Aviation Week and Space Technology

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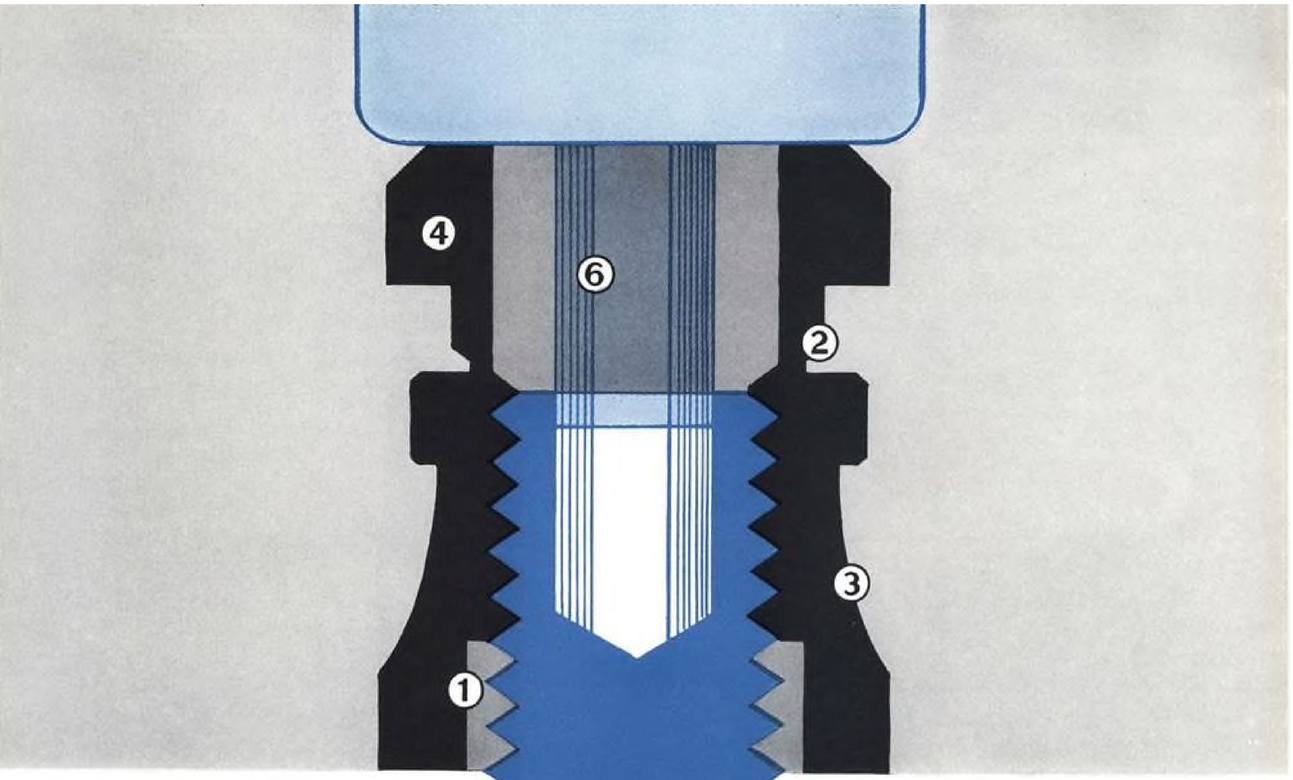
A McGraw-Hill Publication

December 19, 1960

Ultraviolet Space Communications System Details

Sikorsky S-61L

Aircraft Nuclear Propulsion Program Report



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❷ Progressive tightening: Hi-Lok cannot over-torque. The collar separates at pre-established torque level.

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❹ Clearance: Hi-Lok pin head and collar diameters allow smaller wrench clearance. The "torque-off" hex-wrenching section projects to allow small tool accessibility.

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Consistently controlled preload, minimum size and weight, plus speed of installation are outstanding advantages of the new Hi-Lok fastener now being produced by Voi-Shan. The Hi-Lok is the result of a design effort to provide an advanced fastener system incorporating as many desirable features as possible, with the greatest adaptability, in one product. Hi-Lok is driven from one side of the work, thereby saving in installation costs. Power tooling in use adds to time savings. Accurate, automatic torque control is incorporated by means of a closely controlled shear-groove in the Hi-Lok collar. Available in a wide range of sizes and material combinations. The Hi-Lok is produced with the accepted Voi-Shan precision workmanship and quality control for maximum performance. Write for further details and specifications.

❻ Silent installation: Automatic and high speed power tool use is fast and quiet. Hand tool installation and removal is easy and permits re-use of the Hi-Lok pin.

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VSI

Convair's sleek 880, the nation's fastest jetliner, designed for medium-range service—makes more landings, take-offs and taxi runs than long-range planes. Mighty rough duty for its wheels and brakes.

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Air Force—B-58 Supersonic bomber · F-105D fighter-bomber · T-39 trainer

Army—Grumman OA-1 · Vertol YHC-1B helicopter

Executive—Grumman Gulfstream · Beechcraft Queen Air

Light—Aero Commander Model 680F · Cessna Model 210

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AVIATION CALENDAR

Dec. 26-31—127th Meeting, American Association for the Advancement of Science, New York, N. Y.
Dec. 28-30—Seventh King Orange International Model Plane Meet, Miami, Fla.
Jan. 9-11—Seventh National Symposium on Reliability and Quality Control, Bellevue-Stratford Hotel, Philadelphia, Pa.
Jan. 9-13—International Congress and Exposition, Society of Automotive Engineers, Cobo Hall, Detroit, Mich.
Jan. 15-18—13th Annual Convention, Helicopter Assn. of America, Cherry Hill Inn, Haddonfield, N. J.
Jan. 16-18—Seventh Annual National Meeting, American Astronautical Society, Dallas, Tex.
Jan. 17-19—Winter Instrument-Automation Conference & Exhibit, Instrument Society of America, Jefferson Hotel and Kiel Auditorium, St. Louis, Mo.
Jan. 23-25—29th Annual Meeting, Institute of the Aeronautical Sciences, Hotel Astor, New York, N. Y. Honors Night Dinner, Jan. 24.
Feb. 1-3—Second Winter Military Electronics Convention, Institute of Radio Engineers, Biltmore Hotel, Los Angeles.
Feb. 1-3—Solid Propellants Conference, American Rocket Society, Salt Lake City.
Feb. 14-16—Second Annual Symposium on Non-destructive Testing of Aircraft and Missile Components (unclassified), Society for Non-destructive Testing and Southwest Research Institute, Gunter Hotel, San Antonio, Tex.
Feb. 15-17—International Solid-State Circuits Conference, Institute of Radio Engineers, Sheraton Hotel, Philadelphia.

(*Continued on page 6*)

AVIATION WEEK and Space Technology
December 19, 1960
Vol. 73, No. 25

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AVIATION CALENDAR

(*Continued from page 5*)

Mar. 5-9—Sixth Annual Gas Turbine Conference and Exhibit, American Society of Mechanical Engineers, Shoreham Hotel, Washington, D. C.

Mar. 9-10—Second Symposium on Engineering Aspects of Magnetohydrodynamics, University of Pennsylvania, Philadelphia.

Mar. 9-10—Flight Propulsion Meeting, Institute of the Aeronautical Sciences, Cleveland, Ohio (classified).

Mar. 12-16—Aviation Conference, American Society of Mechanical Engineers, Statler-Hilton, Los Angeles, Calif.

Mar. 13-15—Flight Testing Conference, American Rocket Society, Los Angeles.

Mar. 13-16—Test, Operations and Support Conference, American Rocket Society, Biltmore Hotel, Los Angeles, Calif.

Mar. 16-18—Fifth National Conference on Aviation Education, Mayflower Hotel, Washington, D. C.

Mar. 20-23—International Convention, Institute of Radio Engineers, Coliseum and Waldorf Astoria Hotel, New York, N. Y.

Mar. 20-24—1961 Western Metal Exposition, American Society for Metals, Pan-Pacific Auditorium, Los Angeles, Calif.

Mar. 27-31—1961 Symposium on Temperature, Its Measurement and Control in Science and Industry, Columbus, Ohio. For information: V. W. Sikora, Instrument Society of America, 313 Sixth Ave., Pittsburgh 22, Pa.

Apr. 4-6—International Symposium on Electromagnetics and Fluid Dynamics of Gaseous Plasma, Polytechnic Institute of Brooklyn, Brooklyn, N. Y.

Apr. 5-7—Lifting Re-entry Vehicles: Structures, Materials & Design, American Rocket Society, Palm Springs, Calif.

Apr. 10-11—Spring Meeting, Western States Section/The Combustion Institute, Aeronutronics Division of Ford Motor Co., Newport Beach, Calif.

Apr. 17-28—14th Technical Conference, International Air Transport Assn., Queen Elizabeth Hotel, Montreal, Canada.

Apr. 18-20—Symposium on Chemical Reactions in the Lower and Upper Atmosphere, Stanford Research Institute, Mark Hopkins Hotel, San Francisco, Calif.

Apr. 20-22—General Meeting, American Meteorological Society with the American Geophysical Union, Washington, D. C.

Apr. 26-28—Liquid Rockets, Propellants and Combustion Conference, American Rocket Society, Palm Beach Biltmore, Palm Beach, Fla.

Apr. 30-May 4—Seventh National Aero-Space Instrumentation Symposium, Instrument Society of America, Adolphus Hotel, Houston, Tex.

May 8-10—National Aeronautical Electronics Conference, Institute of Radio Engineers, Miami and Biltmore Hotels, Dayton, Ohio.

May 9-11—Western Joint Computer Conference and Exhibit, Ambassador Hotel, Los Angeles, Calif.

May 22-24—National Telemetering Conference, Sheraton-Towers Hotel, Chicago, Ill.

May 26-June 4—24th French International Air Show, Le Bourget, Paris, France.

Sept. 4-10—1961 Flying Display and Exhibition, Society of British Aircraft Constructors, Farnborough, England.

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DEFENSE: One requirement of a sound defense is knowledge of the opponent's offense... his deployment, striking power, electronic capabilities. Our interest: applying our electronics systems experience to problems of combat surveillance including passive detection, countermeasures, reconnaissance, order of battle, and other intelligence needs. Advanced techniques in the use of microwaves, infrared, ultraviolet —perhaps the whole spectrum—are involved; more specifically, subminiaturized receivers, computers, amplifiers, and antennas. Result: faster, more accurate intelligence to improve kill probability in...

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KNOW YOUR ALLOY STEELS . . .

This is one 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 who may find it useful to review fundamentals from time to time.

Methods of Carburizing Alloy Steels

Carburizing is a means of impregnating the surface of steel with carbon, usually to very limited depths. Its purpose is to provide a hard, wear-resisting "case," or outer shell. Alloy steels, correctly handled, can be case-hardened without sacrificing desirable core properties.

There are three types of carburizing in general use:

Liquid Carburizing—The medium here is a hot-salt bath composed basically of cyanide compounds. The steel is immersed in the bath, the period of immersion depending upon the analysis of the steel and the depth of case desired. Liquid carburizing is a convenient method of producing thin, hard, wear-resisting cases, generally within the depth range of 0.02 to 0.03 in. However, deeper cases may be obtained, the actual depths depending upon economics and end uses.

Gas Carburizing — This method employs a furnace in which a carbonaceous atmosphere is created; i.e., gases that are high in carbon components, or those containing carbon. Steel subjected to gas carburizing can be case-hardened to depths generally ranging from 0.01 to 0.04 in. When quenching takes place immediately after carburizing, distortion can be kept to a minimum.

Pack Carburizing — Where the pack method is used, the parts to be carburized are buried in a container of dry carbonaceous materials. The container is sealed tight to prevent the infiltration of air, placed in a furnace and kept there for eight hours or more, the actual time depending upon the depth of case desired. Pack carburizing is particularly suitable where a deep case is essential (0.06 in. and over), although medium cases in the 0.04-to-0.06-in. range are possible.

This series of alloy steel advertisements is now available as a compact booklet, "Quick Facts about Alloy Steels." If you would like a free copy, please address your request to Publications Department, Bethlehem Steel Company, Bethlehem, Pa.

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Only Fenwal's complete line of detection systems covers all forms of fire and overheat danger in aircraft, missiles, and space craft. *Only Fenwal covers all "hidden hazards"!*

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And Fenwal contributions to safety in flight go beyond the detection phase. Fenwal also designs Explosion Suppression Systems for protecting both military and commercial aircraft. A Fenwal engineer will be glad to assist with *your* particular detection or explosion protection problems. Write FENWAL INCORPORATED, 1216 Pleasant Street, Ashland, Massachusetts.

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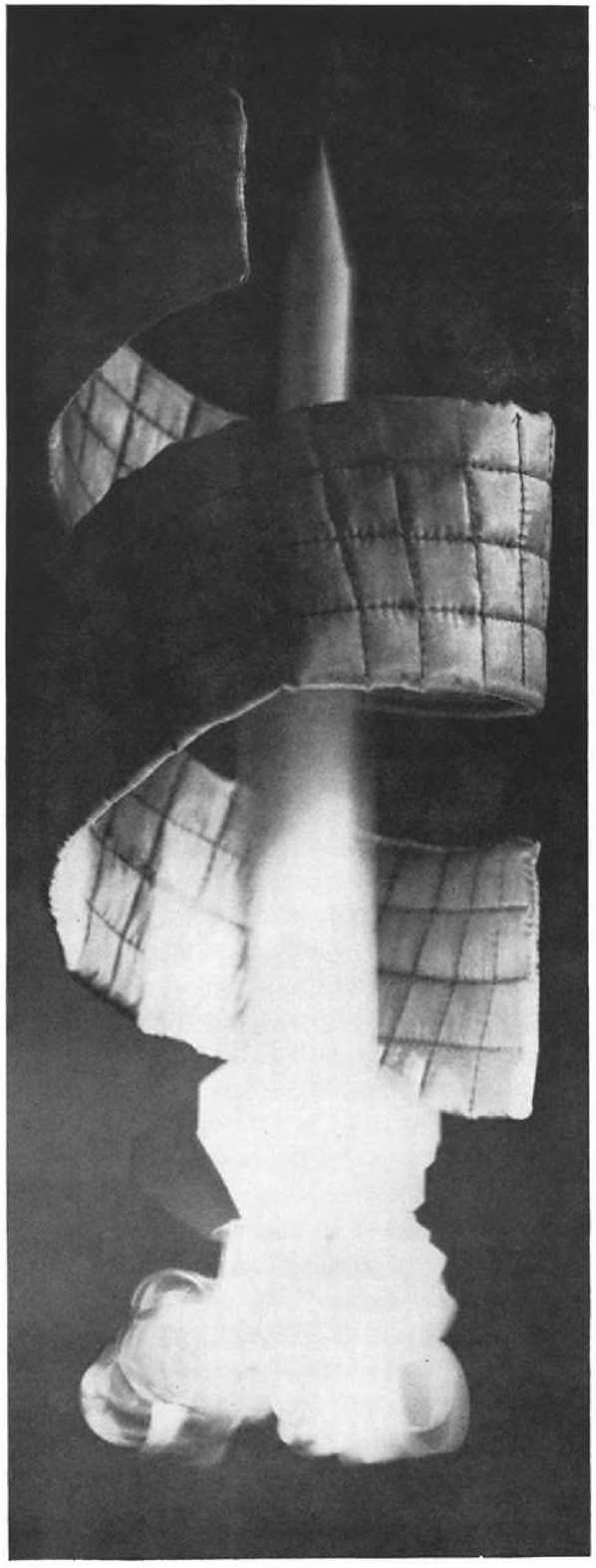

Insulation news from Johns-Manville

Now Min-K® is flexible!

THE INSULATION WITH A LOWER CONDUCTIVITY THAN STILL AIR IS NOW AVAILABLE IN BLANKET AND TAPE FORMS FOR UNLIMITED NEW APPLICATIONS

Min-K, the unique insulating material developed and produced by Johns-Manville, now has an added quality . . . flexibility! Min-K is a new concept in missile insulation. The higher it flies, the better it insulates. Min-K's thermal conductivity drops as atmospheric pressure decreases. Its superior performance has been proved in hundreds of operational U. S. missiles.

New Flexible Min-K offers many special advantages. For example, it is the ideal way to lower prototype costs. You can test performance without the expense of special tooling. The flexible blankets lend themselves to bonding, lamination with reinforced plastics, service coatings and as a component of insulation systems. Further, Min-K can be tailor-made to wrap around a cylinder, cone or other geometric shape. And, it is also available in 1½" and 2" tapes for spiral winding on a duct or pipe.

Because of the added quality of flexibility, Min-K's unique insulating characteristics now can be used in virtually unlimited new applications. For full details on Flexible Min-K, Min-K and other J-M aviation insulations, write Johns-Manville, Box 14, New York 16, New York. In Canada: Port Credit, Ontario. Cable address: Johnmanvil.

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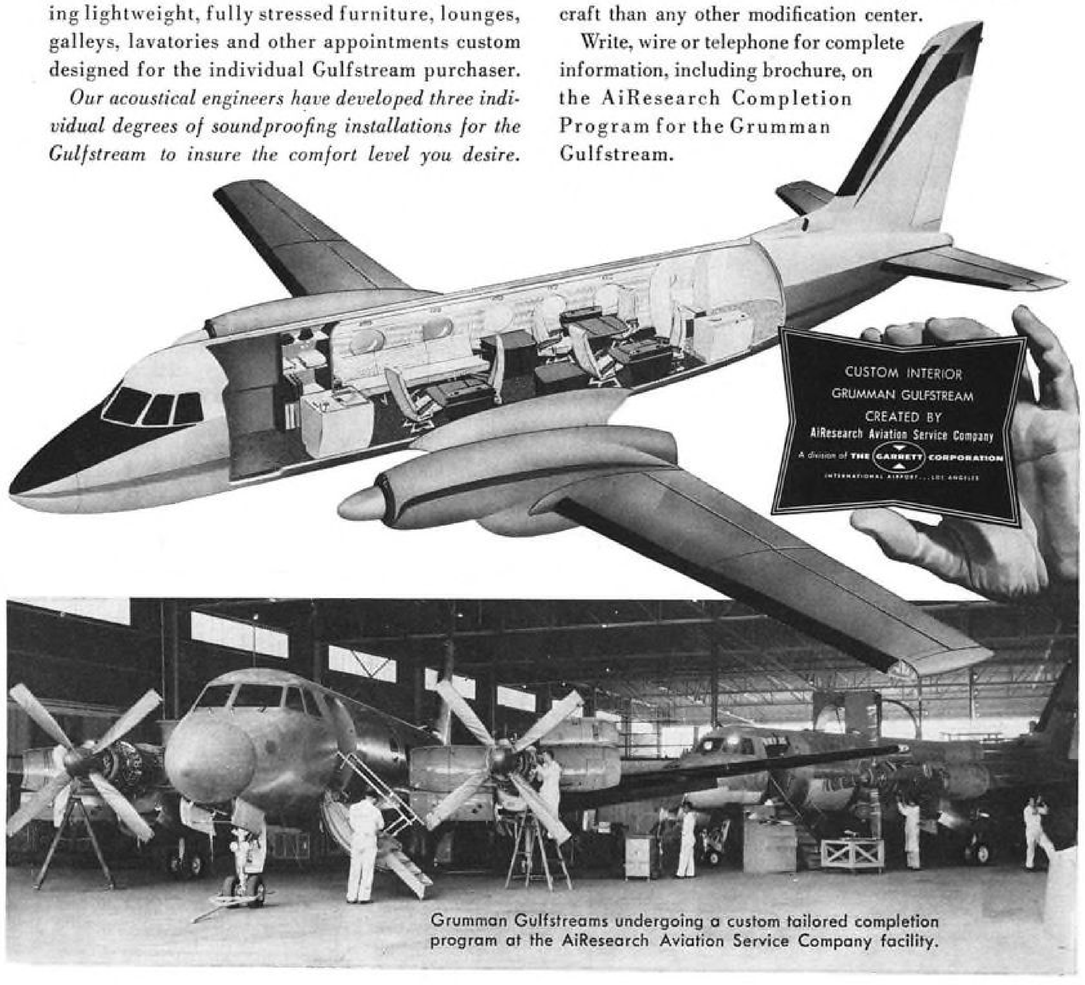
AiResearch personnel have been factory trained for this special program. Expert craftsmen utilize the newest materials and processes in building and installing lightweight, fully stressed furniture, lounges, galleys, lavatories and other appointments custom designed for the individual Gulfstream purchaser.

Our acoustical engineers have developed three individual degrees of soundproofing installations for the Gulfstream to insure the comfort level you desire. And our highly experienced, well-equipped radio and electronics departments design and execute the most modern installations.

By using a full-scale mockup of the fuselage section we are able to prefabricate components for the Gulfstream to expedite delivery time. And AiResearch guarantees the completion weight of your aircraft.

AiResearch has more experience in pressurized aircraft than any other modification center.

Write, wire or telephone for complete information, including brochure, on the AiResearch Completion Program for the Grumman Gulfstream.



Grumman Gulfstreams undergoing a custom tailored completion program at the AiResearch Aviation Service Company facility.

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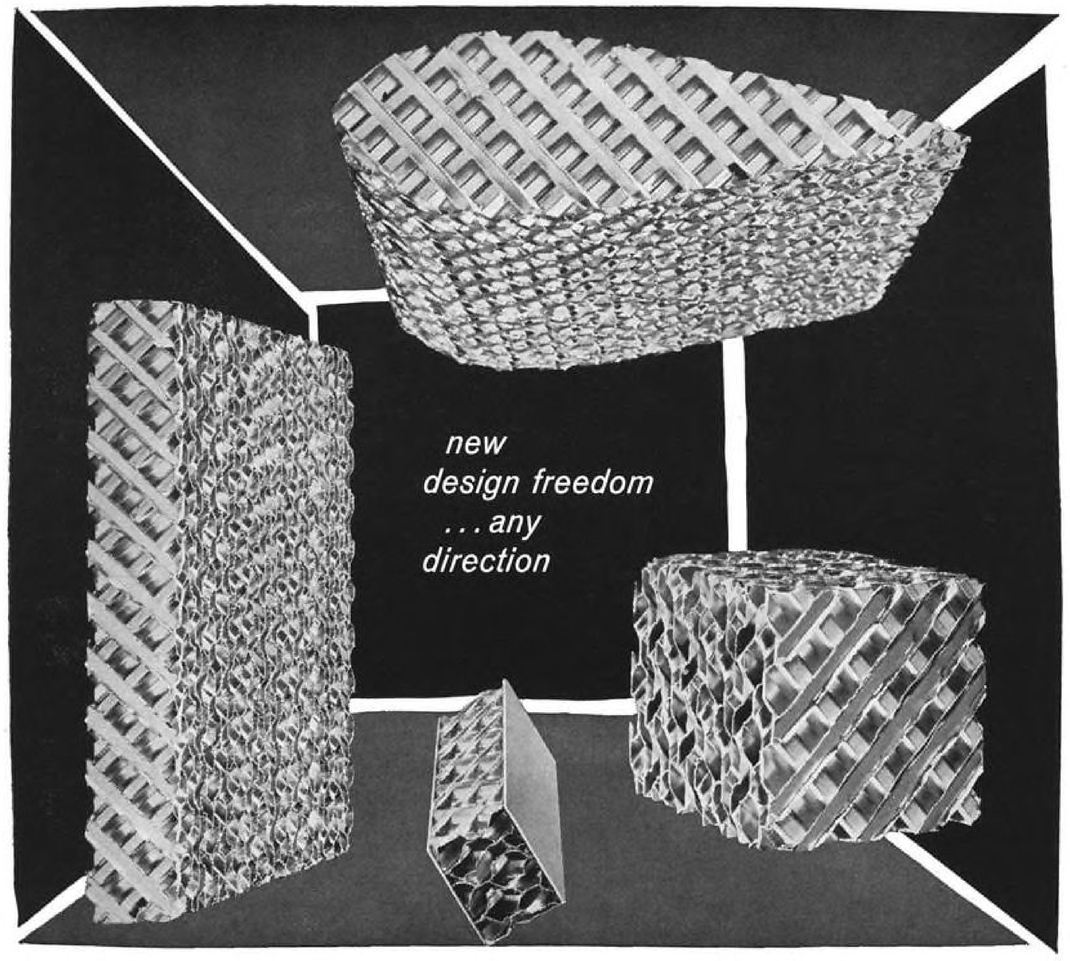

Aluminum core material of Alcoa Foil offers three-dimensional stability

Trussgrid*, a new aluminum core material for sandwich construction, demonstrates interesting versatility in curved or contoured assemblies. Dimensionally stable, Trussgrid does not stretch or shrink. Form it—there's no anticlastic behavior. Bond it—there's no movement. Machine it without stabilizing resin, wax or ice. □ Made with Alcoa® Aluminum Foil, Trussgrid is inherently rigid—can be used without facings for lightly loaded panels. Naturally vented, it bonds with all types of adhesives. Panels can be used for fuel storage or as heat exchangers. The high-strength isotropic plane provides desirable energy absorption properties for packaging. □ Future applications are probably limited only by the imagination. With varying orientation of the structural elements, Trussgrid gives the designer required strength characteristics in any plane of the material.

□ **Alcoa does not make Trussgrid or other aluminum honeycomb materials,** but we will be happy to refer you to the people who do. Our product is aluminum foil, the remarkable material that cuts costs and improves techniques today in scores of industries. □ For more information about Trussgrid, conventional aluminum honeycomb or other Alcoa Foil applications, write to Aluminum Company of America, Industrial Foil Division, 2068-M Alcoa Building, Pittsburgh 19, Pa.

*a product of General Grid Corp., Army Chemical Center, Md.

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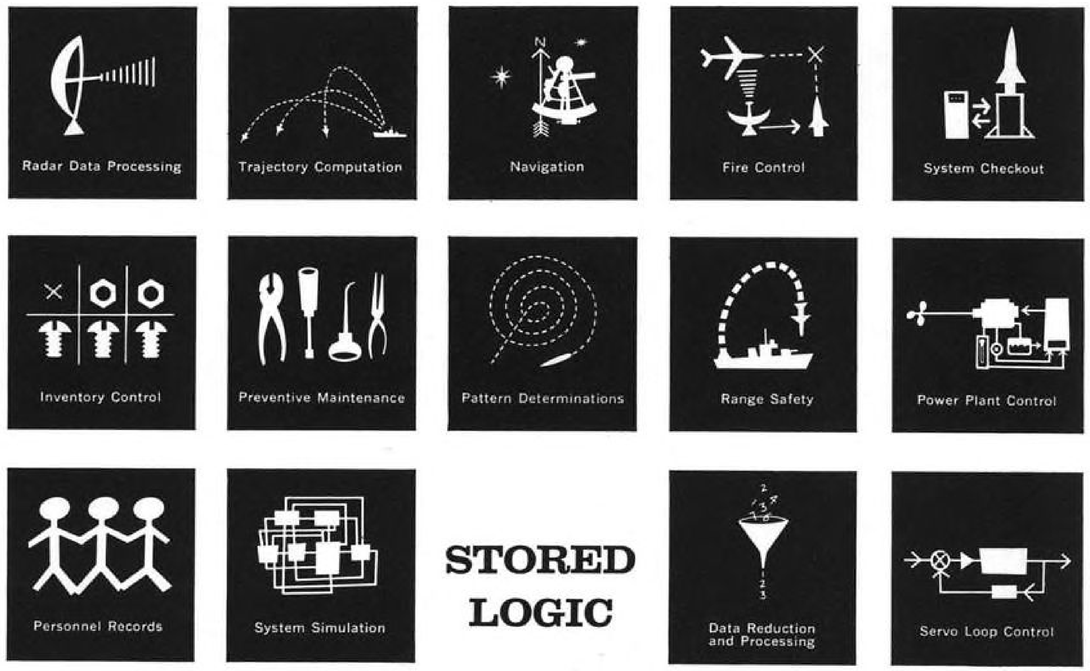

How to get a computer to think it's a one-man gang

Most computers are pretty fussy about the kind of problems they are willing to handle. While it's true that a "business" computer can be made to do "scientific" problems, and vice versa, every experienced computer user knows it's no simple matter to get a machine to accept such a change of character gracefully. Besides the fancy reprogramming involved, the computer is likely to be inefficient and uneconomical at solving problems it wasn't designed for.

From the user's point of view, the "ideal" computer is a *multiple-purpose* machine that can be used *efficiently* in many different types of applications, and at no higher cost than a computer intended primarily for any one of these applications.

From the programmer's point of view, the "ideal" machine is one with a flexible set of instructions that can be easily manipulated to fit just about any kind of problem that comes along. Both programmer and designer are likely to agree that the most practical way to realize this "ideal" computer is by using the *stored logic* principle.

Stored logic concepts developed by Ramo-Wooldridge are being used in the AN/UYK-1, a low-price, multiple-purpose Navy computer intended for shipboard use. In the Ramo-Wooldridge approach, stored logic permits the user to select a word length, order structure and instruction repertoire especially suited to the problem at hand. These normally "wired in" characteristics are specified by data stored in the computer's memory and may be changed during the normal loading procedure without hardware modification.

The AN/UYK-1 "Stored Logic" Multiple-Purpose Computer takes its place alongside the RW-400 "Polymorphic" data processing system as an outstanding example of the kind of advanced work in computer design which has characterized Ramo-Wooldridge over the past six years. Senior programmers are urgently needed to help develop a large "software" package for commercial and military applications of R-W *stored logic* computers, to prepare programs for the polymorphic data processing system, and to work on challenging applications engineering problems.

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December 19, 1960

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COVER: Sikorsky's twin-turboshaft S-61L, a 25 to 28-passenger helicopter ordered by Los Angeles Airways and Chicago Helicopter Airways, made its first flight on Dec. 6 and should earn full certification next September. The five aircraft slated for the Los Angeles carrier feature a removable baggage pod capable of carrying 1,200 lb. of mixed luggage. Pod's outline can be seen just above the right main landing gear of the helicopter, first of 11 already ordered (see p. 42).

PICTURE CREDITS

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84,616 copies of this issue printed.

EDITORIAL

Moving Toward Mobility

Last week we attended the Air Force design engineering inspection of the mobile Minuteman at one of Boeing's Seattle plants. It was probably the first Air Force DEI exercise ever attended by the top executives of the nation's railroads. For mobile Minuteman is being born out of an unusual marriage of the railroad train, an elderly, respectable form of transport, and the newest and youngest offspring of the intercontinental ballistic missile family which is still in its infancy and has only recently begun to achieve military respectability.

Strategic Air Command and the Association of American Railroads will form a partnership in providing an element of mobile strategic deterrent that few military prophets would have dared to predict several years ago. It still may be hard for some observers to realize that the rail-borne Minuteman can reach its intercontinental targets faster than the supersonic bombers of SAC. Certainly no Air Force officer now in service ever visualized his duty station as a 24-hr. day rolling along the 100,000 mi. U.S. railroad network or sitting on a siding in the launch control car of a Minuteman train inside a locked compartment with his copilot-launching officer on the other side of a bulletproof glass partition.

In the hands of both launch control officers, locked in on opposite sides of this bulletproof glass, will be keys that, when inserted in the proper slot and turned simultaneously, can fire five ICBMs at enemy targets. By 1963, the first of more than 100 of these SAC Minuteman trains will be operational, moving at random over 900-1,200 mi. track patterns on two-week duty runs.

Strategic Deterrent Changing

The mobile Minuteman is another example of how the concept of mobility and complexity is changing the basic character of the U.S. strategic deterrent forces. The fixed, hardened Atlas and Titan sites will always represent an asset in this deterrent, with their value increasing as SAC's capability of maintaining and operating them on an extremely high plateau of reliability matures. But they now represent a distinctly early, relatively complex, and expensive first generation of operational ICBMs that was absolutely necessary both in the technical development history of this unique weapon and in the current military equation.

Minuteman is one of the second generation missiles that offers major improvements in faster reaction capability, greater reliability and better mobility plus major reductions in procurement and operation costs. There is tremendous military and industrial pressure generated behind its development, aimed at utilizing the experience gained from Atlas and Titan programs to compress to an absolute minimum its time cycle to first operational capability. For if the promise of its economy, reliability, quick reaction time and mobility are realized in fact, the Minuteman can provide a major improvement in both quantity and quality of the U.S. counter strike force. It also can considerably upgrade our deterrent capability in relation to any potential aggressors.

Although the hardened, fixed Minuteman installations will offer some of these advantages, it is in its mobile, rail-borne deployment that this missile will apparently make its greatest contribution. History has shown a very poor effectiveness record for fixed military installations ranging from the Chinese wall to the Maginot line. All of these fixed defenses fell before an enemy strategy based on mobility, so it is heartening to see this concept receiving new impetus in the strategic deterrent forces.

The Navy's Polaris-firing, nuclear-powered submarines are certainly a valuable element in utilizing the vast reaches and depths of the sea to provide mobility and concealment. The mobile Minuteman offers similar possibilities for land-based ICBMs, although we think SAC is needlessly sacrificing some of the possibilities for concealment by insisting that its missile trains be painted standard Air Force blue and be marked by conspicuous blue and white starred belly-bands incorporating the SAC insignia. Since they will be powered by standard locomotives with railroad markings, these missile trains might appear less conspicuous either on the road or in their temporary siding stops if they bore the standard commercial livery of freight cars.

Airborne Missile Platforms

Another element of increased mobility will be added to the deterrent forces by airborne missiles such as Hound Dog and Skybolt. USAF has shown considerable imagination and technical boldness in pushing toward solution of the air-launched ballistic missile problem. But it has not exhibited similar characteristics in developing suitable airborne launching platforms for this weapon. The B-52, while adequate for current use as a Skybolt launching platform, is certainly not the best that could be devised to provide an airborne mobility for ballistic missiles similar to that provided by nuclear-powered submarines in the sea or the rail-borne Minuteman on land. Certainly either a Dromedary-type aircraft, using the technology of boundary layer control to gain its maximum dividend in endurance, or the nuclear-powered aircraft still offers genuine promise for a future mating of aerial platform and solid-fuel, long-range missiles to add a third and equally perplexing element of deterrence to aggressors.

The goal of the strategic deterrent in the immediate future must be to diversify and conceal its various elements to such a degree that the possibility of any aggressor being able to eliminate or significantly cripple it by an initial surprise attack is reduced to the smallest fraction of success.

We appear to be well along on bringing mobile deterrent elements into the pattern on land and sea. But the possibilities for an even more elusive and effective airborne element for this combination do not appear to be fully exploited, even by the service that has spent its life in the air.

—Robert Hotz

WHO'S WHERE

In the Front Office

Joseph G. Beerer, vice president-engineering, North American Aviation, Inc., Los Angeles, Calif., and **Harrison A. Storms,** a vice president. Mr. Storms succeeds Mr. Beerer as head of corporation's Missile Division. **Warren E. Swanson** succeeds Mr. Storms as vice president and chief engineer of the Los Angeles Division. Also: **E. F. Brown,** vice president-administration, Rocketdyne, a division of North American.

George J. Dickey, vice president and assistant general manager, Stromberg-Carlson Division of General Dynamics Corp., Rochester, N. Y.

James E. Upfield, a director, Missile Systems Corp., North Hollywood, Calif. Mr. Upfield is president of the corporation's Emtex Division.

Rex Brack and **Capt. R. V. Carleton,** senior vice presidents, Braniff Airways, Inc. Elected vice presidents: **Capt. Dan Hughes**-flight and ground operations and communications; **Robert H. Burck, Jr.**-sales, traffic and passenger service; **Joseph R. Horton**-maintenance, overhaul and engineering activities.

Dr. William V. Wright, a vice president, Electro-Optical Systems, Inc., Pasadena, Calif. Dr. Wright will continue as manager of Electro-Optical System's Solid State Division.

James B. Gordon, secretary, The Bendix Corp., Detroit, Mich.

Allan R. Gruber, a director of Solid State Radiations, Inc., Culver City, Calif. Mr. Gruber is director of Marquardt Corp.'s Nuclear Systems Division.

Hubert Bennett, assistant to the president, McCormick Selph Associates, Hollister, Calif.

Honors and Elections

Dr. Ernst Stuhlinger, director of the Research Projects Division, George C. Marshall Space Flight Center, was awarded the American Rocket Society's annual Propulsion Award for his "outstanding contribution to electrical propulsion research."

Albert Berger, contract manager for Otis Elevator Co.'s Defense & Industrial Division, has been elected president of the Government Contract Management Assn. of America, New York, N. Y.

Changes

R. J. B. Woodhams, chief designer, British Executive & General Aviation, Ltd. (Beagle), London, England.

Thomas A. Pendleton, head of the Advanced Technical Development Department, Jansky & Bailey, Washington, D. C., a division of Atlantic Research Corp.

Raymond LaFontaine, chief engineer-advanced products, Koehler Aircraft Products Co., Dayton, Ohio, and Harold Herkenhine, chief engineer-production products.

Dr. Ned S. Rasor, director, and **Dr. Donald E. McKenzie,** associate director, of the newly formed Energy Conversion Department of Atomics International, a division of North American Aviation, Inc., Canoga Park, Calif.

(*Continued on page 119*)

INDUSTRY OBSERVER

► Hybrid rocket concept involving a low-temperature, three-component system called Hyfox is under study by Astropower, Inc., a Douglas Aircraft subsidiary. Hyfox is reported capable of achieving a specific impulse of more than 500 sec.

► **Plan to start limited production of the Nike Zeus system has reached the Joint Chiefs of Staff, and a decision is expected by mid-January. The proposal involves a calculated gamble that new techniques for discriminating between ICBM warheads and decoys, stemming from Project Defender research, will increase Zeus effectiveness. Prime contractor, Western Electric, has told Defense it will be forced to lay off or divert Zeus manpower unless such a plan is adopted quickly.**

► Air Force feels limited war requirements may demand development of a cheap, relatively small missile which would carry a clean nuclear warhead with yield ranging up to 100 kilotons. Circular error probability would be small—perhaps no more than a fifth of a mile.

► **Promising new technique for electric propulsion of space vehicles, which uses exploding wires made of magnetic materials that are accelerated and controlled by magnetic fields. is being investigated by Air Force Cambridge Research Laboratories. Principle was discovered by a German scientist 30 years ago during a purely academic investigation.**

► Marquardt Position Attitude Control System using liquid pulse-rockets with a computer for satellite orientation, will be used on Air Force-Lockheed Samos reconnaissance and Midas infrared early warning satellites.

► **Cryogenic nuclear gyroscope, in which the absence of moving parts should provide extremely long trouble-free life combined with extremely low drift rate, is reported feasible by Sperry Microwave Electronics Co. scientists. Sperry claims it has developed a new technique for sensing reference direction, a problem that has handicapped previous work with this type of exotic gyro. Defense Department is interested in sponsoring continued work on this company-financed program.**

► Study program involving an electronic countermeasures surveillance missile is under way at Naval Air Missile Test Center, Pt. Mugu, Calif. Such an intelligence weapon potentially could detect and relay information on radar facilities—location, sweep rates, wavelengths, beam intensity and pulse current rate.

► **Hughes, McDonnell, North American and Space Technology Laboratories will brief National Aeronautics and Space Administration's Jet Propulsion Laboratory today and tomorrow on proposals submitted last week for the Project Surveyor soft lunar landing program. JPL will question bidders in another session early next month before evaluating proposals.**

► First operational sea test of the Bell Aerosystems AN/SPN-10 automatic carrier landing system is scheduled for 1962 aboard the USS Enterprise. Navy has ordered 12 of the Bell systems for carrier and land installations. SPN-10 is similar to the AN/GSN-5 the Federal Aviation Agency is evaluating for possible civil and Air Force use.

