile runup building; note sound suppressor fitted to Hound Dog's J52 exhaust stack. Missile not yet fitted with pylon is at right. Hound Dog made its first powered flight last April 23 with "completely successful" results.

... WHAT IS HAPPENING INELECTRONICS AT STAVID ? •





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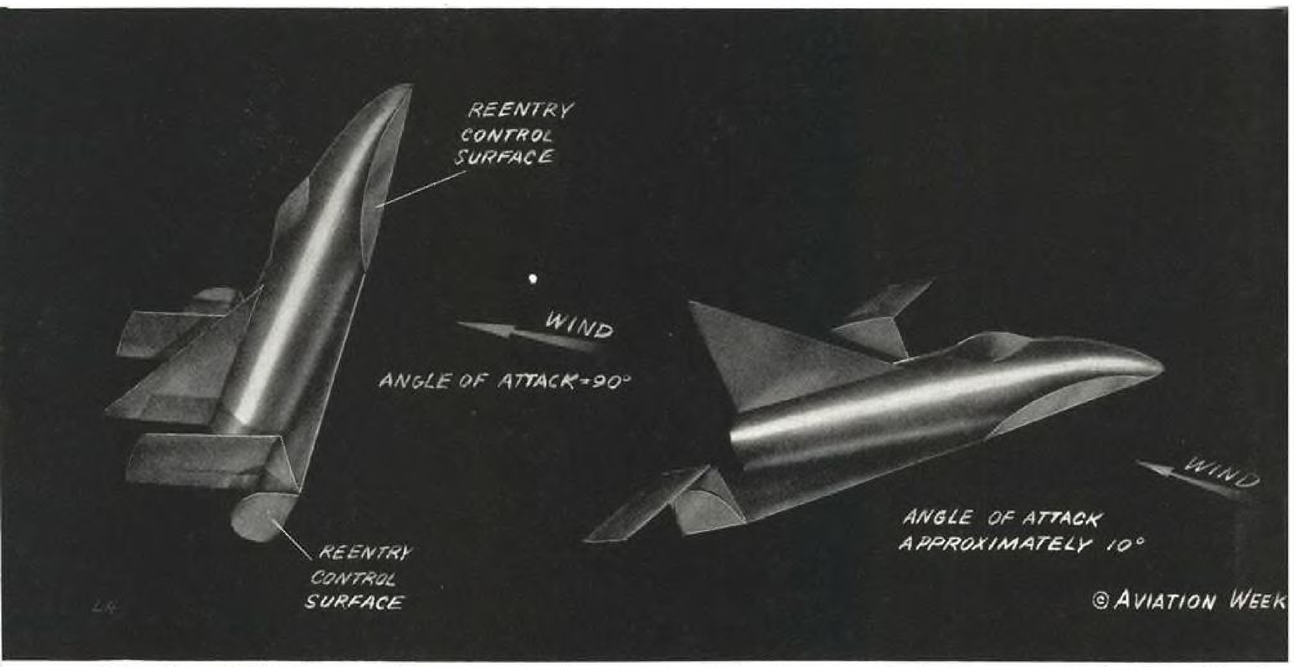


VARIABLE GEOMETRY which could serve as a ferry between a space station and the ground is in its re-entry attitude at left. When it had slowed to Mach 2 or 3, it would nose over (right) and extend its control surfaces. The bottom surface is a heat shield and the top portion constructed like current supersonic aircraft. At high angles of attack, it would have motion characteristics similar to a ballistic capsule. Flipper surfaces fore and aft would provide control.

Controllable Re-Entry Techniques Probed

By J. S. Butz, Jr.

Langley Field, Va.—Three principal categories of re-entry vehicles with six primary types of configurations are under consideration by National Aeronautics and Space Administration at its Ames and Langley research centers.

Ultimate usefulness of each of these vehicles depends upon the further development of high temperature materials, but NASA engineers generally agree with those in industry who believe that it has been possible for at least the past two years to build controllable winged vehicles that can maneuver well and extensively as they re-enter the atmosphere.

The three general categories of re-entry vehicles being studied are:

• **Winged gliders of metal** construction resembling current high-speed aircraft with delta wings. Dyna-Soar-type vehicles that must re-enter quickly to maintain high speed over a target and lower performance gliders with the sole mission of re-entering the atmosphere and landing at a field the size of Edwards AFB, Calif., are the two major subdivisions in this category.

• **Very lightly loaded vehicles** with inflatable or collapsible structures. Triangular winged gliders of nearly blimp-size and collapsible lifting surfaces resembling kites are the two principal ideas in this area.

• **Ballistic capsules,** some of which are pure drag shapes of the Mercury variety and others unsymmetrical bodies developing lift, are being investigated in this category.

Each of these categories represents a different approach to handling aerodynamic heating which is the primary design problem with re-entry aircraft. Ballistic and semi-ballistic capsules experience the highest heating rates, but they expose a very small area to intensive temperatures. Inflatable and collapsible vehicles are extremely large with a wing loading in the neighborhood of one pound per square foot and they will permit flight at altitudes of 300,000 ft. and more.

Therefore, they are able to slow down considerably before reaching dense air, keeping both heating rates and total heat input very low.

Winged gliders of metal construction will have wing loadings of approximately 25 lb. per sq. ft. They will heat at a lower rate than the ballistic capsule, but their total heat input will be much higher. They will descend below 250,000 ft. before their wings will substantially contribute to their support. Their speed will be high when they reach dense air, and they will experience high heating conditions for at least 20 min.

Winged aircraft of this type, however, have the best performance and maneuvering potential of all the re-entry vehicles. Air Force believes that they will make the most useful military weapons for alternately operating in and out of the atmosphere, and industry papers relating to Dyna-Soar requirements mention missions that would require high heating conditions for two hours with a 2g acceleration limit during this period.

Delta-winged re-entry vehicle believed by NASA to be the best for ferry service to and from an orbit would have a heavy heat shield covering its lower surface. The upper portion would be constructed in much the same manner as present Mach 2 aircraft. This aircraft would re-enter at an angle of attack of about 90 deg. and stay in that attitude throughout the period of high temperature flight. Large horizontal control surfaces that will make slow speed flight an easy matter for the aircraft would be folded back onto the top near the vertical tail.

The lower surface heat shield would be the only portion of the aircraft to reach temperatures of much above 200F. The fact that this heat shield would have an almost triangular shape would make the aircraft more difficult to stabilize than a Mercury capsule during re-entry. Large moments are created by small changes in attitude with this type of aircraft, and it would not be possible to use small rockets or other thrust devices for stabilization.

Therefore, NASA is studying the use of two control surfaces on the nose and two others near the tail. These surfaces would periodically flip into the main flow to keep the aircraft at the required angle of attack.

After flight speeds of Mach 2 or 3 were reached, the aircraft would begin to nose over and finally extend its tail surfaces well beyond the original wing span of the aircraft. The extendable surfaces would be in an L shape so that they would add to the vertical as well as the horizontal tail area. This variable geometry approach would provide better control effectiveness about all three axes than that usually attainable with a delta wing. The re-entry ferry's landing speed could be slower than those of high performance aircraft now in service.

The re-entry ferry described above resembles a ballistic capsule during long periods of its flight. It slows down rapidly at a fairly high altitude and could not fly for 20 min. under high heating conditions. Its maneuverability above Mach 3 is limited. These characteristics would severely affect its military usefulness.

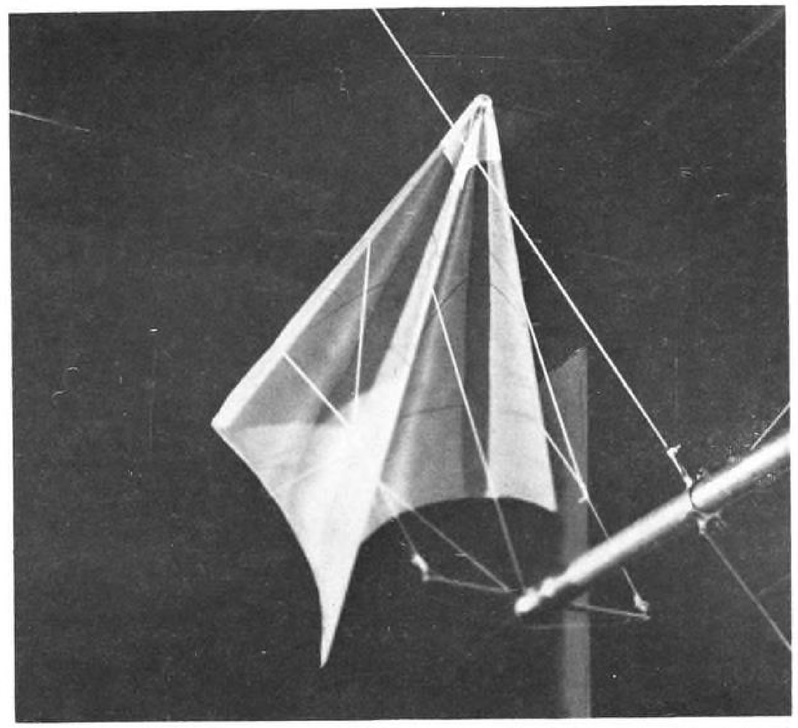
Effectiveness Criteria

Attack and reconnaissance effectiveness of the global bombing systems, the ultimate objectives of the Dyna-Soar program, will depend upon maintaining speeds of up to 12,000 mph. while maneuvering over several thousand miles of enemy territory.

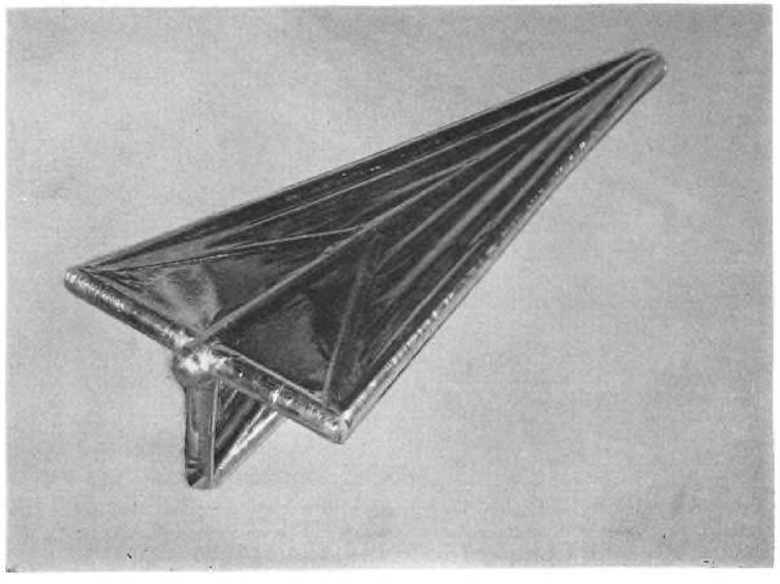
Rapid deceleration of the aircraft as it flew below 200,000 ft. to increase the accuracy of its weapons or reconnaissance equipment would add substantially to its chance of being intercepted. This requirement for high speed and relatively low altitude flight cannot be satisfied unless the aircraft can operate at a lift/drag ratio of approximately four. To accomplish this at hypersonic speeds, the aircraft must be long and slender and fly at a low angle of attack.