► **Jaguar air-launched radiation probe with altitude capability of several hundred thousand feet, developed by Air Force Special Weapons Center, is scheduled for firing over the Pacific Missile Range. The three-stage vehicle will be launched into a steep trajectory from aircraft at about 35,000 ft.**

► Terrain clearance simulator will be built by Aero Service Corp. for the Republic Aviation F-105 ground pilot trainer. Aero Service simulator will include coordination between maps and practice radar presentations.

Washington Roundup

Space Study Group

A committee is being formed to prepare a position paper on the U. S. space program for whatever use President-elect Kennedy can make of it. If Kennedy has a space task force of his own among the groups he has asked to study specific problems, its existence has not been made known. Meanwhile, George Feldman, New York attorney and former staff director of the House Select Committee on Astronautics and Space Exploration, is putting together an independent group that will write the position paper.

Already named are Adm. Thomas F. Connolly, Navy's astronautics director; Brig. Gen. Homer A. Boushey, commander of USAF's Arnold Engineering Development Center; Richard S. Morse, director of Army research and development; Dr. Charles S. Sheldon, technical director, and Spencer M. Beresford, special counsel of the House space committee. Other members are expected to be drawn from the National Academy of Science's Space Sciences Board and from the office of research and engineering in the Defense Department.

Air Force's ambitious space program, much of which is aimed at systems that would be operating four or more years away, has been generally accepted within the service except for the Positive Control Bombardment System, or recallable ICBM (AW Dec. 5, p. 26). This bombs-in-orbit system has created grave doubts among some senior officers about its political acceptability, although most do not question its technical feasibility.

Space Plane has become a controversy before it has become a project. National Aeronautics and Space Administration privately denies, with some feeling, that it ever had any desire to take over development of the proposed manned space vehicle from the Air Force. USAF has asked for $20 million in the next budget to begin work, and some of its spokesmen claimed that NASA felt it should be given the project because the service had no mission requiring such a vehicle.

NASA feels that if the project is begun, its development will follow a pattern similar to that set by X-15 and Dyna-Soar. USAF provides most of the funding, and NASA provides a large portion of the technical support.

Project Golden Ram

Disappointing results of military launchings of Atlas missiles from Vandenberg AFB, Calif., has led to creation of Project Golden Ram. The project is an attempt to standardize procedures and establish operational discipline so firings will have more of the precision gained when contractor teams handled earliest launches. Strategic Air Command, ARDC's Ballistic Missile Division and the major contractors are involved.

Dr. Herbert York, has indicated to intimates that he would like to remain as director of defense research and engineering in the Kennedy Administration. York is a registered Democrat who has remained aloof from politics. He has been on the job for about a month after recovering from a heart attack. His deputy, John Rubel, also would like to remain in government despite attractive industry offers.

Attempt to set 10 international aircraft records with the Convair B-58 over 1,000 km. and 2,000 km. closed courses has been ruled out, apparently for political reasons.

Block of 90 days time had been requested, and the records would have been attempted during acceptance trials. But the Boeing B-52 has just set a record (see p. 27), the B-58 is not in the Fiscal 1962 budget. The setting of 10 records would undoubtedly have raised congressional questions why the North American B-70 is so vitally needed. So there will be no record attempts.

Policy Reins

President-elect Kennedy's choices for Secretary of State and Secretary of Defense are both known as forceful men, but it is unlikely that they will have as strong hands in shaping policy in their own departments as their predecessors have.

The nominee for Defense Secretary, Ford Motor Co. President Robert S. McNamara (see p. 28), will have to coordinate national security matters with State nominee Dean Rusk, who is Rockefeller Foundation president and former Under Secretary of State under former President Truman. This will have to be done more completely and with less feuding than in the past few years of the Eisenhower Administration.

But observers here are convinced that the real policy-maker for both departments will be Kennedy himself. Both his own pronouncements on the role of the presidency and the recommendations of almost all study groups in recent years have favored this kind of approach to national security.

—Washington Staff

$40.5 Billion Defense Budget Approved

Air Force and Army get increases, Navy is cut; major changes planned in weapon system programs.

By Larry Booda

Washington—Defense budget of $40.5 billion for Fiscal 1962 has been approved by the Eisenhower Administration for submission to Congress in January. It consists of $17.9 billion for the Air Force, $12.2 billion for Navy, and $10.4 billion for the Army.

Army's figure is an increase of almost $600 million over the current fiscal year, while USAF's figure is an increase of $30 million. Navy's total is cut by $150 million from Fiscal 1961.

Major changes in future weapons programs have been incorporated in the Fiscal 1962 requests, and materiel buys of current systems have been altered. Highpoints of the budget requests are:

- **No funds are included** for further development of the Navy-Douglas Missileer aircraft, which is the aerial platform for the long range air-to-air Bendix Eagle missile.
- **No funds are included** for further development of the USAF-Douglas Skybolt air-launched ballistic missile.
- **Purchase of Republic F-105** fighter-bombers by USAF will be increased substantially.
- **No funds for further production** of USAF's Boeing B-52 and Convair B-58 bombers are included.
- **Development of the USAF-North** American B-70 bomber will be accelerated.
- **Navy-Lockheed Polaris** missile will receive about the same funding as in Fiscal 1961.
- **USAF-Boeing Minuteman missile** development funds will be increased.
- **Army will purchase more** aircraft than either Air Force or Navy.

Contracting Impact

A factor of increasing importance—economic impact of contracting on a company or a geographical area—will make itself felt in this new budget. One example will be found in the way pending decisions on aircraft buys are made in the light of the elimination of Missileer funding.

The contract for development of this subsonic platform, which is designed to patrol for long periods in defense of Navy's task forces, was let a few months ago to Douglas Aircraft Co. and work is being done at the El Segundo Division.

Missileer was the division's major program for the future, although El Segundo still is producing aircraft and other items on current contracts. At the same time, cutbacks have hit the company's Long Beach Division, which makes the DC-8 commercial transport and USAF C-133B transport, and more are in the offing (AW Dec. 12, p. 36).

Some members of the California congressional delegation already have brought pressure to bear on the Administration, the Air Force and the Navy to funnel more orders into the Douglas areas (AW Oct. 3, p. 25).

The most recent example of congressional interest in what contracts go to California happened last week when Sen. Clair Engle (D.-Calif.) asked Air Force for a status report on its plans for accelerating modernization of the Military Air Transport Service with the purchase of turbojet and turboprop aircraft.

Later, a contract was awarded to Lockheed for 50 long-range C-130Es, 16 in Fiscal 1961 and 34 in Fiscal 1962, costing $170 million. The work will be done at Lockheed's Georgia Division.

Douglas and Convair-San Diego have a direct interest in the purchase of interim jets for MATS with a portion of the $200 million earmarked for modernization from the Fiscal 1961 budget. Both also are interested in the advanced MATS jet, for which $50 million was included in the current budget. Presumably, more funds for further work on the advanced jet are included in the Fiscal 1962 budget also.

Competing with Douglas and Convair for the interim jet are Boeing, Lockheed's Georgia Division and Canadair, Ltd. Boeing is also a strong competitor of the California companies for the Tactical Air Command STOL fighter-bomber, first funds for which were in the current 1961 budget.

As of last week decisions regarding the interim jet and the STOL aircraft were still in the hands of Defense Secretary Thomas S. Gates, Jr.

B-70, Minuteman Amounts

The importance Air Force attaches to the B-70 bomber and Minuteman missile has been reflected in other parts of the budget.

About $400 million will go into the B-70 development program next year. With this start the Air Force hopes to have an operational force of 65 aircraft by 1967.

Elimination of the Skybolt ALBM is tied to this emphasis on the B-70, which requires no standoff missile, and to the gradual phasing out of the B-52, for which Skybolt was intended. Carryover funds from previous fiscal years will permit continuation of B-52 production in Fiscal 1962. There will be little or no carryover funds for the B-58, however.

Increase in purchase of the Republic F-105 fighter-bombers will fill TAC requirements until the STOL configuration goes into production.

Air Force's biggest budget item is the Boeing solid-propellant Minuteman ICBM, which it wants to produce in large numbers. About $850 million will go into this program in Fiscal 1962. Claim is made that this missile will be less vulnerable and cheaper than other ballistic missiles.

Navy Programs

Indication that the Polaris fleet ballistic missile program is leveling off with development of the longer-range A2 and A3 missiles is that a sum similar to the 1961 amount has been allocated to it. As these missiles are proved and produced, the program will fall off, since the size of the missile is tied to the size of the launch tubes in the Polaris submarines. This leveling off and decline will also be true of other missiles fired from buried silos, such as Titan II and Minuteman.

USAF Project Cuts

Washington—Half a dozen major Air Force weapons development programs are being cut back by as much as $150 million per program, apparently because spending of Fiscal 1961 defense funds is running too far ahead of estimates. One report puts the imbalance in Defense Department spending for this fiscal year at close to $1 billion, probably the highest since the overspending that caused severe cutbacks and stretchouts in the industry in the fall of 1957.

Action was initiated by Defense Department comptrollers after they spotted what they called unauthorized spending on some projects in all three services. Army and Navy will take action on their own projects, but the extent of their adjustments will be minor compared with those required by USAF.

Projects which will not require adjustments include Navy's Polaris and USAF's Titan and mobile Minuteman missiles. Procurement freezes have been put on all the USAF projects that are due for major adjustments, and will stay on until after an Air Force team has visited each company involved. Visits are expected to be completed this week.

The term used in connection with the withdrawal of funds for the Missileer aircraft is that the project is still "active." Contracts for the Eagle missile are still in effect with the prime contractor, Bendix Systems Division, at Ann Arbor, Mich. Strategy probably was to keep the development of the entire system under way while giving up a portion of the funding to improve the purchase of other Navy aircraft now in production.

Navy aircraft purchases will be about 635, considerably below what the service considers necessary to maintain a level operational count.

Navy is fighting obsolescence in its ships, including aircraft carriers, by trying to modernize them. This is the subject of much internal discussion as to division of overhaul and maintenance funds.

Air Force space program, still mainly in the study phase, has fared well, with relatively small amounts requested for systems such as Space Track, $25 million; Space Plane, $20 million; maneuverable ballistic shapes, $25 million; Space Combat Weapon System, $50 million, and Saint satellite inspection system, $32 million.

Navy's astronautics program will include about $22 million for continued development and operations of the Transit navigation satellite; more than $100 million for the operation of the Pacific Missile Range and about $10 million for other space projects. Money for the Navy's space surveillance system, or Spasur, has been transferred to the Air Force, whose North American Air Defense Command has been handed the satellite detection responsibility.

New U. S. Records

Washington—Air Force Boeing B-52G set a 10,000 mi. non-refueled closed course endurance record last week, and a Navy North American A3J set a Class C world altitude record of 91,450.8 ft.

The B-52G, piloted by Lt. Col. Neil D. Van Reenen, flew the 10,000 mi. in 19 hr. 45 min., eclipsing the 1947 B-29 record of 8,854.3 mi. The A3J was zoomed to the record altitude by Cmdr. Leroy A. Heath, carrying a 1,000 kg. (2,204 lb.) payload and breaking the 1957 Class C record of 67,096 ft. set by a Russian aircraft. Both new U. S. records have been submitted to the Federation Aeronautique Internationale for certification.

FAI has approved a helicopter speed record set by Army Col. Jack L. Marinelli, flying a Bell HU-1 at 148.456 mph. over a 500 km. closed course. Record set by Army Chief Warrant Officer Clifford V. Turvey, flying an HU-1 at 142.224 mph. over a 100 km. closed course, also has been approved.

Thirty Mercury Changes Made To Improve Capsule Capability

By Edward H. Kolcum

Washington—Project Mercury development program has resulted in approximately 30 changes in specifications for design, system arrangement and structure to enable the capsule to meet its mission objectives, according to George M. Low, manned space flight programs chief for the National Aeronautics and Space Administration.

Despite changes, test setbacks, and the fact that the program is pushing the state of the art in some unexpected areas, Low said the Mercury management concept is the fastest, most expert and perhaps cheapest way to evolve what he calls the most complex space flight program in the country.

Low told AVIATION WEEK that McDonnell Aircraft Corp. hardware production would certainly have moved faster if the original specifications for 12 identical capsules had been followed, but experience through the two-year life of the program has shown that changes were mandatory to recover the pilot after a successful orbital flight.

Program changes have been made in design and in actual capsule hardware to improve reliability and safety.

Design changes have ranged from major structural modifications to deletions of entire systems. Among significant alterations are:

- **Window design,** changed from a small porthole to a rectangular window at the suggestion of the astronauts at their first engineering mockup inspection. More recent modification now under consideration is use of a windscreen-type deflector for protection against the sandblast effect of escape rocket exhaust. Erosion effect was discovered on the second Little Joe flight in which the escape rocket and parachute recovery systems were activated at high altitude. The window was enlarged to permit the astronaut to see the horizon when the capsule is oriented for re-entry.
- **Balloon antenna** was eliminated and will be replaced with either a telescoping or whip antenna. Change was made because in rain with a low wind, a balloon is ineffective.
- **Flashing light** and minitrack beacon were eliminated because the Minitrack network will not be used for the Mercury mission and the flashing light would not add to real-time orbital element information. Orbital data will come from telemetry.
- **Escape hatch** was added to provide an alternate exit from the capsule in case it springs a leak on impact. Astronaut now will have three ways to leave the capsule: through the top; through a side door opened mechanically, and through the quick-disconnect escape hatch operated by explosive bolts.
- **Separation rockets,** originally installed on the Atlas booster, now are in the capsule retrorocket package. This change was the first design alteration. It was made because it was determined that accelerating the lighter of the two vehicles would provide greater separation distance when the satellite is injected into orbit.
- **Impact skirt** was added. It is designed specifically to attenuate landing shock on a ground impact, which could occur in an off-the-pad abort escape maneuver.
- **Ringsail recovery** parachute replaced the extended skirt chute, which would not remain inflated at high velocity.

Most changes are being phased in the capsules, Low said, because there is no reason to have such improvements as window enlargement or pilot instrument panel for chimpanzee or instrumented flights. An improved instrument panel, suggested by the astronauts, will not be incorporated in any but manned orbital capsules.

Changes in the capsule necessary to meet performance specifications include replacement of high temperature nickel-cobalt alloy with beryllium around the parachute canister, an area where the Big Joe test showed heating higher than estimated. Wiring changes were made in the escape tower separation circuitry as a result of Little Joe tests.

At the inception of the Mercury program, Low said, it was clear that development of an environmental system was necessary, but it was believed that many of the other systems could be obtained off-the-shelf. As the program developed and weight became critical, NASA found that an entire miniaturization program would be required for the telemetry-communications system, even to tape recorders.

Unlike capsule design changes uncovered in the development program, contract amendments were anticipated when the capsule award was made to McDonnell Aircraft in January, 1959.

NASA told Mercury bidders that ground support equipment contracts would be forthcoming after the prime capsule award was made. The agency has ordered support equipment from McDonnell in the form of contract changes, and they include such major hardware as a capsule simulator, spare parts and capsules, Little Joe escape towers and instrumentation for checkout trailers.

Defense Reorganization Will Await McNamara's Study of the Pentagon

By Ford Eastman

Washington—Pattern of the Kennedy Administration's reorganization of the Defense Department will not take shape next year until the new defense secretary, Robert S. McNamara, has studied the Pentagon structure and recommended changes.

President-elect John F. Kennedy said that McNamara, named last week, has read the reorganization report prepared by Sen. Stuart Symington (AW Dec. 12, p. 21, p. 34) but that he is not committed to its findings. Changes will await study of the problem by McNamara and top defense officials; Kennedy said "then we will talk about it after mid-winter."

McNamara will resign Jan. 1 as president of the Ford Motor Co., but he already has begun preparing to take over the top Pentagon job. He met for two hours last week with Defense Secretary Thomas S. Gates, Jr., and he will confer with Kennedy this week on appointment of other top defense officials.

Like other cabinet officers, McNamara will be expected to stay at his post through the four years of the Kennedy Administration. In announcing the appointment, Kennedy said "we are both agreed" that anyone accepting a position of responsibility in the new Administration, particularly one involving national security, should be willing to "serve a long period of time, because they become far more efficient and far more effective as time goes on."

McNamara is expected to press for tighter control of defense spending in an effort to boost military power without a big budget increase. The defense secretary-nominee is a former accountant, and he earned a wide reputation as a cost-cutter and fiscal planner during his business career.

"Mr. McNamara and I are agreed that this country must have a defense establishment second to none," Kennedy said. "The establishment must be efficient so that the wisest possible use is made of the public moneys devoted to its maintenance. It must be organized in such a way that it makes the most immediate and effective use of our changing weapons technology. It must, in short, be so strong that it cannot merely defend the nation in the event of war, but, rather, so strong that it can maintain the peace . . . I am delighted that Mr. McNamara is accepting this sober responsibility."

McNamara was born June 9, 1916, in San Francisco, Calif., and he graduated Phi Beta Kappa from the University of California in 1937. He received a master's degree in business administration in 1939 from the Harvard Graduate School of Business Administration and joined the accounting firm of Price, Waterhouse and Co.

Returning to Harvard in 1940, McNamara served as assistant professor of business administration and at the same time was a War Department consultant on installation of an Air Force statistical control system.

He went to England in 1943 as a civilian War Department consultant and later was commissioned an Air Force captain. McNamara served in England, India, China and the Pacific, won the Legion of Merit and was discharged as a lieutenant colonel.

After World War II, McNamara and nine other Air Force officers formed a statistical control team and joined Ford as a group which became known as the Whiz Kids. He became manager of the company's planning office and its financial analysis office, and he was promoted to controller in 1949. McNamara became assistant general manager of the Ford Division in 1953 and vice president and division general manager in 1955. He moved through higher executive positions, including directors and executive committee member, before being named president Nov. 9.

In accepting the $25,000-a-year post, McNamara is giving up an income in excess of $400,000 annually in addition to expected profits on stock and options he owns. He estimated that this would amount to about $3 million over the next four years. McNamara said he owned 24,250 shares of Ford Co. stock, which at the current market price would bring about $1.6 million, and that he had options on 30,000 more shares. He sold the stock last week and said he will not exercise the options. He also sold 100 shares he owned in the Scott Paper Co. and is resigning as a Scott director.

McNamara is considered somewhat aloof, except with intimates, yet knowledgeable and tough, and he shuns publicity. He gets to work at 7:30 a.m. and often stays until 6:30 p.m. He prefers to study facts and figures rather than to rely on intuition in making decisions.

On any controversial question, he is known to thoroughly study both sides before making up his mind. Once he has made a decision, he is also considered very adept at selling his course of action, a trait which could serve him well when appearing before congressional committees.

McNamara will join the new Administration as political independent, although he is registered as a Republican. He supported the successful Senate bid of Phillip Hart who ran as the Democratic opponent of former Sen. Charles Potter (R.-Mich.) in 1958. In the 1960 elections, McNamara supported Sen. Kennedy for the presidency and Republican Paul Bagwell, the unsuccessful candidate for governor of Michigan.

Von Braun Not Joining Lionel, Medaris Says

New York—Reports that Dr. Wernher von Braun would join the Lionel Corp. were denied by Maj. Gen. John B. Medaris (Army, ret.), president of Lionel, in a talk before the New York Society of Security Analysts.

Lionel stock rose 2 points to 30 the day before Medaris spoke to the analysts, apparently on the basis of reports that Medaris would hint in his speech that von Braun, director of NASA's Marshall Space Flight Center, would join Lionel.

However, Medaris told the security analysts that "I do not see any probability in the foreseeable future that he [von Braun] will join me in Lionel," and added that "the rumor has no foundation."

The New York Stock Exchange said last week it was "looking into" reports that an advance draft of Medaris' speech was circulated among some New York brokers the day before Medaris appeared before the security analysts. The advance draft purportedly indicated Medaris would say that von Braun "may be with us some day."

Medaris told the analysts there had been no advance of the speech and that he was speaking from notes.

A New York Stock Exchange spokesman said the Exchange was looking into the situation as it normally would in cases where it appeared that advance information may have been leaked. If any irregularities are found, the Exchange could take action if any of its rules were violated, or it could present its findings to the Securities and Exchange Commission for possible action.

Lionel Corp.'s total sales for 1961 may be near $40 million, Medaris said. Total volume for 1960 is expected to exceed $30 million. Net earnings for 1960 are anticipated to total $1.4 million or a little better. Lionel had a loss of $1.25 million in 1959.

The company has budgeted $500,000 for research and development in 1961 and Medaris said Lionel "can now bid on complete, smaller, complex missile systems."

Killian Cautions Against Excessive Stress on Man-in-Space Program

New York—The United States must decide whether it can justify billions of dollars for man in space when its educational system is so inadequately supported, Dr. James R. Killian, Jr., said last week.

The nation must seek to determine whether it is now proceeding too rapidly in this area and whether it can manage the present man-in-space program without weakening other important national programs, including defense, Killian said in a speech at the annual dinner of the Massachusetts Institute of Technology Club of New York. Dr. Killian is chairman of the M. I. T. Corp. and served as President Eisenhower's first scientific adviser in the post-Sputnik era (AW July 4, p. 21).

Killian said, "I believe that in space exploration, as in all other fields that we choose to go into, we must never be content to be second best, but I do not believe that this requires us to engage in a prestige race with the Soviets. We should pursue our own objectives in space science and exploration and not let the Soviets choose them for us by our copying what they do."

Killian said he did not oppose a man-in-space program but asked that the public be given a better opportunity to understand and to debate the rate at which the U.S. proceeds with this program. He asked rhetorically, "Will several billion dollars a year additional for enhancing the quality of education not do more for the future of the United States and its position in the world than several billion dollars a year additional for man in space? The image of America may be shaped by the quality of its inner life more than by its exploits in outer space."

The U.S. public should insist on a space program that is in balance with our other vital endeavors in science and technology and that does not rob them because they currently are less spectacular, Killian said. He praised the U.S. space program to date as being well-planned and remarkably successful, and said that by concentrating on scientific discovery and practical objectives as improved weather forecasting and communications, we have exploited our own special genius.

The Soviet Union, Killian said, has "sought constantly to present spectacular accomplishments in space technology as an index of national strength, and too often the press and the public at large have interpreted these spectacular exploits as indices of strength.

"It must be admitted that spectacular accomplishments in space technology have enhanced the prestige of the Soviet Union, and we can all admire their achievements. But their expensive emphasis on space exploration will not be enough in the long pull to sustain an image of strength.

"This will only be accomplished by a balanced effort in science and technology. True strength and lasting prestige will come from the richness, variety, and depth of a nation's total program and from an outpouring of great discoveries and creative accomplishments on a wide front by its scientists and engineers."

"Today," Killian said, "the pressures are very great to engage in an item-by-item race with the Soviets. Our man-in-space program is the principal victim of these pressures and it is certain to present some difficult policy questions in the near future.

"It may be argued that the appeal of space exploration by man is so great that nothing will deter his engaging in manned exploration. It also may be argued that our man-in-space program is trying to proceed too fast and that it is on the way to become excessively extravagant and will be justified only as a competitor for world prestige with the Soviet man-in-space program. Many thoughtful citizens are convinced that the really exciting discoveries in space can be realized better by instruments than by man."

Killian pointed out that decisions must soon be made as to how far the U.S. goes with its man-in-space program and the future scale of total space efforts. He said, "Unless decisions result in containing our development of man-in-space systems and big rocket boosters, we will soon have committed ourselves to a multi-billion-dollar space program.

"I have never seen any public statement estimating the costs of the successive generations of big boosters for man in space or for the other parts of the program, he said. "How many billions of dollars will they cost over the next decade or more? How much is it likely to cost to orbit a man about the earth, to achieve a manned circumnavigation of the moon, or a lunar landing? The public should have some feel for the magnitudes involved.

"However much they may cost," Killian said, "we may decide we must spend the money but we should make this decision with a clear understanding of the startling costs entailed. We should not permit ourselves to slide unwittingly past a point of no return or to make the commitment without comparing its desirability with alternative expenditures."

Dr. Killian urged encouragement of more of the International Geophysical Year type of programs which are managed by nonpolitical, private scientific organizations, and encouragement of more international conferences such as the Conference on the Peaceful Uses of Atomic Energy.

He specifically urged support of the proposed United Nations conference on the peaceful use of outer space and on technical aid.

Killian said his views were "not consciously shaped by any recent or present political commitment."

AMC Is Developing Program Control Plan

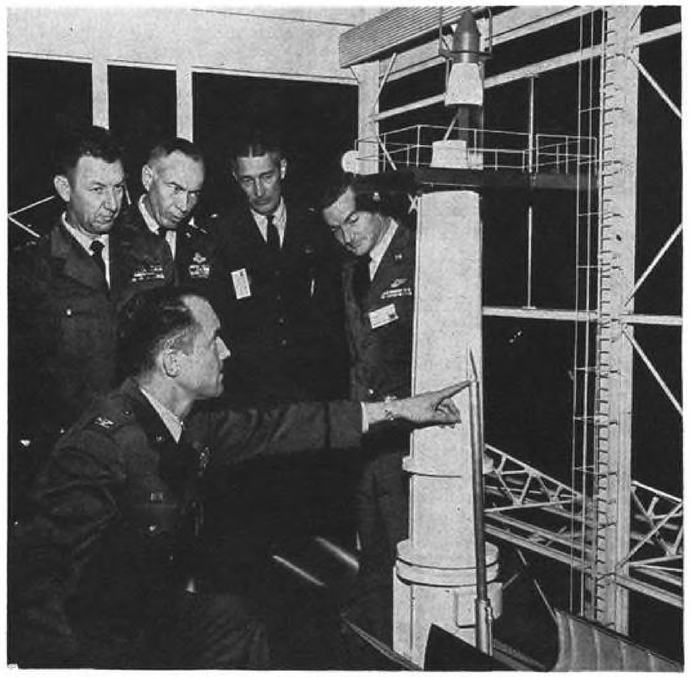
Dayton—Air Materiel Command and 19 major Air Force contractors are attempting to develop a mathematical control technique which will enable top decision-makers to quickly determine the approximate impact of reprograming on the cost and availability of major weapon systems.

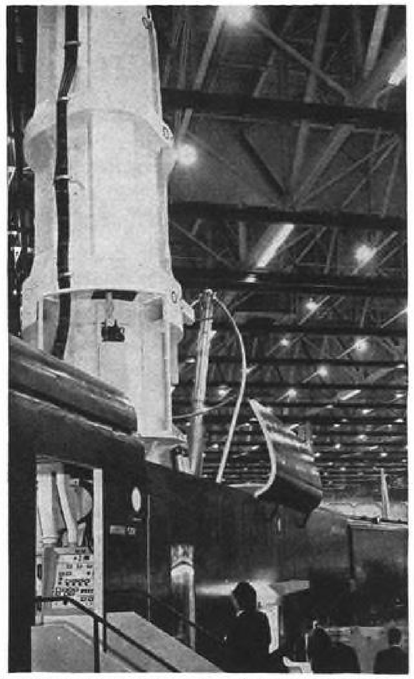
The program is known as Weapon Systems Program and Control System (WSPACS).

Second meeting of the AMC-industry WSPACS policy committee was held last week in Dayton. Industry members, representing a cross-section of Air Force aircraft, missile and major subsystem suppliers, are attempting to develop equations which define production rates and costs of a weapon in terms of total weapons produced, the go-ahead date and the date the last weapon is delivered.

If such equations can be developed, and AMC officials are moderately optimistic with the progress to date, then USAF officials can use digital computers to quickly assess the relative effects of increased or decreased funds on its many weapon system programs. At present, these effects are determined by a cut-and-try process which may take weeks or months and often involves repeated analyses by manufacturers, each based on a different funding level and production rate until a reasonable balance has been achieved in the reprograming.

Present AMC-industry studies are concentrating on aircraft production, with some effort being devoted to missiles. If successful, WSPACS studies will be extended to ground-based support systems. If the technique proves feasible, AMC expects to apply it to all major USAF contractors, both for production and research and development contracts. Earliest implementation date is estimated to be 12 to 18 months away.





TRANSFER process whereby Minuteman ICBMs will be placed aboard special railroad launching cars is described to Air Force officers by Col. S. C. Phillips, Minuteman program director. Full scale mockup of Minuteman train is shown at Boeing Seattle plant (right).

Minuteman Train Mockup Gains Approval

By William S. Reed

Seattle, Wash.—Full-scale mockup of the specially designed and equipped railroad cars which will roam the nation's more than 200,000 mi. of track carrying from three to five Minuteman missiles was formally approved by representatives of the U. S. Air Force, Assn. of American Railroads, Boeing Airplane Co. and subcontractors at a developmental engineering inspection here last week.

Lt. Gen. Bernard A. Schriever, commander of the Air Research and Development Command, revealed that the first fully-equipped mobile Minuteman train will take to the rails in mid-1963 with "more than 100" of the difficult-to-target ICBM launchers eventually slated to roam about the country in random patterns on two-week "cruises."

Each train will be composed of 11 to 15 cars depending on the number of missile cars carried. Launch control center car is programed for up to five missiles carried in a strongback in separate cars. A typical train will consist of:

• **Missile cars weighing 300,000 lb.** and measuring 88 ft. in length. Cars are fully enclosed with a hinged roof and hydraulically operated leveling devices. Plans are for the trains to lie on any of several hundred sidings in various locations which will be benchmarked for guidance accuracy. When in position, preprogramed tapes with target information will be fed into the launch control system and a self-aligning system, developed by Autonetics Division of North American Aviation, Inc., will seek true north and orient the Minuteman's inertial guidance system. Hydraulically-operated jacks are built into each missile car to ensure that each car is stabilized in a level attitude.

• **Launch control center car** housing two identical operator consoles, both of which must be sequenced before any of the missiles are fired. These consoles are entered through separate, locked doors and although the launch panel operators are sitting side-by-side, they are separated by a thick plate of bullet-proof glass. Launch consoles are connected in series so that one man cannot fire a missile without the proper switches being closed on the other console. The train commander also has a station in the launch control car from which he can maintain communications by several means including UHF radio, single sideband transceivers and other backup communications. Direct communication is possible with Strategic Air Command headquarters, local headquarters and the aerial command posts SAC plans to keep in the air.

• **Power car,** housing, in addition to diesel generators, sufficient fuel to keep the generators running throughout the two-week cruise. The system is designed so that any two of the five generators will run all the system in the train and one generator will supply power for missile launching.

• **Personnel cars,** three for sleeping and living quarters and one for a combination mess hall, recreation area and ready room. Sufficient food and water will be carried so that the train will not need to be resupplied during the time it is on-station or roaming about. Sleeping quarters also are provided for the civilian railroad crew as well as dining facilities. Not yet determined is whether the military and civilian crews will live as a unit or separately while on duty. Train operating crewmen probably will rotate each day or be on board only when the unit is scheduled to move to a new location.

• **Engines and operating crews** will be supplied by the railroads. They will not necessarily be apprised, for security reasons, of the particular duty or destination involved prior to reporting for work. The Brotherhood of Railroad Trainmen has pledged to the Assn. of American Railroads and to the Air Force that labor disputes which may arise in the future will in no way affect crews operating Minuteman trains. Railroad crews will receive standard wages for Minuteman duty as well as hours and working conditions on a par or better than that for civilian duty. Railroad officials claim that the mobile Minuteman trains can be effectively moved about over the roads without interfering with regular passenger or freight traffic and they foresee no difficulty whatever in their operation.

Reimbursement to the railroads will be on a mileage basis when the trains are under way and other costs will be paid according to the terms of agreements which are not yet completely worked out.

Rolling Stock

New rolling stock will be constructed by American Machine and Foundry and by American Car and Foundry. Ultimately, more than 1,000 new railroad cars will be needed for the 100-plus trains planned.

Fully-armed and ready Minuteman missiles will be carried in special cars enclosed in strongbacks. A constant environment for the missile and its guidance system is assured by electric heating and ventilating systems integral with the strongback, in addition to the fact that the missile is carried in a horizontal attitude enclosed within the car. When on an alert status, the roof of the car will be opened and the missile and strongback erected to the vertical. Just prior to firing, to assure proper environment for propellant and guidance for as long as possible, the strongback will open petal-fashion in two sections exposing the missile. Blast deflectors built into the floor of the car and lowered hydraulically will minimize damage to the car and permit reuse after refitting at a depot.

Also carried aboard the train in the rear of the last car is a ¼ ton, 4 x 4 truck (Jeep) for the train commander's use and for local transportation. Part of the 15-man SAC crew will be composed of a security force which will patrol the surrounding area on the alert for possible sabotage efforts. Gen. Schriever, although not considering it impossible, considers sabotage unlikely because of the remoteness of siding locations and the random movement pattern of the trains. Boeing officials pointed out, however, that the strongbacks in which Minuteman will be carried are for supporting the missile while en route, providing it with a constant environment and protecting it from the elements. The casings are not planned for armor against small arms fire or other sabotage measures.

Possibility of damage to the other cars in the train is slight, according to Maj. Gen. O. J. Ritland, commander of Ballistic Missile Division, but still above the risk level commanders are willing to take for peacetime or training exercises. The first developmental launch from a missile car scheduled for mid-1961 from Vandenberg AFB, Calif., will not see crews exposed unnecessarily and firing will be conducted from a remote blockhouse. Under wartime conditions, however, Gen. Ritland said, the slight risk caused by exposure of the crew would have to be taken since the command cars cannot be considered as safe as blockhouses.

Hazards of transporting fueled and armed missiles over the rails and through towns and in close proximity to other rail equipment was likened by Gen. Schriever as no more hazardous than transporting gasoline tank cars. Railroad officials expressed confidence in the fact that Minuteman trains would present less of a danger to personnel and equipment than do the thousands of gasoline and chemical tank cars moved daily throughout the nation.

Also on display at the engineering inspection was a model of a complete mobile unit support base (MUSB), one similar to which will be built near Hill AFB, Utah. At the sprawling MUSB, missiles will be armed with nuclear warheads and loaded aboard missile cars in their strongbacks, personnel and messing cars will be resupplied, power generators will be removed and replaced by over-hauled units and other rolling stock maintenance will be performed by Air Force and civilian crews. Turnaround time for the cars, except where other than preventive maintenance is performed, is estimated at 8 hr.

First Launch Date

First launch of a USAF-Boeing Minuteman still is scheduled for December although the launch now has slipped past its original target date. Best estimate is that the first firing, still planned for all three stages, will come in the week between Christmas and New Year's Day.

Additional sites for more squadrons of Minuteman beyond the three squadrons of 50 missiles each now scheduled for Malmstrom AFB, Mont. are being considered by the Air Force. A decision has not been made, however, as to where the installations will be made.

Earth Current Communication System

Seattle—Lt. Gen. Bernard A. Schriever disclosed that, beginning with the fourth Minuteman squadron in hardened, dispersed sites, an "earth current" system will be employed for communications between control centers and remote missile silos.

First reported by Aviation Week (AW May 18, 1959, p. 26), the system features buried antennas which emit and receive radio waves just like above-ground installations. Vertically-polarized radio waves are broadcast by the transmitter antenna which are refracted at the earth's surface. Waves which normally are considered as ground loss in above-ground installations travel along the earth-air interface and are received by buried antenna on the receiving end.

A Boeing Airplane Co. official said that tests conducted have enabled signals of 3 watts power to be received at 15 mi. and 30 watt signals received at 150 mi. Careful design of antennas results in minimum attenuation of signal strength due to passage of signals through the earth.

Buried antennas are said by Gen. Schriever to be sabotage-proof and use of standard anti-jamming techniques will render them jam proof. Cost of underground cables to pass alert and execute signals from blockhouse to missile is said by Schriever to be $20,000 to $25,000 per mile and since the five command centers, in a 50-missile complex, all must be able to launch each missile, the cost of cabling is high. Estimates are that the "earth current" communications technique will save about $300,000 per missile.

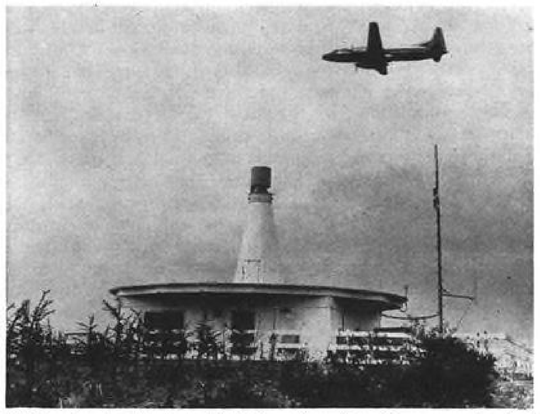
Discoverer XVIII Capsule Recovered

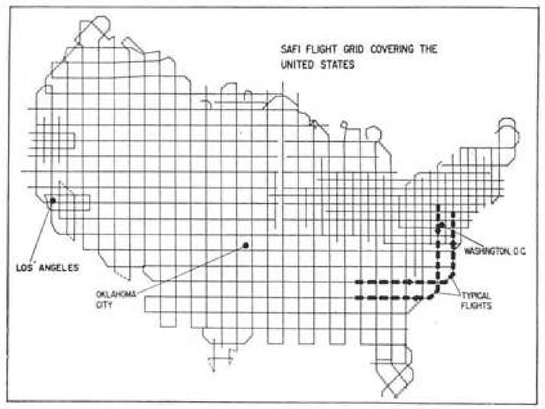
Los Angeles—Discoverer XVIII reentry capsule was recovered 400 mi. northwest of Hawaii in the third successful air snatch by a USAF Fairchild C-119, and the payload of 82 biomedical experiments is now being studied by scientists at the USAF School of Aviation Medicine at Brooks AFB, Tex.

The re-entry capsule was caught at an altitude of 13,000 ft. on the first pass. Capt. Gene W. Jones who made the successful catch was also the pilot of the C-119 that recovered Discoverer XVII a month earlier.

The re-entry capsule of Discoverer XVIII was returned to earth after the Agena B spacecraft had remained in orbit for 75 hr. and completed 48 passes. Air Force Ballistic Missile Division Commander Maj. Gen. Osmond J. Ritland called it "the most precise and successful flight test of a Discoverer vehicle to date."

Evaluation of experimental results will probably not be complete for at least another three weeks. Discoverer XVIII was not subject to the intense solar flare radiation of Discoverer XVII but it did penetrate the lower part of the inner Van Allen belt at its apogee of 450 mi.





SAFI system installed on FAA Convairs will enable agency to check performance of every navigation aid in the nation at two-month intervals. System permits time-saving flights along predetermined grid paths with aircraft flown under autopilot control from magnetic tape.

System to Speed FAA Nav-Aid Inspection

By Philip J. Klass

Washington—New Semi-Automatic Flight Inspection (SAFI) system, which will enable Federal Aviation Agency to measure the accuracy of the nation's vast network of navigation aids with increased precision and speed at all altitudes, was accepted here last week by the FAA.

New SAFI system is installed on three FAA Convairs (C-131Es), and is being installed on two others, which will perform a navigation aid inspection mission that previously required 15 FAA aircraft. The agency is readying plans to install SAFI systems on one or more of its Boeing KC-135 jets to evaluate navigation aid performance at altitudes above 20,000 ft. System was developed by Airborne Instruments Laboratory, a division of Cutler-Hammer.

Despite the smaller fleet of inspection aircraft, FAA hopes its five SAFI-equipped Convairs eventually will permit inspection of the nation's navigation aid network in as little as two months, compared with the four months now required.

An appreciation of the magnitude of the FAA's task in checking out the nation's navigation aids can be gained from the fact that there now are more than 800 omnirange (VOR) stations in operation plus another 400 Tacans and 200 of the old civil distance measuring equipments (DMEs). By 1965, FAA expects to be operating some 1,200 Vortac stations (combination VOR and Tacan).

The new AIL/FAA system largely automates the checkout procedure. Magnetic tapes prepared by the FAA's Aeronautical Center at Oklahoma City, which electronically define the precise flight path to be flown by the instrumented Convairs and the stations to be checked, are used to control aircraft flight through its automatic pilot.

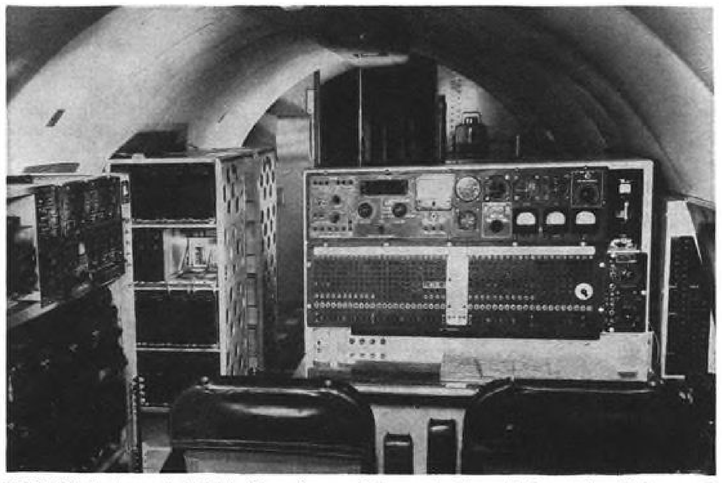
Performance data on navigation aids being checked during the run is recorded in digital form on magnetic tape aboard the aircraft. Following the flight, these tapes are sent to the FAA Oklahoma City facility where they will be speedily analyzed and processed by an International Business Machine Corp. IBM 704 computer. The use of the computer not only greatly speeds up the data reduction process but also permits much more detailed analysis of individual station errors than previously possible.

The traditional method of checking VOR and Tacan stations required the aircraft to orbit and fly radials to and from the station while its bearing to the station was visually determined by an observer at the station using an optical theodolite. Beyond ranges of aircraft visibility, ground landmarks had to be used to determine aircraft position relative to the station.

This old technique posed problems of coordination between aircraft and ground observer and was limited to lower altitudes and favorable weather conditions for visibility. Also, at higher altitudes the use of landmarks for determining aircraft position is increasingly imprecise.

An added disadvantage of the previous methods was that the data was obtained in a form requiring considerable manual effort and which did not lend itself to the use of computer analysis.

With the new SAFI system, the use of ground observers and visual sightings on landmarks is completely eliminated, permitting operational checks in all kinds of weather and at any altitude.



HEAVILY instrumented FAA Convairs, used for navigation aid inspection flights, each carry 11 VOR receivers, 11 Tacan and four DME sets, plus equipment for recording station performance on magnetic tape in digital form.

Aircraft position is precisely determined by means of distance measurements to two ground Vortac, Tacan or civil DME stations, one located along the aircraft's flight path and the other approximately at right angles to it. Two alternate ground stations are programed into the flight tape in the event either of the two primary stations should be inoperative or otherwise unavailable.

The use of distance measuring equipment to determine aircraft slant range to the ground stations is considered the most accurate means of establishing aircraft position short of setting up special additional ground facilities just for this purpose. The slant range (distance) to the ground stations is measured by Tacan equipments which have been modified to minimize instrumentation errors.

In addition to these reference units used to determine aircraft position, each of the FAA aircraft also is outfitted with airborne VOR, DME and Tacan receivers which also have been modified to minimize internal error so that the measured deviatio.. is largely an indication of ground station error. Each FAA Convair carries 11 Tacan sets, 11 VOR receivers and four civil DME sets. These numbers of equipments may later be expanded to a maximum of 20 VORs and 23 Tacan sets, the latter replacing civil DME sets as the old DME ground stations are decommissioned.

Grid Inspection

The use of automatic flight- and data-reduction techniques in SAFI will enable the FAA aircraft to fly a much more efficient nationwide grid pattern in its navigation aid inspections instead of flying a localized pattern around each station as in the past.

The use of grid flight path enables an FAA inspection aircraft to obtain performance data on a large number of stations in a single flight, with correlation of data obtained on different flights being performed subsequently by the IBM 704 computer. The grid flight plan minimizes the unnecessary redundant data formerly obtained when local station flight paths were employed.

The grid lines which the aircraft flies are separated by approximately 80 mi. in most parts of the country except the high density "golden triangle" (Boston-Chicago-Washington) where the grid line separation is 40 mi.

Using the grid flight plan, an FAA Convair can check as many as 37 stations in a five-hour period which formerly required nearly 100 hr. of flight time.

The IBM 704 is used to prepare the individual inspection flight tapes. In the process it determines which stations will be within receiving range of the aircraft for its particular flight path and altitude. The 704 then computes the slant range (distance) from the aircraft to four selected ground stations, one ahead of the aircraft, one behind, one to its left and one to its right, as a function of the aircraft's movement along its scheduled flight path.

The computer also calculates what the aircraft's bearing will be relative to each VOR/Tacan station within receiving range at every instant in its inspection run. This is also recorded on the flight tape and continuously compared with actual VOR/Tacan bearing readings obtained in flight. If bearing error exceeds certain limits, the FAA inspection crew is automatically alerted in order to take speedy action to shut down the erring station.

The flight tape also contains pre-recorded information on the operating frequency of each station along the route which automatically tunes an appropriate airborne equipment to the desired frequency as it comes within receiving range.

Bearing and distance measurements obtained from stations being inspected are recorded simultaneously on two tape transports as protection against loss of recorded data. Tapes subsequently are returned to Oklahoma City for analysis by the IBM 704. Measurements are recorded every half second during the flight, corresponding to a distance of 0.03 mi. at an aircraft speed of 225 kt.

Also recorded on the airborne flight log are periodic measurements of VOR station polarization error, station signal level, aircraft attitude and other supplemental data. All voice communications between the flight crew and the monitor console in the cabin also are recorded on magnetic tape.

Using the IBM 704, FAA will be able to process and analyze tapes from four of its inspection aircraft within an eight-hour period. The results, printed out by a separate plotting device, show in graphic form the bearing and distance measuring equipment accuracies of each FAA station. The data also is preserved on historical magnetic tapes for future comparison with subsequent flight inspection data to pinpoint deteriorating performance.

The SAFI installation in each Convair, including navigation receivers and instrumentation, weighs about 5,000 lb. The AIL contract, covering development of the system and its installation in the five aircraft, totaled about $3 million.

FAA currently is studying feasibility of developing similar semi-automatic equipment and techniques for inspecting instrument approach facilities using terminal area Vortac stations in combination with a small portable radar beacon suitably placed so that the FAA inspection aircraft can precisely determine its position during the final approach.

Swiss Delay Jet Fighter Selection

Emmen, Switzerland—Swiss parliament expects to reach a final decision in the drawn-out selection of a new fighter aircraft for the Swiss air force "sometime during the first half of next year," possibly during its March session.

Tentative schedule was announced by the Swiss military council earlier this month, when, as expected, (AW Oct. 31, p. 28) the French Dassault Mirage III-C and Swedish Saab J35-B—two remaining contenders for the Swiss order for 100 aircraft valued at around $125 million—demonstrated their capabilities to high military and government officials.

Both aircraft gave impressive proof during the demonstration of their ability to fill the air force's major requirements—relatively short takeoff and landing distances and high altitude capabilities enabling them to operate from the narrow Swiss military airstrips in the mountains.

A Dassault brochure lists takeoff distance of the Mirage III as 2,296 ft., landing distance with brake parachute as 1,968 ft., although "in certain conditions as little as about 1,640 ft. is needed." Without afterburner, thrust of the Snecma Atar-9 engine is 13,200 lb., but a rocket booster installed in the rear section of the fuselage adds an additional 3,300 lb.

Top speed in level flight is listed as Mach 2.15.

Draken requires between 1,640 and 1,968 ft. for takeoff and from 1,312 to 1,968 ft. for landing with brake parachute, according to Saab. Its speed is in the Mach 2-plus category. Its Rolls-Royce RB.146 engine also is in 13,200 lb. thrust category without afterburner.

Sweden was regarded in a strong position to obtain the Swiss order. One of the reasons behind this opinion is that Sweden is ready to offer the Swiss air force use of its military missile and rocket ranges for the testing and training it would require if the Draken is chosen.

France is not able to offer similar facilities, and Switzerland has none of its own.

Another factor in the Draken's favor is the fact that both Sweden and Switzerland have outwardly assumed a "neutralist" mantle and both are members of the European outer seven economic community whereas France is a member of the rival inner six.

Tory II-A Nuclear Ramjet Nears Testing

By Russell Hawkes

Mercury, Nev.—Testing of the Tory II-A experimental nuclear ramjet engine subsystems has begun here and first run of the complete engine is expected early in January.

Tory II-A is the first nuclear reactor designed to operate in conditions similar to those imposed on the reactor of a nuclear ramjet in flight. It will be followed by Tory II-C which will also be a non-flying test device in the National Aeronautics and Space Administration-Atomic Energy Commission joint Project Pluto. Tory II-C is expected to be very close in design to a flyable propulsion system. Unlike Tory II-A, its reactor control system will be designed to meet the requirements of flight. If Project Pluto annual funding continues at the present level, Tory II-C testing should end in late 1962 (AW Aug. 8, p. 39), and the project should end with it since no later phases are planned.

Since USAF canceled Project Slam, there is no existing military or civilian requirement for a nuclear ramjet. However, funding has continued on the development of terrain avoidance radar and automatic navigation systems vital to an unmanned nuclear ramjet aircraft. Project Pluto engines are theoretically designed for Mach 3 flight at altitudes between sea level and 1,000 ft.

Two reactors called Tory II-A1 and -A2 will be used in the present phase of the project. They are similar in design but the fuel elements are manufactured by different techniques. Elements for -A1 are made by General Electric Aircraft Nuclear Propulsion Department and those for -A2 are made by North American Aviation Atomics International Division. Elements for Tory II-C will be made by the Coors Porcelain Co.

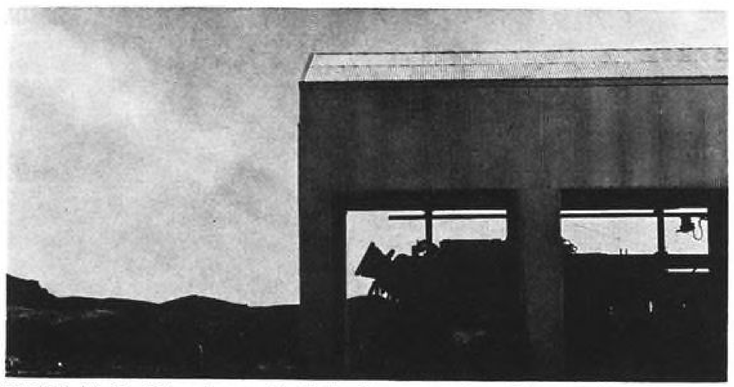
Tory II-A reactor core is made up of about 100,000 hollow, hexagonal fuel elements made of a homogenized mixture of enriched uranium and beryllium oxide. They are fabricated by General Electric Aircraft Nuclear Propulsion Department at Evendale, Ohio. Each fuel element is about four inches long and about a half inch in diameter. The elements are stacked in end-to-end layers to a total length of 45 in. All layers are bound within hexagonal matrices to prevent the layers of fuel elements from shifting about. Diameter of the core is 32 in. The front 10 in. and the aft two inches of the core are made of inert elements of pure beryllium oxide acting as neutron reflectors. A skeleton of unfueled elements prevents dislocations and ensures against bad load distribution.

The air supply in the Tory test bunker in area 401 is designed to deliver 720 lb. of air per second at Mach 0.1, 360 psi. and 1,060F. With the reactor operating at full power, the 120,000 lb. of air stored at 3,600 psi. would allow runs up to 90 sec. long. The pressure differential between the inlet and exit sides of the reactor exerts a pressure of 100,000 lb. upon the core. The core is braced aaginst this force by a molybdenum baseplate suspended from the cooler structure in the diffuser by 72 nickel alloy tension rods at the corners of the hexagonal fuel matrices. The shroud is also of high temperature nickel alloy. Design maximum temperature of the reactor is 2,300F. Tailpipe temperature is 1,950F and reactor power is 150 thermal megawatts. The chance of damage by thermal stresses is minimized by building the core of many small unattached elements.

To minimize costs, Tory II-A was made as small as possible. Tory II-C will be a much larger reactor. To get critical mass with minimum size and expenditure of fuel, Tory II-A was designed with a two foot-thick graphite neutron reflector around the core. The reflector is split vertically to make it possible to install and remove the reactor core; it contains eight reactor control vanes. Each vane is a row of boron metal rods in the side of a solid graphite cylinder that can be rotated within the graphite shield. Boron is a neutron absorber and reduces the neutron flux in the core. The vanes can cram the reactor within 0.5 sec. Four linear Boron-steel control rods penetrating the core are used for fast power changes and are capable of scramming the reactor within 0.2 sec. Vanes and rods are both hydraulically actuated.

Thrust will not be measured in the Tory II-A tests. Marquardt Corp., major ramjet contractor in the program, designed the nozzle mainly to keep pressure on the reactor core and to prevent airflow from going supersonic in the reactor. It is angled upward to minimize ground contamination. The purpose of the first tests is to demonstrate the feasibility of using a reactor to heat air for propulson and at the same time use the air to cool the reactor. The heat of the nuclear reaction is transferred directly to the propulsive flow as the air passes through the small holes in the fuel elements. The holes make up about half the cross-sectional area of the core.

The graphite reflector is cooled by heavy water pumped through channels bored in the graphite. Heavy water is a better neutron reflector than ordinary water which is used to cool the nozzle. After the 90 sec. power run, large blowers supply cooling air to dissipate residual heat for about two hours after the run.



TORY II-A is the first nuclear reactor designed to operate in conditions similar to those that would be imposed on the reactor of a nuclear ramjet in flight.

USAF C-130s Airlift Austrians to Congo

Wiesbaden—Five Lockheed C-130 turboprop transports of the Air Force's 322nd Air Division, which commanded the maximum-effort U.S. airlift to the Congo last summer, were scheduled to complete a mercy mission to the same strife-torn country last week.

At United Nations request, the C-130s were airlifting 49 Austrian medical technicians and 51 tons of supplies to Goma. Austrians, representing the 16th nationality to be flown to the Congo by U.S. aircraft since the Congo crisis began in June, raised the Air Force's total airlift figure to 17,500 persons and seven million tons of cargo.

Project Phoenix Aimed At Cheaper Launches

Washington—Air Force's Project Phoenix is aimed at making future launchings of large space vehicles as common and as reasonable in cost as takeoffs of B-52 bombers.

The Phoenix studies (AW Dec. 5, p. 26) are an attempt to integrate the best features of all phases of vehicle launching operations into a utilitarian approach that would be valid for at least 10 years.

Development of systems growing out of the studies is expected to begin next year. Test launches would begin in 1964, and the systems would be operational by 1965.

Work now is being done by Aerospace Corp., the Rand Corp., and Air Research and Development Command's Ballistic Missile Division. Initial recommendations are expected to go to BMD by the middle of next year. Aerospace is handling design work. Based on this, Rand will conduct economic studies.

Phoenix work is being done simultaneously in Defense Department Ballistic Missile Committee evaluations of low-cost upper stages for space vehicles.

Emphasis in the Phoenix work currently is on the launching of satellites and space probes, rather than missiles, but the advantages would apply equally to either type of weapon system. USAF has established a requirement for an 800,000-lb. booster in connection with Phoenix, but the studies are much broader than just development of a low-cost booster. Aspects of the studies are:

- **Missile launch complex** design, including new concepts in ground support equipment.
- **Low vulnerability.**
- **Quick reaction time.**
- **Extended shelf life** of booster components. Generally, Phoenix concepts probably will be applicable to handling of two-stage vehicles.
- **Recoverable boosters.**
- **Flexibility**, including the ability to handle solid and liquid propellant rockets, conventional or exotic fuels, and boosters of various sizes.
- **Economy**—reliability and utility at minimum cost.
- **Adaptability** to various environmental and geographic conditions.
- **Utility** resulting from rugged, uncomplicated, easily maintained and repaired vehicles and launch facilities.

The likelihood is that facilities resulting from Phoenix will be erected first at Atlantic Missile Range launch sites and later at the Pacific Missile Range. PMR lists Phoenix among its scheduled range programs.

One Phoenix scheme under study calls for an off-shore, Texas tower type of launching complex, consisting of one central control station for each pair of pads. Bolstering this approach are a number of company studies, both funded and unfunded, that also contemplate water-based launchings (AW Dec. 12, p. 69).

Nuclear Test Facility

Washington—Team of Ralph M. Parsons and Thiokol Chemical Corp. was selected last week by National Aeronautics and Space Administration to conduct a four-month design study for the National Nuclear Rocket Development Facility (AW Dec. 5, p. 37). Contract in excess of $100,000 will be negotiated. The study essentially is aimed at defining test facility requirements and recommending a site.

Bids Are Due Dec. 28 On Nimbus Integration

Washington—Bidders for the Nimbus weather satellite systems integration job must submit proposals by Dec. 28 to National Aeronautics and Space Administration's Goddard Space Flight Center.

Industry also is preparing proposals for the Nimbus spacecraft. Systems integrator will be responsible for packaging the stabilization, power and sensory subsystems in the spacecraft structure. Bidders' conference on both projects was held Nov. 28 at Goddard.

Nimbus component contracts already have been awarded to General Electronics Laboratory, Inc., for 17 telemetry transmitters; Radio Corp. of America, for design and construction of an electrostatic television camera laboratory model, and International Telephone and Telegraph Corp., for a radiometer.

Another Goddard contract expected to be awarded within the next few weeks is the orbiting geophysical observatory (OGO). Contenders for this modular spacecraft (AW Sept. 5, p. 26) include Aerojet-General Corp., Bendix, Convair, General Electric, Grumman, Hughes, Lockheed, Radio Corp. of America and Space Technology Laboratories.

News Digest

Atlas Able lunar orbiting payload launch failed Dec. 15 when the launch vehicle exploded 68 sec. after liftoff and fell in 70 ft. of water 8-12 mi. off Cape Canaveral.

Convair-Astronautics will build three experimental satellite payloads under a $1.9-million Advanced Research Projects Agency contract. The three piggyback payloads will be launched into 22,000-mi. orbits on Atlas Centaur test flights starting in 1962.

Republic Aviation has moved the annual August vacation period back to Dec. 22-Jan. 9 for F-105 production workers. Company said the move was made to permit F-105 acceptances to catch up with production.

Rep. Chet Holifield (D.-Calif.), who who will become chairman of the Joint Congressional Committee on Atomic Energy in the new Congress, charged last week that Department of Defense is blocking development of Project Pluto as a nuclear ramjet engine for a low-level supersonic missile.

Minneapolis-Honeywell has won a contract for first-phase in the development of an intertial guidance system for Dyna-Soar (AW Nov. 14, p. 23). Honeywell's Aeronautical Division will function as an associate prime contractor in the Dyna-Soar program under the six-month contract.

American Rocket Society has asked the U. S. Court of Appeals to block the recent action of Federal Communications Commission in denying petitions of American Telephone & Telegraph Co. and other common carriers who opposed the granting of frequencies above 890 mc. to private microwave users until the spectrum needs of commercial communications satellites are established.

Australia will place an initial order for 30 Dassault Mirage III interceptors, choosing the French Snecma Atar 9-powered aircraft over the Lockheed F-104 (AW Dec. 5, p. 23). Australia probably will build subsequent aircraft under license, but may replace French with U.S. avionic equipment. Switzerland, also considering the airplane, has been approached by Australia about handling design changes in common.

United Aircraft Corp. has acquired 15% interest in Ratier-Figeac, a French company that has manufactured propellers and components for the French air force and NATO under license to United's Hamilton Standard Division for six years. Other Hamilton Standard products may be added to the company's lines later for sale in the European common market.

Army-Martin Pershing made its second successful two-stage flight at the Atlantic Missile Range last week, carrying a Bendix inertial guidance system for the first time. Guidance was flown for checkout only and did not control the missile.

Carriers Scramble to Fill Florida Seats

Jet competition into Florida from northern points heavier than ever despite leveling off of market.

By Glenn Garrison

New York—Airlines serving the Florida market look forward to an excellent Christmas holiday business, but their fingers are crossed as to whether traffic over the entire winter season will fill greatly expanded jet capacities from the northeast and midwest.

Miami's growth as a travel market has shown signs of leveling off in the face of competition from other jet-accessible travel areas (AW Oct. 3, p. 39). Nevertheless, competition on many routes into Florida from northern points will be heavier than ever this year, with jets now serving all the major cities. Some airline officials believe that seats in anything but jets will be hard to sell during the season.

Airlines will operate 434 million seat miles into Florida from the northeast this month, according to one airline estimate—an increase of about 8% from last December. From the midwest, the estimated total is 361 million seat miles, an increase of about 18%, according to the estimate. Of the northeast capacity, about 50% will be in jets; the percentage from the midwest will be about 35% jet during December and higher late in the season. Seat-mile totals for the rest of the winter season certainly should not be relatively less than the December estimates.

In the New York-Miami market, the jet situation has at least temporarily brought a marked change in the carriers' relative positions. Eastern Air Lines, traditionally the heaviest operator on this route, will have fewer jet seats this winter than either of its two competitors, National Airlines and Northeast Airlines. Northeast plans to schedule the most jet seats of the three airlines.

But when piston and Lockheed Electra turboprop schedules are included, Eastern still will be way out in front in volume of New York-Miami service.

Eastern, with a current jet fleet of 11 Douglas DC-8s, has had to spread its jets to meet competition in many markets.

It also recently inaugurated jet service to Mexico City, a market it believes has great potential.

Increased Competition

Florida faces increasing competition from other tourist areas as the jets cut travel times and begin to reshape travel patterns around the world. Examples of areas competing strongly with Florida as tourist markets are the Caribbean and Puerto Rico.

Jet service to Florida from midwestern points will leap in volume this winter. Eastern and Delta will offer more jet seats from Chicago and other cities; Trans World Airlines will continue to provide jet service from St. Louis; Capital Airlines will enter the jet market with leased Boeing 720s from Pittsburgh and Cleveland. Northwest Orient Airlines' plans are clouded by an engineers' strike, but if that is settled soon the carrier will schedule jets from Chicago to Miami.

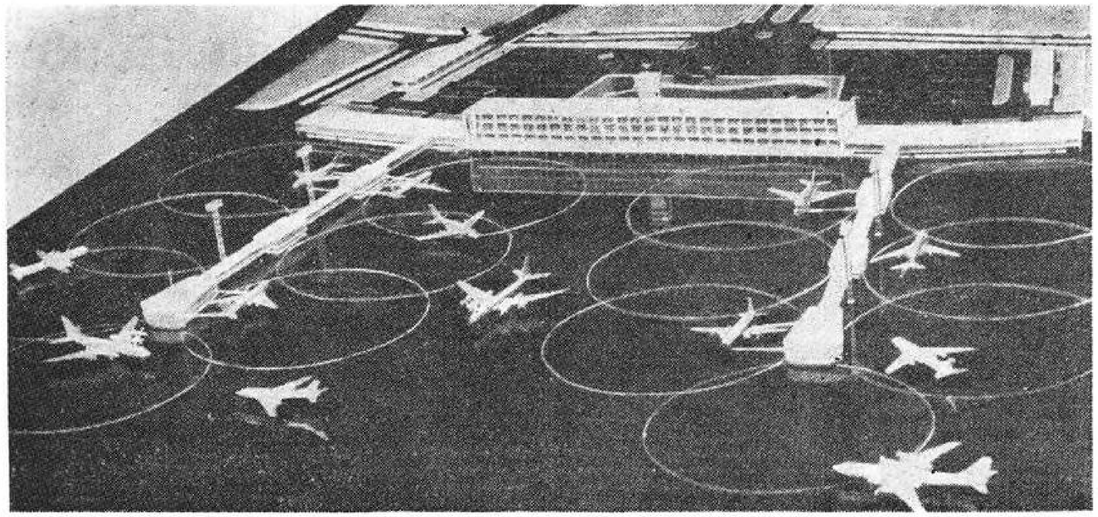
Market Outlook

Here is the outlook of seven airlines which are now presently serving the Florida market:

• **Capital** is leasing two 720s from United Air Lines and plans two daily flights from Cleveland to Miami and two daily flights from Pittsburgh to Miami. The aircraft will be 97-passenger mixed configuration; two will operate in mixed-class service and two as night coach. From its three major Florida markets—Buffalo, Cleveland, and Pittsburgh—and other Great Lakes area points, Capital will offer 872 daily seats in jets, Douglas DC-6Bs and a Vickers Viscount turboprop. The seat total is up about 112 from last winter's peak, but flights total 10 instead of 12. This is Capital's third season in the Florida service. The airline expects to do well this season because it will have no jet competition on its Cleveland-Miami and Pittsburgh-Miami runs. From Capital's point of view, Miami offers not only a market in itself but a gateway to the Caribbean from Capital's midwest points.

• **Delta** believes competition in some of its Florida markets will be strong this season, but points out that the situation is not new. Delta expects to be in a good competitive position, having been first with both DC-8s and Convair 880s from the midwest. As of next month, Delta will be offering 1,001 daily jet seats to Miami in nine flights, up from 595 jet seats in five flights last January. The 880s, in all-first-class 84-seat configuration, will serve Miami from Chicago and Cincinnati. Miami will be served from Chicago and Detroit by DC-8s carrying 119 seats in mixed configuration. Including other Florida cities, Delta will be offering 1,842 seats in jet and piston aircraft, up from 1,553 last January. Delta feels it will get its share of the Florida market because of its jet position. What the over-all market will be this season, according to Delta, depends on such factors as the weather and whether there is an economic recession. In the past, schedules sometimes have been cut back when the traffic hasn't materialized, and Delta will do this again if it becomes necessary. This is not expected, however.

• **Eastern** will be operating a normal 138 flights in and out of Miami this season to and from northern cities, up 24 flights from last season. The figures do not include extra sections. There will be 18 jet flights a day in and out of Miami to northern points, including New York, Chicago, Boston, Philadelphia and Detroit. Eastern's 115-passenger DC-8s will be competing with jets on every route to Miami. Examples: from New York, Eastern will schedule 345 daily jet seats against 516 seats by National and 630 seats by Northeast. From Chicago, Eastern's daily jet seat total will be 230 against 240 by Northwest (assuming its strike is settled in time) and 560 seats by Delta. From Detroit, Eastern's 230 jet seats will be matched by 238 Delta jet seats. Eastern will be serving several Florida points with jets this season: Tampa with daily DC-8 flights, West Palm Beach with the same. Including DC-7Bs and Electras as well as jets, Eastern plans to offer more than 10,000 seats a day in and out of Miami to northern points. An extra daily jet flight over the coming holidays has been scheduled and has been sold out. Bookings to Florida, Eastern reports, are up 10% (compared with an increase of 100% for bookings to Puerto Rico). Eastern, accepting a delay in DC-8 delivery in return for getting the more powerful JT4 engine, got a late start in the jet competition to Florida. In New York-Miami service, National scored by leasing Pan American 707-120s for the 1958-1959 winter season, and Northeast leased 707-320s from TWA the following winter.



New Airport for Moscow

Modern concrete and glass terminal over 1,000-ft. long is under construction at the new Domodedovo Airport 25 mi. south of Moscow. Terminal is designed to handle simultaneously 14 transports as large as the Tu-114 and presumably will serve international traffic now handled at Sheremetyevo Airport. Passengers will board through covered walkways extending from two loading fingers. Traffic pattern will not conflict with those at Moscow's present airports—Vnukovo, Sheremetyevo and Bykovo. Runways are nearly complete, and Aeroflot training flights are scheduled to start soon at Domodedovo.

Eastern's first DC-8 service was inaugurated late last January, and last winter's peak jet frequency was three daily flights in each direction. This winter's total of nine round-trip jet flights in and out of Miami does not include space in a thrice-weekly Braniff jet interchange, which is expected to provide 106 seats.

• **National's** jet capacity is up this season, but over-all capacity is down. Total seats available this month from key northern cities to Florida, including extra sections for the holidays, is 55,420; last December's figure was 60,052 seats. National's peak winter daily round-trip jet flights will total six, four of which will be New York-Miami, one Philadelphia-Miami, and one New York-Tampa. In addition, there will be a daily interchange jet flight with Panagra. During the last peak season, National operated four daily New York-Miami round trips with leased Pan American 707-120s, carrying 125 seats in mixed configuration. The carrier got its first DC-8s last February, and in February and March inaugurated DC-8 schedules for Philadelphia-Miami and New York-Tampa. The DC-8s, of which National now has three, carry 101 coach and 28 first-class seats. National has not leased jets this year.

• **Northeast,** with six 880s leased from General Dynamics, expects to operate a substantial proportion of the jet service between Miami and the northeast this season. For Northeast, this temporary edge in jet capacity will provide a "wonderful opportunity" and may enable the airline to get into the black in 1961. First-quarter 1961 results will tell the tale, the airline feels. Last winter, Northeast operated one daily round trip with its leased 140-passenger 707-320, but otherwise largely withdrew from the New York-Miami market and its heavy competition. This year, with the leased 320 still providing one daily schedule, five 880 daily round trips are planned between New York and Miami. From all northern points to the east coast of Florida, Northeast will fly 11 daily 880 round trips, five DC-6B round trips, and the 320 flight, for a total of 1,581 seats in each direction. These seats will be 76% jet. Last winter's seat total was 976. The DC-6B schedules will operate into other Florida points than Miami, but may be completely withdrawn from Florida by May 1, depending on how the traffic develops. Northeast will be operating from Boston, Philadelphia, New York and Washington to Miami, Ft. Lauderdale, Jacksonville and Tampa. During the December, 1959, through April, 1960, period, Northeast's Florida traffic was up 5% over the previous like period. However, with December excluded, the increase was 22.4%. This is because the Eastern strike of December, 1958, gave Northeast an abnormally high total, so last December's total showed a drop. Last summer's business was way down: July off 32%, August off 22%, for example. One reason: the recession starting about May "dried Miami out a little." But Northeast expects a good season generally this year in Florida.

• **Northwest** feels it would be premature to announce any jet schedules until the result of the strike is determined. Timetables out before the strike began called for a DC-8 flight beginning Dec. 15, Seattle-Chicago-Miami. Another flight was to have been added in January, Minneapolis/St. Paul-Chicago-Miami. Present schedules are three daily Electras from Minneapolis/St. Paul to Miami via Chicago. In January, February and March of 1960, Northwest carried about 69,000 passengers in and out of Florida, up from 59,412 for the previous like period. Northwest says the potential Florida season looks good on the basis of telephoned requests for space, but of course its own results are hard to predict because of the strike.

• **Trans World Airlines** will offer the same daily St. Louis-Miami round trip nonstop service in 707-120s, plus two daily Super G round trips with stops, that it offered last season. In addition, a 707-320 will make a Kansas City-St. Louis-Miami round trip on four peak days of the week beginning Jan. 10. TWA has no jet competition on this route and feels it will have no problem filling the jets. However, TWA was forced to discontinue the practice of operating its Miami-St. Louis jet on to Los Angeles with only a change of flight number. Civil Aeronautics Board required the airline to change planes at St. Louis, which it now does as a connecting flight to the West Coast. Including the four-a-week 707-320 service, TWA's round trip seats to Miami will total 300 first class and 446 coach.

Chosen Instrument Urged on Space Routes

By L. L. Doty

Washington—Institution of a single carrier, or chosen instrument, operation to replace competition between U. S. flag carriers on low traffic density international routes has been proposed by United Research, Inc., in a report prepared for the White House.

The report, which urges that international civil air operations continue to be conducted on an economic rather than political basis, proposes a traffic volume formula as the determining factor in judging how many carriers should serve a given route. In addition, the report found that all-cargo carriers make only a "modest contribution" toward national defense and that relatively few overseas routes have sufficient potential to support an all-cargo airline during the next few years.

The United Research report was issued to coincide with the arrival last week of the Civil Aeronautics Board final decision in the Transpacific Route Case at the White House. If the CAB followed Examiner William Madden's recommendations that competition be increased, the two documents will be in sharp contrast, since United Research takes strong issue with the examiner's initial decision on grounds that traffic in the Pacific area is not promising.

Coincidentally, the Aviation Securities Committee of the Investment Bankers Assn. of America recommended just before issuance of the United Research report that the pros and cons of a return to a chosen instrument policy in international air transportation be studied. "If our international airlines are to meet their foreign competition successfully," the report said, "it may be that they should complement each other's services more rather than draining themselves in internecine conflict."

Many of the committee's recommendation's reflected points made in previous years, but the chosen instrument one was a new element.

Chances are strong that President Eisenhower will use the report as a guide in approving or disapproving the CAB decision in the Transpacific Case, but it is unlikely that it will play a material role in presidential decisions in other major areas of the world once the Kennedy Administration moves into office.

Here are the highlights of the report:

• **More than one U. S. carrier** should operate over a given route only when the carriers can be expected to have available a minimum of 116,000 Third and Fourth Freedom passengers in both directions or 58,000 in each direction. This standard applies to long-haul international routes only. Traffic volume below this minimum will not support adequate, economical and profitable service by more than one airline.

• **Multiple designation** of U. S. carriers does not adversely affect political relations with foreign governments but it does complicate the task of U. S. negotiators because of conflicts of carrier interests. In addition, multiple designation becomes an issue in international relations when total capacity offered by U. S. carriers may be draining traffic from foreign carriers.

• **No points in Europe** or the Middle East in addition to those now being served by U. S. carriers warrant more than one carrier either now or in the future.

• **Importance of London,** Paris and Lisbon as gateways will be reduced when Rome and Frankfurt receive direct service as primary gateways. Traffic at and through Lisbon already falls below minimum standards for competition between U. S. carriers. Competitive service by two U. S. carriers is not justified at Madrid.

• **Traffic potential** from Frankfurt will provide only marginal support for competing U. S. carriers if the German city becomes a primary gateway, and suspension of one of the existing U. S. carriers, "presumably Trans World," should be considered.

• **Competition by two** U. S. carriers at London, Paris and Rome is now warranted and will continue to be warranted, but no second around-the-world service in competition with that offered by Pan American is justified.

• **Expansion of U. S. gateways** to include major cities other than New York should be treated as separate routes and should be tested for the number of carriers by the minimum traffic volume formula. All-cargo service of Seaboard and Western Airlines "does not appear to have caused appreciable competitive harm to our carriers, but it should not be subsidized or expanded to handle additional types of traffic."

• **Traffic density** in the Pacific area, even with substantial growth, will be much less than in the Atlantic area, and traffic from the U. S. East Coast to the Far East over the polar route does not warrant competitive service, contrary to Madden's recommendation. Pan American should not be awarded access to East Coast coterminals on its Central Pacific route, and Northwest should neither be certificated into California gateways for Central Pacific traffic nor awarded a Central Pacific route. However, if it is decided that Northwest should receive a Central Pacific route for reasons other than economic, its present Portland-Seattle route to Hawaii should be extended to Tokyo.

• **Traffic is not sufficient** to support an extension of Trans World Airlines' route, which now terminates at Bangkok, to Hong Kong and Tokyo. If, for reasons other than economic, it is concluded that a second around-the-world service is necessary, TWA and Northwest should be joined at Hong Kong.

• **Point-to-point competition** in South America is excessive, but the report urged that no action should be taken to correct the situation pending a settlement of the government's antitrust suit against Pan American, Panagra and W. R. Grace & Co.

• **U. S. airline service** in South America should consist of a single East Coast carrier and a single West Coast carrier competing with one another only at Buenos Aires. "Such a pattern could be achieved by resolution of the Panagra control question, merger of Panagra's and Braniff's routes and suspension of Braniff's spur route into Rio de Janeiro and Sao Paulo."

In developing its standards for multiple designation, the United Research group started on the assumption that when "there is a more or less fixed pool of traffic along a route or series of routes, the splitting of this available traffic between two or more carriers has the tendency to reduce schedule frequencies or load factors." This, the report found, reduces total revenues and has an adverse effect on unit costs.

It stated that if, because of competition, a carrier cannot reach a reasonable utilization of its ground personnel and facilities to the point where it can easily absorb minimum station costs, unit costs will grow.

United Research said that, at any prevailing level of rates and fares, a carrier must achieve a certain minimum load factor in order to cover its aircraft operating costs and a certain higher level to cover its total operating costs. Diversion of traffic by competition, the report concluded, tends to reduce either load factors or number of scheduled frequencies a carrier can operate. A sharp drop in load factors causes a substantial revenue loss, which leaves a carrier with little choice but to cut schedules and thus raise unit costs and lower utilization of personnel and facilities—and create a loss of traffic because of less attractive schedules.

The report admitted that minimum standards for multiple designation could discourage a single carrier from developing traffic above that standard for fear of having another carrier placed alongside it. On this point, the report said that the proposed standard should not be treated as an inflexible formula but regarded as a basis on which CAB and the President can exercise judgment.

USAF Supersonic Transport Policy Outlined

New York—Development of an economical Mach 3 transport is inevitable whether the U. S. or some other country is first to achieve this goal, Air Force Chief of Staff Gen. Thomas D. White told the American Ordnance Assn. here.

USAF has a lively interest in a national program to develop a supersonic transport and stands ready to make available its existing capabilities and to contribute to this program in the area of development management or any other way it can if called upon, he said.

Gen. White noted that some misunderstanding apparently exists on the USAF position in this matter (AW Nov. 14, p. 21) and emphasized that the Air Force does not contend that any commercial supersonic transport must be a modified B-70 Mach 3 bomber.

Gen. White said that only through a national supersonic transport program can the U. S. maintain is over-all leadership in aviation—"a leadership which is mandatory if the Air Force is to continue to be pre-eminent in aerospace power." He also noted that USAF cannot now justify the funding of such a supersonic transport program on military grounds alone, but it can foresee several interesting military applications for such an aircraft and would certainly "make good use of it if it were available through a national program."

"It has long been our conviction," Gen. White said, "that the development of a Mach 3 bomber such as the B-70 would open the door to higher speeds and performance by the civil aircraft of the future. This, however, should not be construed to mean that the Air Force feels that a national supersonic transport must be a derivative of the B-70.

"There is no doubt that the experience and knowledge gained in the B-70 program will reduce the total cost and effort of the supersonic commercial transport development program. Furthermore, unless the aircraft which is first developed under this program takes full advantage of the advanced technology of the B-70 in terms of speed and growth potential, it cannot in my opinion remain commercially competitive for very long."

TWA Seeks Early 880 Deliveries; Financing Program Nears Closing

Trans World Airlines was working last week to get some of its Convair 880s delivered and into service by Christmas. If obstacles are cleared the airplanes probably will go in as extra sections and not scheduled flights.

TWA's one 880 on hand, which has been used in its training program, was being painted at the TWA overhaul base in Kansas City prior to placing it on the line. At least two or three airplanes at Convair's plant at San Diego, could be ready for delivery quickly.

Initial Service

Routes likely to get 880 service first include New York-Chicago and Chicago-West Coast, points where United Air Lines and American Airlines have been pushing jet service. Another service likely is New York-Phoenix where the season is beginning and where American has begun to operate Boeing 720 service. Dayton-Chicago and the West Coast is another possible route. Scheduled service will not begin until January.

Closing of the TWA financing program is scheduled for Dec. 31 but may be moved up to Dec. 29. There is still some possibility of a last minute hitch, but since Howard Hughes' signatures are on letters of intent, this development is not likely. Convair is not expected to raise unnecessary questions on payment for charges incurred by the long delivery delay (AW Dec. 12, p. 29).