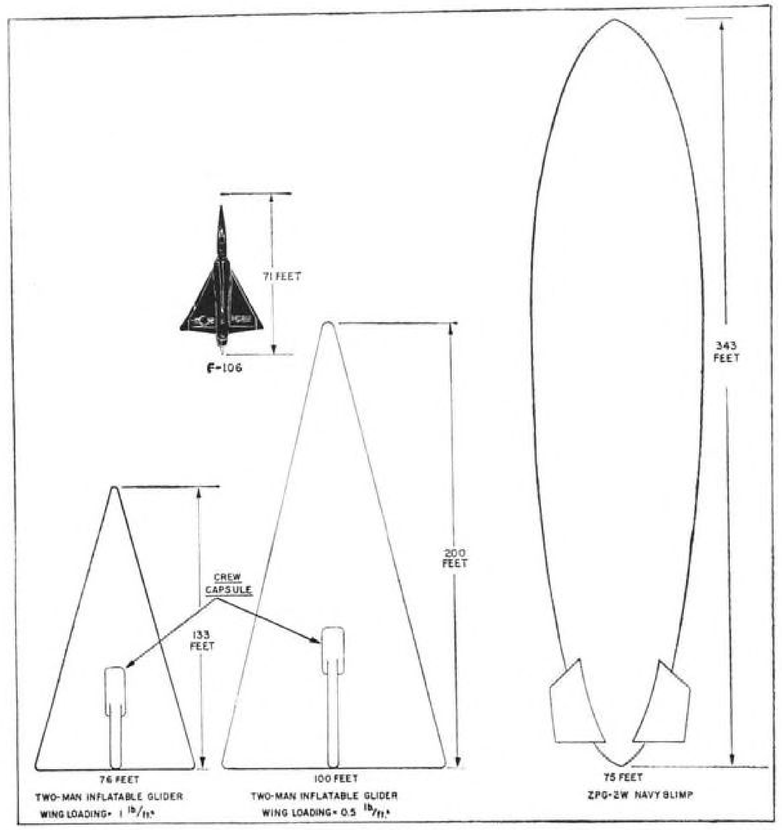
Both the upper and lower surfaces must be able to withstand high surface temperatures. These will be above 3,000F on the leading edge and drop down to 2,500F about one foot back on the wing chord with progressively lower temperatures farther to the rear. Minimum surface temperatures on the rear sections would probably be about 1,500F.

Government and industry structures engineers who were put on the spot by

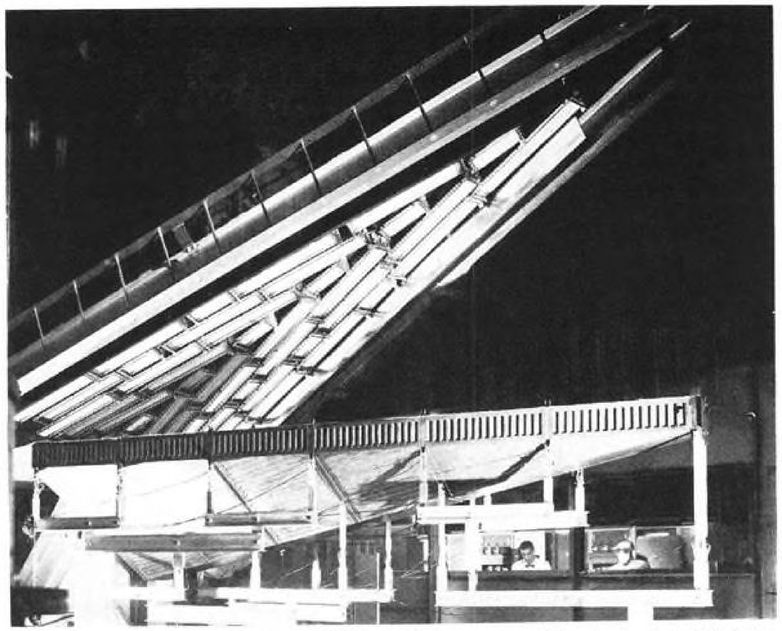


COLLAPSIBLE and inflatable re-entry vehicles are attractive for two reasons: their lifting surfaces can be stowed during takeoffs so that the severe stability problem caused by launching a winged glider on the front of a slim ballistic missile can be avoided, lifting surfaces of this type also offer a possible answer to the heating problem associated with atmospheric re-entry. The vehicles are of light construction and will allow a large wing area to be used so that the altitude performance of a vehicle can be outstanding. Inflatable vehicles similar in appearance to the model below would have a wing loading of one pound per square foot or less and would be able to operate at high aerodynamic lift-to-drag ratios at 300,000 ft. altitude and above. They would be capable of slowing down gradually with relatively little hearing in the thin air at these altitudes. Construction material for such a vehicle probably would be a metal wire covered with a rubber-like compound. The crew would be launched into orbit in a small capsule with the wings folded on its sides. The wings would be inflated shortly before re-entry. The collapsible wings above would be carried on the back of a vehicle during launch and released before re-entry. Wings of this type also could be used to augment the lift of a supersonic aircraft during landing.





TWO INFLATABLE re-entry gliders of the same gross weight but different wing loadings are compared in size (above) to a Convair F-106 aircraft and a large Goodyear-Navy blimp. Inflatable gliders during re-entry probably could be slowed down to subsonic speeds before they got much below 200,000 ft. From this altitude they could spiral slowly down at an airspeed of about 200 mph. and have a wide choice of landing fields.



QUARTZ LAMPS are used to heat the bottom of the re-entry glider structural model shown inverted above. Air loads on the glider are simulated at the same time through the "whiffletree" arrangement of levers hanging below the model.

these high operating temperatures believe that the answer to the problem has been available for more than 24 months and feel that the prototype of a useful military vehicle could have been built during this period.

Further work on materials is always necessary, but they contend that flying with the knowledge now at hand is the only way to uncover the major problems that will never become clear on the ground.

Structure Types

Three general types of structure have been advanced for use on these high performance gliders. They are:

- **Hot load-bearing structure** which stabilizes out at about 2,500F.
- **Load-bearing structure** of near 1,000F which has insulation between it and the surface material.
- **Insulated and cooled load-bearing** structure that never gets above approximately 200F.

NASA engineers apparently favor a simple version of the latter idea. Water would be used as a coolant but no pumps or elaborate plumbing arrangement would be necessary. Depending upon the flight to be made, one or two pounds of water per square foot of vehicle surface would be carried inside hollow members of the main structure. A wick-like substance inside these members would absorb the water and prevent any sloshing. As the heat input began, the water would turn to steam absorbing about 1,050 Btu. per lb. in the process. The steam would be vented out the rear of the vehicle in a manner that would prohibit the building up of a high pressure inside the structure.

Heat Shield

A layer of insulation would also shield the main structure from the intense heat of the outer surface. The outer surface of the aircraft would not carry an appreciably greater load than that of the fabric skins of canvas covered aircraft. Thin gage sheets of steel or molybdenum alloy would cover the re-entry vehicle in contrast to the heavy, thick milled skins of supersonic aircraft. These thin sheets would be cut into small squares or narrow strips and held together by movable joints that would allow them to expand without buckling as their temperature rose.

It is probable that they also would be corrugated in much the same manner as the skin of the old Ford Tri-Motor and Fokker transports. These corrugations would run streamwise down the aircraft and over the wing and would disappear as the aircraft heated and expanded. They would reappear at slow speeds.

Thermal stresses in these structures would not be eliminated, but NASA and industry engineers believe it is possible to keep them from warping the aircraft out of shape or causing abrupt failure. Many different ideas for the construction of flexible joints for attaching the skin to the under structure have been advanced and most of them seem practical. The weight of structure required for a re-entry vehicles with some military usefulness probably will run somewhat over 50% of the total weight as against 20 to 25% for efficient aircraft operating at lower speeds where heat is not a problem.

The leading edge of the wings and the nose, which will experience much greater temperatures than the rest of the aircraft, will require special construction which also has been under extensive study for the last few years. Materials for these areas of the structure which are now under consideration include the refractory metals, graphite, ceramics and ablating plastics.

NASA apparently believes that ablating materials at this stage of their development would be too heavy for a leading edge which would have to undergo high heating for periods of more than 45 min. This type of leading edge also would have to be replaced after each flight, and one of the requirements Air Force is attempting to get into Dyna-Soar program at an early stage is reuse for every component.

Graphite Studied

Graphite appears to be the most promising material now under study. Pure graphite tends to spall or break off in small pieces during heating when it is exposed to high dynamic pressures from an air stream. This drawback is being overcome through the use of surface coatings. Pyrolitic graphite is one of the coated varieties showing promise under test. This graphite has a heavy coating of carbon which is produced by burning it in a methane gas at about 2,000F.

The leading edges and outer skin of all of the three types of high temperature structures mentioned above will be approximately the same. The temperature of the load bearing structure underneath will be the major difference. If a cooling system is not used, insulation will be able to keep the under structure down to about 1,000F during most of a re-entry flight If insulation is not used, the load-bearing structure will rapidly come to skin temperature. Much thought is being given to this type of structure because it is clearly the simplest and may be the lightest in the long run. Under present circumstances, however, such structures cannot be built without the use of materials that have not yet been fully developed. They would have to use molybdenum alloys and the refractory metals in many new and un-

proved ways. These development costs naturally would add to the initial costs of a re-entry vehicle using a "hot" under structure.

Inflatable delta winged glider being discussed as a re-entry vehicle would never have a dynamic air pressure against its structure of more than about 200 to 300 mph. at sea level. Still, as it slowed down from orbital speeds of 18,000 mph. to about 200 mph. relative to the ground, the vehicle would heat to about 1,500F. Goodyear apparently is the only U. S. company working to any large degree on the development of a flexible material that can be used on inflatable vehicles capable of re-entry. This material is a nickel alloy wire cloth coated with a rubber-like material. The principal problem with the material is its tendency to get brittle after each heating, and in its present state a vehicle made of it would not be able to re-enter more than once.

Blimp Structures

The large blimp-like structures considered under this concept of very low wing loading would be kept inflated by air bottles or a small pump. Pressure inside the vehicle would have to be increased as it lost altitude so that structural rigidity could be maintained in the atmospheric pressures near sea level.

Roughly, the flight program for these vehicles would be to decelerate from orbital to subsonic speeds while losing altitude from 300,000 to about 200,000 ft.

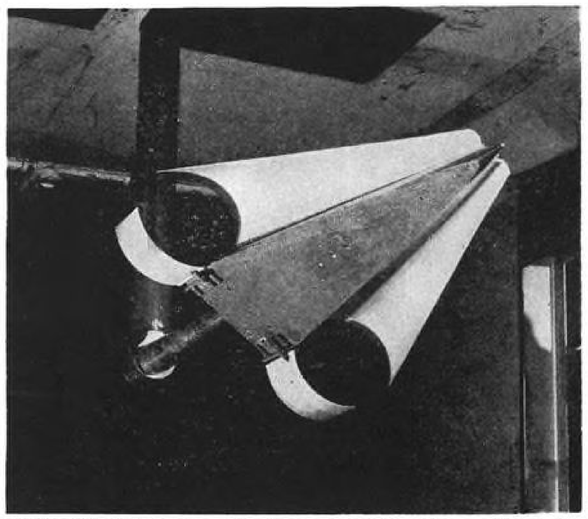
This might require several orbits. Then, the aircraft could spiral slowly down from 200,000 ft. to the ground, with its airspeed never going much above 200 mph. Such a flight schedule would allow a great latitude in the selection of a landing field.

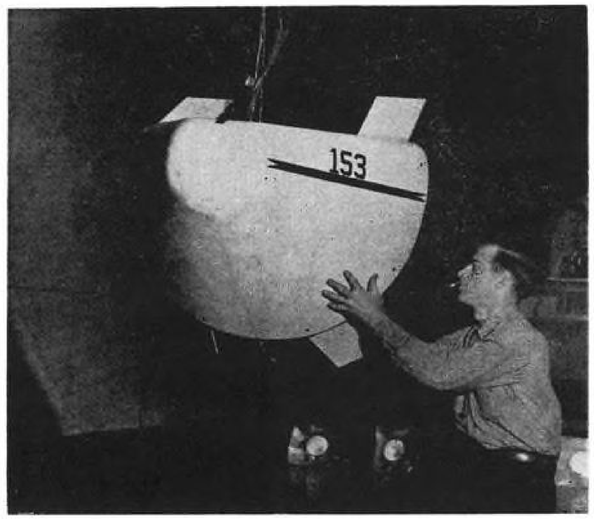
Collapsible Units

Collapsible units resembling kites are being considered by NASA for two possible auxiliary applications. They would increase lift during either the re-entry or landing phases of a flight back from orbit. During the re-entry phase, they would decrease the wing loading and allow a glider of solid structure to have some of the altitude characteristics of the inflatable vehicle. They also would contribute to a lower landing speed.

The collapsible unit would be little more than a square of flexible heat resistant material with three stiff poles connected at one corner and running down two sides and diagonally across the vehicle.

This kite-like wing would be stowed on the upper surface of the re-entry glider until it had reached air dense enough to inflate it. At this point, the wing would be inflated with the flexible





HIGH LIFT, high drag capsule shown at right has been under study at NASA for some time. It is designed to lower the accelerations on a pilot by producing some lift during re-entry. This design also will achieve a compromise between the high heating rates of the pure drag capsule and the high total heat input of the winged vehicle. A re-entry vehicle formed by opening a cylinder after it has been placed into orbit (left) also has been studied during NASA investigations of this class of aerial vehicles.

material blossoming out and forming a lift-producing curved surface.

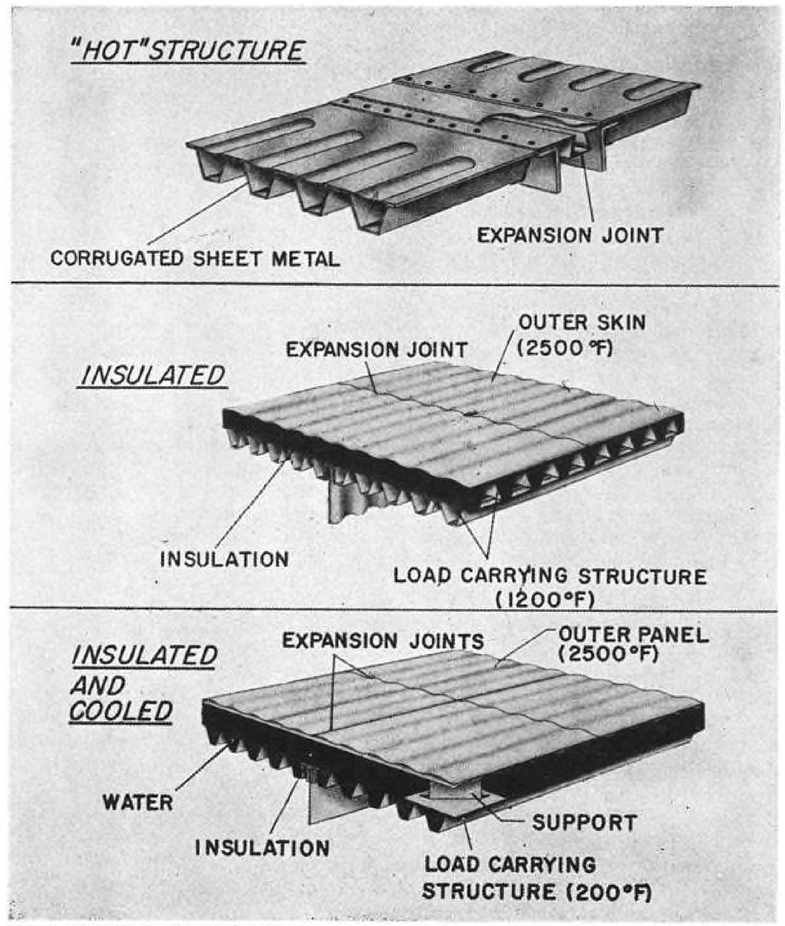
There are strong opinions within NASA, the Air Force and industry regarding the use of collapsible and inflatable structures during re-entry.

One school feels that they offer an excellent opportunity to overcome the high- temperature problem of more-or-less conventional aircraft types. Another is certain that even if their relative low performance can be accepted, crew members would not feel safe in such vehicles and would not accept flying in them as a regular task.

Ballistic Capsules

Ballistic capsules have been under serious study longer than any other type of re-entry vehicle since they are the simplest and offer the quickest solution to the problem. The Mercury design is only one of several that have been proposed in detail to both NASA and Air Force. This particular mode of re-entry is the only one whose feasibility under the current state of the art has been clearly acknowledged by the government, and it is the only one under active development.

Improvements in the handling characteristics of the Mercury or pure ballistic capsule have been under study for some time. The main alteration to any second generation ballistic type vehicle would be to flatten off one side. The idea here would be to provide some lift. This would reduce the accelerations experienced by the pilot during re-entry and provide a compromise between the very high heating rates and short heating time of the pure ballistic capsule and the long heating times and low rates of the winged, lifting vehicles.



THREE GENERAL TYPES of high temperature structures are shown here. The load-carrying members in the cooled structure at bottom never reach a temperature above 200F. In the insulated arrangement shown in the middle picture, this main structure gets to about 1,000F. In the type at the top, the under structure is as hot as the outer skin which would be at 3,000F. Cooled design at the bottom is considered to be feasible now by most engineers.

Writeoffs, R&D Costs Cut Profit Margin

New York—First aviation company 1959 financial results—from Northrop Corp. and McDonnell Aircraft Corp. whose fiscal years end at mid-year—show little difference from last year but figures compiled by Standard & Poor's indicate this may not be the case for the entire industry.

• **McDonnell** sales showed a relatively small drop from 1958—from $442,408,483 to $435,878,979. Earnings on the other hand rose slightly—from $10,028,577 or $6.09 a share to $10,037,995 or $6.10 a share.

• **Northrop** sales also declined—to $263,034,650 from $274,516,325—but its earnings rose to $7,325,404 or $4.01 a share from $7,234,135 or $4.31 a share a year earlier when fewer shares were outstanding.

First Half Results

Standard & Poor's reported that first half results of 19 companies in the industry showed sales down 5% but earnings down 40%, and with profit margins on sales down to 1.6% from 2.5% a year ago. If these trends continue in the last half earnings of the 19 companies will be 35-40% below the 1958 total.

How this pressure on profits has been affecting the industry is reflected in the accompanying chart, which shows McDonnell's results over a 10-year period.

While sales and backlog have risen 10 times or more over 1950, earnings have little more than tripled. Profit margin on sales is characteristically low. Profit margin on net worth, a computation that figures importantly in Renegotiation Board decisions, does not show so clear a trend, but seems headed downward. (However, it is higher than the industry average of 14.5% for 1958 as compiled by the First National City Bank of New York.)

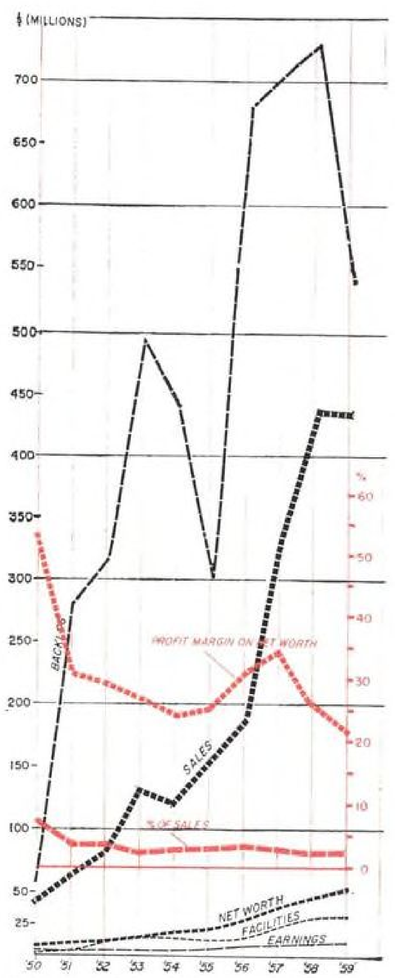
Net Worth Rise

This latter movement is partly due to McDonnell's rise in net worth, which in turn results primarily from McDonnell's policy of plowing back 85% of the company's earnings each year into this account. It would be interesting to speculate how much higher McDonnell's net worth and how much lower its margin on net worth would have been if McDonnell as a defense company had been allowed profit margins on sales comparable with general industry. It is the industry's generally higher profit margins on net worth that has been used as justification by the Renegotiation Board as a basis for redeterminations.

If the current backlog, which includes amounts in the company's $20 million in Mercury man-in-space capsule contracts and $124 million in Quail decoy missile contracts, is not cut, McDonnell sales and earnings for 1960 should approximately equal last year, according to J. S. McDonnell, chairman and president of the company.

"For the longer term future," he said, "there will be growing and diversifying uses for military and civil aircraft, both inhabited and uninhabited, as long as there is air and as long as earth's population continues to grow. There is no need to stampede away from the aircraft business. It will be a good line of business for those creative companies who are best at it and who will be strong enough to survive.

"There will aways be requirements for space projects and for spacecraft, both inhabited and uninhabited, as long as there is space. This will be a good line of highly scientific and technical business for those creative companies who are best at it."



TEN-YEAR financial chart for McDonnell Aircraft Corp. illustrates industry trends. Note downward trend of profit margins on sales and net worth.

Future Potential

McDonnell also stressed the future potential in commercial aircraft, noting the company's Model 119 utility jet transport. The company has spent $12,607,437 on this project, all but $448,472 of which was written off in the last three years.