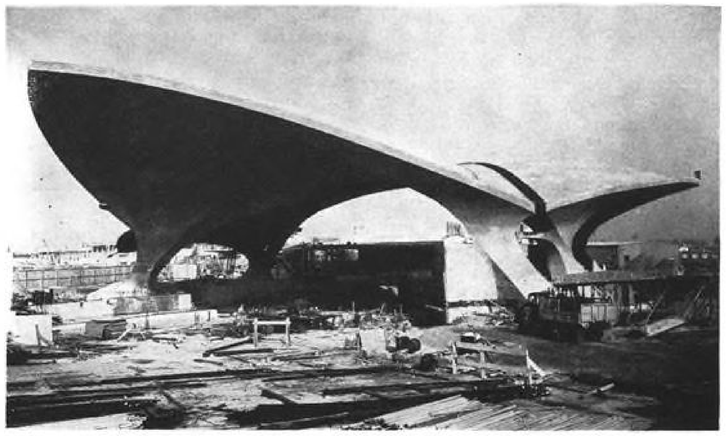
The lenders in the Dillon, Read plan which Hughes offered to accept will choose two trustees on the basis of participation in the loans. Since $90 million of the total of $165 million long term debt contemplated will be provided by Equitable Life Assurance Co. and Metropolitan Life Insurance Co., their influence could be great in the selection.

Balance of the long term debt—$75 million—will be provided by a group of banks headed by Irving Trust Co., and in order of participation after Irving Trust, Bank of America, National Trust and Savings Assn., Bankers Trust Co., Mellon National Bank and Trust Co., Morgan Guaranty Trust Co., First National Bank of Boston, Security First National Bank of Los Angeles, the California Bank and the National Bank of Commerce of Houston.

Debentures Offered

In addition, TWA will offer $100 million of subordinated income debentures with warrants to its stockholders with Hughes Tool Co. purchasing not only its pro rata portion of $78 million, but also enough of the debentures not taken up to provide TWA at least $100 million.

One of the first steps expected will be a reshuffling of TWA's board, after which a new president is expected to be chosen. The proposed merger with Northeast has been extended until Dec. 31 and might be extended further.



Buttresses Support Roof of TWA's Idlewild Terminal

Concrete roof of Trans World Airlines' new passenger terminal at New York International Airport weighs 11 million lb. and is supported by four buttresses. Terminal is expected to accommodate 785,000 passengers during 1962, its first year of operation, and 1.1 million passengers by 1970. A walkway will connect terminal building with a star-shaped building equipped with seven gates for simultaneous accommodation of seven aircraft.

MAXIMUM capacity of Sikorsky's twin-turboshaft S-61L is 28 passengers. In this configuration, helicopter's cargo space totals 116 cu. ft., split between a removable baggage pod and two side-by-side bins in the aft right fuselage.

Sikorsky Rolls Out First Airline S-61

By David H. Hoffman

Stratford, Conn.—Sikorsky's twin-turbine S-61L, a 25 to 28-passenger helicopter purchased by Los Angeles Airways and Chicago Helicopter Airways, should enter airline service shortly after it earns full certification in September of next year, the manufacturer reported last week.

If Sikorsky's timetable unfolds on schedule, the first S-61L will be delivered to Los Angeles Airways in May or June of 1961 with provisional certification. Both carriers plan to inaugurate S-61L schedules next fall.

To date, Los Angeles has ordered five of the 18,700 lb. gross weight helicopters and Chicago has ordered four. Basic price of the aircraft, which includes its two General Electric T58-8 turboshaft engines, is listed at $650,000 by Sikorsky.

Flown here last week in its first public preview, the S-61L incorporates a lockout device that enables its pilot to check hydraulic, servo, electrical, communications and other systems without engaging the helicopter's rotor. This is accomplished by linking the left engine's turboshaft to the accessory section of the aircraft's main gear box.

Because the pay of helicopter airline pilots usually is based upon rotor time, and because only the left engine of the S-61L need be started to work through preliminary checklists, the disengaging feature is expected to earn substantial savings for future operators.

Aircraft delivered to Los Angeles Airways will carry removable baggage pods, an innovation for helicopters designed by Clarence M. Belinn, president of the airline. Located just aft of the cockpit at the base of the fuselage, the drawer-like pod can carry about 1,200 lb. of baggage or about 25 suitcases in mixed assortment (AW Oct. 3, p. 82).

Carts for conveying the pods to the terminal after they have been rolled out of and off the aircraft now are being fabricated at the Sikorsky plant here.

The four aircraft slated for Chicago operation will not contain the pod feature. John S. Gleason, Jr., president of the airline, has said that his S-61Ls will be used exclusively for passenger service.

Designed specifically for airline use (most other helicopters in commercial service represent outgrowths of military projects), the S-61L, in its several configurations, also incorporates:

- **Fore and aft doors** to enable simultaneous loading and unloading of passengers and cargo. Forward door is 50-in. wide, used primarily for freight and located just under twin jet intakes on top of fuselage. Aft door has built-in airstair that free-falls open and retracts with the aid of power stored in a spring motor.
- **Movable cabin bulkhead** that adjusts the size of cargo and passenger compartments to take full advantage of available loads. The fully upholstered bulkhead, which fits from ceiling to floor and from wall to wall, contains a door to link the two compartments in flight.
- **Large hold under cockpit** to house electronic and communications gear. An external door permits easy entry for maintenance purposes.
- **Soundproof interior** offering an in-flight noise level about 50% less than the comparable level in the piston-engine Sikorsky S-58 operated by Chicago Helicopter Airways.

Speed range of the S-61L on one engine is from 40 to 100 kt. Although the helicopter cannot hover on single engine, it can maintain a positive rate of climb at average gross weights if airspeed is kept above 60 to 65 kt.

Potential Growth

Growth potential of the S-61L is illustrated by its maximum structural design weight of 20,500 lb.—a weight 1,800 lb. greater than the one at which the helicopter first will be certificated. The 20,500-lb. figure, therefore, marks the ultimate gross weight the aircraft can operate at without undergoing another costly round of airframe stress testing.

A Navy version of the S-61L, the HSS-2 anti-submarine warfare helicopter (AW Nov. 7, p. 19), already has logged 1,400 hr. in test and demonstration flights. According to Sikorsky, the HSS-2 has been pushed well beyond its 155 mph. maximum design speed without mishap and has satisfactorily demonstrated its capability to perform its design mission: a 4 hr. ASW patrol carrying both search gear and attack weapons.

Although the HSS-2 has an amphibious hull and side pontoons, the S-61Ls ordered by Chicago and Los Angeles will be limited to land operations. With over-land route structures, the two carriers elected to save the extra cost of the amphibious version of the S-61L.

Sikorsky S-61L Data

Gross weight	18,700 lb.
Empty weight	9,270 lb.
Useful load	9,430 lb.
Fuel capacity	390 gal.
Main rotor diameter	62 ft.
Fuselage length	58 ft. 11 in.
Over-all length	72 ft. 8.5 in.
Engines	Two General Electric T58-8 turboshaft engines developing a maximum of 1,250 shp. and having a normal power rating of 1,050 shp.
Maximum speed at sea level at average gross weight	147 mph.
Average cruise speed at sea level	136 mph.
Best rate of climb at sea level	1,600 fpm.
Range with full fuel load	350 stat. mi.

Quesada Blasts AOPA and ALPA During FAA Report to Congress

Washington—The Federal Aviation Agency Administrator E. R. Quesada accused Aircraft Owners and Pilots Assn. and Air Lines Pilots Assn. last week of attempting to undermine Federal Aviation Agency's safety rules and enforcement during a farewell appearance before a House Commerce subcommittee report on FAA's two-year existence.

In his two-hour, 47-page testimony, Quesada told the subcommittee, headed by Rep. John Bell Williams (D.-Miss.), that when he became administrator of the newly-created agency on Nov. 1, 1958, "I was by no means naive as to the past history of the AOPA as a self-serving group. But I must admit I was not fully prepared for the intensity of their invective or for the imaginative and sometimes devious methods they employ." He will leave the FAA post Jan. 20 when President Eisenhower leaves the White House.

Declaring that he refused to be "intimidated" or allow FAA personnel to be intimidated, Quesada presented a case-by-case list of AOPA and ALPA attacks on FAA and urged the subcommittee to continue to insist on effective administration for air safety.

The type of pressure "widely employed" against FAA, Quesada said, follows this pattern: "First, attack the rule. If our action is not in accord with the desires of the pressure group, it is termed 'arbitrary' and 'capricious.' Second, attack the procedure. When the wisdom of the action is so clear that it cannot be successfully attacked, the procedure by which the action is taken is described as 'unfair' or 'unjust.' Third, attack the agency. Assuming the procedure is above reproach, they attack the agency itself. The agency is characterized as a 'dictatorship.' Fourth, attack the man. When the agency withstands this attack, they attack the administrator. His resignation is publicly demanded, or communications are addressed to the President calling for his dismissal."

He challenged AOPA to test the validity of its accusations that FAA is a "police state" and a "reign of terror" in the courts of the land, commenting that the association was financially able to do this with its annual income "conservatively estimated to be in excess of $1 million." Quesada said that frequently AOPA attributes "dark intentions" to FAA, tells its pilot members the agency is about to "harm them irrevocably" and then takes credit for defeating self-generated proposals which existed only in their imagination. He noted that AOPA officers are neither elected by "or in any way controlled by the membership" of over 80,000 pilots.

Quesada was critical of ALPA for its opposition to FAA's 60-year age limitation on airline pilots and its unsuccessful refusal to allow cockpit space for FAA in-flight inspectors. "We had no intention of abandoning our inspection duties under the Federal Aviation Act at the whim of ALPA," he commented. Quesada noted that all of the court decisions that have been handed down so far in two cases involving pilot age have supported FAA's 60-year limit. ALPA has appealed one case to the U. S. Court of Appeals.

Examiner Proposes Short Coach Flights

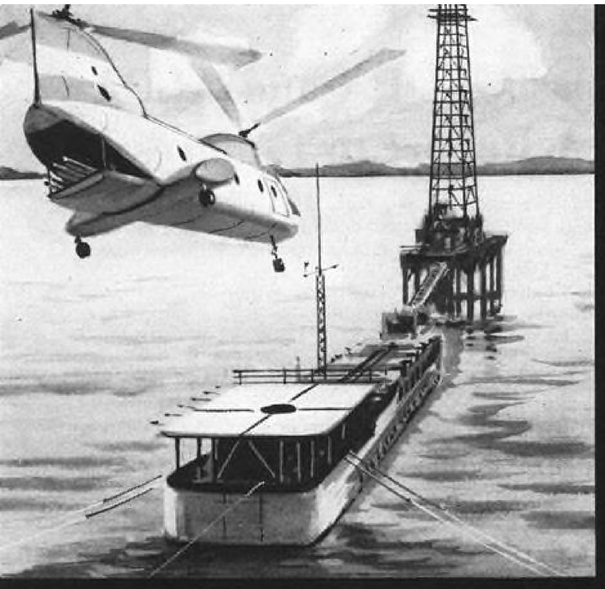
Washington—U. S. Civil Aeronautics Board Examiner Paul N. Pfeiffer termed coach service economically feasible in short haul markets last week and proposed that minimum service standards be set in short-haul markets serving New York.

In his initial decision in the New York Short-Haul Coach Investigation, Pfeiffer said that short-haul coach service is used by passengers in approximately the same proportion as it is offered.

He said such service conducted with Douglas DC-6, DC-6B and Lockheed 1049C equipment can be operated as profitably and, in some instances, more profitably than first-class service in short-haul markets.

His recommendations called for the inauguration of a New York-Washington no-reservation, economy service by American, Northeast, National and Eastern within 90 days of the Board's final decision in the case. He urged that, if at least one of these carriers has not instituted the service within that time, that Allegheny Airlines be granted an exemption lifting its one-stop restriction so it may conduct the service on a one-year experimental basis.

He proposed this standard as a means of ensuring minimum adequate coach service in all short-haul markets: short-haul markets should be provided with a minimum of two daily coach flights in each direction, one during the morning commuter period, which he defined as between 7:00 a.m. and 10:00 a. m., and the other between evening commuter hours—4:00-7:00 p.m. Pfeiffer said this service would permit round-trip commuting in one day.



NEW SPEED, NEW VERSATILITY, NEW ECONOMY

WITH THE VERTOL 107-MODEL II

The new twin-turbine powered Vertol 107 has inaugurated a new era in helicopter operations. New York Airways has already ordered ten of these tandem-rotor helicopters in the luxurious airline version. Five will go into service by the spring of 1961, providing New York Airways passengers with the comforts now enjoyed in conventional fixed-wing aircraft. For greater passenger convenience, Vertol's unique mobile baggage container can be removed, unloaded and replaced in minimum time, eliminating one of the most annoying causes of passenger delay.

Airline operation is only one of the many applications for the Vertol 107-Model II. Its twin-turbine reliability and ease of handling—its altitude and speed characteristics—its water-landing capabilities—its extra-large cargo capacity and straight-in rear loading—its ability to haul loads internally, externally or half-in, half-out—all add up to new speed, new dimensions in versatility and new economy for many commercial and industrial applications such as petroleum, mining, logging, and construction.

For complete details on the Vertol 107-Model II, write: Commercial Sales Manager.

VERTOL DIVISION BOEING
MORTON PENNSYLVANIA

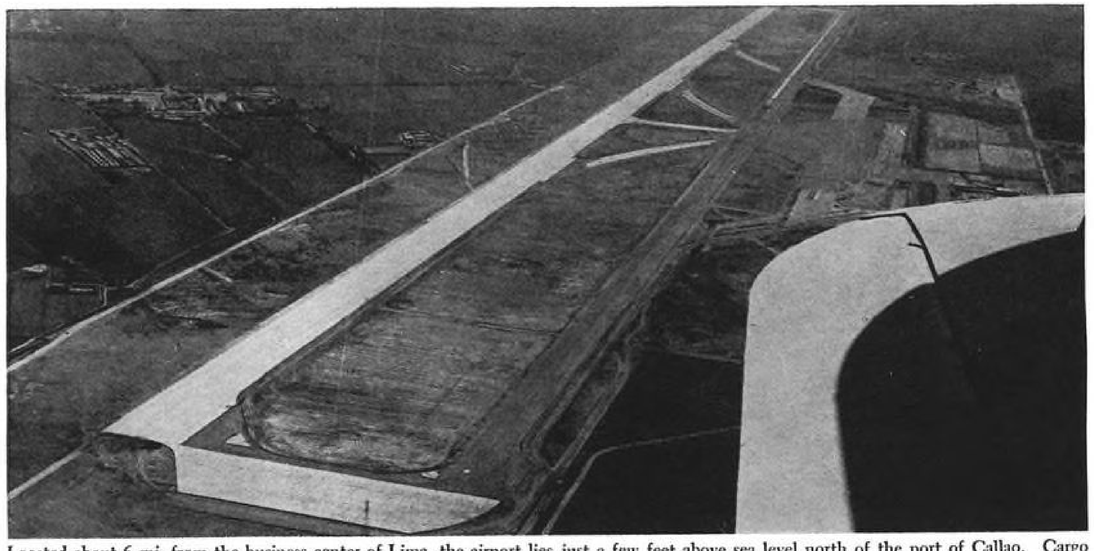
Airline Traffic—October, 1960

	Revenue Passengers	Revenue Passengers Miles (000)	Load Factor %	U. S. Mail Ton-Miles	Express Ton-Miles	Freight Ton-Miles	Total Revenue Ton-Miles	Over-all Revenue Load Factor %
DOMESTIC TRUNK								
American	699,672	556,199	65.9	1,775,581	1,144,642	10,905,306	67,158,951	56.7
Braniff	196,684	94,434	59.8	472,453	136,201	496,567	10,158,318	47.6
Capital	310,994	125,674	54.1	567,458	352,558	545,563	13,502,888	49.7
Continental	116,421	75,504	50.2	238,561	138,949	587,432	8,201,950	41.0
Delta	295,503	156,965	58.6	499,625	351,773	1,320,813	17,254,472	49.7
Eastern	626,402	310,135	48.81	1,312,318	644,609	2,196,640	34,056,458	39.11
National	123,178	70,233	47.2	298,867	62,568	642,380	7,789,361	37.2
Northeast	123,502	40,901	47.3	122,153	51,216	229,824	4,311,004	41.5
Northwest	152,303	103,145	50.9	640,965	324,484	1,576,551	12,446,774	47.5
Trans World	428,304	378,332	64.2	1,466,793	843,589	4,253,333	42,826,009	51.4
United	713,288	516,480	65.6	3,416,887	1,049,881	7,401,184	64,394,961	56.3
Western	133,693	73,638	57.4	289,604	114,161	348,250	7,806,353	50.8
INTERNATIONAL								
American	6,995	6,717	41.4	13,208	3,571	316,573	1,028,612	42.1
Braniff	5,550	11,223	55.1	42,420	.....	104,490	1,339,628	48.2
Caribbean Atlantic	26,282	1,800	61.7	2,007	.....	6,685	175,908	61.0
Delta	1,549	2,071	33.4	1,829	.....	27,078	260,350	34.6
Eastern	36,881	54,080	47.86	133,187	.....	380,738	5,540,958	41.21
Mackey	6,514	1,814	51.9	.....	58	4,169	180,627	50.5
National	3,150	2,752	70.2	1,249	.....	8,864	318,474	66.7
Northwest	13,399	21,209	50.8	1,254,584	12,765	935,340	4,471,820	56.4
Pan American								
Alaska	4,950	5,377	49.0	35,021	.....	201,084	793,100	52.9
Atlantic	145,178	195,034	59.7	2,426,000	.....	5,250,002	28,037,781	55.0
Latin America	82,069	96,221	55.8	434,198	.....	4,748,890	14,937,696	57.1
Pacific	40,242	156,504	70.5	2,636,890	.....	3,901,180	22,701,837	62.0
Panagra	10,068	17,275	57.1	89,250	.....	526,239	2,489,585	54.9
Resort[2]	.....	.....	.....	.....	.....	.....	.....	.....
Trans Caribbean	9,679	15,005	82.8	.....	.....	506,983	1,770,994	83.9
Trans World	37,672	117,327	63.3	1,540,430	.....	1,907,985	15,766,966	64.7
United	16,074	39,932	67.1	289,337	18,731	166,692	4,527,264	66.4
Western	3,336	5,188	46.7	9,493	.....	21,845	574,512	49.4
LOCAL SERVICE								
Allegheny	66,934	13,653	42.0	18,116	38,118	53,920	1,412,448	43.0
Bonanza	24,258	5,991	44.6	7,138	4,700	11,110	597,158	45.7
Central	15,195	3,063	41.7	8,491	6,008	18,202	326,176	38.1
Frontier	29,955	8,067	40.9	28,914	12,617	67,113	886,221	45.4
Lake Central	20,297	3,272	40.8	6,272	21,451	.....	340,632	45.3
Mohawk	60,463	12,269	47.0	19,650	21,121	21,660	1,232,154	43.3
North Central	85,505	14,932	45.23	39,261	52,256	53,427	1,592,238	46.85
Ozark	54,303	9,672	44.3	18,764	30,639	39,207	1,014,177	48.4
Pacific[1]	.....	.....	.....	.....	.....	.....	.....	.....
Piedmont	42,211	8,841	47.6	14,183	16,260	22,636	899,607	49.0
Southern[1]	.....	.....	.....	.....	.....	.....	.....	.....
Trans-Texas[3]	.....	.....	.....	.....	.....	.....	.....	.....
West Coast	31,739	7,674	43.40	15,120	5,483	22,733	776,235	43.90
HAWAIIAN LINES								
Aloha	26,539	3,921	53.1	3,059	.....	5,744	322,932	45.4
Hawaiian	38,112	7,698	58.9	4,106	.....	225,855	846,143	55.8
CARGO LINES								
AAXICO[2]	.....	.....	.....	.....	.....	.....	.....	.....
Aerovias Sud Americana[1]	.....	.....	.....	.....	.....	.....	.....	.....
Flying Tiger	2,712	15,386	70.1	35,922	60,659	11,640,766	13,275,937	75.2
Riddle—Domestic	.....	.....	.....	19,811	44,793	3,058,188	3,122,792	64.8
Overseas	.....	.....	.....	5,092	30	467,368	472,490	57.9
Seaboard & Western	1,749	6,943	100.0	965,353	.....	3,288,809	4,958,332	72.3
Slick	3,870	24,932	100.0	.....	.....	2,200,522	4,693,759	100.0
HELICOPTER LINES								
Chicago Helicopter	29,756	498	49.0	1,198	.....	.....	48,768	40.8
Los Angeles Airways	2,731	97.6	54.5	5,105	2,511	.....	16,977	64.6
New York Airways	13,795	292	55.1	1,567	802	516	30,785	53.5
ALASKA LINES								
Alaska Airlines	9,434	8,911	52.2	63,985	4,760	427,205	1,382,290	62.3
Alaska Coastal	4,249	431	56.0	4,208	.....	5,448	53,968	64.2
Cordova	1,348	205	34.7	3,871	.....	48,927	74,300	48.7
Ellis[1]	.....	.....	.....	.....	.....	.....	.....	.....
Northern Consolidated	1,860	562	28.4	43,648	.....	68,896	174,951	53.1
Pacific Northern	9,276	8,891	44.4	152,232	12,906	419,892	1,553,411	63.2
Reeve Aleutian	1,173	1,086	37.4	53,171	.....	75,853	248,011	59.2
Western Alaska	414	23	59.0	741	.....	1,158	4,068	53.2
Wien Alaska	2,362	568	31.3	44,097	.....	91,033	194,433	50.6
Avalon Air Transport	3,796	241	63.5	455	.....	395	23,809	65.9

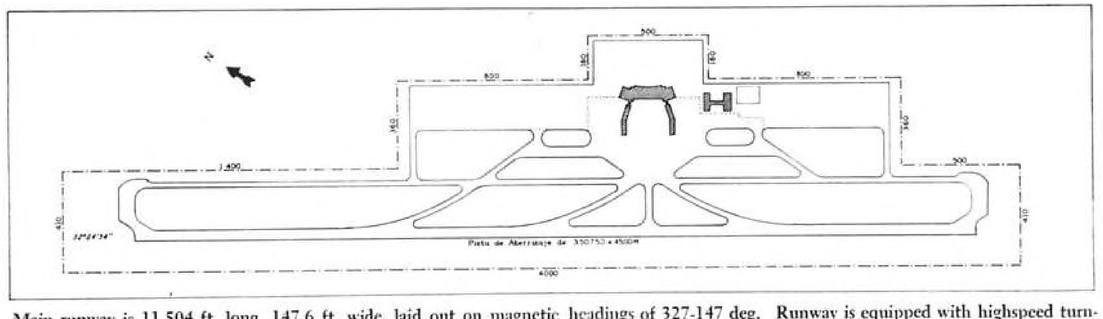
[1] Not available. [2] No operations this month. [3] Extensions granted due to destruction of records by fire.
Compiled by Aviation Week from airline reports to the Civil Aeronautics Board.

First aircraft to land at new Lima-Callao International Airport was this Panagra Douglas DC-8 en route from New York to Buenos Aires. The 618-acre $8-million airport, which replaces Limatambo Airport, was inaugurated Oct. 29. Activation was delayed until construction of a two-mile double-lane access highway and a four-lane bridge over the Rimac River were completed.

New Lima-Callao Airport Designed for Jet Traffic



Located about 6 mi. from the business center of Lima, the airport lies just a few feet above sea level north of the port of Callao. Cargo building will serve as temporary passenger building until new terminal is completed next year. Jet traffic approaches the airport from the sea, eliminating noise problem. Runway is equipped with ILS and latest lighting aids.



Main runway is 11,504 ft. long, 147.6 ft. wide, laid out on magnetic headings of 327-147 deg. Runway is equipped with highspeed turn-offs to accelerate traffic flow. Also, 18,358 ft. of taxiways have been laid and ample room exists for construction of parallel strips.

Fairchild Write-down Includes Unsold F-27s

Fairchild Engine & Airplane Corp.'s latest inventory write-down of $5,500,000 includes four completed but unsold F-27s now parked on the ramp at Hagerstown, Md., and six others, also unsold, in various states of completion.

Fairchild will commit no more lots to production until these airplanes are sold and until there are indications future lots can be sold profitably. Sales interest is reported in the completed airplanes, primarily by corporate customers (AW Oct. 24, p. 27).

The write-off, taken in the third quarter, plus an operating loss of $1.3 million for the year to date, gave Fairchild a nine-month total loss of $6.8 million on sales of $65,501,000. Sales for the same period last year were $86,217,000 and a net profit of $728,000 or 24 cents a share was reported.

Fairchild reports it has ample spares inventory for F-27 operators and is maintaining its existing service organization. Certification of the airplane at a higher gross weight of 38,500 lb. is near completion and a new Walter Kidde nose wheel steering system will be available.

Washington Helicopter Network to Be Studied

Washington—Civil Aeronautics Board will investigate the need for scheduled helicopter operations between Washington and the three airports serving it, reversing a long-standing ban against consideration of expanding scheduled helicopter service.

The case will be limited to the question of service between National Airport, Dulles International Airport and Friendship Airport and a point or points in Washington. This excludes consideration of service between Washington suburbs and the downtown area.

The Board has refused for several years to consider expanding the experiment in helicopter operation now being conducted by New York Airways, Chicago Helicopter Airways and Los Angeles Airways. Basic reason is the continuing heavy requirement for subsidy, which ran more than $4 million last year for the three carriers. Congress has been pressing the CAB to reduce airline subsidies.

Now the Board says it will consider helicopter service here because Washington ranked third in flight departures and fourth in passenger boardings among U. S. cities in 1959. CAB also noted that of the number of other applications on file, none involves a city served by three airports.

Federal Aviation Agency expects to complete the new Dulles International Airport in Virginia next year, adding a third airport to the two through which Washington currently is served—National Airport and Baltimore's Friendship Airport. Dulles is 23 air miles and 27 miles by highway from downtown Washington, and it is 46 air miles and 50 road miles from Friendship. National is close to the downtown area.

Authority to operate scheduled helicopter service in the Washington area has been requested by the Baltimore & Annapolis Railroad Co., the Maryland Co., Henry M. Bliss, Pilgrim Helicopter Services, Inc., the Rumson Co., Chesapeake & Potomac Airways, Inc., D. C. Transit System, Inc., and New York Airways, Inc. These and any other applications will be heard in a single case.

TWA's 1649A Cargo Conversions Total 12

Los Angeles—Six more Lockheed 1649A Super Constellations will be converted to all-cargo service for Trans World Airlines by Lockheed Aircraft Service for $1.7 million, making a total of 12 of the conversions ordered by TWA.

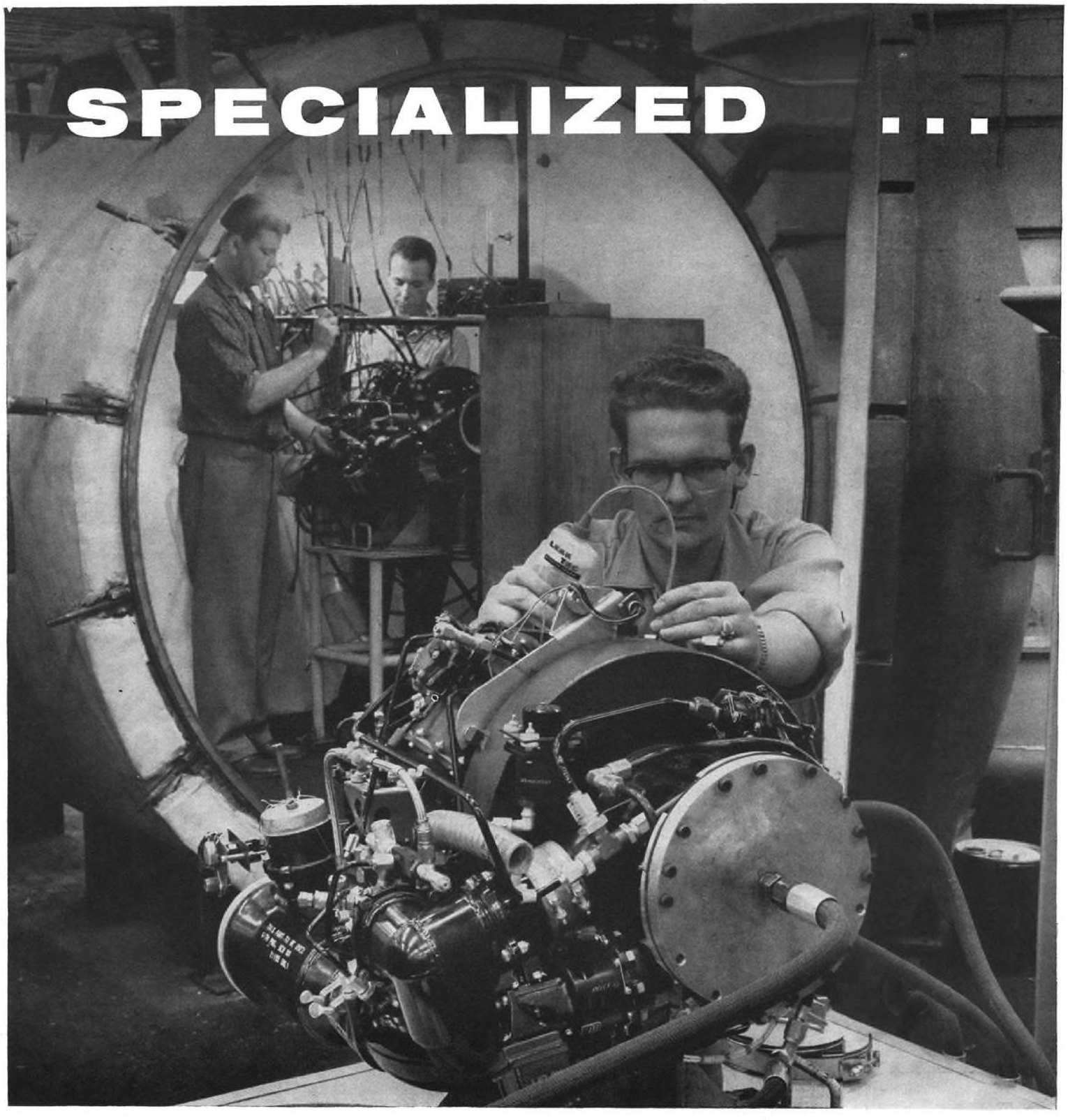
Work is nearing completion on the first six and will start on the new group by the end of the month. Converted aircraft have stronger structure to increase maximum landing weight and thereby increase the payload weight limit. Three Super Constellations in the new order will be given weather radar installations. TWA claims the converted aircraft will be the world's longest range all-cargo aircraft.

Use of Word 'Jet' Curbed in Advertising

Washington—Air Traffic Conference issued new voluntary advertising regula-regulations for member airlines.

Chief among the new rules is clarification of turbine-powered aircraft handling in advertisements and the use of the term "jet." Jet will be used only when describing turbojet aircraft. In describing turboprop transports, airlines will use turboprop, jet prop or prop jet. In advertising involving turboprops, airlines will make clear by drawing propellers or traces of propellers that the aircraft is powered by turboprop engines, not turbojets.

Airlines also agreed not to advertise flight time which is less than the time shown in its published schedules and not to advertise a lower fare structure than its officially filed tariffs. The new regulations will become effective Jan. 1.



How Hamilton Standard factory overhaul cuts these important maintenance costs

1. **PERSONNEL TRAINING EXPENSE.** Many of today's aircraft components demand scrupulous engineering service which can be costly to you in manpower and training. At Hamilton Standard, nearly 500 thoroughly trained technicians and engineers concentrate exclusively on overhaul. For 42 years, the company has specialized in re-conditioning such components for virtually every U.S. commercial transport . . . a wide range of military fighters, bombers, transports . . . and private and executive aircraft. Examples:

   - Jet fuel controls
   - Air-conditioning systems and components
   - Pressurization systems and components
   - Fuel-air and pneumatic starters
   - Propellers—blades, controls, gear boxes
   - Actuators
   - Valve assemblies
   - Electrical and electronic components
   - Test equipment

2. **INVESTMENT IN SPACE, SPECIAL EQUIPMENT, PARTS.** Hamilton Standard maintains independent, fully equipped overhaul facilities with large parts inventories and the latest machine-shop and quality-control equipment. In addition, the company's extensive test chambers and development laboratories are available for special structural and operational testing of components.

3. **DOWN-TIME OF AIRCRAFT.** By efficiently programming all work, Hamilton Standard is able to provide exceptionally fast turn-around service: as little as 5 days on propellers . . . 5 to 10 days on most other components. Hamilton Standard's location—adjacent to Bradley Field, the Hartford-Springfield airport—also makes possible quick, convenient "Fly-in" service.

To learn how economically Hamilton Standard's specialized overhaul experience and facilities can aid your maintenance program, phone or write: Manager, Overhaul & Repair Department.

HAMILTON STANDARD

HAMILTON STANDARD

DIVISION OF UNITED AIRCRAFT CORPORATION

WINDSOR LOCKS, CONNECTICUT

AIRLINE OBSERVER

► Vickers-Armstrongs is continuing to hold engineering and performance parameters of the VC.11 medium range jet transport in a flexible state despite the fact that it has received an option for 15 of the aircraft from a North American airline. Vickers does not feel that the single option would justify freezing the design of the VC.11 around one customer's requirements. Also, some consideration is being given to designing the aircraft around U.S.-built turbofans rather than Rolls-Royce bypass engines as a means of attracting U. S. markets.

► **Inauguration of the first new Il-18 service since the Ilyushin turboprop transport was grounded last August because of fuel injection problems has been announced in the Soviet press. The new service is further evidence that the bulk of Il-18 service has been resumed. The newest Il-18 run is from Moscow to Krasnoyarsk in central Siberia, a 2,235 mi. route which will be flown daily on a 5 hr. 40 min. nonstop schedule.**

► De Havilland Aircraft has expanded its efforts to sell the triple turbojet DH-121 Trident transport to U. S. carriers. A 10-man de Havilland sales team spent part of last week trying to transfer American Airlines' interest in Boeing 727 triple-turbofan transport (AW Dec. 12, p. 40) to the Trident.

► **Federal Aviation Agency has ordered nine additional long-range radars from Raytheon Co. at a cost of $5.2 million. This will bring the agency's total of long range radar facilities to 52. Use of amplitrons on the new equipment gives the radars a range of 200 mi., and up to 60,000 ft. altitude capability on shorter ranges.**

► Trans World Airlines is considering showing first run motion pictures on long-haul transcontinental and overseas turbojet flights. Custom-designed projector, the Strato-Cinema developed by David Flexer of Inflight Motion Pictures, Inc., is concealed in a ceiling compartment at the rear of the first-class cabin and the screen is placed in front of the compartment behind the lounge. Ear sets with individual volume control carry the sound to the passengers. One unit has already been installed in a Boeing 707 for evaluation.

► **Federal Aviation Agency has forecast an increase in the number of passengers carried by the three U. S. certificated helicopter airlines from 366,000 in 1959 to more than 2 million by 1970. The FAA also has evaluated requirements for helicopter services in metropolitan areas other than New York, Chicago and Los Angeles, where service has already been established. Washington, D. C., and San Francisco-Oakland stand out as likely possibilities for certificated operations in the next decade, according to FAA.**

► Continental Airlines has been authorized by the Federal Aviation Agency to increase time between overhauls on its Pratt & Whitney JT3C6 turbojet engines from 200 hr. to a total of 1,600 hr.

► **Recent mild strength in airline stocks was triggered in part by several large orders to buy American Airlines, including one by a major investment trust. The ensuing move by the group probably was encouraged by Civil Aeronautics Board reaffirmation of the 10.5% rate of return of investment, but technical market factors also played a role. One analyst pointed out that the year-end rally under way now might continue to push up prices of depressed airline stocks into January. But without any fundamental improvement in business in sight, he said prices are apt to fall back quickly, especially since general economic conditions show little sign of supporting a general, sustained market rally.**

► West Indian Civil Aviation Commission recommendation for a West Indian national airline might mean liquidation of British West Indian Airways and formation of a new company. British Overseas Airways Corp., which owns BWIA now, would only be permitted to hold a minority interest in the West Indian airline. The Commission recommended a small jet fleet—a minimum of four aircraft—for the projected airline, with short-to-medium range aircraft as the Boeing 727, Vickers VC. 11 or the DH 121 listed as suitable.

SHORTLINES

► **British Overseas Airways Corp.** has been recommended by a Civil Aeronautics Board examiner for authority to serve Philadelphia, Baltimore and Washington as additional co-terminal points with New York on its transatlantic route. Examiner also recommended that Boston, now classified as an intermediate point, be reclassified as a co-terminal point.

► **De Havilland Aircraft Co., Ltd.,** has delivered the last of three Comet 4C transports ordered by Compania Mexicana de Aviacion. To date, de Havilland has delivered or has on order 60 Comet 4, 4B, or 4C aircraft to eight airlines, the Royal Air Force and the Royal Canadian Air Force.

► **Eastern Air Lines** has started daily round trip Douglas DC-8B turbojet service between New York International Airport and Palm Beach International Airport, Fla., bringing to five the number of daily turbojet flights operated by Eastern to Florida from New York.

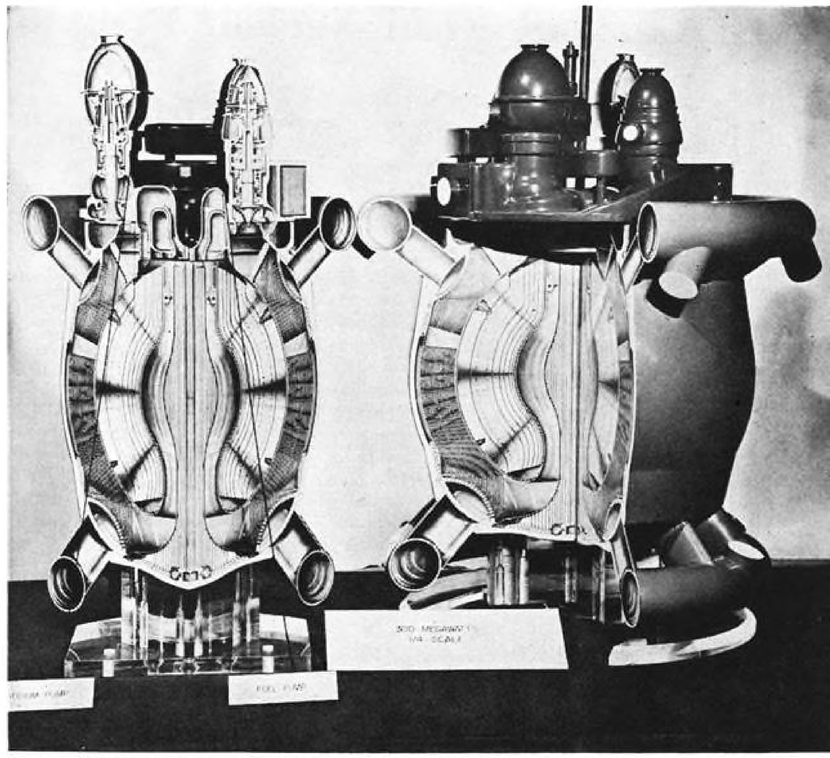
► **El Al Israel Airlines** plans to begin operating weekly Boeing 707-420 turbojet service direct from New York to Tel Aviv Jan. 5. Aircraft will be leased from Varig Airlines until the first of El Al's 707s are delivered next spring.

► **International Civil Aviation** Organization has three new African members, bringing total membership to 83. The three nations are Republics of Mali, of Senegal and Federation of Nigeria.