Writeoffs such as these are noted by Standard & Poor's as among the major problems of the industry—especially to such commercial transport producers as Boeing, Douglas, General Dynamics and Lockheed.

Other factors cited as bringing pressure on profits include increased research and development costs generally, smaller unit profits on a higher proportion of military business on a cost-plus-fixed-fee basis and rising depreciation and interest charges (AW June 8, p. 97; July 7, 1958, p. 54).

Rohr's Experience

A case in point is Rohr Aircraft Corp., which reported a 29% increase in sales but a drop in earnings from $4,048,097 to $2,586,300 in its fiscal year ended July 31. This was caused by heavy starting costs on contracts for major components for the Lockheed Electra, Boeing 707 and Convair 880 and greatly increased interest charges on borrowings which rose from $27 million to $40 million to meet these costs.

Rohr sales rose from $147,538,056 to $191,272,128.

The investment survey company feels that despite these drawbacks, prospects of the industry are such that most of the 19 companies included in its study should show improved earnings in 1960.

Nine of the 19 companies will show increased 1959 earnings, the survey reports, but these will be more than offset by declines for the rest—including the five largest.

The increasing burden of research and development was emphasized also at a recent meeting here of top United Aircraft Corp. officials. United's Chairman H. M. Horner said that the company would spend $75 million for R&D facilities alone in 1959 and 1960.

"The big problem is the tremendous cost of R&D," he said. "It's difficult to accomplish what we would like to do with profit margins as low as they are. If any industry needs these profits, it is the aero-space industry."

United is concerned with the debt situation, and though it has no plans to enter the public bond market now there were hints this step might be necessary in the future. If it had not been for United's $100 million line of short term bank credit, the company would be in the long term market now, the company officials reported.

Financial Briefs

Chance Vought Aircraft reported net income of $4,297,437 ($3.61 per share) for the first nine months of 1959, compared with $7,235,892 ($6.08 per share) for the same period last year. Comparative sales figures for the periods were $191,686,384 in first nine months of current year as against $240,927,097 for last year, the drop in ratio of earnings to sales being attributed to emphasis on research and development efforts to carry out planned diversification. Chance Vought unfilled orders as of Sept. 30, including letters of intent, totaled $313 million.

Cessna Aircraft Co. directors have approved a proposal calling for a 3 for 1 stock split. Holders will be asked to approve an increase in authorized capital from 1.5 million to 5 million common $1.00 par value shares. Firm currently has 1,071,502 shares of stock outstanding. If stockholders approve the split, they will receive two shares for each one they hold as of Feb. 8, 1960, with issuance of extra shares being made Mar. 4, 1960. Directors also approved issuance of regular 50 cents dividend payable Nov. 17 to holders of record Nov. 3. Company president Dwane L. Wallace announced that company's total sales for the 1959 fiscal year were approximately $100,500,000 based on unaudited figures, a new record for Cessna, and that earnings of approximately $7.60 per share this year will also constitute a new record for the firm. New sales mark represents an increase of more than $14.3 million over 1958 sales despite an anticipated decline in military sales and includes eight months of sales volume of company's new subsidiary, Aircraft Radio Corp., which contributed some $8.8 million in sales volume to the overall increase. Commercial products sales in Fiscal 1959 were up about $8.4 million over last year and industrial products sales increased about $4.1 million. Wallace predicted higher volumes for commercial and industrial products in Fiscal 1960.

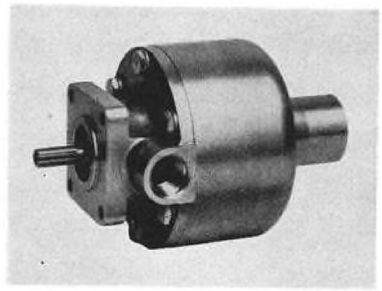
Vertol Aircraft Corp. lost $117,738 in the third quarter because of writeoffs on development of electronic equipment, flight test and demonstration costs of its Model 107 helicopter and the sale of New York Airways' former fleet of Sikorsky helicopters to Sikorsky at a price lower than their original inventory value. For the first nine months, total sales were $2,568,110, compared with $29,668,815 last year and earnings were $109,558 or 16 cents a share, compared with earnings of $345,711 or 51 cents a share the year before.

Potter Instrument Co., New York, sold $750,000 worth of convertible debentures to Electronics Capital Corp. of San Diego, Calif., the first loan by the investment company organized under the Small Business Investment Company Act. Electronics Capital also will provide additional working capital under a $250,000 loan commitment. Potter Instrument produces magnetic tape recording equipment for commercial and military digital data handling systems.

NEW AVIATION PRODUCTS

Vane-Type Fuel Pump

Fixed-displacement, vane-type fuel pumps for jet engines provide from 10 to 25% weight savings and meet Mil Specs MIL-E-5009B and MIL-E-8595B for contamination clearance.



Fuel flow rates at pressures up to 1,500 psi. range from 400 to 50,000 lb. per hour at up to 6,000 rpm. pump speed.

Some models are capable of speeds up to 20,000 rpm. and operation at pressure exceeding 1,500 psi.

Pumping parts are contained in a replaceable cartridge that can be incorporated in a fuel control body to save space and weight.

Multi-element units for dual reliability performance capable of up to 50,000 lb. per hour are available.

Vickers, Inc., Detroit 32, Mich.

Air Pressure Switch

High temperature, miniaturized absolute air pressure switch with aircraft, missile and drone applications has been developed by Newark Controls Co., Bloomfield, N. J.

RR-58 switch monitors a constant

pressure over a wide temperature range and is said to be stable under high shock and vibration.

Pressure range is from 5-30 psia. Company says the switch has an accuracy of + or −0.5 psi. from −85F to 185F, and + or −1.5 psi. from 185F to 400F. Unit weighs less than 1.8 oz.

Newark Controls Co., 15 Ward St., Bloomfield, N. J.

Avionic Cooling Fan

Vane axial blower is designed for cooling radar and other avionic compartments.

Blower is powered by a 115 v., 60 to 400 cps. single-phase motor. The unit, model A5B, produces 75 cfm. at ½ in. of water static pressure.

Electro Products Division, Western Gear Corp., 132 W. Colorado Blvd., Pasadena, Calif.

Spaced Gang Channel

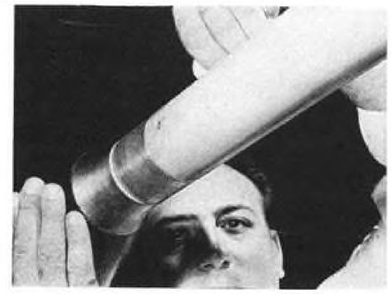
Gang channel, spaced for particular application, permits time savings in the installation of equipment in missiles and aircraft.

Model G1928 channel has nut spacings of ⅝, ¾ and ½ in., to correspond to bolt hole spacings in an electronic package. The rail of the gang channel is aluminum alloy. Carbon steel nuts are the floating, all metal, self-locking type for 550F applications.

Kaynar Mfg. Co., Inc., Box 2001 Terminal Annex, Los Angeles 54, Calif.

Radome De-Icer

Porous metal sleeve of sintered wound wire, to prevent formation of ice on radomes and ensure safe operation at high altitudes, has been developed for installation on pitot tubes on

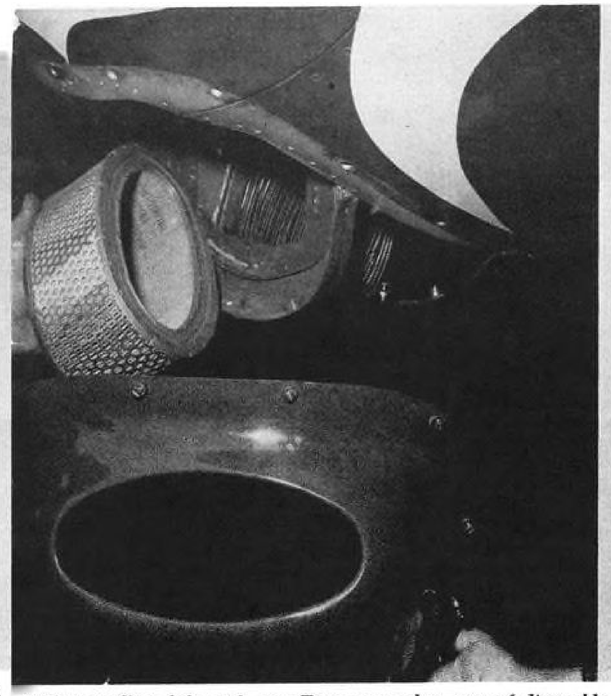


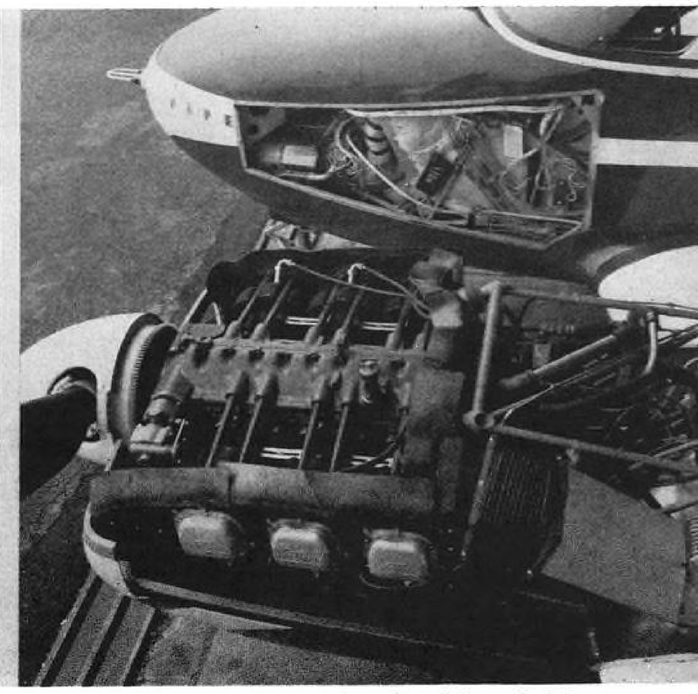
Convair F-102A and F-106 jet interceptors. De-icing fluid flows through dimensioned pores back over the radome.

Porous metal, called Poroloy and made by Bendix Filter Division, was selected because of highly controllable flow characteristics.

Bendix Filter Division, 434 12-Mile Rd., Madison Heights, Mich.

PIPER AZTEC, powered by two 250-hp. Lycoming O-540 engines, has a top speed of 215 mph. Useful load is 2,025 lb. and maximum gross weight 4,800 lb. Distinctive feature is the swept rudder and single-piece stabilator similar to that of the Piper Comanche.





AZTEC air filter, left, with new Fram paper-pleat type of disposable filter, protecting engine against wear from dirt. Split cowl, right, bares Lycoming O-540 engine for ease of maintenance. Removable side panel of nose provides access to avionic equipment.

Piper Unveils Aztec as 1960 Sales Spur

Williamsport, Pa.—Highlighting the rapid growth of business flying, Piper Aircraft Co., at its International Distributor Conference, forecast a total market of $265 million for 1965, of which the Lock Haven, Pa., company has set a goal of 45%, or about $119 million.

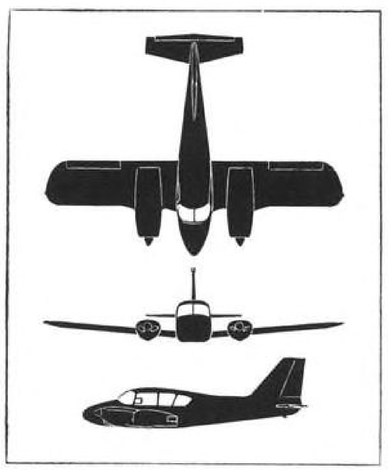
Some 350 U.S. and foreign representatives attended the company's annual meet in this city where Piper wound up its 1959 sales year—the biggest in its history—with retail orders totaling $45 million, a 26% retail volume increase and 29% company boost over comparative 1958 figures.

Piper has set a $60 million sales quota for the 1960 year, a jump of 40% over its 1959 sales. As a spur toward this figure, the company is offering the following new package to its distributors-dealers:

• **Aztec executive transport.** New five-place light twin, with top speed specified at 215 mph., is powered by two 250 hp. Lycoming O-540 engines. Price, with exception of radio equipment, is $49,500. Fully equipped Super Custom model, with Piper AutoControl, will cost $54,105. Deliveries will begin in December. Aztec details will follow later in this story.

• **Marketing-merchandising program.** Piper will invest almost $500,000 in advertising in 1960, including two-page spreads in consumer and aviation publications. Company also is evaluating sales methods and materials in two test cities—Detroit and Pittsburgh—in addition to running a continuing study of business trends aimed at determining prime customer prospects (heavy construction and machine tool companies are considered in this category). Another new service, a marketing survey program covering each distributor's territory, will be completed later this year.

• **Sales organization.** Some 50 distributors and 350 dealers comprise the Piper sales organization. Company feels it needs a few additional dealers to handle a larger volume of lower-priced aircraft. New sales manual, "Personalized Transportation," will be used to sell the money- and time-saving advantages of business flying as against competitive airline-ground means of travel.



THREE-VIEW drawing of Aztec PA-23.

• **Sales personnel.** Piper plans expansion of sales personnel within its present structure. Importance attached to individual sales and merchandising people was stressed with Piper's introduction of Dr. John Bone, an adviser to the company and a psychologist at Lock Haven State Teachers' College. Dr. Bone urged the use of psychologists by the distributors as an aid in the selection of competent salesmen.

Basic Prices

Basic prices of Piper's 1960 line (in each instance for the standard model) will run as follows: PA-22 (Caribbean) 150, $8,795; PA-22 (Tri-Pacer) 160, $9,345; PA-18 (Super Cub) 95, $6,145; PA-18 150, $7,795; PA-18A 150, $8,045; PA-25 (Pawnee) 150, $8,995; Comanche 180, $15,800; Comanche 250, $19,800; Apache 160, $36,990.

Main improvements to the 1960 line include: PA-18 series—new air intake system adding more power, propeller pitch increased 2 in.; Comanche—new paper carburetor air filter (18% more efficient than the old), a completely revamped cabin heating-ventilation system with eight outlets plus four fresh-air "airline vents," three-position reclining front seats with head-rests optional, engine in the 180 series canted 3 deg. right to eliminate the takeoff torque.

Edo Corp., College Pt., N. Y., also has installed its 2700 floats on one of the Comanche 250s, a smart-looking seaplane configuration that promoted considerable interest while on display at Williamsport. This airplane carries a Hartzell propeller of 88 in. diameter (as compared with the standard 77 in. diameter propeller of the 250). Speed and performance are comparable with the Comanche 180, AVIATION WEEK was told. Cost, with floats, would be in the neighborhood of $30,000.

Cherokee Development

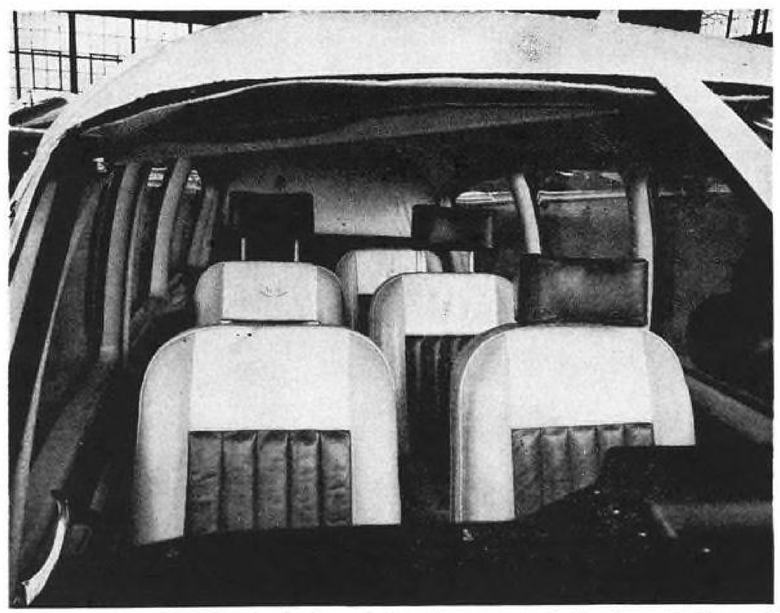
Still in the development stage at the Vero Beach plant is Piper's low-wing, all-metal, four-place Cherokee, yet to fly and which will be competitive to the Tri-Pacer. Still in the design stage at this plant is the company's two-place Pawnee trainer (AW Oct. 26, p. 37).

Piper feels that 95% of its customers use their aircraft—or a portion thereof—for business purposes. Company sees its biggest expansion in the sales of its light twins—the Apache and Aztec—but expects that the single-engine Comanche 180 and 250 will bring in the most dollars.

Polled by AVIATION WEEK, several of Piper's biggest distributors felt that 1960 would be a better year, competitively, than 1959. They were unanimous in the feeling that their biggest market lies with the small business firm; that 90 to 95% of the business is financed, even with big companies. "Cash sales are about unheard of anymore." They also feel that the equity in the Apache makes this light twin ideal for a change to the newer and swifter Aztec.

Feeling was also voiced that "It's harder to sell a $5,000 airplane than a $20,000 airplane, because there's no tax advantage . . . small type aircraft move better on the used market." Elaborate showrooms and tie-ins with finance companies are now on the scene with the larger dealers.

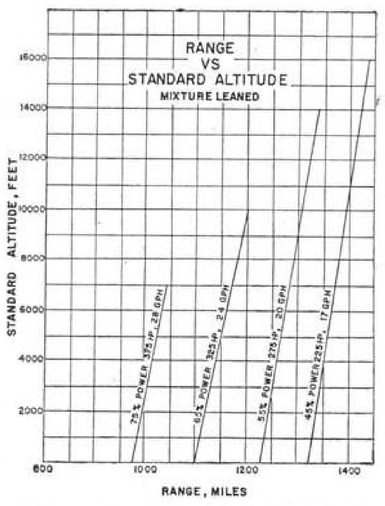
Survey statistics, covering the 1958



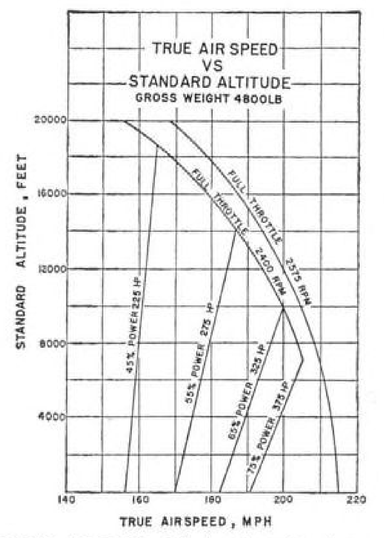
INTERIOR of the PA-23 has five leather-upholstered seats as standard equipment. Front and center seats have three-position backs, adjust fore and aft. Headrests are standard.

calendar year and cited by Piper, indicate that business flying has increased 600% since 1946. During 1958, 5.2 million hours were flown by business aircraft, and over 800 million miles were flown. Of single-engine business airplanes, 90% were flown by non-professional pilots last year, and of the twin-engine business aircraft, 85% were flown by professional pilots. Decentralization of industry, another spur to business flying, was noted with the statistics that only 33% of U.S. plants are located in cities of over 100,000 population.

Typical of the sales pattern are these figures for 1959, released to AVIATION WEEK by the following dealers: Baker Aircraft Sales of Long Beach, Calif.,



AZTEC optimum range chart, standard altitude. At 45% power airplane burns 17 gph.



TRUE AIRSPEED-altitude chart for Aztec, at maximum gross weight. Top speed is 215 mph.

PIPER COMANCHES have been modified to include revised cabin air heating and ventilating system, adjustable backs on forward seats, and a new Fram carburetor air filter—said to be 99.5% efficient—and using easily replaceable, inexpensive paper filters. Ventilating-heating system entails eight warm air outlets with two each on the instrument cowl to defrost windshield and two along the front wind sills to defrost side panels. There are 10 cabin cooling fresh air outlets, designed to provide large volume with minimum of noise. Forward seat backs are adjustable in any of three positions. Piper notes that an increasing number of women are flying Comanches, and accordingly has increased front seat travel to provide easier access to rudder pedals. As photo shows, new models are different externally in paint schemes—to distinguish 1960 Comanche 250-hp. version (foreground) from 180-hp. model (top). Since Comanche was introduced a year and a half ago, some 1,500 airplanes of the two versions have been produced at Lock Haven, Pa.

Piper's biggest domestic distributor, sold 207 airplanes in 1959. Of these, 107 were Comanches and 33 Apaches. In addition, 150 trade-ins were sold by Baker. Des Moines (Iowa) Flying Service, Inc., sold 78 new aircraft, including 12 Apaches and 38 Comanches, plus 58 used trade-ins. Anderson Aviation, Phoenix, Ariz., sold 57 new aircraft in 1959, including 12 Apache and 28 Comanches, boosting sales $300,000 over 1958 figures. Trade-ins numbered about 30.

Wiggins Airways, Norwood, Mass., sold 55 Piper aircraft in 1959, including 12 Apaches and 13 Comanches.

Growth of the market was indicated by John V. Baker, who told AVIATION WEEK that 10 years ago his sales ran just under $400,000. This year Baker did about $5 million worth of business and he's "just getting started." Baker, who is opening new Long Beach facilities in February, also stressed the lack of needed hangar space throughout the country; he is building T-hangars that will rent for $75 a month, with water and electricity outlets, etc.