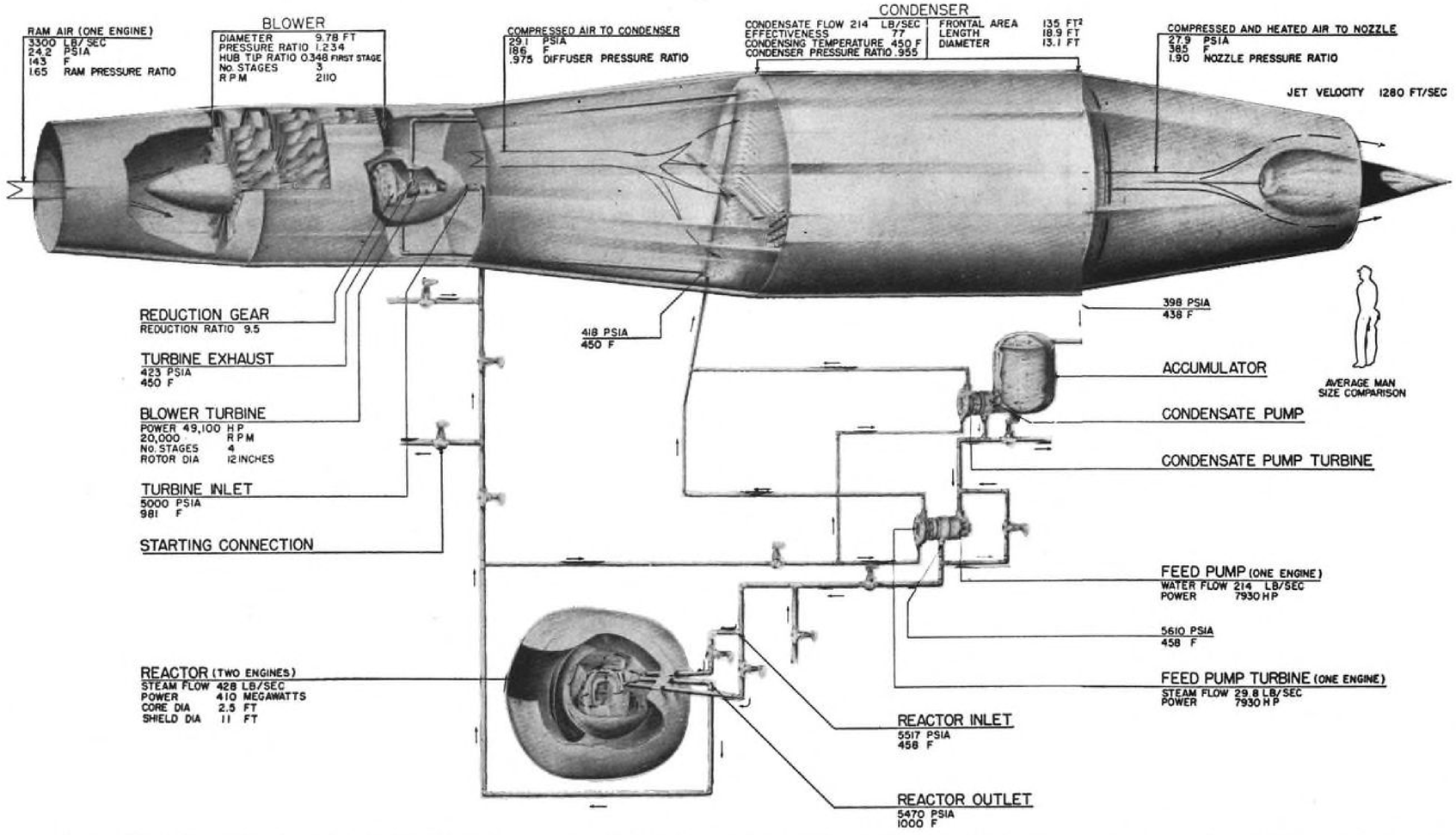
► **Northwest Airlines** reports traffic in November was off 27.6% from the same month last year and attributes the decline to the strike by DC-8 flight engineers. All Northwest's DC-8s are grounded.

► **Pan American World Airways** plans to begin twice weekly turbojet service from New York to African points Jan. 3. Operating with both Douglas DC-8 and Boeing 707 turbojets, the flights will leave New York on Tuesday for Dakar, Monrovia, Accra, Leopoldville and Johannesburg. On Saturday, a flight will originate in New York for Santa Maria, Azores, Lisbon, Dakar, Monrovia and Accra.

► **Piedmont Airlines** plans to initiate a seven-day-a-week family plan service Jan. 1 if CAB approves it. Under the plan, one parent buys a full fare and the other adult and all children under 22 pay two-thirds fare.



MODEL of the circulating fuel reactor designed for the Pratt & Whitney engines for the once-planned USAF WS-125A aircraft is shown above. This reactor was developed by Pratt & Whitney in conjunction with the Oak Ridge National Laboratory. While it did not prove suitable for aircraft use, this type of reactor has a bright future for ground-based industrial powerplants. Liquid metal was used as the heat transfer agent and coolant.



FIRST indirect cycle nuclear aircraft engine design seriously considered in the U.S. was the very large ducted fan shown above. The fan or engine air was heated in the condenser after it was compressed by the blower. This engine was under development by Pratt & Whitney from 1951 to 1953.

Special Report:

Disputes Cloud Nuclear Plane Effort in Critical Period

This is the first of a series of articles on the various applications of nuclear power to aircraft and space vehicles.

Washington—U.S. effort to develop a nuclear-powered aircraft is entering a critical period in its 14-year history, still clouded by technical disagreement and a general lack of public understanding. It is now finally committed to a flight program, but many financial and technical questions remain unanswered.

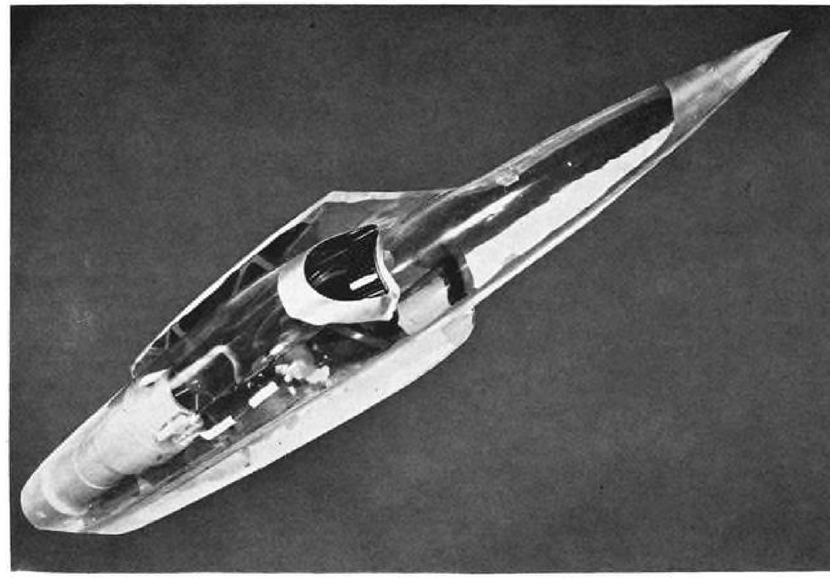
This new period of difficulty for the Aircraft Nuclear Propulsion program arises from the nearly $1 billion spent on the program so far with no result than can easily be demonstrated to the technical community, Congress, the services or the public. This lack of understanding complicates the problem of justifying the $750 million expenditure conservatively estimated to be needed before the first test aircraft flies.

The financial problem is further complicated by marked technical disagreement among the few experts in the field. Chief cause of contention is the choice between direct and indirect cycle nuclear powerplants. The experts at least agree on the necessity for developing both powerplants further before choosing—and this is one factor that continues to make ANP expensive.

Current Air Force plans call for the first nuclear-powered flight of a subsonic experimental aircraft in 1965. This testbed aircraft, weighing about 500,000 lb., will be built by Convair Division of General Dynamics Corp. and will be flown extensively with conventional turbojet engines before nuclear powerplants are installed and flown. The current program also calls for continued development of these two nuclear powerplants:

- **General Electric direct cycle** nuclear turbojet in which the reactor is used in place of the normal chemical fuel combustion chamber, with the engine air flow and the compressor shaft passing through the reactor. This engine concept has been under constant study and development since 1951.
- **Pratt & Whitney indirect cycle** nuclear turbojet in which the reactor is placed to the side of the engine. The conventional chemical combustion chamber heat source is replaced by a large radiator on this engine. The radiator is kept hot by a closed loop heat transfer system in which a fluid is circulated through the reactor, into the radiator and back to the reactor.

First development work with the indirect cycle engine concept concentrated on the use of pressurized water as the heat transfer fluid. It began in 1951 and was abandoned as unsatisfactory in 1953. A circulating fuel reactor was experimented with from 1953 to 1956 for use in the aircraft indirect cycle engine. This liquid fuel reactor proved unsatisfactory for aircraft use but has shown considerable promise for stationary ground power stations. Current indirect cycle engine heat transfer



PODDED installation of indirect cycle nuclear turbojets in a completely self-contained power package has been proposed by Pratt & Whitney. The podded unit shown in a conceptual model above has two turbojets which operate from a single reactor.

Chronology of Nuclear Program Reorientations

• **1946.** Air Force began funding the Nuclear Energy Propulsion for Aircraft (NEPA) program, which was to determine the feasibilitay of nuclear-powered aircraft flight. Fairchild Engine and Airplane Corp. was the program manager.

• **1948.** Atomic Energy Commission established the Lexington Project at the Massachusetts Institute of Technology with the same purpose as the NEPA program.

• **1950.** Lexington Project and the NEPA program both concluded that nuclear-powered aircraft flight was possible, even though it would be difficult and expensive to achieve. Most of the scientists on these two projects concurred in the estimate that it would take 15 years and over $1 billion to accomplish the projected nuclear flight.

Air Force and Atomic Energy Commission phased out the NEPA program and the Lexington Project in 1950 and jointly formed the Aircraft Nuclear Propulsion program. Objective of this program was to develop the technology of reactor materials, shielding and powerplant and aircraft design to the point where feasibility could be established on a detailed and firm basis. It was believed that this technology could be developed within five years if the problems were pursued with maximum effort.

The ANP takes a novel management approach. The man in charge must be a member of the AEC organization to satisfy the law that all U. S. reactor and shield development be under the control of that agency. He must also be a member of the Air Force to discharge USAF responsibility for developing airframes, engines and auxiliary systems needed for flight.

Brig. Gen. Irving L. Branch, who is in charge of the ANP program, is assistant director of the AEC's Division of Reactor Development for Aircraft Reactors and holds the Air Force positions of Chief of the Aircraft Nuclear Propulsion Office and Assistant Deputy Chief of Staff Development for Nuclear Systems. Gen. Branch replaced Maj. Gen. Donald J. Keirn in these posts in 1959. Gen. Keirn had been in charge of the ANP program since 1950.

Technical management of the program is conducted from the ANP office at AEC headquarters in Germantown, Md. Personnel of this office include Air Force officers and Air Force and AEC civilians who exercise Gen. Branch's authority over both AEC and Air Force portions of the program. From the contracting standpoint, the AEC finances the reactor and shield development, and other systems are funded by the Air Force.

The ANP office has cognizance over the nuclear aircraft, Pluto nuclear ramjet and SNAP nuclear auxiliary power programs. Authority over the Rover nuclear rocket program was transferred from the ANP office last October to a new AEC-National Aeronautics and Space Administration office similar to the ANP office.

• **1951.** Objective of the ANP program was expanded to include the demonstration of nuclear-powered flight. Development work began on two types of nuclear engines. General Electric obtained a contract to develop the direct cycle engine, and Pratt & Whitney contracted to develop an indirect cycle engine. Pressurized water was used in this indirect cycle designed to get the reactor heat to the engine which was actually a large ducted fan about 13.1 ft. in dia. and 67.6 ft. long.

• **1952.** Decision was made to build an experimental nuclear engine suitable for flight testing in the Convair B-36, with the flight date projected for 1956. Direct cycle was chosen for this engine, and General Electric gave its aircraft nuclear propulsion project department status and began work on this flight engine on a six-day a week basis.

• **1953.** Convair-GE experimental flight test program with the B-36 was canceled, primarily at the insistence of Defense Secretary Charles E. Wilson. General Electric direct cycle development work was continued through Air Force Secretary Harold Talbott's diversion of unallocated funds to the project.

Pratt & Whitney work with the pressurized water indirect cycle engine was terminated because of the engine's poor growth potential. The company then began a close association with the Oak Ridge National Laboratory in the development of a molten salt, circulating fuel reactor for use with an indirect cycle nuclear turbojet engine.

• **1954.** Air Force developed a strategic weapon system requirement for the nuclear aircraft in reply to top level insistence that experimental or proof-of-principle flights were not worthwhile unless they were performed with a weapon system prototype. This weapon system requirement, WS-125A, called for a subsonic cruise bomber with supersonic dash capability. Chemically fueled turbojets would have been carried to augment the nuclear engines and provide the total power requirement for supersonic flight. Pratt & Whitney and General Electric were the engine contractors, and Lockheed and Convair the airframe contractors.

• **1955.** Contractors were split into two engine-airframe teams for the WS-125A competition. Convair and GE were one team, and Lockheed and Pratt & Whitney the other. Navy began independent nuclear-powered seaplane studies during this period.

• **1956.** USAF canceled the WS-125A program. Powerplant development continued with no specific program goals.

• **1957.** Pratt & Whitney work with circulating fuel reactors was terminated, and a small effort continued on heat exchanger and materials studies.

• **1958.** President Eisenhower informed Congress that there was no urgency in the nuclear aircraft propulsion program. He rejected an effort to accelerate the program and get a flying testbed into the air as soon as possible. The President authorized a continued low budget development program, about $150 million a year, with no clearcut goal.

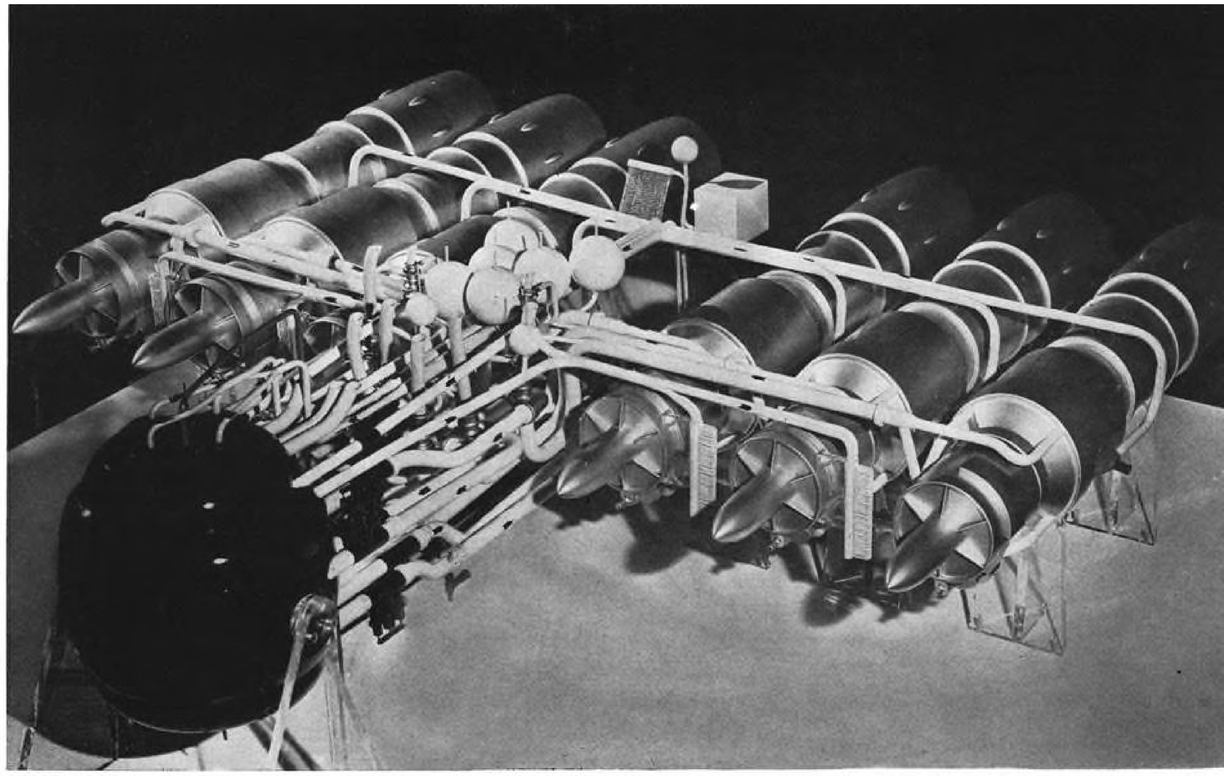
Several months later, the Air Force proposed another weapon system, the CAMAL nuclear aircraft, to provide continuous airborne alert, missile launching and low-level penetration capability.

Part of the low-budget development program funds were used to allow Pratt & Whitney to begin limited work on a solid fuel reactor for the indirect cycle engine, as well as to continue its materials and heat transfer experiments. General Electric's work with the direct cycle was also continued.

• **1959.** Convair won the CAMAL airframe competition. Dr. Herbert York, Director of Defense Research and Engineering, subsequently rejected the subsonic CAMAL program on the grounds that a militarily useful aircraft must be capable of sustained supersonic flight and it was not clear to him that this could ever be achieved with the available reactor materials. Dr. York directed that the major effort of the ANP program be aimed at developing improved materials, and he vetoed a fly-early experimental craft program as well as the CAMAL weapon system. Engine development programs at General Electric and Pratt & Whitney were continued. Dr. York did not question U. S. ability to produce a subsonic aircraft of the approximate size and weight of the B-52 which could stay aloft continuously for about five days.

• **1960.** Air Force went ahead with plans to build two Convair NX-2 subsonic experimental nuclear-powered aircraft, with first flight tentatively scheduled for 1965. It has been estimated that this can be accomplished within the constant budget of $150 million per year set down by the Eisenhower Administration. Flight test data from these aircraft will be used to write detailed specifications for the reactors, engines, airframe systems and ground-handling equipment required for nuclear weapon systems.

General Electric and Pratt & Whitney engine projects were continued.



MODEL of the Pratt & Whitney indirect cycle nuclear engine design intended for the once planned USAF-WS-125A nuclear bomber is shown above. Six J91 turbojets are mated to a circulating fuel reactor which is the black vessel in the left foreground. Plumbing arrangement is about the simplest that would ever be considered. If a second reactor had been added to the system to improve reliability, the plumbing complexity would have been greatly increased because of the interconnections needed to allow either reactor to operate all of the engines. This engine system was under development from 1953 to 1957.

system and its reactor have been under development for about three years. Liquid metal is being used as the heat transfer fluid, and the reactor has fuel elements made of solid fissionable materials.

Financial Problems

Total development costs approaching an estimated $2 billion to bring the nuclear-powered aircraft to first flight have caused concern in Congress and the Pentagon, but they are only part of the financial story. These development costs are dwarfed when the discussion turns to operational analysis and the cost of building, maintaining and operating a fleet of nuclear attack aircraft. Depending on the original assumptions, the estimated costs for this operation run to $10 billion or more for about 100 aircraft.

Policy approach of the government during most of the 1950s made it inevitable that any discussion of large financial commitments turn immediately to operations analysis and cost effectiveness studies for operational weapons. The Administration never regarded the nuclear aircraft engine as a fundamentally new power system which should be pursued simply because it held promise of revolutionizing many types of flight by giving almost infinite range and endurance to transports as well as bombers.

The nuclear-powered aircraft has had to be justified almost solely as a competitor of such large weapon systems as the ICBM and the Polaris submarine. The current Air Force program to fly an experimental aircraft is only a few months old, and it is the first break with this concept of fiscal competition since 1953.

One of the principal results of this past effort to make the nuclear-powered aircraft qualify as a strategic weapon system without passing through an experimental flight phase has been to distort and confuse the technical achievements of the ANP group. While this group has not been able to hold its own without flight test data in a sophisticated operational analysis against strategic missiles, it has succeeded in solving the basic problems of nuclear-powered flight.

No one from the President's scientific advisers down disputes the fact that the reactors, engines, shielding and all auxiliary systems needed in a nuclear-powered aircraft can be built within the current state of the art. Both the direct cycle and indirect cycle nuclear engines are considered feasible systems. Arguments over the nuclear aircraft have moved completely beyond subsonic feasibility and mostly concern the feasibility of supersonic nuclear flight, the cost of these high speed systems and whether they are worth the money.

Technical Record

In the shift of arguments against the nuclear aircraft and its costs, the technical record of the ANP group has been largely overlooked. There is little doubt that, in proving the feasibility of subsonic nuclear flight, it has solved a large collection of some of the most difficult problems which have ever faced the nuclear scientist or the aeronautical engineer.

Significant achievements in this record:

• **Nuclear engine systems** devised by the ANP group and its contractors are approximately 50 times better from a power-to-weight standpoint than the powerplant in the submarine USS Nautilus and nearly 200 times better than the system in the NS Savannah, a cargo and passenger ship.

• **Competent technical authorities** in the U. S. and England, who had access to the necessary information, agreed nearly three years ago that the ANP

group had amassed the proper experimental proof that a nuclear-powered aircraft could be flown.

• **High temperature reactor** technology in the U.S. has grown out of ANP work. The nuclear aircraft project was the first to depend completely on high temperature reactors for success, and through the ANP work, reactor operating temperatures have risen from 450F in the Nautilus to 1,600F in the most advanced experimental reactors for the direct cycle engine. This increase in temperature is now the best hope for making nuclear electric power systems economically competitive with coal and oil systems in the near future.

Another factor weighing in favor of the ANP group is that it has been the victim of the bookkeeping system to a substantial degree. While there is no way to get around the fact that this type of development work is very expensive, the ANP program has been charged with expenditures which have done it little good but have paid off well in other areas of the over-all atomic energy program.

Value of By-Products

For example, $85 million of ANP funds was spent on the circulating fuel, or molten salt, reactor development. While its maintenance problems proved too involved for a flight system, this reactor has an important future industrially. It would be difficult to say that this money was wasted, yet on the books it was written off against the program and amounts to about 10% of ANP spending to date.

The majority of high temperature nuclear studies in the U. S. have also been charged to the program. This work was vital to the ANP effort, but it also formed much of the technical foundation for the Rover nuclear rocket program, Pluto nuclear ramjet development and high temperature power systems for industrial use.

The management technique of putting the nuclear aircraft program in competition with major strategic systems to get its money and support has resulted in a number of rather abrupt changes and reorientations in the primary program goals. Considerable criticism of the ANP program has developed because of these policy changes and reorientations, which came from the highest levels in the Pentagon and the Administration.

From the program's beginning in 1946, progress was rather straightforward until 1953, when Defense Secretary Charles E. Wilson and others canceled plans for an experimental flight test program being conducted by Convair and General Electric with a modified B-36. Since then, various phases of both the airframe and engine work have been terminated and begun again, and two different nuclear-powered weapon systems have been proposed and later abandoned.

Although a specific flight date has been set for a nuclear aircraft and a positive experimental schedule has been established, the possibility of a reorientation of the ANP program in the near future is as strong as it ever was. The new Kennedy Administration taking office in January could bring major changes in the ANP program's rate of progress and its immediate objectives. If the new Administration feels that the current course is proper, there are still some controversial factors which could lead to a significant program reorientation.

Current Controversies

The main controversies today revolve around the comparative desirability of the direct and indirect cycle engine systems and the size of the development budget. Cancellation of the development effort on either the direct cycle or indirect cycle nuclear aircraft engine is being urged in certain quarters to cut over-all cost of the ANP program or to allow an acceleration within the current budget. Some members of Congress, elements of Defense Department civilian leadership, budget officials in the Administration and certain groups with the Air Force and the other services believe that the ANP program would be benefited if one of the two competing engine systems were dropped and effort concentrated on the other.

On a purely technical basis, ANP program officials contend that it is impossible now to make a sound choice between the engine systems and that enough test data to permit a sound decision probably won't be available for another couple of years. The sound choice they seek requires the answer to two questions. These questions are:

• **Growth potential** of each engine must be firmly established experimentally. Apparently most officials competent to judge in the ANP program and in Dr. York's office now believe that the indirect cycle engine has the most growth potential and will make the most efficient nuclear powerplant for supersonic as well as subsonic flight. This opinion is based largely on theory, and it will be at least two years before much additional proof will be available to substantiate it.

• **Time required** to bring the two engines to flight status is not the same. Three major reactor experiments have been completed for the direct cycle engine, which will require only slight modification to be capable of flight, and the next major development unit is a complete engine prototype. It is scheduled to run in about two years. The first reactor experiment for the current indirect cycle engine design will not be conducted for more than two years, and the first full system test is not due until the middle of 1964 under the present schedule.

It now appears that the subsonic direct cycle engine could be flown two years or more ahead of the subsonic indirect cycle turbojet. This time factor could be a major consideration if events in the U.S. or abroad transform the nuclear-powered aircraft project into an urgent, high priority program.

Dissenting Views

While the majority of nuclear engine designers and managers apparently agree with these views, there is a large minority that strongly disagrees. It is not difficult to find people in this field who believe that the direct cycle has as much promise for a supersonic engine as the indirect cycle. Others argue that the indirect cycle engine could be developed much more quickly than the present schedule calls for and that if maximum effort were applied, an operational engine could be ready in about half the time now programed.

It is not possible to completely ignore these dissents because on many points they are based on substantial technical opinion. Unfortunately, there is no simple way to positively resolve these disagreements. The great potentialities of nuclear power for aircraft are locked in some extremely involved technical questions. Although the ANP program has been active for more than 10 years, only a few men regardless of their training have spent enough time with these questions to be entirely competent to answer them. Close secrecy surrounding the program has prevented any widespread understanding of ANP problems in the military services or among airframe and aircraft engine manufacturers.

If opponents of the dual engine development program prevail and one of the two engines must be canceled in the near future, officers in charge of the ANP program and technical officials of the AEC and the Department of Defense will be faced with an agonizing and controversial decision. The disagreements over the technical merits of the direct and indirect cycle engines involve not only the contractors. They extend through the Air Force and AEC personnel managing the ANP program and into top Defense and Air Force management.

The factor that claims unanimous agreement, however, is that the decision whether to cancel or not to cancel one of these engine systems in the near future probably is the most important one to be made concerning the nuclear-powered aircraft in the next decade. Following that, the next most important decision would be which engine to drop.

Satellite Size Limits Bio-Astronautics Data

By David A. Anderton

Washington—The major problem in bio-astronautics—getting large biological specimens into a space environment and measuring their responses—still remains a major problem because of weight and volume limitations of the various U.S. satellites.

These limitations have forced development of miniature, sophisticated sensors and instruments for biological experimentation. But bio-medical scientists reporting problems and progress to the 15th annual meeting of the American Rocket Society here pointed out that there is no parallel development of miniaturized animals.

"If all you can lift is mice, you work with mice," said Capt. Bruce Pine of USAF's Directorate of Bio-Astronautics Projects.

Available Data

Available U. S. bio-astronautical data, which is at a low absolute level, sinks relatively lower when compared with data the Russians telemetered from Sputnik V, which carried specimens and instrumentation to perform about 50 different experiments. Payload capacity to spare, made possible by the large military booster stages available to the Russian bio-astronautical program, gave space and weight for such large animal specimens as dogs and rabbits plus multi-channel conventional instrumentation and transmitting or recording equipment.

In contrast, many of the U. S. experiments performed in bio-astronautics so far have not shown much more than the feasibility of such experiments. Even the future availability of man-carrying Mercury space capsules will not add much to available data, because there is very little physiological instrumentation planned for the astronauts themselves.

Response Measurements

"What we'd really like to get in animal experiments are physiological and psychological measurements of response to the environment," said Dr. Albert Hetherington of USAF's Air Research and Development Command. These include electrocardiograph data, blood pressure, body temperature, electromiograms from muscle activity, such as the postural-support mechanisms, and photography of eye movements to detect disorientation.

Psychological data would come from an operant task, where the animal learns to do something because of the reward it will get for performance. These data would be supplemented by real-time television transmission and on-board recording.

Contrast between Hetherington's stated goals and current Russian achievements was underscored by Sputnik V and VI bio-astronautical satellite experiments (AW Dec. 12, p. 29). Russian physiological test program apparently parallels that cited by Hetherington; psychological tests were not detailed by the Russians but certainly were included because of the emphasis by their scientists on television observation of the animal behavior.

First steps toward Hetherington's set of goals include the development and experimentation with the Mk. 2 biomedical recovery capsule, currently in advanced design stage. This capsule, containing a single monkey, carries instrumentation to measure internal compartment pressure, temperature and relative humidity. The monkey will be instrumented to produce an electrocardiograph and to record its respiration rate, both for transmission by continuous telemetering.

A simple shock-avoidance task mechanism will test the monkey's psychomotor facilities and will transmit results by commutated telemetry. Other measurements will include acoustical noise level and three-axis accelerations on reentry. The animal's face will be photographed every three seconds to detect eye motion.

In addition to telemetry, recording equipment will be carried to store data during the re-entry phase when telemetry transmission is impossible through the ionization sheath.

Instrumentation task for animal experiments may be eased considerably as a result of work with surgically implanted sensors and transmitters which have proven the feasibility of telemetering data through intact animal skin. This work, done on two rhesus monkeys named Charlie Brown and Lucy, was a joint project which was conducted by North American Aviation, Spacelabs, Inc., and Wyle Laboratories and was sponsored by USAF Ballistic Missile Division.

Ben L. Ettelson of Spacelabs said a rocket flight test is scheduled for next year as a further step in the program. Current results from experiments made on a centrifuge and in severe environments have proved the basic concept. But techniques of surgical attachment

Sterilization Study

Washington—NASA requirement that all spacecraft on impact trajectories must be biologically sterile and the possibility that unburned propellant containing viable organisms could survive a landing have led to the establishment of a research program at Jet Propulsion Laboratory to investigate methods of sterilizing solid propellants.

Initially, JPL is evaluating the effects of a 24-hr. heat soak at 125C and radiation dosages of 10^7 roentgens. Early indications are that such treatments adversely affect the physical and ballistic properties of the solid propellant grain. Other avenues that might be investigated, suggested at the ARS meeting by JPL's Winston Gin and Leonard R. Piasecki, are research to determine which solid propellant candidates may already be inherently sterile and exploration of methods to incorporate agents in the propellant formulation to kill bacteria.

New Aurora Theory

Washington—A new theory to explain auroras, if confirmed, will make it possible to use auroras to determine the condition of earth's magnetic and electric fields near the geomagnetic equatorial plane many thousands of miles out from the earth.

The theory, advanced at the American Rocket Society meeting by S. I. Akasofu of the Alaska Geophysical Institute and Sydney Chapman of the High Altitude Observatory in Colorado, seeks to explain why the aurora generally appears in the form of one or more long thin bands of light in the east-west direction, mainly at high latitudes, and subsequently breaks up into rayed bands, folded and pleated, while strong earth currents simultaneously appear around the earth in the auroral zone.

Akasofu and Chapman suggest that streams of protons and electrons arriving from the sun, which are trapped by the earth's magnetic field, produce new earth currents and magnetic fields that alter the earth's magnetic field and produce neutral lines of magnetic field—which in turn produce the aurora. The subsequent change in aurora is believed to be due to the growth of an eastward electric field and current along these neutral lines.

New Hydrazine Method

Washington—Aerojet-General Nucleonics reports that it has succeeded in producing "measurable quantities" of hydrazine by fission fragment irradiation of liquid ammonia.

Indications are that the fission-chemical reactor, developed under a USAF Air Materiel Command contract, will be able to produce hydrazine at an amortized cost of approximately 25 cents per pound, according to the company. It is too early to tell what effect this significantly lower cost predicted for hydrazine will have on the material's use in rocket propellants.

and the reduction of self-generated noise in the transmitter are problems that need more work, Ettelson said.

First phase of the joint program was the development, implanting and use of a pulse rate modulated transmitter with RF oscillator, driven by the input from an amplifier connected to sutures acting as electrodes for taking the electrocardiogram. The complete package, about the size of a hi-fi or stereo pick-up head, was surgically implanted in the peritoneal cavities of the monkeys.

Output of the transmitter was received by an antenna molded into the restraint couch holding the animal, and the signal was retransmitted.

Second phase of the work, now under contract, is to develop and flight-test a three-channel FM/FM telemetry system to measure and transmit the electrocardiogram, phonocardiogram and respiration of the animal. End point of this phase is the scheduled rocket flight.

Surgical implantation, combined with developments in microminiaturization, may produce a revolution in clinical medicine as one by-product of bio-astronautical experimentation. "Mini sensors" combining sensor, amplifier and FM transmitter in a package about the size of a nickel have been developed at Douglas Aircraft Co. These units, first aimed at measuring physiological impairment of tissues anod psychological aspects of fatigue, could be combined with data-processing techniques and display devices to open new avenues in medical and psychological research.

One example is a cardiac diagnostic machine developed in feasibility form at Douglas and described to the meeting by Dr. Harry L. Wolbers. This machine uses detection and classification techniques of sonar returns to analyze sound patterns of heart disorders. Output of a phonocardiac pickup on a human is fed into the machine, and an indicator light shows the nature of one of several heart disorders, normally undetectable by conventional sound recording techniques alone.

Mini sensors can free a human subject from the wiring of conventional diagnostic machinery so that an electroencephalogram could be made at the limits of human performance instead of with the subject at rest.

But even farther down the scale of miniaturization was a sensor-transmitter unit described by Alfred M. Mayo, NASA assistant director for bio-engineering. Mayo said a sample unit, about the size of an uncooked flake of oatmeal, had been functioning since 1957 in proof of the high reliability of the components.

Reliability of such units, which increases as the size decreases and the design gets farther away from conventional wired components, was emphasized as the real gain in miniaturization.

Mayo said the use of advanced electronic equipment as tools for the medical profession has received terrific impetus. Computers have been used to study respiratory gas exchange, the mechanisms of muscular contraction, analyses of coronary heart disease and the storing and interpretation of personality tests.

A need for miniaturized computers of this type, growing in part out of advanced studies aimed at improving display techniques for pilots, has produced the RV-2-1 computer now under development. This unit uses thin films of magnetic material, microcircuit amplifiers and solid-state power supplies. It could handle up to 80 million bits of information per second, and fit into a volume of ¼ cu. ft., Mayo said.

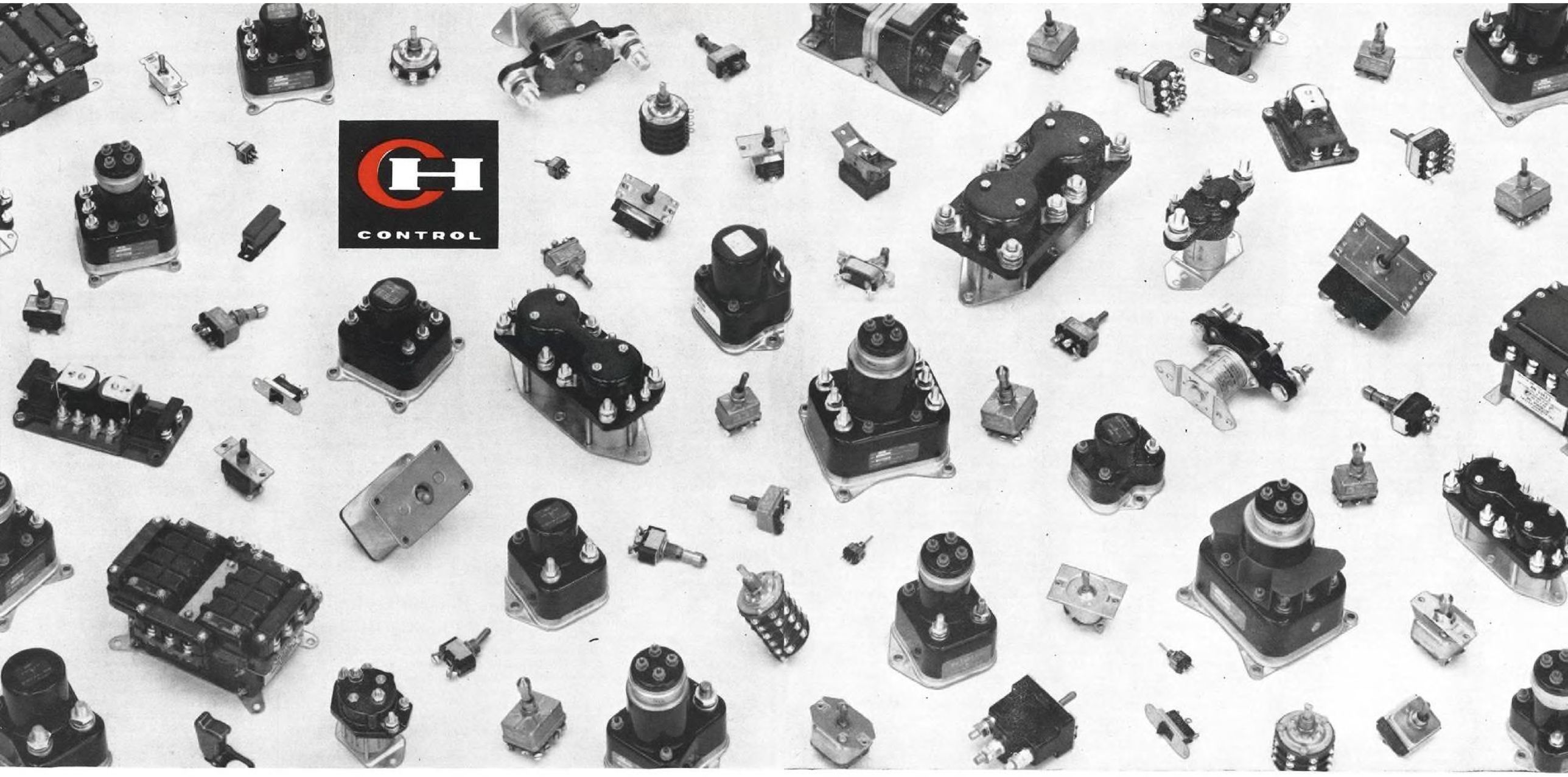
New Plasma Technique Uses Pulsing RF Field

Washington—New technique for accelerating a neutral plasma for space vehicle propulsion by using a pulsating radio-frequency (RF) field, which appears to offer attractive advantages over present techniques, was reported here during the American Rocket Society meeting.

The technique, called plasma acceleration by quasi-static RF electric field gradient, eliminates the problem of space charge neutralization that exists in ion engines and eliminates the heavy equipment required to produce magnetic accelerating fields now used in plasma engines.

The new approach, which has been experimentally verified, was reported by three Radio Corp. of America scientists: T. T. Reboul, G. A. Swartz and G. D. Gordon. The technique is an outgrowth of the use of RF fields to confine plasmas for various fusion power studies.

When a radio frequency voltage is applied to a cylindrical electrode, producing an electric field that varies sinu-



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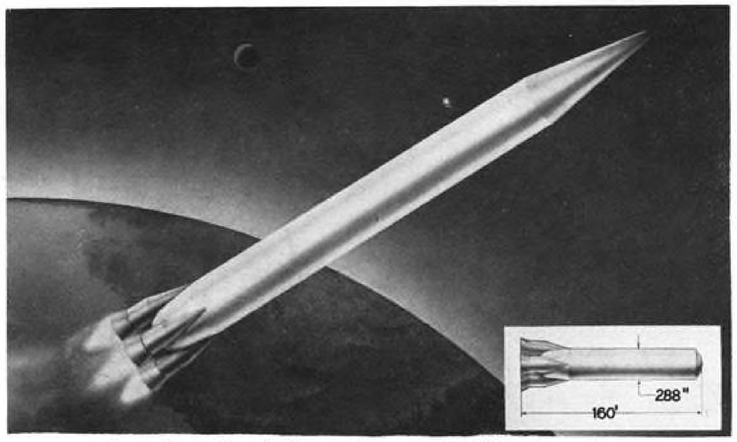


Aerojet Envisions Large Solid Boosters

Large single-engine, solid propellant booster, with 7 million lb. takeoff weight, (above) would be 160 ft. long and 24 ft. in diameter, according to this possible configuration developed by Aerojet-General Corp. (AW Dec. 12, p. 27). Aerojet is one of three firms conducting large solid booster feasibility studies under contract to National Aeronautics and Space Administration (AW Sept. 19, p. 28). Multiple nozzle arrangement at exits is steering jet system. Another, a large clustered solid motor in a possible Aerojet configuration would be 100 ft. long and each chamber would be 10 ft. in diameter. Booster also would have gross takeoff weight of 7 million lb.

soidally in time while remaining fixed in space, the neutral plasma will be accelerated toward the low-field region if the applied RF frequency is greater than the plasma's critical frequency. It will be accelerated toward the high-field region if the RF frequency is less than the critical frequency.