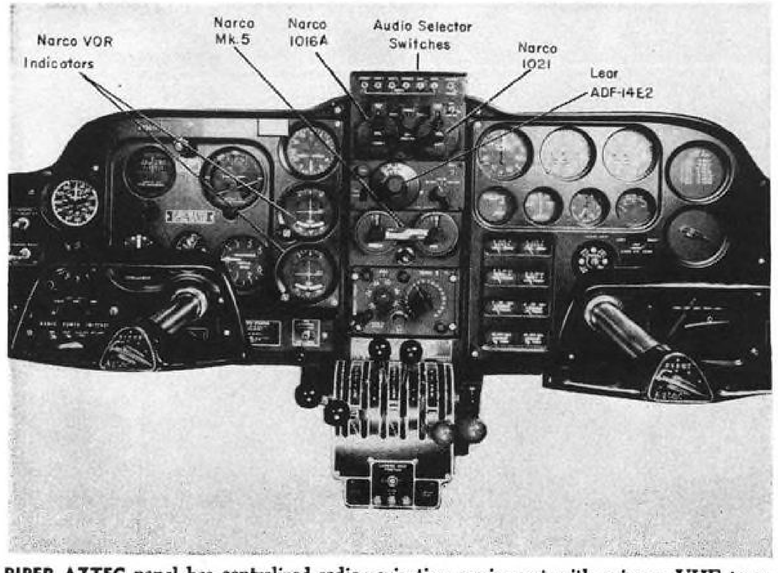
Howard Gregory, president of Des Moines Flying Service, also is constructing T-hangars that will rent, monthly, for $50.

Both indicated that "in 18 months we'll be back where we are now—without sufficient hangar space."

Piper presented sales awards to 20 of its distributors which had exceeded their 1959 quota. In addition, achievement awards were presented to the "top 10" in number of aircraft sold: Baker Aircraft Sales; A. W. Whitaker, Portland, Ore.; Wes-Tex Aircraft Sales, Lubbock, Tex.; Des Moines Flying Service; Tufts-Edgcumbe, Inc., Chicago; Mountain States Aviation, Inc., Denver; Safair Flying Service, Inc., Teterboro, N. J.; Ken-Mar Airpark, Inc., Wichita; Piedmont Aviation, Inc., Winston-Salem; Anderson Aviation Co., Inc., and St. Louis Flying Service, Mo. Jonas Aircraft & Arms Co., Inc., N. Y., exported 211 aircraft.

Brightest picture of the year was that painted of Piper's new Aztec, which has a normal cruising range of 1,025 mi. (1,400 mi. at economy cruise). The first two Aztecs will roll off the Piper production line in November; 20 are scheduled for December, 30 for January and 42 for February. Beginning in March, production will be at the rate of two a day, divided between the Aztec and the Apache, depending on demand for respective aircraft. Piper feels that the demand for the slower Apache will still hold because it is "economical and practical."

Prototype Aztec has been evaluated by the Navy, in competition with the Cessna 310, Aero Commander 500 and



PIPER AZTEC panel has centralized radio-navigation equipment with primary VHF transmitter for contact with ATC, plus standby VHF for contact with omni-range stations.

Piper Aztec Performance

Top speed	215 mph.
Optimum cruise speed (75% power at 7,000 ft.)	205 mph.
Cruise speed (65% power at 9,000 ft.)	200 mph.
Stalling speed	62 mph.
Takeoff run	750 ft.
Takeoff run (over 50 ft. barrier)	1,100 ft.
Landing roll	900 ft.
Landing (over 50 ft. barrier)	1,360 ft.
Rate of climb	1,650 fpm.
Best rate of climb speed	113 mph.
Single-engine rate of climb	365 fpm.
Best single-engine climb speed	110 mph.
Absolute ceiling	23,750 ft.
Service ceiling	22,500 ft.
Single-engine absolute	8,800 ft.
Single-engine service ceiling	7,400 ft.
Fuel consumption (75% power)	28 gph.
Fuel consumption (65% power)	24 gph.
Cruising range (max. at 75% power)	1,025 stat. mi.
Cruising range (max. at 65% power at 9,000 ft.)	1,200 stat. mi.
Cruising range (max. at 45% power at 10,000 ft.)	1,400 stat. mi.

Beech Travel Aire. Evaluation has been narrowed to the Aztec and the 310. Piper has offered the Navy the same support system, tied to its distributors (eliminating the stocking of spares), that Cessna provides USAF for its 310s (U-3As). Company also has demonstrated the Aztec to the Air Force and will make the airplane available for Army evaluation late this year or early in 1960 (AW Oct. 26, p. 34).

Piper states that comparative flight tests show the Aztec to have the highest single-engine ceiling of any light twin in its class carrying a similar payload. Single-engine ceiling with full fuel, five passengers, baggage and equipment is 7,400 ft. At a gross weight of 4,400 lb. the ceiling is 10,500 ft.

Aztec sea-level rate of climb is 1,650 fpm.; rate at 10,000 ft. is 860 fpm. Service ceiling is 22,500 ft. Cruise speed, 7,000 ft. at 75% power, is specified as 205 mph. Cost of basic (Standard model) airplane, $49,500, includes four fuel cells totaling 144 gal.; dual generators, dual vacuum pumps, fifth seat; a rotating beacon, heated pitot tube, instrumentation for instrument flight rule operation.

Additional Aztec characteristics, as cited by Howard Piper, company vice president for research and development, include: single-engine control speed of 80 mph.; gear extension at 150 mph. and flap extension at 125 mph.; an increased useful load capacity 500 lb. greater than that for the Apache.

Aztec is basically a derivative of the Apache, with these physical exceptions: fuselage incorporates a new empennage including a swept rudder and single-piece stabilator similar to that of the Comanche; two rear windows have been added abreast of the rear fifth seat. Airplane does utilize systems (such as electrical and hydraulic) and components of the Apache.

Single-piece stabilator is equipped with an anti-servo tab running nearly the whole span of the leading edge, which minimizes pitch changes. Servo tab on the rudder, which also acts as a trimming device, provides aerodynamic boost when rudder pressures are applied. Aztec's two forward and two center seats can be adjusted to any of three positions; head-rests are standard equipment. All five seats adjust fore and aft.

Aztec Specifications

Gross weight	4,800 lb.
Empty weight	2,775 lb.
Useful load	2,025 lb.
Empty weight (super custom equip.)	2,850 lb.
Useful load (super custom equip.)	1,950 lb.
Wing span	37 ft.
Wing area	207 sq. ft.
Length	27.6 ft.
Height	10.3 ft.
Power loading	9.6 lb./hp.
Wing-loading	23.5 psf.
Baggage capacity	200 lb.
Baggage compartment space	25 cu. ft.
Fuel capacity	144 gal.
Engines: Two six-cylinder direct-drive Lycoming O-540 developing 250 hp. at 2,575 rpm. at sea level.	
Propellers: Two constant-speed, full-feathering Hartzell of 76 in. diameter.	

Cabin Heat

Cabin heat for winter operations is provided by a 27,500 Btu. Southwind gasoline heater located in the nose, which can be turned on before takeoff. Cabin is sound-proofed, including double-thick windows and quarter-inch windshield. Engine exhausts are located under-wing and outboard of nacelles. Airplane's empty weight of 2,775 lb. and gross weight of 4,800 lb. (1,000 lb. more than that of the Apache) allows for a payload of 2,025 lb. which might include 144 gal. of fuel, oil, five 170-lb. passengers and 247 lb. of radio equipment and baggage.

Aztec gear has been beefed up to accommodate heavier gross weight. Construction includes stepped-down spar passing through fuselage under front seats.

Welded steel framework is incorporated around cabin section for additional strength.

Fuel is carried in four 36-gal. rubber wing cells, outboard of each engine. Either of the two tanks on the same side will feed directly to each engine. Cross-feed allows either engine to feed from any of the four tanks during single-engine operation. System includes two engine-driven fuel pumps supple-

mented by four electrically driven booster pumps. Either outboard or inboard tanks can be utilized for all takeoff, flight or landing operations.

The Lycoming O-540 engines utilize a new nose-cowl section which draws air into two small openings located slightly below the cylinder banks. Design aims at maximum cooling during takeoff and climb and minimum drag during cruise flight. Engines operate with a low-pressure fuel system, using 91/100 octane fuel.

Two 250-w. landing lights, one in the nose and the other mounted on the nose landing gear strut, are included as standard equipment. Aztec's instrument panel seats flight instruments to the left, radios in the center, and engine instruments to the right.

IFR Training Feasible In 10 hr., Study Finds

The average certificated pilot can be taught to fly on instruments in less than 10 hr., results indicate from an experimental project designed to determine the type and amount of training necessary for elementary IFR competence recently concluded at West Virginia University.

Project, funded by the Link Foundation, followed a previous study by the university which showed conclusively that instrument training could be successfully incorporated in the primary flight training curriculum starting in the pre-solo stage (AW Mar. 10, 1958, p. 77). Latest study was an attempt to see what training certificated pilots with no previous exposure to instrument flight schooling would require to equal the competence level attained by students in the earlier West Virginia University study.

Project is significant in light of Federal Aviation Agency's interest in upgrading private and commercial pilot competence in view of the annual fatality rate of approximately 100 pilots in these categories who inadvertently or purposely are exposed to instrument conditions from which they fail to escape. FAA is also concerned with improving pilot standards in view of trends in traffic control which require competence in use of communications and navigation equipment.

Highlights of a report compiled by West Virginia University on the results of its latest project indicate:

• **Age is eliminated** as a criteria for predicting aptitude of the subject for absorbing instrument flight instruction. Subject pilots had an age range of 25 years, from 20 to 45 years old.

• **Previous contact flight experience** is of no particular value to the IFR student—in fact of the four trainees who had more than 500 hr. of contact flight

experience, only one gave an average performance during the project's flight tests.

This student had 200 hr. of night contact flying experience, which may have weighed in his favor, university officials point out.

To point up further that greater benefits are possible to a pilot who starts instrument instruction as early as possible in his flying career, FAA examiners who checked out the test group noted that three trainees, with 585 hr., 327 hr., and 304 hr. contact flying experience, gave them the poorest rides and one student, with more than 4,000 hr., was judged by an examiner as giving ". . . a generally weak performance."

One student, with but four hours solo, was rated: recovery from unusual attitudes, good; over-all proficiency, good.

Best performance during the flight checks was turned in by seven students, six of whom had from 60 to 125 hr. previous contact experience; and the seventh, 327 hr.

The 24 subject pilots selected for the program included eight full-time West Virginia University students and 16 recruited within an area of 40 mi. of Morgantown, W. Va. One of the subjects had a total of 40 hr. flight time and had not flown since his private pilot test eight years previously. This subject, incidentally, showed fair proficiency, but poor altitude control in his flight check.

Trainees used a Cessna 140A and a Cessna 170A with full panel instrumentation, the gyro instruments being operated by external venturis. Amber Plexiglas was used over the windshield and side panels in combination with blue-tinted goggles to simulate instrument conditions. University notes that use of amber Plexiglas creates a hazard during limited visibility conditions, particularly as the shields age, providing the safety pilot with a handicap while trying to maintain a sharp lookout for other aircraft when visibility is down or there is an overcast. A mechanical device limiting the student's vision to the instrument panel would be effective in eliminating this hazard, it is noted.

Curriculum provided instruction to students two or three periods a week over six weeks, with students divided into three groups. Included in flight instruction were: straight and level flight, turns–360 deg., to predetermined headings, climbing turns to left and right; climbs and descents–normal glides, power on and power off, normal descents with left and right turns; slow flight and stalls; recoveries from unusual attitudes; simulated GCA approach.

Maximum instrument instruction

given any student was 11 hr. and 22 of the 24 students had from 5½ to 9 hr.

Project provided the university flight training staff with its first opportunity of working with pilots who had not received training at the school, and these trainees were found lacking in certain fundamentals which made IFR training more difficult and in some cases resulting in the trainee getting into a dangerous condition.

Two examples of this occurring most frequently, the university notes, were:

• **Recovery** from a spiral dive. Upon discovery that they were losing altitude in what seemed to be a steep turn, these trainees increased back pressure on the controls in order to slow the airplane, apparently unaware of the need to shallow the angle of bank before attempting to recover.

• **Inability** of pilots to "count." This was shown in poor performance when making turns to a heading—some of the pilots turning the airplane through 270 deg. when instructed to turn from a heading of 90 deg. to 360 deg.

These factors apparently were the result of students learning to fly without a fairly stiff curriculum and extending their instruction over an excessive period of time, the university flight staff concluded.

Colonial Aircraft Sells Skimmer Rights

Lake Aircraft Corp. has purchased from Colonial Aircraft Corp., Sanford, Me., full manufacturing rights and existing inventory of the C-2 Skimmer amphibian.

John F. Strayer, president of the recently formed Lake Aircraft Corp., formerly had been president of Amphibious Aircraft Corp., marketing organization for Colonial.

The all-metal, single-engine four-place Skimmer was first introduced in 1955. The C-2 is powered by a Lycoming 0360-A1A engine, pusher configuration, generating 180 hp. at 2,700 rpm. at takeoff (AW June 9, 1958, p. 58). The amphibian will be manufactured in Sanford where a skilled labor force already exists.

Strayer has firm orders for up to 15 airplanes, the first of which will be completed early in 1960.

Lake is prepared to manufacture 200 aircraft a year, beginning in 1961, according to Strayer.

The Lake board of directors includes Robert Dodge, owner of Industrial Cab Co., Salem, Mass.; Meldrum MacPetrie, president, Acromatic Tool Co., Detroit; Joseph E. Boyle, Boyle & Co., Boston; Frederick Stock, president, M&M Bakeries, Dover, N. H.; William Cressey, Mann & Gould, Salem; and Leon P. Lewis, Norwich, Conn.

WHO'S WHERE

(*Continued from page 23*)

Changes

Norvin E. Erickson, base manager, Aerojet-General Corp.'s operations at the Air Force Missile Test Center, Cape Canaveral, Fla., replacing **Thomas F. Rocco**, deceased.

William W. Harger has joined the technical staff of the Technical Military Planning Operation (TEMPO), Defense Systems Department, General Electric Co., Santa Barbara, Calif.

Warren Hughes, corporate publicity manager, Lockheed Aircraft Corp., Burbank.

John M. Wild, director of Project Orion for General Dynamics Corp.'s General Atomic Division, and also assistant director of the division's John Jay Hopkins Laboratory for Pure and Applied Science, San Diego, Calif.

Edward C. Carman, director of business development planning, Nashville Division, Avco Corp., Cincinnati, Ohio.

William P. Montague, assistant director of electronic requirements, the Martin Co., Baltimore, Md. Also: **Arthur R. Christie,** manager of Martin-Washington, D. C.

John B. Moss, assistant to the president, Vertol Aircraft Corp., Morton, Pa.

Charles E. Reese, Jr., project manager and design specialist, Actuation Research Corp., Glendale, Calif.

Scott H. Hanville, Jr., manager-aviation sales and application engineering, Jack & Heintz, Inc., Cleveland, Ohio.

Neill A. Teets, manager of product marketing, Solid State Electronics Department, Motorola, Inc., Phoenix, Ariz. Also: **Nicolas G. Sakiotis,** project leader in the department's Microwave Applications Laboratory; **Dr. Clinton Jefferson,** senior engineer in the department's Materials Laboratory.

James T. Chinlund, marketing assistant to the vice president of sales, Vapor Heating Corp., Chicago, Ill. Also: **Arthur L. Gibson,** aircraft liaison engineer.

Dr. John G. Frayne, manager of development engineering, Datalab, a division of Consolidated Electrodynamics Corp., Pasadena, Calif.

Hans W. Weickardt, section chief of stress analysis, Research and Development Engineering Division, Solar Aircraft Co., San Diego, Calif.

Herbert J. Pyle, director of service, Cedar Rapids Division, Collins Radio Co., Cedar Rapids, Iowa.

The Cambridge Division of Standard Steel Corp., Lowell, Mass., has announced the following appointments: **L. F. Howard,** assistant director of engineering; **William F. Dolke,** direct sales manager; **Lewis H. Bacon, III,** assistant manager of manufacturing.

Theodore Boxer, director of the newly formed Ordnance Laboratory in the Research and Development Division of the W. L. Maxson Corp., New York, N. Y.

William K. Kindle, chief engineer, Electronic Associates, Inc., Long Branch, N. J.

Richard A. Horton, assistant vice president, Specialties, Inc., Syosset, N. Y.

Howard Katzman, project manager-countermeasures and transmitter development program, Granger Associates, Palo Alto.

Four Companies Share Goose Fleet

Vancouver, B. C.—Four companies have joined forces to set up their own aircraft operating firm, B. N. P. Airways, Ltd., thereby reducing costs and increasing availability.

B in the name is for B. C. Electric Co., N for Northern Construction Co. & J. W. Steward, Ltd., the P for Powell River Co., Ltd. Fourth company, which joined the pool after its formation, is Crown Zellerbach, Canada.

B. N. P. is set up with three Grumman Goose airplanes belonging to the firm, and it also does the maintenance on two others, one belonging to Canadian Forest Products, the other to MacMillan-Bloedel, Ltd.

By having only one type of aircraft, B. N. P. is able to effect savings which would not otherwise be possible if several types of airplanes were in use.

Basic operation has B. N. P. owning and operating the three airplanes, and each of the four firms which are equal shareholders in B. N. P. charters the airplanes whenever it wants to use them. Rates for the charter are set by Air Transport Board of Canadian Government. However, one advantage here is that there is no waiting charge for the time spent while the airplane is away from its base while being used by one of the companies.

The three airplanes usually fly an average of 800 hr. per year total, which breaks down into some 200 hr. per year for each of the using firms. The four are about even in the over-all average utilization of the aircraft.

B. N. P. employs three full-time pilots, and each one flies his particular airplane, another advantage in that any pilot feels more comfortable flying the same craft all the time. All are on full salary; flight time does not count in any way toward pay.

In addition, all operations are strictly VFR. B. N. P. has a completely accident-free record.

Maintenance is done by seven full-time engineers (a licensed mechanic is known as an engineer). These seven are spread over two shifts per day, seven days per week, thus making airplanes available all the time, since very few departures or arrivals are in the very early hours. If an early morning take-off is scheduled, crews report in early for that day's mission. Usually, two men are working per shift. The company has good hangar space and maintenance equipment and facilities at Vancouver Airport.

Flights are primarily, (about 80%) conducted onto water from the main Vancouver base. Of these flights, about 60% are in lumbering, pulp and paper areas, 25% into construction sites. Planes also are used for hunting and fishing trips for guests of the four companies.

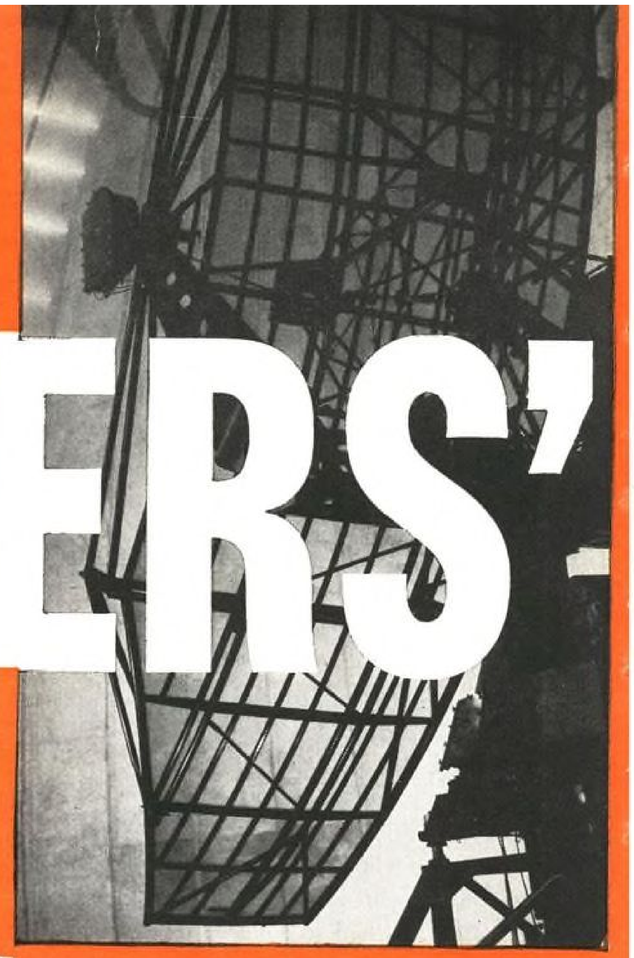
B. N. P.'s total staff is 11 persons. One of the pilots also serves as general manager, and there is one man in the office in addition to the three pilots and seven engineers.

Financially, the companies make out better than if they had to own and maintain their own aircraft. In addition, there is the added availability of two or more aircraft if the need for more than one at a time should arise. B. N. P. makes no real effort to lure new business. It does have a few outside clients in addition to the owner firms, but the main idea is airplane availability which is reduced if too many clients are using the aircraft.

B. N. P. started in 1950 with Malibu Sierro Co., Ltd., which had one Goose in use. B. N. P. Airways, Ltd., bought the airplane, and the operating license as well. Since then B. N. P. has bought two more Goose aircraft from Powell River Co.