In RCA experiments, a thin mercury plasma was accelerated from 500,000 to 2.5 million cm./sec. as the maximum electric field was increased from zero to 170 volts/cm., using an RF frequency of 140 mc. Both plasma acceleration and deceleration has been obtained in RCA experiments at 140 mc. Tests also were conducted at 350 mc.

A study of eight possible propellants for electrothermal jet engines (in which propellant is electrically heated prior to expansion in the nozzle) indicates that hydrogen and helium are best for specific impulses of about 1,000 sec., while lithium becomes more efficient at specific impulses greater than 1,600 sec., J. R. Jack of Lewis Research Center said.

An analytic study by NASA of a space engine using an electrically powered, resistance-heated Prous propellant heater indicates an efficiency of about 76% at specific impulses near 1,000 sec. if regenerative cooling is employed.

Jack said that an increase in operating pressure level improves frozen flow performance of all propellants considered, but this increase in efficiency is accompanied by an increase in heat transfer, so a decrease in propellant heater efficiency may occur which partially nullifies the gain.

Power Produced With Dual Metal Sandwich

Washington—Production of electrical power by uniform heating of a metallic and vitreous enamel sandwich was demonstrated for the first time by an engineering team from the Westinghouse Electric Corp. at the 15th annual meeting of the American Rocket Society here.

The simple, rugged device could be developed to produce as high as one-fifth of a kilowatt-hour per pound of weight, according to B. O. Austin, of Westinghouse, who reported on the development.

The unit is made of an iron plate, to which is bonded a layer of vitreous enamel. A third layer of silver metal is added on top of the enamel. With uniform heating applied to the sheet —in the demonstrations a commercial kitchen toaster was used—production of electrical power begins at about 250F.

Westinghouse predicts long shelf life for the unit and believes that manufacturing costs will be low. Company scientists feel there is no size limitation, and therefore no upper limit on the amount of producible power.

Possible applications include power production from the heat of rocket exhausts, or from aerodynamic heating during re-entry. The company is continuing basic and applied research in the field and expects to be able to make a complete technical report in about one year.

Range Radar May Locate Satellite Orbits

By George Alexander

Boston—Use of radar which measures only range for exact determination of satellite orbits—with a distinct space-borne application to an advanced Saint (Satellite Interceptor) program—was described here by 1st Lt. Robert M. Baker, USAF, project officer in the Air Force Ballistic Missile Division's Space Systems Directorate.

In a report to the recent Air Research and Development Command's seventh annual science and engineering symposium, Baker said that range-radar techniques could be applied to "an advanced interceptor satellite" (presumably an advanced Saint), as well as the national space surveillance system, and tracking of lunar or deep-space probes with maximum accuracy, economy and simplicity of operation.

Either pure range data, derived from a standard pulsed radar, or range-rate data, derived from a doppler radar, Baker said, would give the two key factors in all satellite orbits:

• **Angular momentum,** which is the product of the satellite's velocity, tangential to its orbit in the plane of its orbit, and its distance from the center of the earth. Thus, the angular momentum of a satellite at its perigee of 400 mi. with a velocity of approximately 24,000 fps. is the same at its apogee of 600 mi. with a velocity of 16,000 fps.

• **"W" vector,** which is essentially the angle of inclination. This vector may be pictured as the altitude of an eccentric, elliptical cone with the circumference of the cone's base representing the orbital plot of the satellite. Distances from the apex of the cone to points on the base will vary, but the altitude will remain constant. This vector is perpendicular to the orbital plane of the satellite, as is a true north vector to the equatorial plane, and the angle formed between the two vectors is identical to angle forced between the two planes.

An advanced interceptor satellite, or Saint, equipped with a small omnidirectional range radar, a lightweight digital computer and a memory unit, could easily determine these two factors in any satellite's orbit and could thus perform its own tracking operation in space. With such a system, ionospheric refraction would present no problem at orbiting altitudes and frequencies could be selected that would effectively preclude jamming from enemy ground stations.

The Saint program now under development by USAF calls for ground-based angular tracking of unknown satellites, with the information transmitted to the Saint vehicle overhead.

With range radar, however, an advanced Saint might operate like this: Detection of another satellite reveals a range separation of 150 mi. At one-second intervals, range approximately decreases to 140 mi., 131 mi., 122 mi., 112.36 mi., 102.95 mi., 93.54 mi., etc. Knowing its own altitude and speed to be 400 mi. and 24,500 fps., the advanced Saint's computer would rapidly figure that a vehicle giving these readings would necessarily be traveling at a velocity of 25,120 fps. in an orbit 200 mi. high and moving in an opposite direction.

Since a number of range readings will describe the unique circumference of this imaginary cone, the computer would also determine the unknown satellite's "W" vector, or angle of inclination, providing the advanced Saint with all necessary information on the other's orbit.

The memory unit would then search its catalog of known orbits for a satellite operating at that altitude and velocity and at that time and relative position over the earth. If the observed parameters checked with those of a Discoverer, Courier, Sputnik or Tiros, then the Saint would merely record the intercept and pass on. If, however, the observed orbital characteristics did match those of the orbits filed in the memory unit, the advanced Saint would immediately report an unknown, unidentified satellite in orbit and begin intercept and inspection procedures.

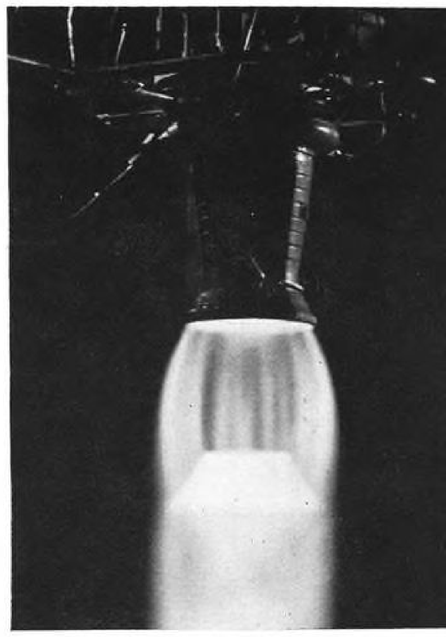
Because this advanced Saint would employ an omnidirectional antenna, attitude stabilization and angular reference systems could be eliminated. With only two orbital characteristics to compute, the computer could be a relatively uncomplex lightweight digital unit as are presently under development. Net result, as Baker sees it, would be a Saint vehicle that is considerably lighter, cheaper and—being less complex—more reliable than the presently-planned Saint payload. The one disadvantage inherent in such an advanced Saint, Baker said, would be the large power supply required to run the systems; SNAP (Systems for Nuclear Auxiliary Power), however, might be one answer.

Range radar, Baker said, could also greatly simplify the task of the national space surveillance tracking net. As more and more satellites are placed in orbit within the next few years, the problem of tracking all vehicles, and identifying new ones, with slewable angular-tracking radars will be tremendously difficult and complex, if not almost impossible.

Although angular-track radars can plot orbits within a degree of accuracy, their limited "look" angle, their physical characteristics of slewing and the tight coordination required between other angular trackers in the net do not hold as much promise as range and/or range-rate radars. Baker feels that a system of about six high-accuracy doppler or pulsed radars could easily handle the universe of satellites and still be able to spot new or unidentified vehicles in either high or low orbits, lunar shots or deep probes.

Further, although Discoverer, Tiros, Echo, etc., could satisfactorily perform their tasks within fairly wide orbital tolerances, some future programs—Saint is one—will demand extremely accurate orbital computations in order to carry out their missions.

Lunar, interplanetary and deep-space probes could also use the accuracies of range-radar tracking, Baker thinks. As a deep-space vehicle recedes farther from earth, its angle relative to its launch plane varies only slightly when compared with the great increases in distance with time. Range radar could more accurately measure large increments in distance than angular tracking radars could distinguish slight variations in angles.



Exotic Fuel Tests

Externally cooled tube wall thrust chamber used by Rocketdyne for studies of high-energy, hydrazine-fluorine fuel combinations to propel upper stage rockets is shown above.

Hollow Fibers Cut Space Vehicle Weight

By Michael Yaffee

Washington—Substitution of hollow glass fibers for the conventional glass fibers used in reinforced plastics promises significant weight reduction in structural elements of aerospace vehicles.

In a structure under compression, composite materials made with these new hollow fibers, which are now available in semi-production quantities, in effect provide a four-fold increase in strength at no increase in density.

These new low density materials are also expected to have a significantly lower dielectric constant and electrical loss factor, giving them an important advantage in radome structures, according to Irving J. Gruntfest and Norris F. Dow, consulting engineers at General Electric's Missile and Space Vehicle Department.

Work on the hollow fiber materials was carried out by General Electric under a contract from the Air Force Ballistic Missile Division. It was one of several new developments in materials and structures discussed at the recent annual meeting of the American Rocket Society.

Another report concerned a family of tungsten-base composites developed by Avco Corp.'s Research and Advanced Development Division for the use in rocket nozzles. These materials, trademarked Avcomet, are capable of operating in exhaust gas temperatures above 6,170F, almost 600 deg. above the service limit of pure tungsten, according to Avco's S. R. Maloof.

Subscale rocket nozzles made from Avcomet-1, the best of the tungsten-base composites developed to date, have been successfully fired for 60 sec. on solid propellant rocket motors using aluminized propellant at 1,000 psia., Maloof said.

Full scale nozzle inserts and blast tubes for the Minuteman second stage made of Avcomet will be evaluated shortly by Space Technology Laboratories. In addition to its greater temperature resistance, Maloof said, the tungsten composite is stronger and more ductile than pure tungsten, and therefore breakage during machining and assembly is significantly reduced. Also, the composite material can be fabricated with standard carbide cutting tools and techniques without the need for grinding.

Along the same lines, the Aircraft Division of Hughes Tool Co. has developed a refractory composite material for solid propellant rocket nozzles. Nozzles made from this material have been successfully fired on motors using an aluminized polyurethane-base solid propellant that is believed to be similar to the propellant developed by Aerojet-General for the Polaris.

The nozzle, described by A. V. Levy and H. Leggett of Hughes and S. R. Locke of Aerojet, consists of a thin tungsten sheet metal liner that is formed to the desired contour and then bonded to a graphite backup structure. After bonding, molybdenum wire is wrapped around the graphite and an insulating layer made from phenolic plastic reinforced with ceramic fibers is integrally molded around the composite and cured. Finally, the structure is placed in a steel outer shell to complete the assembly of the nozzle.

To meet the requirements for a successful composite, the authors said each material should overcome the shortcomings of another and should be present in a sufficiently large homogeneous mass to maintain its own attractive properties. In the case of the Hughes rocket nozzle, the tungsten liner serves as the erosion barrier while the graphite heat-sink backup provides light weight. The molybdenum wire wrapping is used to keep the graphite in compression during firing, and the reinforced plastic insulation layer serves to protect the steel shell which carries the hoop tension.

National Research Corp., another company working on the development of high temperature materials for advanced solid propellant rocket motor nozzles, is approaching the problem through alloys rather than composite materials. This group is particularly interested in high tantalum, low tungsten alloys which are said to be significantly more ductile and easier to fabricate than straight tungsten. NRC is currently carrying out development work on a 90% tantalum—10% tungsten alloy under Navy contract.

Currently, Aerojet is believed to be using pure tungsten inserts on graphite backup blocks for the nozzles in its Polaris motors. But with the Navy looking to an advanced 2,500-mi. Polaris and beyond, there has been growing interest in developing lighter-weight rocket nozzles capable of withstanding significantly higher combustion temperatures for prolonged burning times.

Some rocket engineers don't feel that the nozzle requirements of these advanced solid propellant motors can ever be satisfied through materials development alone. Aviation Week has learned that these engineers are advocating a transpiration cooling system for nozzles employing double wall construction and a light weight and low melting point metal such as sodium or lithium.

The low melting point metal, which would be carried between the walls of the nozzle, would boil off through porous walls, absorbing enough heat in the process to keep nozzle temperature well within the operating limit of the wall materials. Other engineers believe that a cooling system such as this would entail too great a weight penalty.

In their paper on composite ceramic-metal systems, Levy, Leggett and Locke discussed several advances made in ceramics reinforced with refractory metal fibers. One of these was the marked improvement obtained in the thermal cycling and shock behavior of thoria by incorporating 20% by weight of molybdenum fibers, .002-in. in diameter and .125-in. long. Somewhat along the same lines, they talked about a molybdenum fiber felting impregnated with a magnesia slurry that measured

New USAF Booster

Washington—Air Force wants a space launch vehicle in the thrust class between Centaur and Saturn to explore the military potential of space. H. J. Weigand, technical adviser in the USAF Systems Development Directorate, feels the answer may lie in development of large storable liquid fuel engines.

Weigand told an American Rocket Society panel that storable hypergolic fuels show promise for improved reliability at reduced cost compared with conventional liquid engines under development by NASA.

ARS Elects Officers

Washington—Harold W. Ritchey, vice president and technical director of rocket operations for Thiokol Chemical Corp., was elected president of the American Rocket Society, succeeding Howard S. Seifert.

William H. Pickering, director of the Jet Propulsion Laboratory, was elected vice president. ARS Fellow Memberships were granted to George D. Colchagoff, Thomas F. Dixon, A. J. Eggers, Jr., Bernard H. Goethert, Willis Hawkins, W. D. Rannie and Mortimer Rosenbaum.

Theodore Von Karman received this year's Robert H. Goddard Memorial Award, the Society's top honor. ARS Propulsion Award for 1960 went to Ernest Stuhlinger; the James H. Wyld Memorial Award to Robert L. Johnson; and the G. Edward Pendray Award to Luigi Crocco. Scott Crossfield received the ARS Astronautics Award.

out to better than 97% of theoretical density.

This molybdenum fiber-magnesia composite (70% by weight molybdenum) was exposed to flame temperatures of 4,500F and then water quenched for five cycles with no apparent damage, therein showing a marked improvement over standard magnesia in thermal shock resistance.

The authors also discussed experimental composite structures made from several different carbides reinforced with tungsten fibers. Tested in a rocket motor firing, a nozzle made from hot pressed tungsten-reinforced titanium carbide showed excellent thermal shock resistance and no apparent erosion, according to the authors.

At the same time, it was found that silicon carbide, boron carbide and tantalum carbide react with tungsten to produce brittle networks of tungsten silicides, etc., thereby eliminating these carbides as base materials for tungsten-reinforced nozzles.

Another promising development reported was Armour Research Foundation's technique for fabricating a rocket nozzle insert from a ceramic reinforced with tungsten fibers. Essentially a felting technique, it involves first shaping the fibers, .005-in. in diameter, into the insert configuration. The shaped fiber skeleton is then placed in a porous mold, and an acqueous base slip of the ceramic material is vacuum filtered through the skeleton. After drying, the composite is then hot-pressed and sintered in a carbon mold at 4,000 psi.

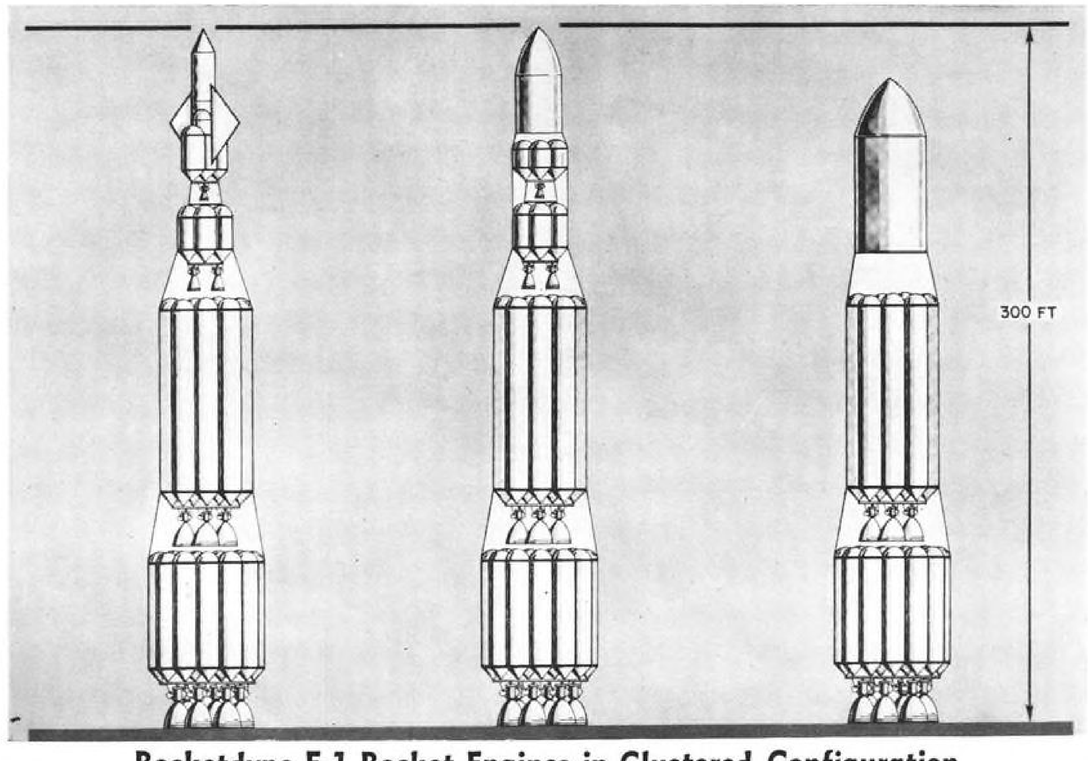
An extension of the work in fiber-reinforced ceramics is the work under way in sheet or wire-reinforced ceramics in which the ceramic is troweled on the metal instead of being impregnated in the felted fiber by means of a liquid slurry. As a result of this work, the authors said, large composite systems have been produced for use as insulating coatings and structural elements that appear extremely promising for cyclic service at temperatures up to 4,500F.

One particular material mentioned by the authors consists of a stainless steel corrugated strip used to reinforce aluminum phosphate bonded alumina. This material, they said, has been used successfully as a coating in ramjet combustion chambers 8 ft. long and up to several feet in diameter. With molybdenum wire mesh precoated with a pack cementation coating substituted for the corrugated steel strip, the material also has been used in structural applications such as wing leading edges which have successfully withstood several 20-min. cycles of exposure to temperatures of 3,500F. Use of these materials can be extended to higher temperatures by going to ceramics such as zirconia, according to the authors.

Csar Satellite

Washington—Air Force is investigating high-gain passive reflectors using radio frequency lenses mounted over spherical reflectors for possible use in passive communication satellites (AW May 23, p. 86). Program is part of USAF Project Csar (pronounced "Caesar"), an acronym for Communication Satellite Applied Research.

Initial tests of the high-gain reflector, expected to provide a 100 to 1 increase in reflected signal strength over the Echo I type spherical reflector, will be made with a high altitude balloon using a 10 ft. diameter model. USAF is viewing passive communication satellites with increased interest because of their low cost, early availability, extreme reliability and operational flexibility compared with active type communication satellites.



Rocketdyne F-1 Rocket Engines in Clustered Configuration

F-1 rocket engine, providing 1.5 million lb. thrust, is under development by Rocketdyne Division of North American Aviation, Inc. The engine, expected to be ready on schedule early in 1963, may be clustered to provide launching thrusts from nine to 12 million lb. Engine will make possible a launching vehicle able to send 200 tons into low orbit and placing 45-ton space stations in orbit about Mars.

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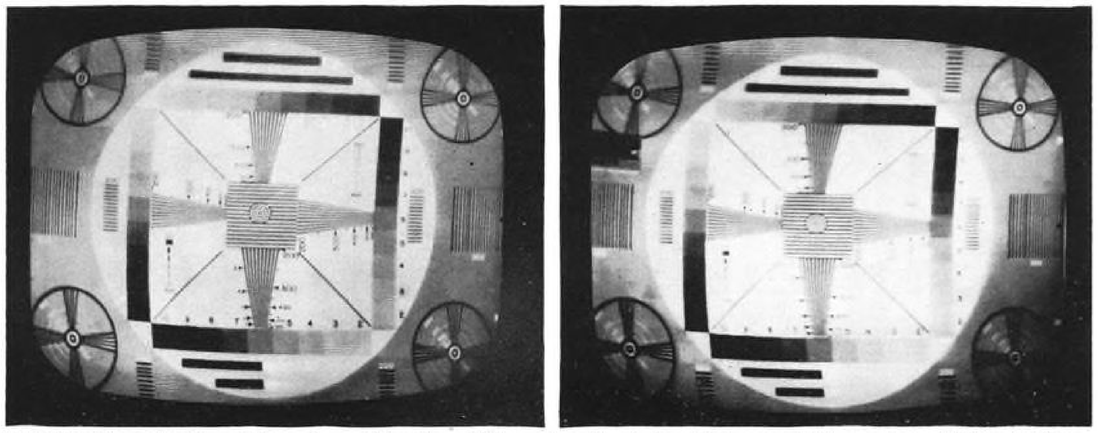


TWO television test pattern pictures show wideband capabilities and quality of ultraviolet communications system. Picture at left was made from TV monitor fed directly by TV camera, while photo at right was transmitted over ultraviolet beam before being displayed.

Ultraviolet Tested for Communications

By Philip J. Klass

Baltimore—Basic techniques for a space communication system that operates in the ultraviolet spectrum, giving it many important advantages over radio frequencies for space vehicles, have been developed here by Westinghouse Electric's Air Arm Division.

Westinghouse tests and calculations indicate that an ultraviolet communications system can provide narrow-band communications over distances of 20 million mi. with a radiated power of only one watt and a power consumption of only a few watts. Using radio frequencies, the radiated power would have to be 100 times higher, or more.

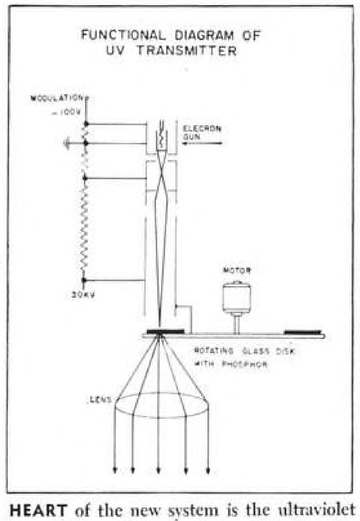
Ultraviolet communications also appear attractive as a means of transferring messages directly between communications satellites in synchronous orbit, such as the Army's Project Advent, without using an earth-based station as a relay.

Limited Use

Because the earth's ozone layer and atmosphere absorb and attenuate ultraviolet (UV) radiation heavily, it appears likely that this portion of the spectrum will be limited to use in space. However, a combination of radio and ultraviolet could be employed for communication with far-ranging space vehicles, using an earth satellite which would convert radio signals from an earth-based station into ultraviolet for relaying to the space vehicle, and vice versa.

Heart of the proposed ultraviolet communication system which Westinghouse calls Ultracom, is a relatively simple technique which has been developed for generating a very small and extremely intense spot-source of narrow-band ultraviolet (UV) radiation which can be amplitude-modulated easily.

Basically, this UV generator consists of a conventional cathode ray tube whose face is coated with a P16 phosphor that produces ultraviolet radiation when excited by an electron beam. Using a standard 5ZP16 tube, Air Arm scientists have produced one watt of ultraviolet radiation from a spot only 0.011 in. in diameter, according to Dr. Paul Pan who heads Air Arm's applied physics group. Pan is confident that radiated power can be increased to 20 watts without increasing spot size (and hence radiated beamwidth) in a tube especially designed for this application.



HEART of the new system is the ultraviolet transmitter which produces high-intensity spot source of ultraviolet radiation. Transmitter resembles conventional cathode ray tube, except that a very short-persistence phosphor that produces ultraviolet is used. To increase intensity of radiation without burning out the phosphor, it can be placed on a rotating disk. Signal is impressed on ultraviolet beam by amplitude modulation of the electron beam intensity.

Ultraviolet Advantages

The ultraviolet region of the electromagnetic spectrum offers several attractive features for space communications that the radio portion of the spectrum lacks. Most of these stem from the fact that UV has a frequency that is at least one million times that of the radio bands normally used for space communications.

Because the beamwidth of radiated energy is proportional to frequency, ultraviolet provides vastly increased energy concentration. This means that longer communication ranges can be obtained with far less power and with much smaller antennas/collectors than at radio frequencies. Both are important considerations for space vehicles where electric power is at a premium and large antenna structures pose weight and mechanical design problems.

The narrow beamwidth, which can be a tiny fraction of a degree using modest size optics in the UV transmitter, offers another attractive advantage, particularly for military use. These are communications privacy and comparative security from man-made and certain types of natural interference. An ultraviolet communications receiver aboard a space vehicle would be swamped if aimed directly at the sun, as would an optical or infrared

communications system. But the narrow beamwidth and absence of sidebands will enable the receiver to "look" in the vicinity of the sun without being overpowered by solar radiation.

Because the ultraviolet region covers a band of more than 1,000 mc., it offers extremely wideband capabilities, up to about 10 mc., limited only by the available transmitter power. In a demonstration for AVIATION WEEK, using an experimental setup with a radiated power of about one watt, Air Arm scientists transmitted both television and voice simultaneously over a distance of about 10 ft. using an ultraviolet beam. Beam was amplitude-modulated by varying the intensity of the electron beam.

Another virtue of ultraviolet communications for space, where reliability is so important, is the comparative simplicity of the required equipment.

Ultraviolet Generator

To engineers accustomed to the long-persistence type phosphors used in cathode ray tubes for radar applications, the concept of transmitting wideband information by varying cathode ray tube spot brightness might seem questionable at first glance. However, the brightness level of commercially available P16 phosphor drops to one tenth of its peak value within 0.2 microseconds after excitation is removed. Other available phosphors have even shorter persistence times.

The principal problem in using a cathode ray tube as an ultraviolet generator is to devise techniques which will permit sizable levels of ultraviolet energy to be generated in a tiny spot without overheating and destroying the phosphor.

The P16 phosphor used in Westinghouse experiments has a conversion efficiency of about 10%, according to Jon W. Ogland, one of Dr. Pan's associates in the applied physics group. This means that 10 watts of electron beam energy impinging on a small spot of phosphor on the CRT face are required to produce one watt of ultraviolet radiation. By using more efficient phosphor materials, Ogland says it should be possible to increase conversion efficiency to around 40%. This would increase ultraviolet power density by a factor of four.

But further increases in ultraviolet radiation level require higher electron beam energies, and this will overheat the phosphor, causing burn-out of that spot on the CRT face.

One way to increase electron beam energy level without damage to the phophor, and without increasing size of the UV radiation source, is to physically rotate the CRT about its longitudinal axis, while maintaining the electron beam deflection yoke fixed. This is an adaptation of a technique used in X-ray tubes.

This arrangement keeps the electron beam and the radiated ultraviolet fixed in space while the phosphor-coated CRT face is continuously rotating and bringing cool phophor areas under beam excitation and spinning hot areas away for a cooling-off period.

One of several other possible techniques for accomplishing the same objective eliminates rotation of the CRT by placing a rotating mirror, at a 45-deg. angle, directly over the tube's face. In this case the electron beam rotates around the CRT face in synchronization with the rotating mirror which is mounted so that the activated phosphor image on the face appears to be fixed at the focal point of a parabolic reflector.

A means of providing additional cooling for the phosphor, under consideration by Westinghouse scientists, is to deposit phosphor on a metal substrate which can provide conduction cooling. The ultraviolet radiation is then obtained, by reflection through the glass walls of the tube instead of through its face.

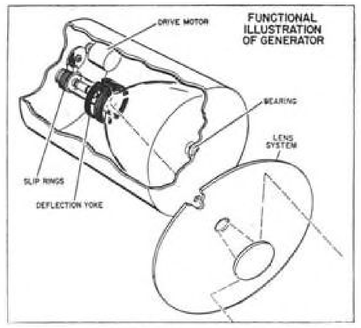
By means of these, and possibly other, techniques, Ogland believes it should be possible to obtain as much as 20 watts of UV radiated power.

At the receiving end of a communications system, radio has a slight edge over ultraviolet because all of the energy available in the radio signal can be used whereas the photon energy available in ultraviolet must first be converted into electricity and the efficiency of available sensors is low, approximately 20%.

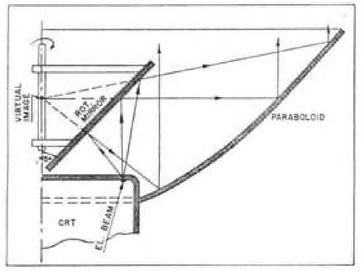
Westinghouse calculations show that power received must be about 60 times higher for ultraviolet than for a radio signal for the same signal-to-noise ratio. However, this is more than compensated for by the greatly increased energy concentration possible at ultraviolet frequencies, previously described.

Dr. Pan reports that Westinghouse scientists are working on a promising

ULTRAVIOLET communications system, developed by Westinghouse Electric for use by space vehicles and communication satellites, is demonstrated in laboratory. Television camera (1) trained on subject produces signal used to modulate cathode ray tube (2) which produces narrow beam of ultraviolet radiation (not visible in picture). Ultraviolet beam is directed at photometer (3), which converts modulated ultraviolet into video signal displayed on TV monitor (4).



TWO possible solutions to the problem of increasing electron beam energy in the ultraviolet transmitter are shown. Top view shows cathode ray tube which is rotated by drive motor, while its deflection yoke remains fixed to maintain electron beam in fixed position. Bottom sketch shows a rotating mirror which spins in synchronism with rotating beam of CRT, creating image making ultraviolet beam appear to come from center axis and remain fixed.



new sensor for conversion of ultraviolet photon energy into electricity. It is expected to be considerably more sensitive than sensors now available.

The company is not yet ready to disclose details on the new sensor, but its work in multi-stage photoelectric tubes with extremely high sensitivity in the visible light region suggests that new UV sensor might employ similar principles.

An additional problem is that a sensor's frequency sensitivity must be fairly closely matched to the spectrum emitted by the CRT generator to make maximum use of the energy spectrum generated by the ultraviolet transmitter and to minimize noise due to radiation from other sources. The earth is not a troublesome source of noise to an ultraviolet communications system, as it would be to a system operating in the infrared region, Ogland points out, because the earth's atmosphere serves as an effective shield for UV radiation.

Tests and analyses conducted to date indicate that a combination ultraviolet transmitter and receiver, and associated power supply, could be built for a total weight of less than 30 lb., including a 3-ft.-dia. antenna/collector. Total volume, excluding antenna/collector, would be less than one cubic foot.

Based on the one-watt radiated power level already achieved, Westinghouse scientists believe the system could transmit a 10 cps. bandwidth over a distance of about 15 million mi., or wideband video signals over distances of about 300,000 mi. This would permit television transmission by ultraviolet from the moon to an earth satellite for radio relay to the earth.

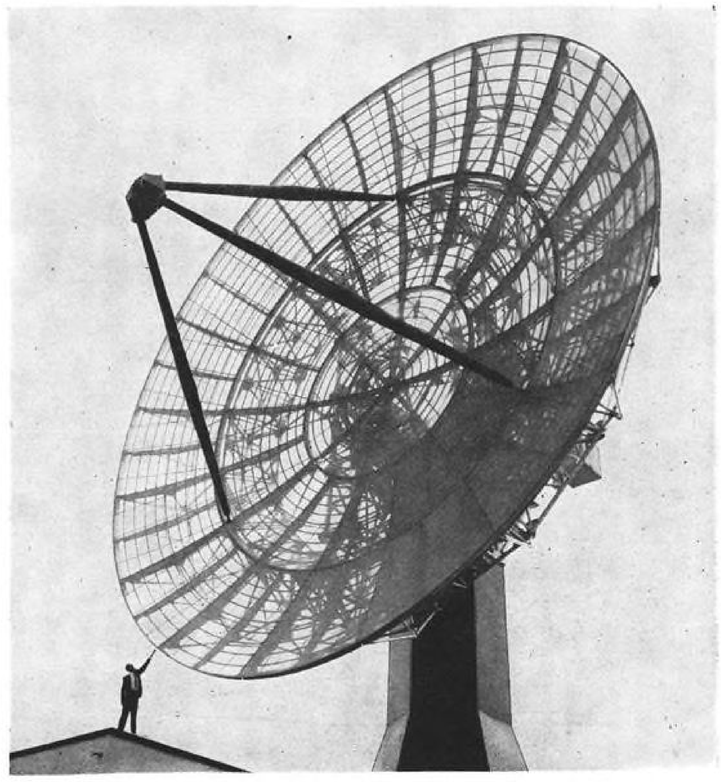
With the 20:1 increase in power density which company scientists believe they can achieve, using techniques described earlier, the range of the system could be increased by 350%.

To date the ultraviolet communications program has been carried on with Westinghouse funds. Recently the company made unsolicited proposals to Wright Air Development Division, Army Signal Corps and the National Aeronautics and Space Administration in an effort to obtain modest funding to expand the program. With the funds, company proposes to investigate heat transfer problems, tube configuration details and improved phosphors.

Under the program, company scientists would conduct ultraviolet transmission tests over longer distances in an effort to corroborate the meager data now available on atmospheric attenuation of ultraviolet. Dr. Pan says that there is a slim possibility that ultraviolet of the longer wavelengths may not suffer so much attenuation and might be usable for earth to satellite communications.

Westinghouse scientists also are "doing considerable thinking" on the subject of devising a means of generating coherent ultraviolet radiation, Dr. Pan says. This would permit the use of frequency modulation instead of amplitude modulation, with the familiar advantages of FM over AM. If Dr. Pan and his associates have some ideas on how this might be accomplished, they are tight lipped on the subject.

The recent development of the optical maser, which produces coherent radiation in the visible and infrared portion of the spectrum (AW Oct. 24, p. 75), suggests that such a device might provide a source of coherent ultraviolet for space communications.



Cornell Develops Tracking Antenna

Peak powers of 50 megawatts will be transmitted from this 60-ft. diameter antenna by Cornell Aeronautical Laboratory scientists in experiments intended to improve ballistic missile and satellite detection and tracking. Program is sponsored by Advanced Research Projects Agency under Army supervision. Antenna was built by FXR, Inc., Woodside, N. Y.

LING-TEMCO ON THE AN/USD-7 TEAM

Temco's Overhaul & Aerosystems Division was a natural choice as one of the seven outstanding companies selected to work on the AN/USD-7 project because of its systems integration, installation and flight testing capabilities. Temco provides these specialized airframe and aerosystems capabilities to the team headed by Airborne Instruments Laboratory, a division of Cutler-Hammer, Inc., prime contractor, charged with producing this electronics equipment for the U. S. Air Force. ■ Other team members are Aerojet-General Corporation, Filtron Company, Inc., Raytheon Manufacturing Company, Sperry Gyroscope Company and Sylvania Electric Products, Inc. Additional support on the AN/USD-7 program is provided by Temco's Electronics and Missiles & Aircraft Divisions. ■ Temco's Overhaul & Aerosystems Division also specializes in electronics systems development, from components to complete systems. It is a major maintenance depot for SAC's tanker fleet of KC-97s, and performs depot level maintenance and modification for several other Air Force organizations. Temco's complete capabilities include quick-turn-around maintenance to major engineering and manufacture for changing an aircraft's mission.

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▶**Semiconductor Firm Picks Name**—MicroSemiconductor Corp. is the name of a new firm (AW Oct. 3, p. 73) which plans to specialize in micro semiconductor components and circuits. Arthur Feldon, formerly manager of reliability at Pacific Semiconductors, Inc., will be president of the company, now located at 11250 Playa Court, Culver City, Calif.

▶**Mallory Forms Micro Component Section**—New department to develop and produce micro components and to advise industry on their use was set up recently by P. R. Mallory & Co., Inc. Company's Microcomponent Department will be headed by Stanley M. Stuhlbarg, who has surveyed industry interest in Mallory's micro component program (AW Sept. 5, p. 90; Oct. 24, p. 93).

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

• **Giannini Controls Corp.** will produce gyro systems for the Titan ICBM under $225,000 contract from Martin Co., Denver.

• **Hughes Aircraft Co.** will develop a guidance unit for the Mauler air defense system under a $300,000 contract from Convair Pomona Division of General Dynamics, prime contractor on the Army Mauler system.

• **Ling-Temco's** Continental Electronics Mfg. Co. and Collins Radio's Alpha Corp. jointly will construct a Voice of America broadcasting station, known as Consolidated East Coast Facility of United States Information Agency, near Greenville, N. C. USIA contracts for the station which will broadcast to Africa, the Near East and South America exceed $12,000,000.

• **Ling-Temco Electronics, Inc.,** will manufacture components for the Boeing B-52H under a $6,000,000 contract from Boeing Wichita Division.

• **Electro-Optical Systems, Inc.,** has reveived an $84,404 contract from Rome Air Development Center for correlating relevant facts which may be used in intelligence analysis.

• **Beckman Instruments' Systems Division** will build 17 electronic units employed in automatic checkout of Air Force Minuteman ICBM. Contract for $740,855 was awarded by Autonetics Division of North American Aviation.

• **Goodyear Aircraft Corp.** will continue research and development on the Nike Zeus anti-missile system under $5,375,000 order as part of a near $200 million award to Western Electric from Army Ordnance.

PRODUCTION BRIEFING

Blaine Electronics, Inc., will produce antenna pattern test range towers for Boeing Airplane Co., Wichita, Kan., and Jet Propulsion Laboratory, Pasadena, Calif., under contracts amounting to $40,000. The towers will allow automatic positioning of large models and antennas for research and development work.

Ling-Temco Electronics, Inc., has been awarded a $1,750,000 contract by Lockheed Aircraft Corp. for continued production of components of the P2V ASW system. LTE's subsidiary, Temco Electronics and Missiles Co., will do the work on the contract in Dallas, Tex.

Sundstrand Aviation proposal for an improved electrical system for the Navy P2V-7 Neptune has been approved by Lockheed's California Division. The new system consists of two fixed-frequency 30 kva. a.c. generators and two Sundstrand 30 kva. constant-speed drives and it will replace a 30-kva. variable-frequency a.c. generator, the 400-cycle inverters that supply 7.5 kva. and one of the three 12 kw. d.c. generators on the Neptune. The radial drives, similar to those supplied by Sundstrand for the Navy's F8U-2N, have an attached air cooler and oil reservoir and will be mounted in the Neptune's engine nacelles.

Land-Air, Inc., a subsidiary of California Eastern Aviation, Inc., has been awarded two contracts totaling $2,170,000 by the USAF Air Materiel Command. Technicians of the Field Operations Division of Land-Air, Inc., will perform the contract work which calls for maintenance and modification of airframes, engines and electronics equipment of USAF aircraft at overseas bases.

Garrett Corp.'s AiResearch Manufacturing Division has received an order from the Navy for 23 mobile gas turbine test stands and 90 engine analyzers designed for maintenance of AiResearch-Navy auxiliary power equipment. Each test stand includes its own fuel and lubrication supply, jib crane and chain hoist, and a mount for the turbine to be tested. Weighing 2,100 lb., the 12-ft.-long test unit can be towed by standard Navy vehicles. The engine analyzers, which can be used independent of the test stand, are furnished in "suitcase" packages weighing 45 lb.

Avco Electronics and Ordnance Division has received a $34,978,000 contract from Army for production of a

PROBLEMATICAL RECREATIONS 45

Find the flaw: Clearly, if it is known of three balls in a bag only that each is either black or white and if the probability of drawing black in 1 try is ⅔ then 2 are black and 1 is white. Take now 2 balls in a bag, each being of unknown color, but either black or white. Add one black ball. The probability of drawing in 1 try is ¼ · ⅓ + ½ · ⅔ + ¼ · 1 = 1/12 + 4/12 + 3/12 = ⅔. Thus of the unknown balls one was necessarily black and the other white. —*Contributed*

ANSWER TO LAST WEEK'S PROBLEM: From the given equation the following is found: $x^6 + x^5 + x^4 - 28x^3 + x^2 + x + 1 = 0$. Divide by x^3. Now, putting $x + 1/x = z$, then $(z^2 + 4z + 10)(z-3) = 0$, from which the only real value is $z = 3$. Hence $x + 1/x = 3$, and the quadratic is $x^2 - 3x + 1 = 0$. Hence $x = \frac{3 \pm \sqrt{5}}{2}$ or $x = 2.618$ or 0.382.

transistorized, lightweight radio communications unit. Known as the AN/VRC-12 series, the Avco unit weighs 48% less than existing models and has a 920-channel capacity instead of the 350 channels now available on tactical equipment. The unit will consist of a medium-powered receiver-transmitter, an auxiliary receiver and operational accessories.

Raytheon Co. has been awarded a $2,250,000 contract for further research on the Army's surface-to-air Hawk missile.

General Precision, Inc., has received a subcontract from IBM to expand current work on the AN/ASQ-28 doppler radar equipment for the B-70 bombing navigation missile guidance system. The cost of the program through the prototype phase is expected to come to several million dollars.

Sanders Associates, Nashua, N. H., contractors for the target-seeking system in the Navy Eagle air-to-air missile, is transferring its work on the missile to the company's new Advanced Systems Laboratories in Burlington, Mass. The new facility, which now occupies 27,000 sq. ft., will be enlarged by 50,000 sq. ft. in the coming year and will eventually cover 100,000 sq. ft. and employ about 500 people.

Electro-Optical Systems, Inc., has been awarded an $84,404 contract by the Air Force for projects aimed at simplifying the data search portion of intelligence analysis thereby giving analysts more time to interpret intelligence information. Electro-Optical will work on the recognition and separation of significant words, sentences and concepts and their correlation into a summary of the facts relevant to a stated request.

Ryan Aeronautical Co. has purchased 20¼ acres of land in San Diego from Magnetron Corp. of America, Inc. Since 1957, Ryan has leased 13½ acres of the land, including its electronics plant and two buildings which house its environmental laboratory and its sales and engineering headquarters, from Magnetron. The adjoining seven acres of undeveloped land were bought by Ryan to provide room for expansion if present floor space, which exceeds 100,000 ft., needs supplementing.

Martin Co., Orlando, Fla., will continue engineering and development of the Pershing missile under $20-million Army contract.

Goodyear Aircraft Corp., Litchfield Park, Ariz., will resume development and flight testing of the B-70 radar data processor under contract from IBM Corp.'s Federal Systems Division. The contract resulted from the reactivation of the North American B-70 bomber program.

Allison Division of General Motors, Indianapolis, Ind., will continue production of the T56 turboprop engines under $19.5-million Air Materiel Command contract. Both T56-A-7 engines for Navy, Coast Guard and Air Force Lockheed C-130B aircraft and T56-A-8 powerplants for the Navy's Grumman W2F-1 are included in the award.

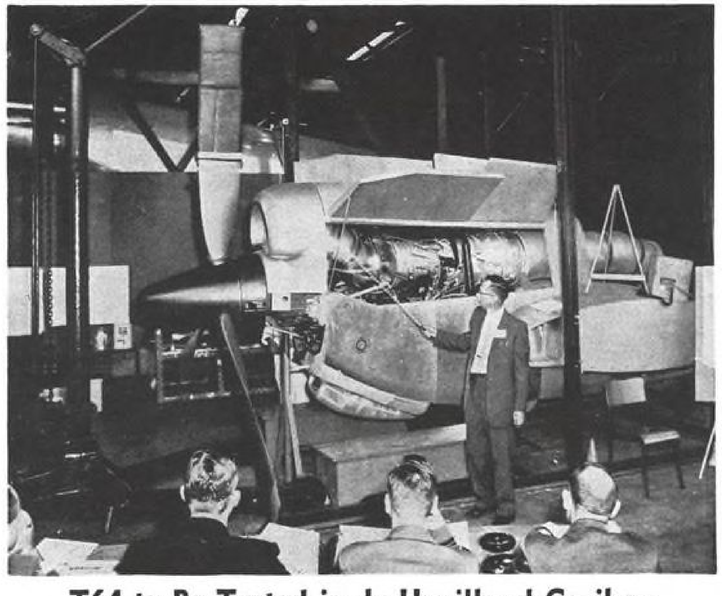
Sperry Gyroscope Co. has been awarded two contracts by Air Force, totaling $3.4 million for the production of navigation aids. Under the terms of a $2.3-million contract, Sperry will make remote attitude indicators which show the pilot such information as flight direction, pitch and roll. The other contract, for $1.1 million, calls for production of flight director computers which collect information from several sources and present it on the remote attitude indicator to inform the pilot of flight changes needed to stay on course. Sperry has already delivered more than 600 of these units in the past two years.

Lockheed's Marietta, Ga., division has received a $70,000 letter contract for development and flight evaluation of the company-designed MADREC (Malfunction Detection and Recording) system which monitors the functioning of aircraft systems in flight. First installation of the system, which can monitor six systems at one time and record the information on an oscillograph, will be made in a SAC Boeing B-52. Target date for the program completion is May 31, 1961.

Collins Radio Co. will deliver AQU-2/A and AF/A24J-1 Horizontal Situation Indicators and amplifiers to Air Force under terms of a $689,479 contract. Horizontal System Indicator presents a pilot with a plan view of his aircraft with reference to his navigation position.

Royal Canadian Navy transferred the first five of a total of 17 Tracker ASW aircraft to The Netherlands under terms of mutual aid to member nations of NATO. The aircraft are built by the de Havilland Aircraft of Canada, Ltd., under license from Grumman Aircraft Engineering Corp.

General Electric Co., will continue production of the 20-mm. Vulcan cannon under the terms of a $2,000,000 contract awarded by the Army's Boston Ordnance District. The contract represents partial funding for an order which eventually will call for 800 of the 6,000-round-per-minute cannons.

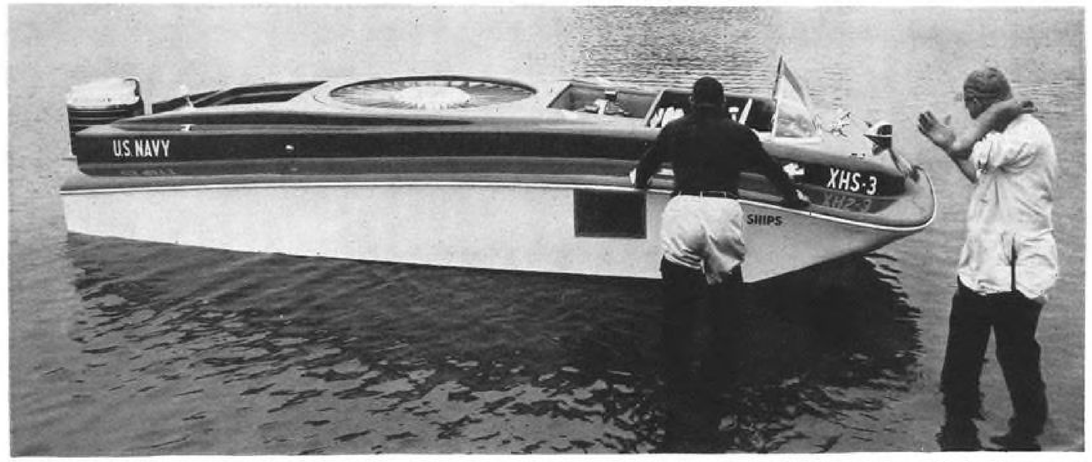


T64 to Be Tested in de Havilland Caribou

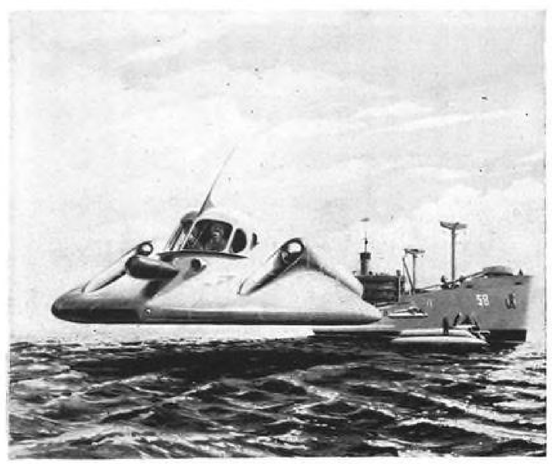
General Electric's T64 turboprop engine is shown in a mockup of de Havilland of Canada's DHC-4 Caribou engine nacelle. Two of the 2700-hp. engines will be evaluated in flight tests starting next May. Each will get 20 hr. of ground checkout followed by 400 hr. in the air. The low specific fuel consumption (0.495) turboprop has logged 4,200 hr. of testing in GE's Lynn, Mass., test cells, will log a total of 7,000 hr. before its first flight.

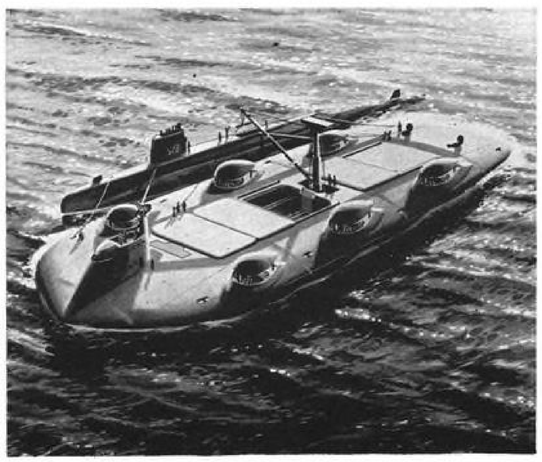
Experimental hydroskimmer naval craft, developed by Bell Aerosystems Co., rides above the water's surface on a cushion of air formed by a large fan located amidship. The research vehicle above is propelled by a standard outboard motor.

Navy Evaluates Bell Hydroskimmer Research Vehicle

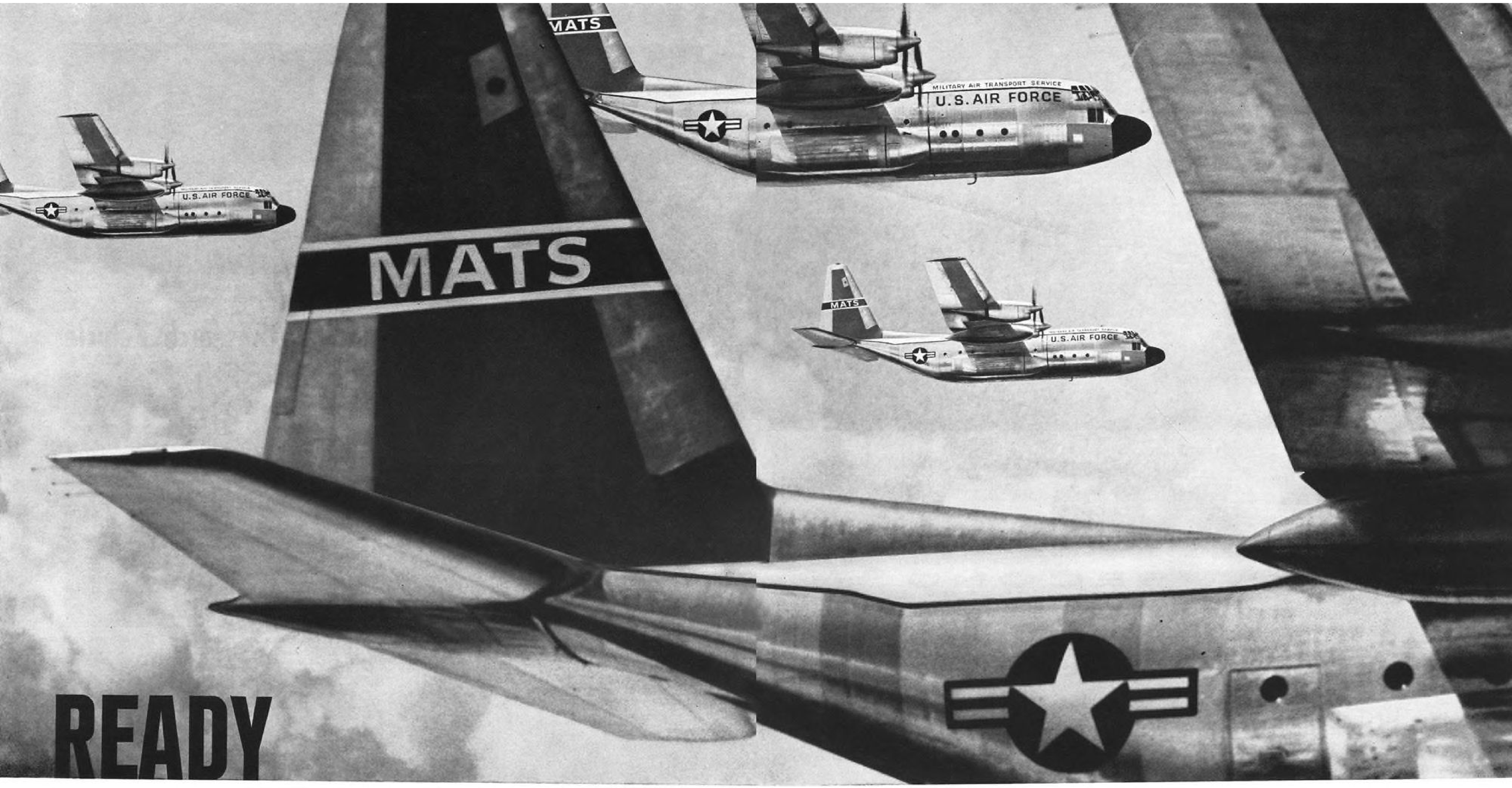


The large fan seen above drives air under the hull and holds it above the water reducing wave and frictional drag. Hydroskimmer was recently delivered to the Navy for test and evaluation. It is 18-ft. long, has an 8-ft. beam and weighs 2,300 lb.





Artist's concept of a future naval attack vehicle utilizing the air cushion principle is shown at left. Artist's concept at right shows submarine receiving fuel and supplies from hydroskimmer. Vehicle would be capable of high speed with relatively low horsepower, Bell says.



READY FOR USAF

The Military Air Transport Service will get the new extended-range C-130E Hercules fast, because the basic design is already proved. The long-range Hercules goes into production at once to meet the immediate need for a modern strategic airlift force.

The new long-range version of the versatile Lockheed C-130 Hercules gives the Air Force a strategic airlifter that can carry a 20,000 pound payload for more than 4,000 miles at average speeds up to 300 knots. Or 2,900 miles with a whopping 35,000 pound cargo. The big propjet C-130E meets these requirements for airlift operation: straight-in end loading; truck-bed height cargo floor; air-conditioned, pressurized cargo compartment; and the ability to lift, land, or airdrop heavy, bulky pieces of freight.

LOCKHEED GEORGIA

WORLD HEADQUARTERS FOR AIRLIFTERS AND CARGOLOADERS

New Offerings

Delta Design, Inc., San Diego, Calif., engaged in the design and development of portable control chambers for use in the evaluation of solid state electronic circuitry, controlled atmosphere processing chambers and pre-engineered high vacuum system components. Offering is 100,000 shares of capital stock, for public sale at $4.50 per share, to be made through company officials and employes. Of the proceeds, $210,000 will be used for the acquisition of land and the construction thereon of a factory to include office space and laboratory facilities; $110,000 for the purchase of new machinery and tooling and research equipment; the balance for financing additional inventory and for working capital.

Texas Research & Electronic Corp., Dallas, Tex.; organized under Minnesota law in September, 1960, the company proposes to engage in various phases of the electronics business through the acquisition of one or more existing businesses. The company has not as yet made any commitments to acquire any business, and there is no assurance as to when it will be able to commence business operations. Offering is 600,000 shares of common stock, for public sale at $1.15 per share. The proceeds, together with $400,000 cash on hand, will be used in the negotiation for and acquisition of one or more small businesses. It is estimated that $10,000 will be used in connection with setting up the company's office and other initial expenses.

Howell Instruments, Inc., Ft. Worth, Tex., (formerly named B & H Instrument Co., Inc.) engaged in the design, development, manufacture and sale of precision electronic and electromechanical instruments for use in testing instrument systems, and for measurement, automatic control, and recording applications. Offering is 140,000 outstanding shares of common stock, for public sale by the present holders thereof; offering price and underwriting terms to be supplied by amendment.

Madigan Electronic Corp., Carle Place, N. Y., engaged in the design, development, manufacture and sale of electronic equipment for use primarily in weapon systems and data processing systems; it also offers specialized field engineering services and technical publications. Offering is 110,000 shares of common stock, at $4.25 per share; 40,000 shares will be offered for sale to certain employes of the company and their relatives, purchasers of the company's products and to certain other persons known to the company who have indicated an interest in its affairs; 10,000 shares will be offered to persons associated with the underwriter. Of the proceeds, $200,000 will be applied in reduction of a $483,500 bank indebtedness; the balance for working capital.

The Foxboro Co., Foxboro, Mass., engaged in the manufacture of industrial instruments for indicating, recording and controlling temperatures, pressure, flow, humidity, liquid level and other process variables, primarily for use in the process industries in the manufacture or conversion of raw materials into finished or semi-finished goods. Offering is 211,000 shares of common stock; 125,000 shares for public sale by the issuing company, and 86,000 outstanding shares by certain holders thereof; public offering price and underwriting terms to be supplied by amendment. Of the proceeds, $500,000 will be used for construction of additional warehouse facilities at the company's Foxboro plant; $600,000 for construction of plant facilities in East Bridgewater, Mass., for the production of the company's Electronic Consotrol line of instruments; $500,000 for additional plant facilities for the company's Dutch subsidiary; $450,000 for the plant facilities of its Canadian subsidiary; the balance for working capital requirements.

The B. F. Goodrich Co., New York, N. Y., engaged directly and through its subsidiaries and associate companies in the manufacture and sale of tires and tubes, and also products for the aviation and space industries. Offering is $60,000,000 of sinking fund debentures due November, 1985, for public sale; interest rate, public offering price and underwriting terms to be supplied by amendment. Proceeds will be added to the company's general funds to be available for capital expenditures and other investment outlays, as well as for additional working capital expected to be needed during the next several years. As of Sept. 1, 1960, approximately $62,000,000 (including amounts actually committed) had been authorized but not expended for additions, improvements and replacements of operating facilities, including the construction of a tire plant in Fort Wayne, Ind., and a tire plant in Kitchener, Ontario, Canada, as well as the construction,

Love Field Installs Center Line Lights

Delta Air Lines Douglas DC-8 passes over towers of new Configuration A approach lighting system being installed off the approach end of Instrument Runway 13-31 at Love Field, Dallas, Tex. System is expected to be operational Jan. 2. New system, extending 3,000 ft. from the centerline of the runway, is approximately 300 ft. longer than left-hand approach light system now in use. Federal Aviation Agency is funding the $205,000 cost of installing the new system, which will have Sylvania Electric sequence flashing strobe lights and General Electric sealed beam lights and regulators.

Aeronaves, Eastern Open Mexico City DC-8 Service

Two Douglas DC-8 turbojet transports of Aeronaves de Mexico and Eastern Air Lines are shown at New York International Airport on return from pre-inaugural flights to Mexico City (AW Nov. 28, p. 43). Daily flights began earlier this month.

completion or expansion of tire and polyvinyl chloride facilities abroad.

Pall Corp., Glen Cove, N. Y., engaged in the production of metal filters for fluids, chemicals and gases, and porous plastic filters and other materials capable of meeting comparable requirements; products are used primarily in the aircraft, missile, atomic energy, chemical, etc., industries. The company's subsidiary, Fibrous Glass Products, Inc., is in the business of molding fibrous glass insulation for use in marine, appliance, construction, electronic and packaging industries, and proposes to enter into the manufacture of glass fibers and the production of finished products in a proposed plant.

Offering is 80,000 shares of Class A stock; 30,000 shares for public sale by the company, and 50,000 outstanding shares by the present holders thereof. Public offering price and underwriting terms to be supplied by amendment. Of the proceeds, $50,000 will be applied to planned expansion of the company's existing plant to perform manufacturing operations which are now being subcontracted. The balance of such proceeds will be temporarily added to working capital and applied to the company's proposed entry into fiber glass manufacture; if such plans are not effected, the balance will be invested in short-term government securities or interest-bearing deposits.

Elion Instruments, Inc., Bristol, Pa., engaged in the design, development, manufacture and sale of specialized instruments and equipment intended to perform instantaneous, precise measurements and analyses for science and industry. Offering is 60,000 outstanding shares of capital stock and five-year warrants to purchase 6,000 new capital shares, for public sale in units (each consisting of one share of stock and one-tenth of a warrant; no sale will be made of less than 10 units). Public offering price of the units will be related to the price of the company's stock on the over-the-counter market during the period immediately prior to the offering; underwriting terms to be supplied by amendment. Also, the underwriters will purchase from the company, for $1,000, warrants expiring in 1965 to purchase 20,000 shares of company stock at $20 per share. Following the initial public sale of the units, 840 outstanding capital shares are to be offered for public sale by the present holders thereof.

Herbert A. Elion, president, and Robert J. Zeigler, vice president, propose to sell 30,000 shares each, and have agreed to lend to the company the net proceeds received by them from such sales. Proceeds from the loan together with the $1,000 from the company's sale of 20,000 stock purchase warrants will be used by the company to pay off in part bank loans aggregating $75,000, which were used for working capital; the balance to be added to the company's general funds.

Slick Airways, Inc., Burbank, Calif., engaged exclusively as a contract and charter carrier until July 1, 1960, when it diversified into the manufacturing field by the acquisition of the assets and assumption of the liabilities of Illinois Shade Cloth Corp. The company has agreed to purchase from Canadair, Ltd., two model CL-44D turbine-powered aircraft (and related spare parts and five spare engines), on which it is obligated to make payments in 1961 aggregating about $1,893,000. Slick plans to resume scheduled common carrier operations no later than a reasonable time after delivery of such aircraft, scheduled for September or October, 1961. It is estimated that during 1961 the company will incur expenditures of $1,050,000 in connection with the recommencement of such operations. Additional capital is sought at this time in order to strengthen the company's financial position in view of such proposed acquisition and resumption of scheduled common carrier operations; net proceeds of the stock sale will be added to general funds and used for general corporate purposes.

The offering is 600,000 shares of common stock, for public sale; offering price and underwriting terms to be supplied by amendment.

CAB Accident Investigation Report:

Overtaking F-86L Failed to Sight C-35

At 1520 MST, Dec. 15, 1959, an F-86L flown by Capt. William E. Meckem, the wingman in a formation of two Wyoming Air National Guard F-86Ls, and a Beechcraft C-35, flown by Gene A. Lewis, collided at 9,000 ft. msl., or 2,850 ft. above the ground. The collision occurred about 4.5 mi. south-southwest of the southern boundary of the Cheyenne Municipal Airport, within the airport control zone. The pilot of the Beechcraft, the only occupant, received fatal injuries. The pilot of the F-86L ejected safely but sustained minor injuries. Both aircraft were destroyed.

Shortly before the collision the F-86L flight leader made a simulated ILS and low approach during which the wingman flew in safety-observer position. Following the low approach the wingman joined in close formation. The accident occurred thereafter while the flight was proceeding to the initial point to enter the tactical pattern for landing. The Beechcraft was en route to Denver, Colo., from St. Cloud, Minn., with an en route business and fueling stop at Dickinson, N.D.

Both flights were being made on VFR flight plans and the weather conditions in which the collision occurred were: high thin cirrus clouds; visibility 90 mi.

At the time of the collision the F-86L formation was on a heading of 110 deg. magnetic, in straight and level flight, and at a computed true airspeed of 312 kt. Analytical calculations indicate that the Bonanza was being flown on a heading of approximately 154 deg. magnetic, in straight and level flight, and at a calculated true airspeed of 139 kt. The evidence indicates that the flight conditions for the Beechcraft were constant for at least a 60-sec. period prior to the collision. For the first 30 sec. of the same period the F-86L formation was climbing, accelerating, and turning left. For the final 30 sec. the flight conditions of the colliding F-86L were constant as stated.

The accident took place in excellent weather conditions which, under the appropriate Civil Air Regulations and military rules, place the responsibility for collision avoidance on the pilot through visual detection and avoidance of other aircraft.

An analytical study based on all of the evidence shows that at the start of the 60-sec. period the colliding aircraft were separated 3.48 stat. mi. At this time the F-86Ls were positioned 129 deg. to the right rear of the Beechcraft and the Beechcraft was 67 deg. to the left of the nose of the aircraft of the jet formation leader. During the final 30-sec. period the F-86Ls were positioned 110 deg. to the right rear of the Bonanza while the Bonanza was 26 deg. to the left of the nose of the aircraft of the jet formation leader. Separation between the planes was then 2.8 stat. mi.

It is the conclusion of the Board that, from all the evidence, an overtaking situation occurred in which the F-86Ls overtook the Bonanza from the right rear. The Board concludes that during closure there was sufficient opportunity for the jet formation leader to have seen the Beechcraft and to have avoided the collision, in accordance with the responsibility of the pilot of an overtaking aircraft. It is the further conclusion of the Board that the opportunities afforded Lewis were not sufficient to have expected him to have seen the jets.

Following the accident the Air National Guard unit at Cheyenne required that on missions which require a safety observer the pilot performing this responsibility will do so throughout the entire mission. The directive requires that the safety observer will not join formation even though that portion of the flight requiring a safety observer is completed. The unit also raised, for its jet aircraft, the flight altitudes specified for the control zone prior to the initial point 1,000 ft. The first action intends to enable all pilots flying as a flight to look for other aircraft. The second action intends to reduce collision exposure by greater traffic segregation.

INVESTIGATION

Beechcraft C-35, N 1839D. Investigation disclosed that on Dec. 15, Gene A. Lewis, the pilot of N 1839D, planned and prepared for a flight from St. Cloud, Minn. to Denver, Colo., with an en route combined business and fueling stop at Dickinson, N.D. He departed St. Cloud at 0700[1] and flew, VFR—no flight plan—to Dickinson, arriving about 1050. There Lewis conducted his business and the Bonanza was fueled to capacity by adding 22.3 gal. of gasoline.

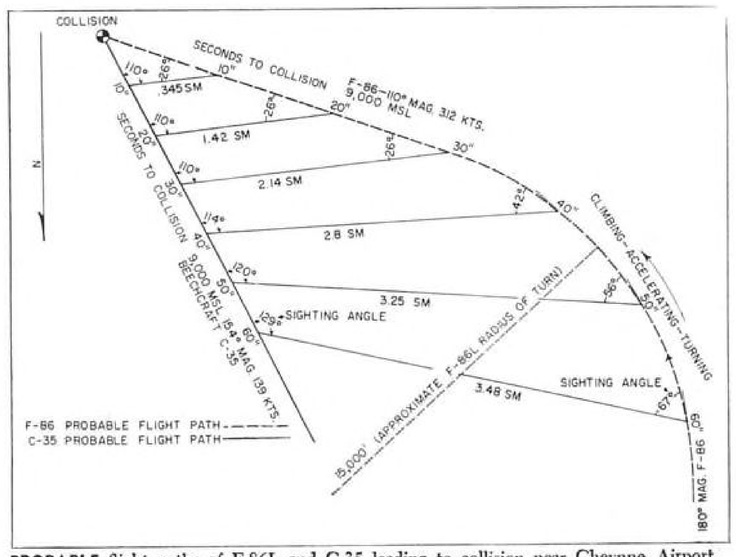
Lewis left Dickinson at 1235 and shortly after takeoff air-filed a VFR flight plan to Denver with the Dickinson FAA communications station. According to the flight plan he proposed to fly to Rapid City, S.D., direct to Denver, at 8,500 ft. He estimated 3 hr. 15 min. en route with 5 hr. of fuel aboard. About 1343 Pilot Lewis contacted Rapid City radio stating he was at 4,500 ft. over the city, VFR to Denver. He requested and was furnished the latest winds aloft and weather appropriate to his flight.

Flight Identified

About 1515 N 1839D called Cheyenne radio on 122.1 mc. and requested the latest winds aloft. Lewis identified his flight as "Bonanza N 1839D" and stated he was VFR en route to Denver; he did not give his position or altitude. The controller furnished the most favorable winds aloft for a Bonanza en route from Cheyenne to Denver, which were between 8,000 and 11,000 ft.

Lewis asked that the information be repeated, which was done. His acknowledgment was the last communication from the aircraft.

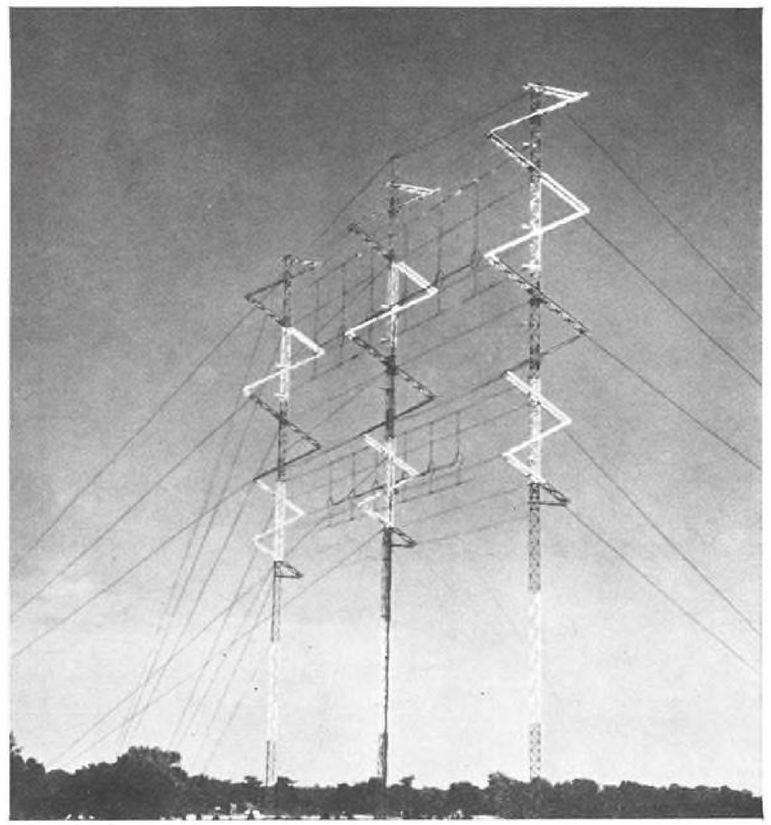
F-86L Flight. At 1420 that afternoon F-86L, 55-3662, piloted by Capt. William E. Meckem, and F-86L, 52-9993, piloted

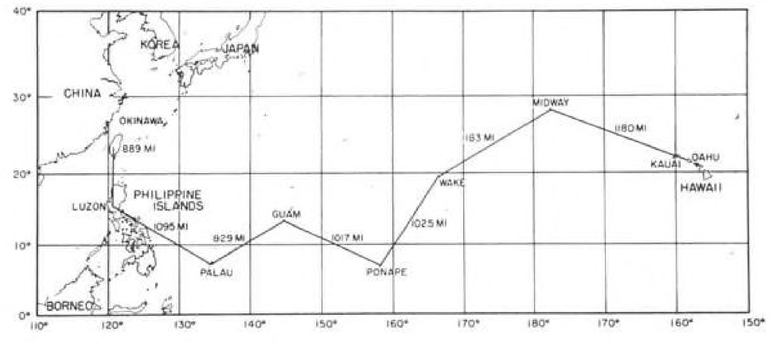


PROBABLE flight paths of F-86L and C-35 leading to collision near Cheyenne Airport.

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

Engineer inspects Styroflex® cable installed on an antenna array at one of Pacific Scatter Communication System stations shown at right.





Over 40 miles of *Styroflex® Coaxial Cable* help assure Pacific Scatter Communication System reliability!

More than 200,000 feet of Styroflex® coaxial cables are in active use as balanced antenna feed lines in the recently completed Pacific Scatter Communication System stretching from the Hawaiian Islands to Okinawa. This trans-Pacific system, one of the largest and most advanced of its kind in the world, uses ionospheric and tropospheric propagation techniques that produce over 99% reliability. An important part of the Strategic Army Communications Network (STARCOM), the system was designed, developed and constructed by Page Communications Engineers, Inc. for the U. S. Army Signal Corps.

Each of the nine stations in the network is equipped with the same major component parts—transmitters, exciters, multiplex terminals and antennas. The cables used in the 200- and 400-foot antenna arrays range from ⅞" jacketed Styroflex® cable to 3⅛" jacketed Styroflex® cable. About 7,000 feet of ½" jacketed Foamflex® cable is also used in the system. The Styroflex® cables were spliced in the field by an inert-gas Heliarc welding process to assure noise-free connections required for successful duplexed antenna operation.

The extremely low inherent noise level and low attenuation of Styroflex®—together with this air-dielectric cable's stable electrical and mechanical properties—especially qualify it for the critical specifications of this STARCOM system. If your system requirements call for a cable with low loss and high reliability, investigate the successful record of Styroflex®!

(Photos courtesy of Page Communications Engineers, Inc.)

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CORPORATION
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by First Lieutenant Howard T. Anderson, took off from the Cheyenne Municipal Airport as a flight of two. Both pilots were members of the 187th Fighter Interceptor Squadron, Wyoming Air National Guard, which is based on the Cheyenne joint-use airport. The unit performs an air defense mission using the F-86L, an all-weather single-place jet interceptor.

The purpose of the flight was a tactical evaluation for Lt. Anderson, given by Capt. Meckem who was also a full-time training supervisor for the squadron. Briefly, the tactical evaluation is performed pursuant to CONAC (Continental Air Command) directives and intends to permit an evaluation of pilot proficiency relative to combat-readiness standards. It is given semiannually and incorporates the various ground and flight training curricula necessary in the all-weather intercept mission. Accordingly, prior to the flight, Lt. Anderson demonstrated to Capt. Meckem satisfactory knowledge of the F-86L aircraft and its systems and the regulatory materials governing the squadron's air defense mission. He also conducted a briefing of the flight portion of the evaluation covering its various requirements. These included a scramble from a simulated advanced state of readiness, a maximum performance without afterburner climb to high altitude, all-weather type GCI intercepts, a simulated instrument penetration, and ILS low approach. The flight portion also included, if remaining fuel permitted, a simulated flameout pattern following the ILS approach.

Because of the all-weather nature of the flight, after takeoff Lt. Anderson flew his aircraft principally by reference to instruments while Capt. Meckem flew as safety observer, positioning his aircraft behind, slightly below, and to the right of Lt. Anderson. At this time it was Capt. Meckem's responsibility as safety pilot for the flight to look out for other aircraft and avoid collision. This responsibility is according to appropriate Civil Air Regulations and Air Force directives. According to their testimony, this was clearly understood by both pilots.

Weather conditions at this time and at the time of the accident were: High thin cirrus; visibility 90 mi.

About 1500, after the intercept phase was finished, Lt. Anderson called Cheyenne tower and requested a practice VFR-VOR jet penetration and ILS low approach.[2] The tower cleared the flight as requested, advising it to maintain VFR at all times, to report leaving the VOR outbound at 20,000 ft. and when leaving the outer marker inbound to the ILS runway. The reports were made. At 1517, about 200 ft. over the middle marker and at approximately 160 kt., Lt. Anderson finished the ILS and reported "on the go" to the tower. He continued down the runway and as the aircraft accelerated retracted speed brakes, gear, and flaps. At this time the simulated instrument flight portion of the mission ended and Lt. Anderson returned to visual flight. Capt. Meckem remained in the safety-observer position as chase pilot. Each of the pilots said that at this time he watched for other aircraft but saw none.

As the flight crossed the airport above Runway 26 Lt. Anderson asked for a "simulated flameout pattern."[3] The tower approved the request; however, Capt. Meckem, about this time, informed Lt. Anderson he had insufficient fuel for the maneuver prior to landing. Lt. Anderson, therefore, transmitted to him, "Let's enter on initial and join on the turn." This transmission in jet fighter parlance meant the simulated flameout would not be made, the flight would proceed to the initial point,[4] enter the initial approach,[5] and land. It also meant for Capt. Meckem to join in close formation. Although the tower was not directly informed of the intention the controller said he overheard the transmission, understood the meaning.

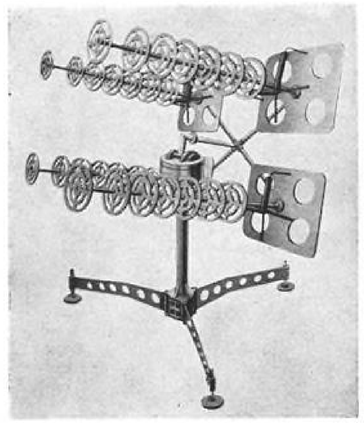
The tower controller stated he watched the low approach and saw the jet flight make an approximate 30-deg. right turn just past the end of the runway. This was in conformity with a noise-abatement procedure to avoid flying over the Ft. Warren hospital. He stated that he watched the flight then continue outside the traffic pattern limits in a left climbing turn. At this time the controller turned his attention to a T-33 which was in the traffic pattern

[2] The penetration is an instrument procedure to transition jet fighters from high altitude to the instrument landing system. Low approach meant the plane would not land after the ILS but would go around, passing over the landing runway. The ILS at Cheyenne is from east to west; the runway is 26, 260 deg.

[3] A pattern used in event of a jet power loss commonly referred to as a "flameout." The pattern is practiced by nearly all units using subsonic and transonic fighters.

[4] This is a location five miles east of Runway 26. Jet fighters pass over the location, establish a flightpath from it along the runway extended centerline to the end of the landing runway. The landing from this position is a 360-deg. overhead pattern.

[5] Initial approach is that portion along the runway extended centerline.

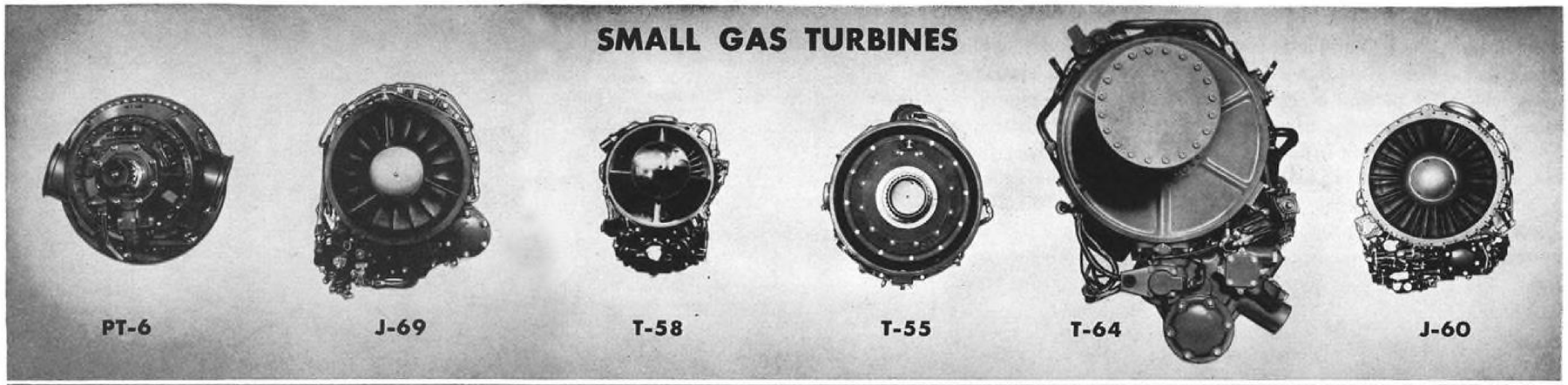


VHF Tracking Antenna

Lightweight VHF tracking-telemetry antenna, Model 420A, provides dual polarization with 18 db. gain over band of 215 to 260 mc. and permits simultaneous tracking at 2,000 mc. Antenna, which measures 8 ft. square by 6 ft. deep, is available in collapsible model which reduces to 5 ft. square by 2 ft. deep. Antenna weighs 250 lb., operates in 125 mph. winds without a counterweight, according to firm: Avien, Inc., 58-15 Northern Blvd., Woodside 77, N. Y.