ANNOUNCING AVIATION WEEK'S
5th ANNUAL

BUYERS' GUIDE ISSUE



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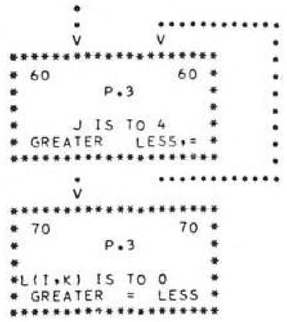

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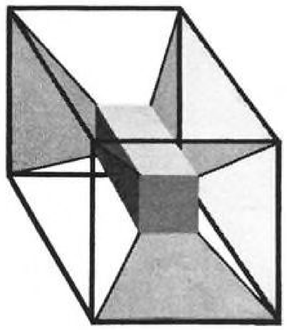

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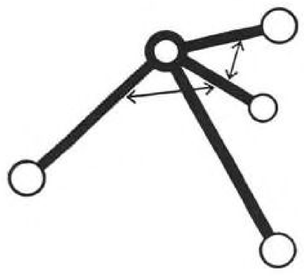

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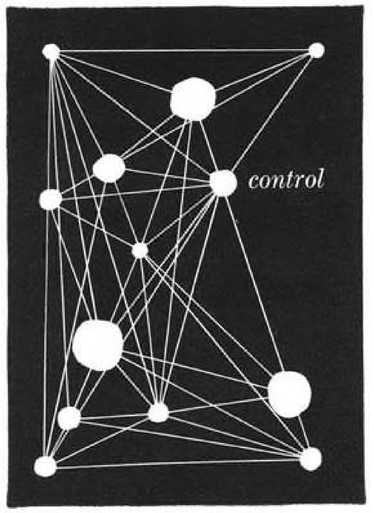

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AVIATION WEEK, NOVEMBER 2, 1959

CLASSIFIED ADVERTISING

F. J. Eberle, Business Mgr.

ADVERTISERS INDEX

LETTERS

Preflight Check

The following, though not editorial comment, is worthy of special mention.

While waiting for a flight out of Idlewild on Oct. 1, I was treated to a sight which warmed this old single-engine jockey's heart.

There was the 3-striper of PanAm Flight 293 (I later verified) religiously checking visually each fuel tank and giving his DC-6 a most thorough walk-around inspection.

Not wanting to take anything away from other airlines or other crew's ground support people, I will bet that this crew strapped in with just a little more confidence than most who walk directly from Flight Planning to cockpit.

Either he was exceptionally conscientious or worked for a real "taut-ship" captain.

ROBERT L. DAHLBERG
Minneapolis, Minn.

Anti-Collision Lights

Your Oct. 12 issue of Aviation Week carried an interesting item concerning the Atkins-Honeywell Maximum Safety Light, in the Airline Observer column (p. 52).

Please be advised that the Hoskins Twilighters are also approved for installation on all aircraft. Unlike the Atkins lights, which have a red filter that must be flipped into place when the lights are to be used during the hours of darkness, the Twilighters must be turned off within a half hour after sun-down.

The conventional red, anti-collision lights are then placed in operation.

It does seem a bit strange, though, that the FAA has seen fit to approve these white condenser discharge lights for daytime operation, but still require a red light to be displayed during the hours of darkness when they have their greatest effectiveness.

For the record, I wonder how many of your readers, if permitted to do so by part 18 of the CAR, would install condenser discharge anti-collision lights on their aircraft. I am certain that they would be in a tremendous majority, and their opinions on the matter would be an eye opener to the hold-outs at the head office of the Federal Aviation Agency.

DON HOSKINS
Chicago, Ill.

Space 'Race'

Your editorial "Lessons of Lunik," (AW Sept. 21), and the letter from Mr. T. M. Sprague, (AW Oct. 12, p. 150) which endorses it, force me to write in opposition to the philosophy contained in both of these works.

Many people including yourself, are trying to stir up fear and other ugly emotions based on the assumption that we are in a race to space with Russia and that we are losing that race, and that national jeopardy and disgrace are the inevitable results of

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this situation. What is a "race"? It is a contest in which each contestant, starting at the same instant, bends every effort to attain a specific, well-defined goal first. If the goal and the starting time and all other conditions are not agreed on, it is not a race; the two parties take independent action and it is inevitable that each one will attain some accomplishment first—the other may not have even undertaken the project.

It is claimed that because Russia first sent a missile into sun orbit she is automatically "ahead" of us. Should Russia get that much credit for missing the original target, the moon? Should Russia get so much credit for Sputnik I, merely because she was first? Were we in a race with Russia to be first? Might not we have been first if we had slowed down some other project and put more effort on Vanguard I? Is it a disgrace if our national planning has allocated priorities which are not identical with Russia's priorities? Is it not conceivable that the USA has made progress, and learned things, and built machines which are of more value than the first earth satellite, or the first shot to miss the moon and fall into the sun, or the first shot to land on the moon?

Do you know what accuracy is required to hit the moon?

It is about 4½ mils, considered as an aiming problem. (There is no accepted evidence that Lunik hit any particular part of the moon's disk.)

In the same issue of AW, which ran the subject editorial, there is a small news item reporting that an Atlas shot attained an accuracy of ¼ mil in a 4,400 mi. range (Industry Observer, p. 23) ". . . within one-mile radius of the target point located 4,480 mi. from the launch point." Why not write an editorial singing the praises of such outstanding accuracy? Why not point out that this proves the fantastic superiority of American guidance systems? Why not point out that this missile, with suitable warheads, can control any hostile spot on the earth? If this be considered war mongering, then let us agree on a basic ground rule: are we or are we not primarily concerned with national physical safety here on earth?

Who wins the "Race to Space"? The first human to get blasted off into oblivion? The nation that sends up the greatest tonnage of materiel per year to be sucked into the solar furnace?

This the sun will hardly feel, and the decrease in the earth's inertia will not be measured by man.

Why do you make a point of Russia's "larger" rocket engines? Lunik proves nothing about size, since the first stage was undoubtedly a cluster. Anyone can cluster engines, and with enough tries they will all bang off together.

I believe, based on information in AW and other sources available to the layman, that the USA has as much breadth and sophistication in its knowledge of rockets, ballistics, control systems, communications, etc., concerning missiles of all kinds as has Russia.

I believe that in the field of ICBMs and such things as Sidewinders, Sparrows, and Polaris' our accomplishments are greater, and of far more importance than Luniks. I believe that since no racing rules were ever agreed to by the two countries, prior accomplishment by one casts no reflection on the other; in other words, he who tries something first will probably succeed first, and there are some things which we have decided not to try first.

This business of space is not the most important issue involved in national or military policy, or allocation of public money. It holds out less of potential value to our national safety than does our military missile program, and appears rather negative in all other respects. Otherwise there would not be so much confusion and disagreement as to exactly what we are trying to accomplish. The technical basis for space exploration is being laid in the current progress being made in propulsion, ballistics, guidance and communication. Let us walk before we try to run, and not get involved in a childish battle of one-upmanship with Russia. Let us maintain a sense of perspective and proportion even when we feel obligated to stump for special interests.

I would be grateful if you publish this letter, for I believe that this point of view should be available for discussion.

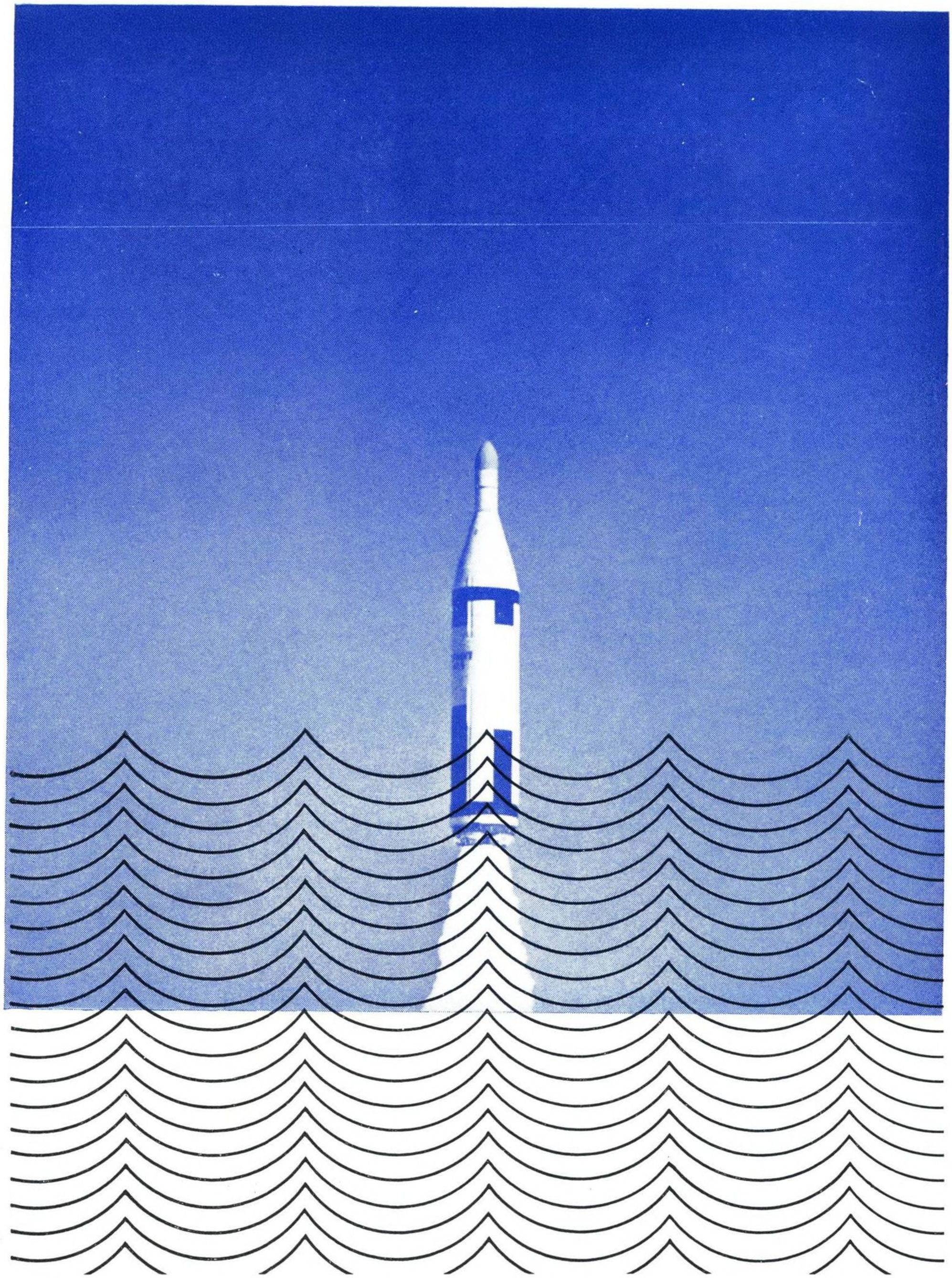
WALDO M. CLAFLIN, II
Member
Institute of the Aeronautical Sciences
Huntington, N. Y.

Space Ranks

"Si non e vero e bene trovato." Galileo would have said had he been able to read "Space Ranks" letter (AW Oct. 12, p. 150) and understand its English. But yours is the country where the impossible often happens even though you had, so far, laid few, if any, claims to miracles. So let us give the elder spaceman whose name was "Withheld by Request" the benefit of the doubt and move an amendment to the list as follows:

1. That the proposed rank title of Lifttenant (misspelt Liftenant) Galacteer be changed to Relativeer.
2. That the three non-commissioned rank titles senior to Chief Nozzleman be changed to read, in ascending order:
   Leader/Cheer
   Blasteer
   Praydear

J. GUTKOWSKI
Weston, Ontario
Canada



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