Controls for the "hot ones"

- for over 23,000 aircraft gas turbines
- for a liquid hydrogen rocket engine
- for the B-70's air-induction system
- for the power forms of tomorrow



Hamilton Standard has supplied fuel and engine controls for over 23,000 aircraft gas turbines–powering 17 types of the nation's leading military and commercial aircraft.

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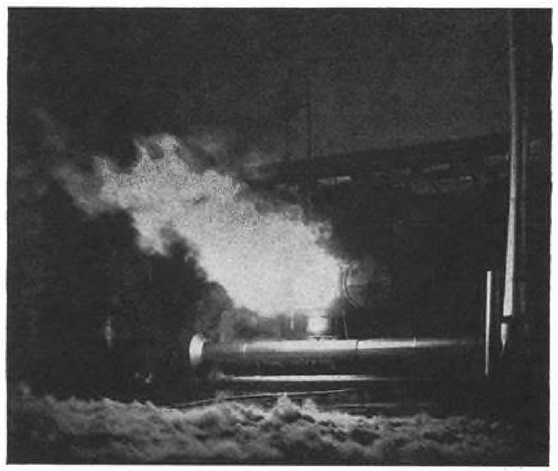
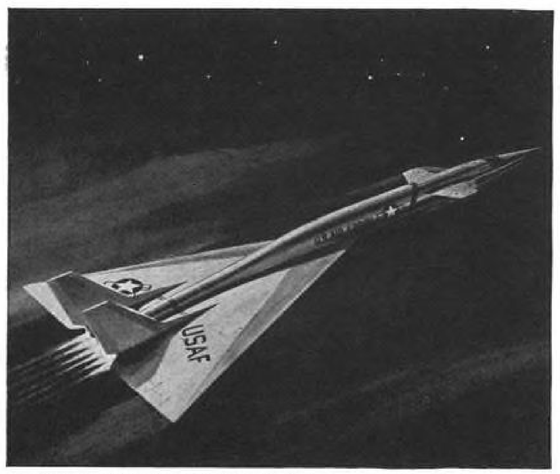


ROCKET ENGINE CONTROLS. Hamilton Standard has developed thrust modulation controls and fuel-oxidizer shut-off valves for an advanced liquid hydrogen engine. This work has provided important breakthroughs in low-temperature sealing problems and system reliability.



B-70'S AIR-INDUCTION CONTROL SYSTEM, now under development at Hamilton Standard, involves some of the most advanced control problems ever encountered. It is designed to provide the most efficient air-flow into the plane's engines over an unusual range of operating conditions.

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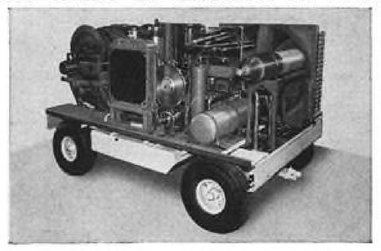
ENVIRONMENTAL CONDITIONING SYSTEMS for space vehicles and such advanced aircraft as the B-58, 880, B-70 are important aspects of Hamilton Standard diversification.



GROUND SUPPORT EQUIPMENT. Hamilton Standard is presently producing a wide range of GSE for both missiles and aircraft—from special tools to complete systems.

ELECTRONICS at Hamilton Standard includes broad experience in flight control, instrumentation, static power inversion and electrical control for aircraft, missile and GSE components.

for landing. The controller indicated that the next call from the jet flight would occur when it entered the tactical pattern at the initial point for Runway 26.

The testimony of Lt. Anderson was in agreement. He stated that his flight passed well to the right of the Ft. Warren hospital, located two-three miles beyond the end of the runway. He stated that approximately abeam of the hospital he began a left turn. He said it was a climbing turn and that the climb was started after the ILS was finished, power was applied, and the aircraft was clearly accelerating with gear and flaps up. The left bank was 30 deg. Lt. Anderson continued the left turn to 110 deg., interrupting it once on a heading of about 180 deg. to clear the turn. Capt. Meckem closed in the turn to close formation. He took position on Lt. Anderson's right wing with his aircraft slightly below the level of Lt. Anderson's with four to five feet wingtip separation. Fore and aft he flew the "slat line." As the turn progressed the flight accelerated to 270 kt. IAS.

Because precision, planning, and coordinated smoothness were important considerations in a satisfactory performance of the evaluation, Lt. Anderson planned to reach 9,000 ft., 270 kt., and the 110-deg. heading simultaneously. For all practical purposes this was done and both pilots estimated that it occurred about 30 sec. before the collision. The pilots testified it was clear to them that at this point Lt. Anderson was the formation leader and Capt. Meckem was the wingman. Accordingly, because flying formation requires the wingman's undivided attention to the leader, the responsibility to see and avoid other aircraft was entirely that of the formation leader. This is in accordance with Civil Air Regulations and military directives.

Cleared the Area

Lt. Anderson stated that he clearly understood his responsibility and believed he had maintained a careful look out for other air traffic. In his testimony he recalled stopping the turn about 180 deg. to clear the area, particularly in the direction he intended to continue. He testified that during the last 30 sec. he scanned the left quadrant, then straight ahead, and then the right quadrant. Lt. Anderson stated that at the same time he scanned he also checked Capt. Meckem's position. He stated that when he returned his vision forward he saw an aircraft immediately in front of him and make a violent pullup to avoid it. He said it all occurred so quickly he had no time to warn Capt. Meckem or even to identify the plane. Lt. Anderson said, in retrospect, he believed that he had scanned for other aircraft in a normal manner and was sure he looked in the area where the Beech was located but had not seen it. He further indicated that except for brief altitude, airspeed, and heading checks there were no duties or occurrences which required his attention within the cockpit.

Capt. Meckem testified that his attention was concentrated on the formation formup and thereafter on holding close position. He was generally aware that heading, speed, and altitude were as Lt. Anderson described them. He was also of the opinion that these factors were constant for at least the final 30 sec. before collision. He said that so far as the collision itself was concerned he recalled a flash on his windscreen an instant before impact. He did not recognize the Bonanza, in fact, assumed he had collided with the T-33 which had been overheard in the traffic pattern.

A concentration of small fuselage pieces of the Beechcraft and its mutilated empennage were found 4.5 mi. south-southwest of the southern boundary of the airport. This wreckage marked the approximate location over which the collision occurred. The F-86L crashed about 1.5 mi. southeast and the Beechcraft about one-half mile south of this location.

Examination of the Beechcraft showed the aircraft struck the ground 40 deg. nose-down on a southerly heading. The wings were attached to the cabin; however, the structure from the aft cabin rearward was destroyed. The powerplant was torn out.

Examination of the Beechcraft structure provided clear information relative to the inflight impact sequence. It showed that the F-86L nose and fuselage structure above the wing penetrated the right side of the Bonanza fuselage at about station 141.0, a location just aft of the rear cabin window. The window frame remained attached to the cabin; the structure aft of the location was destroyed. On the opposite side of the Bonanza fuselage most of the rear cabin window and all structure rearward of station 121.0 were destroyed. Between the left and right locations there was a clear line of destruction which formed an angle of approximately 110 deg. through the fuselage measured clockwise from the nose relative to the fuselage centerline of the Beechcraft. The manner in which the structure was affected showed that the line of shearing was from right to left; however, there was no discernible evidence of vertical forces.

The fact that the Beechcraft wings showed no inflight contact damage indicated that the right wing of the F-86L passed below the plane of the Bonanza wing. Because the F-86L was nearly straight and level at impact, this fact further shows the Bonanza was also nearly straight and level. Finally, calculations based on the heading and speed of the F-86L, the approximate speed of the C-35, and the 110-degree line of structural shearing through the Beechcraft fuselage show a resulting heading for the Bonanza at impact of 154 deg. magnetic. From the only known witness to the collision it was learned that the Bonanza was flown straight and level on a constant heading for a period which he estimated as three to five minutes before the midair impact. Although the witness thought the Bonanza pulled up and banked left one to three seconds before impact, the structural evidence clearly indicates this either occurred after the collision or it was an illusion created as the two planes of different size and speeds merged and collided. The approximate true airspeed of 139 kt. for the Bonanza was based on the manufacturer's operating data for the aircraft at normal cruise and at 9,000 ft.

It is noteworthy that a reasonable variation of this speed factor above or below normal cruise in this instance will not appreciably alter the computed heading of the Beechcraft.

The Cheyenne Municipal Airport is located on the north side of the city. In

addition to being the home base of the Air National Guard Squadron it also serves three scheduled air carriers and considerable general aviation and military traffic. The airport has a conventional five-mile radius control zone and utilizes conventional left traffic patterns, one for light aircraft and the other for heavy traffic. The first is close in and the latter is within three miles of the center of the airport. In addition, the F-86Ls use a tactical approach and 360-deg. overhead landing pattern. All of these patterns were published and disseminated locally. The use of the airport by the jet fighters and the fact that they made instrument low approaches was also published in the Airman's Guide according to its publication procedures.

Another factor relative to this collision is that the F-86L flight utilized UHF (ultra high frequency) communications and the Beechcraft was equipped with VHF (very high frequency) communications. The tower did not, nor does any tower normally, simulcast on both VHF and UHF communications. The F-86L pilots and the Bonanza pilot, therefore, could not overhear radio communications made with respect to the other.

ANALYSIS

From the evidence gathered in the accident investigation it is apparent that the collision occurred outside of the Cheyenne Airport traffic pattern but within the limits of the airport control zone. It occurred while both flights were being made on VFR flight plans and in weather conditions which were virtually clear; visibility was reported as 90 mi. Under these circumstances Civil Air Regulations[6] impose upon the pilot direct and full responsibility to avoid collision through visual detection and avoidance of other aircraft. The Civil Air Regulations also state rules regarding right-of-way under various conflicting situations. Because averting collision rested solely with the pilots it is imperative in accident investigation to determine the opportunities afforded each pilot to carry out this responsibility. In order to determine and evaluate them it is necessary not only to determine the manner in which the aircraft collided but also the relative position of each aircraft with respect to the other during the 60-sec. period of closure prior to collision. The testimony of the jet pilots, the inflight structural damage to the Beechcraft, and other information gathered during the investigation provided a good foundation for an accurate analysis of these important considerations.

Analysis of the factual information and physical evidence leads the Board to the determination that the inflight contact sequence began with the Beechcraft on a heading of 154-deg. and the F-86L on a heading of 110 deg. Initial inflight contact occurred when the F-86L nose structure contacted the fuselage of the Beechcraft just behind the right rear cabin window. The sequence progressed as the nose structure above the wing of the F-86L penetrated and cut through the Beechcraft fuselage at an angle of 110 deg. to the fuselage centerline measured clockwise from the nose. Forces attending the sequence sheared off the Bonanza fuselage aft of the swath line while the right wing of the F-86L most probably passed below the plane of the wings of the Beechcraft.

Because the colliding F-86L was in straight and level flight during the sequence and because the wings of neither aircraft made contact it is most apparent the Bonanza was also straight and level. This is substantiated by the lack of any vertical deformation to the structure involved in the collision. These factors cause the Board to believe that no evasive action occurred which should indicate the Bonanza pilot saw the F-86Ls during the collision closure.

As part of the Board's analysis a vector diagram was prepared using the aforestated factual material necessary to the study. In this manner the probable flightpaths of the aircraft were determined for the 60-sec. period of closure prior to the collision. From the study it was possible to determine the relative position of each aircraft to the other at any given period. Similarly, it was possible to assess the opportunities afforded each pilot to have sighted the other's aircraft in order to avoid the collision.

The study shows that at the beginning of the 60-sec. period the colliding aircraft were separated 3.48 stat. mi. At this time the Beechcraft was located 67 deg. to the left of the nose of the jet formation leader's aircraft. It would have been slightly above the leader and visible to him through the canopy glass, presenting a quartering rear profile. During the first 30 sec., while the F-86Ls were turning, the angular position of the C-35 gradually shifted to a position about 26 deg. to the left of the nose of the leader's aircraft and to approximately eyelevel. During the final 30 sec., with formation straight and level, the position of the Beechcraft would remain unchanged.

The study also shows that at the beginning of the 60-sec. period the F-86L formation was positioned 129 deg. to the right rear of the nose of the Beechcraft, or approximately 40 deg. to the rear of the 90-deg. position. The jets would have been below the level of the Beechcraft. During the first 30 sec. the position of the jet formation would gradually shift forward until it was positioned level at a sighting angle of 110 deg. to the rear of the nose of the C-35. During the final 30 sec. this position would remain unchanged

CONCLUSIONS

From the available evidence and analytical study of this accident it is the conclusion of the Board that an overtaking situation occurred in which the F-86L formation overtook the Beechcraft from its right rear. The Board concludes that during the 60-sec. period of closure the Beechcraft was positioned well within the forward visual quadrant of the jet formation leader and that it presented an adequate profile for visual detection within the distance which separated the aircraft. The Board therefore concludes that there was an adequate opportunity for the jet formation leader to have seen the Beechcraft in time to have led his wingman off collision course, in accordance with the responsibility of an overtaking pilot.

At all times during the 60-sec. period before collision the jet formation was positioned well to the right rear of the Beechcraft. This position was as much as 129 deg. and was never less than 110 deg. It is fundamental that a pilot's primary responsibility is to direct his attention to the most critical area, which is the 180-deg. quadrant ahead of his aircraft. While this is not intended to mean that a pilot should not search all areas available to him, it does mean that his greatest effort should be in the direction of flight with reliance that an overtaking pilot will similarly fulfill the same responsibility. Accordingly, the Board does not believe that the opportunities afforded Lewis were sufficiently adequate to have expected him to have seen the jets.

The Board believes that the action by the National Guard unit to require the safety pilot to remain in this role throughout an entire mission is an effective measure. It is believed to be effective in that the requirement will permit greater utilization of both pilots in such flight in the difficult task of looking for other aircraft. The second action taken was to raise the jet altitude minimum prior to initial approach. This was also done by the Air Guard unit. The Board believes that if there is a concentration of traffic in the Cheyenne Airport area between 3,000 and 4,000 ft., action to utilize a higher altitude by the fighters should also be effective in reducing collision exposure.

The Board determines that the probable cause of this accident was that during an overtaking situation the jet formation leader failed to see the Beechcraft in time to lead his wingman off collision course.

By the Civil Aeronautics Board:

WHITNEY GILLILLAND
Chairman

G. JOSEPH MINETTI
Member

ALAN S. BOYD
Member

J. S. BRAGDON
Member

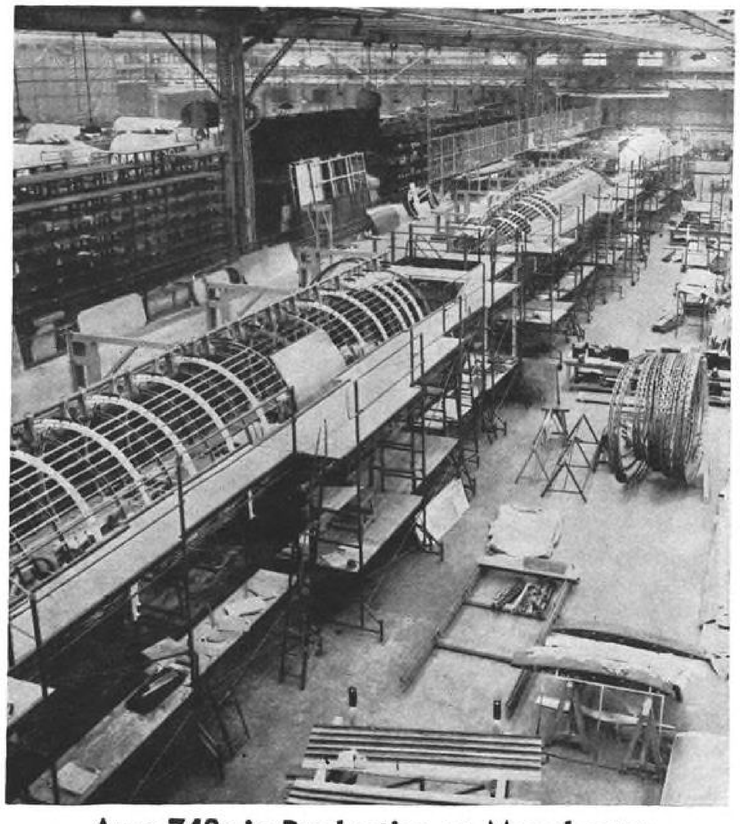
Chan Gurney, Vice Chairman, did not participate in the adoption of this report.

SUPPLEMENTAL DATA

The Civil Aeronautics Board was notified of this accident shortly after it occurred on Dec. 15, 1959. An investigation was initiated in accordance with the provisions of the Federal Aviation Act of 1958. Depositions, ordered by the Board, were taken in Cheyenne, Wyo., on Feb. 4, 1960.

Pilot Gene A. Lewis, 37, resided in

[6] CAR Part 60.10, 60.12 and 60.14.



Avro 748s in Production at Manchester

Avro 748s being built for Hawker Siddeley Aviation are on the production line at the Chadderton (Manchester) factory of A. V. Roe & Co., Ltd. Firm orders for 15 of the 44-seat feeder-line aircraft have been received from several British airlines, and the aircraft is also being built under license by the Indian government. The first production aircraft is due for delivery to Skyways, Ltd., next year. Two Rolls-Royce Dart Mk.514 turboprops, each delivering 1,740 eshp., power the 748, which was first flown in June, 1960.

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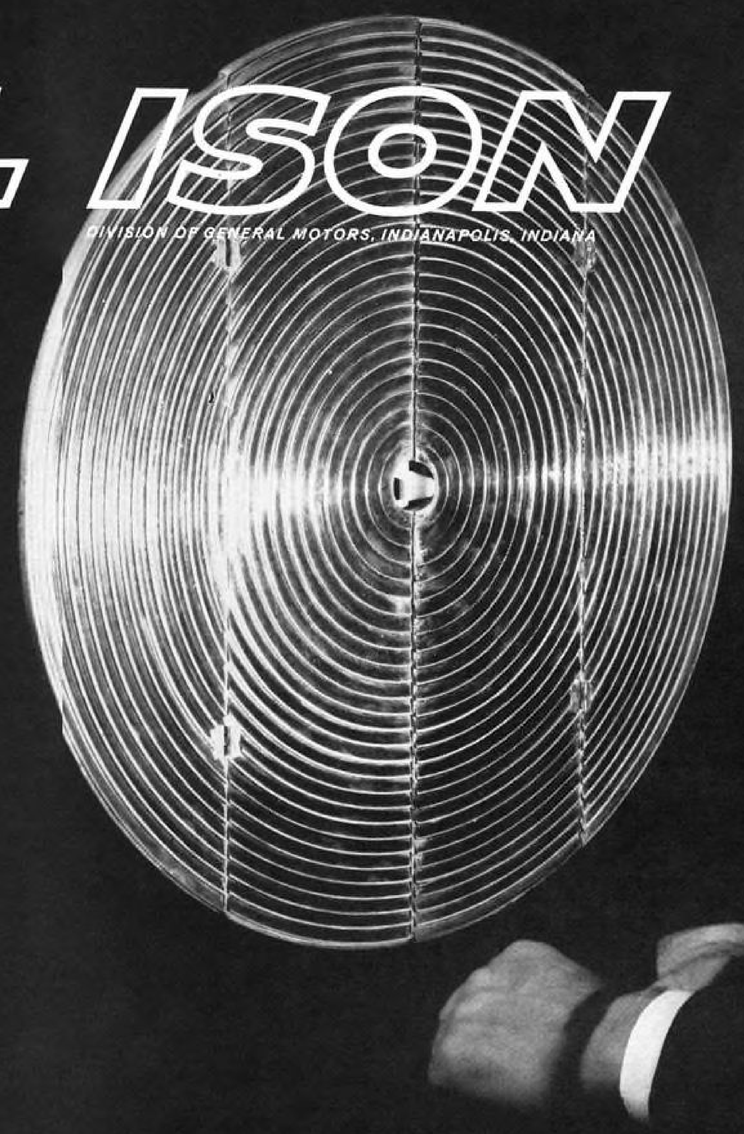

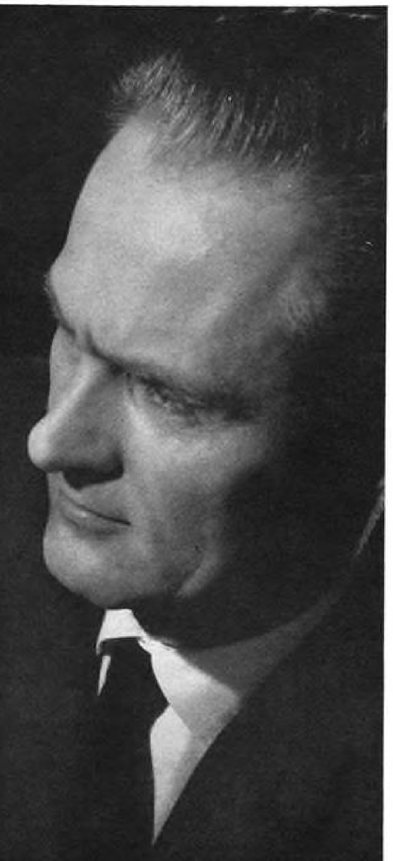

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St. Cloud, Minn., and was the senior member of Scenic Outdoor Advertising, Inc., part owner of the Beechcraft C-35. He held a private pilot certificate with single-engine land rating issued by the Federal Aviation Agency June 29, 1959. FAA records indicate that at that time he had acquired 19 hr. dual, of which 6 hr. were on cross-country. He also had 82 hr. solo, of which 62 were cross-country. As near as can be determined, at the time of the accident he had accumulated a total of 325 hr. of flying. Lewis satisfactorily passed, without waiver, a class III medical examination Apr. 22, 1959.

Capt. William E. Meckem, age 31, resided in Dubois, Wyo. At the time of the accident he was employed by the 187th Fighter Interceptor Squadron of the Wyoming Air National Guard as an air training supervisor on a full-time basis. He was a rated pilot on flying status and possessed a 3-2 (white) instrument card issued by the Air Force. Capt. Meckem also held a commercial pilot certificate with single-engine land and instrument ratings. He held a currently valid military physical examination certificate. He had flown a total of 2,450 hr. Of this total 1,250 were in military aircraft, of which 160 were in the F-86L aircraft.

First Lieutenant Howard T. Anderson, age 30, resided at 1663 Chester, Aurora, Colo., and was employed as a professional pilot. Lieutenant Anderson was also a member of the 187th Fighter Interceptor Squadron as a part-time reserve officer. He was a squadron pilot. He was a rated pilot on flying status and held a 3-2 (white) instrument card issued by the Air Force. He also held a commercial pilot certificate with single-engine, multi-engine, and instrument ratings. Lieutenant Anderson held currently valid FAA and Air Force medical certificates. He had accumulated a total of 1,400 hr. of which 800 were in civilian aircraft and 600 were in military aircraft. He had flown 500 jet hours, of which 250 were in the F-86L aircraft.

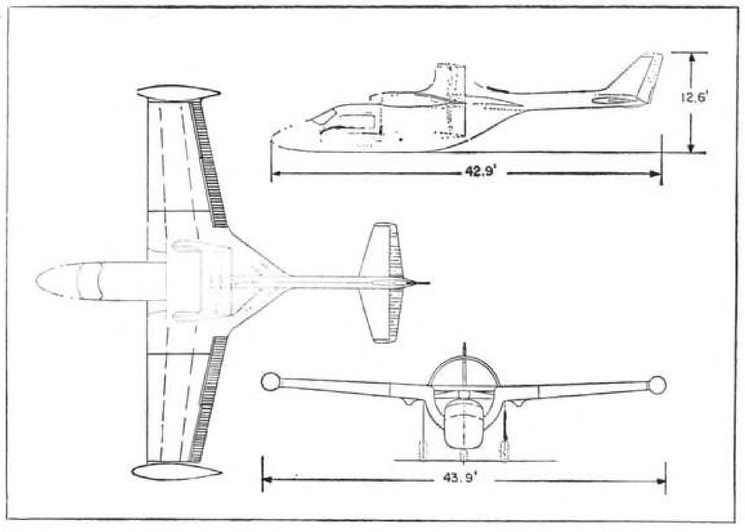
Beechcraft C-35, N 1839D, was manufactured in March, 1952, by the Beech Aircraft Co. Available records indicated it was purchased by its present owners May 19, 1959. The most recent periodic inspection was performed July 24, 1959. All airworthiness directives had been complied with and records indicated the aircraft to have been maintained in an airworthy condition. A recording tachometer showed a total of 1,784 hr. for the aircraft and a log entry of engine overhaul on Jan. 18, 1958, indicated that since then the engine had operated 737 hr. The engine was a Continental, Model E-185-11, and it was equipped with a Beechcraft propeller, model 215-107, blade model 215-207-88.

F-86L, 55-3662, was manufactured by North American Aviation, Inc., in 1953. It was possessed and maintained by the 187th Fighter Interceptor Squadron based on the Cheyenne, Wyoming Municipal Airport. Aircraft records indicated it had flown 988 hr., of which 28 were since last overhaul. The last line maintenance and preflight inspection was performed Dec. 15, 1959, the day of the accident. The aircraft was powered by a General Electric J47-GE-33 turbojet engine. Total time on the engine was 408 hr.

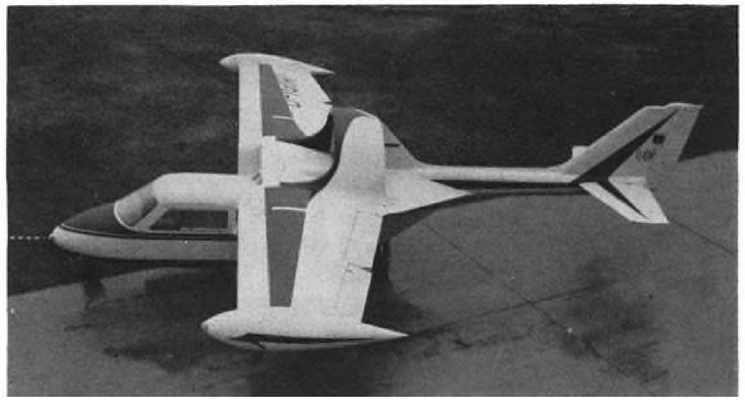
Germans Completing RF-1 Pusher Plane

By Edith Walford

RF-1 executive plane features half-ring wing, thrust deflection flap and a pusher propeller mounted in the ring. Aircraft is scheduled to begin flight trials shortly.



THREE-VIEW of RF-1 monoplane points up straight leading edge and wing thickness for stability. Airplane has short takeoff and land characteristics. Note swept tail (below).



Krefeld-Uerdingen, Germany—Final assembly of the first prototype six-seat, twin-engine RF-1 executive aircraft, built by Rhein-Flugzeugbau GmbH., is now nearing completion at the company's plant here.

Pending delivery of a specially adapted Hartzell propeller from the United States and the completion of some minor alterations being made to the plane's powerplant installation, flight trials are scheduled to begin shortly.

Engineer Hanno Fischer, who also developed the RW-3 Multoplane now in license-production at Uerdingen (AW June 20, p. 284), is responsible for the RF-1 design.

Design Details

The RF-1 is a shoulder-wing monocoque structure made chiefly of plastics to reduce maintenance costs. Like the RW-3, it features several unconventional design details aimed at improving its STOL characteristics and enabling the plane to operate from unprepared ground and grass strips.

The aircraft is powered by two Lycoming O-540-AIA engines rated at 250 hp. each at 2,575 rpm. They are installed in the wings and drive a single, pusher-type Hartzell propeller. A freewheel clutch enables the independent operation of either engine. If one of the engines fails, it can be declutched automatically without adversely influencing the performance of the plane.

The novel design features consisting of a half-ring wing, thrust-deflection flap and the propeller mounted in a ring have combined to form a tunnel effect resulting in increased lift and thrust and enabling the plane to take off after a ground run of about 360 ft.

The low-slung fuselage, fitted with an electrically operated retractable tricycle landing gear, allows passengers to board the aircraft without the aid of steps or a ladder.

Passenger Seating

The cabin accommodates six passengers including the pilot. Pilot and one passenger sit side-by-side in the cockpit and the remaining four passengers sit on the two facing benches in the rear of the cabin, which are separated by a folding table.

By removing the two rear benches, the plane can easily be adapted for freight-carrying or ambulance duty. Two large doors, one on either side of the cabin, open in the middle and fold back upward and downward to simplify loading of bulky baggage or freight. When used as an ambulance, the RF-1 can accommodate up to four stretchers in addition to the pilot and copilot, a doctor or nurse.

A definite price for the RF-1 has not yet been fixed, but Rhein-Flugzeugbau says it will probably cost about $55,000 (DM 220,000).

RF-1 Specifications

Dimensions:	
Span	43.9 ft.
Length	42.9 ft.
Height	12.6 ft.
Weights:	
Empty weight	3,970 lb.
Useful load	1,985 lb.
Gross weight	5,955 lb.
Wing loading	17 psf.
Powerplant:	
Two 250-hp. Lycoming O-540-AIA engines	500 hp.
Fuel:	
Normal fuel capacity	95.1 U.S. gal.
Fuel capacity of auxiliary fuel tanks	84.6 U.S. gal.
Fuel consumption at cruising speed with both engines	26.6 gph.

RF-1 Monoplane Performance

Normal endurance	3.5 hr.
Endurance with auxiliary fuel containers	6.8 hr.
Normal range with 30 min. reserve	465 mi.
Range with auxilary fuel containers and 30 min. reserve	930 mi.
Maximum speed	180 mph.
Cruising speed	160 mph.
Takeoff distance (at 5,072 lb.)	360 ft.
Takeoff distance (at 5,955 lb.)	502 ft.
Rate of climb (at 5,072 lb.)	24.2 fps.
Rate of climb (at 5,955 lb.)	19.1 fps.
Service ceiling (at 5,072 lb.)	21,600 ft.
Service ceiling (at 5,955 lb.)	20,300 ft.

Biologist Seeks Data On Waterfowl Flights

Reports by civilian and military pilots on migratory and navigation patterns of waterfowl (ducks and geese) are being solicited by Eugene Decker, R. D. 1, Emlenton, Pa., a waterfowl biologist. He is seeking reports on (1) waterfowl flocks flying at altitudes above 6,000 ft.; (2) flocks above or between cloud layers; (3) flocks flying in apparent confusion, i.e. lost, and (4) any other unusual flight behavior. Decker is seeking postcard reports giving dates, times, location and current weather during the observation.

Bell Helicopter Cuts 1961 Model Prices

Ft. Worth, Tex.—Significant price reductions will mark Bell Helicopter Co.'s trio of 1961 commercial models in line with firm's intention to stimulate sales and new markets at a faster rate.

New versions of the 47G will sell for $550 less than 1960 models and the executive four-place 47J will sell for $2,500 less than last year's version. Prices of the 1961 models will be: Model 47G-2A, $39,950; Model 47G-3, $43,950 and Model 47J-2, $69,950.

The helicopters also are marked by

significant technical improvements aimed at increasing performance and cutting operating costs. They will be displayed for the first time at Helicopter Assn. of America's annual meeting in Haddonfield, N. J., Jan. 15-18.

Indications are that Bell Helicopter Corp. is getting set to promote a breakthrough in commercial sales and acceptance of helicopters by businessmen and charter operators and is aiming to tilt the industry's normal growth curves upward more sharply from their steady uptrend of the past. In addition, management is aware that the impact of Cessna's entry into the helicopter field with its four-place CH-1C—considering business aircraft maker's financial strength and fixed wing merchandising know-how—provides a competitive factor that requires harder-hitting commercial sales efforts than anytime previously in the rotary wing industry.

Bell Helicopter President E. J. Ducayet said that the price reductions were made possible by standardization of all three models by designing for maximum interchangeability of components and use of rigid cost controls.

Providing as near alike components for all three models not only makes possible production cost cuts because of simplifying procedures, but a higher volume on parts also reduces their manufacturing costs. It is expected that this philosophy will also encourage sales since interchangeability of components will provide fleet operators with savings in spares required, simplify maintenance and reduce labor costs.

Interchangeable Parts

All three models will have interchangeability of dynamic parts including main and tail rotor blades, main rotor hub, transmission and detailed parts. In the case of the three-place 47G-2A and 47G-3 utility models, the only difference is the engine. Not only are dynamic components the same but cabin and center frame are identical. Use of larger, self-aligning boost cylinders and location of the landing light switch and starter button on collective pitch handles on all three models also is aimed at reducing maintenance and improve handling. Here are basic technical features of the 1961 Bell Helicopter line:

• **Model 47G-2A Trooper,** powered by a VO-435 Lycoming engine of 240 hp. for takeoff and 220 hp. continuous, features a 400-lb. payload increase for a new certificated gross weight of 2,850 lb. and will have a top speed of 105 mph., 5 mph. higher than last year's version. Performance increases are made possible by use of the Model 47J rotor system which incorporates main blades 2 ft. larger in diameter than the 47G-2's former system. New useful load of the new 47G-2 is 1,212 lb. Incorporation of the 47J's rotor system and 47G-3's longer tail boom have provided important improvements in handling characteristics, Bell pilots said. Deliveries of the 47G-2A will begin in January.

• **Model 47G-3,** which features high altitude performance through use of the turbo supercharged Franklin 6VS-335A of 240 hp. for takeoff and 220 hp. continuous ratings, has a 200-lb. payload increase, bringing useful load to 1,241 lb. with maximum gross weight of 2,850 lb. First deliveries of this model also are scheduled for January.

• **Model 47J-2 four-placer** has had the takeoff power rating of its VO-540 engine increased 20 hp. to 260 hp., while the continuous rating remains at 220. Performance increase makes it possible for the aircraft to have useful load capability out of ground effect. The new model will be able to lift its 1,120 lb. useful load up to 4,000 ft. out of ground effect or in excess of 12,000 ft. for normal operations. The 47J-2, now in final stages of certification, is expected to be available in early 1961.

Interiors on the new models will include thicker seat cushions, improved sound insulation and washable floor coverings. Seats and forewall covering on the 47G-2A and 47G-3 will be available in a choice of five colors; white, light blue, green, crimson and sand. Standard 47J-2 interiors are the same material with a selection of three colors. De luxe interiors for the 47J-2 are available through Horton & Horton as optional items.

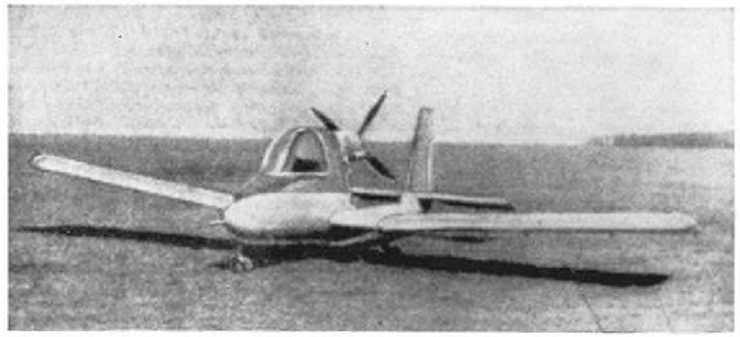
FAA Realigns Rules For Modified Planes

Washington—The Federal Aviation Agency has adopted a program which is designed to accelerate the certification of aircraft modified for business aviation.

The new program was developed by the FAA in consultation with principal aircraft manufacturers, repair stations and corporate owners of aircraft. Purpose of the program is to ensure promptness and uniformity in certifications which totaled 3,500 during the past four years. Here are the major points of the program:

• **Improved system** for dissemination of data and information between FAA regions will be put into effect. Special office in Washington headed by a chief modification engineer is being established to coordinate distribution of data. System is expected to improve uniformity in interpretation of modification data.

• **Industry will be given** more authority in modification programs through a new rating to be known as Approved Modification Station. Such stations will have authority to approve supplemental



Russians Develop Sports Monoplane

Russia's Kharkov Aviation Institute has developed two light, pusher-type sports monoplanes designated KhAI-17 (above) and KhAI-18. The single-place KhAI-17, powered by a 30-hp. engine mounted behind the cockpit, weighs 772 lb., "can fly many hundreds of kilometers nonstop," and has a ceiling of 8,200 ft., designers claim. Top speed is about 93 mph. A two-place, "high-performance" version of the KhAI-17 has also been designed. Designated the KhAI-18, it closely resembles the KhAI-17 but is equipped with a 50-hp. engine. Top speed of the KhAI-18 is over 124 mph., and range is "over 1,863 mi." Gross weight is 1,102 lb. First public demonstration of the KhAI-18 is scheduled for next summer.

type certificates covering their own modifications.

• **FAA will work with industry** to develop improved guidance for FAA field personnel. Manufacturers will be asked to provide manuals in this connection.

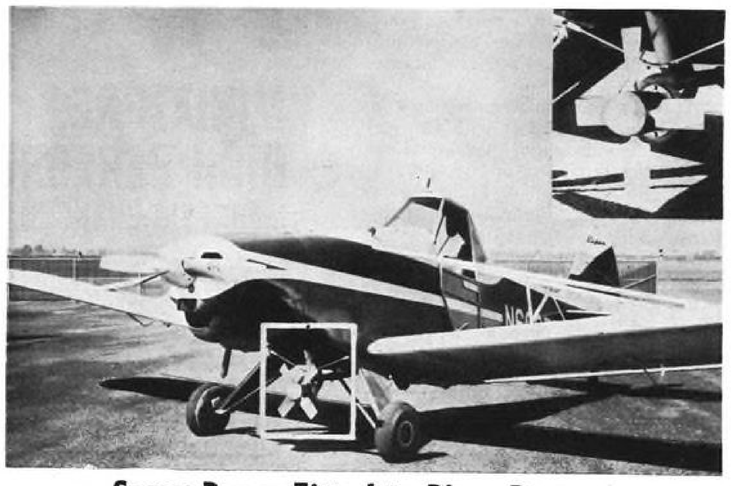
• **Industry will consider** drafting and proposing to FAA a new Civil Air Regulations section pertaining to large aircraft used for business purposes to streamline modification programs.

• **Industry has agreed** to advance planning in modification operations as a means of providing FAA with sufficient warning of peak work loads, particularly when adequate scheduling of required tests must be arranged.

ADMA Members Told To Make Sales Effort

Palm Springs, Calif.—Plans to further expand business and executive aircraft sales by concentrating on the 90% of companies which could, but do not, effectively utilize lightplanes were outlined by the Aviation Distributors and Manufacturers Assn. during their 36th meeting held here.

Members generally agreed with a panel formed to forecast the economic outlook that business aircraft presently are being used by only 10% of the companies which can effectively utilize



Spray Pump Fitted to Piper Pawnee

Agricultural Aviation Engineering Co., Santa Clara, Calif., has developed Series 6600 lightweight spray pump, shown installed here on a Piper Pawnee ag plane. Pump has application rate in excess of 10 gal. per acre. Three fans are available: fixed pitch metal and wooden fans and an adjustable pitch unit. Prices start at $77.20.

them. In the past, distributors and manufacturers have allowed the major manufacturers to carry the message of aircraft usefulness to the market, but incumbent ADMA President Paul A. Kennedy of Southwest Airmotive Corp., recommended that the association undertake a nationwide advertising campaign.

One sample advertisement offered to survey a prospective customer's business transportation requirements and make recommendations as to the type of aircraft suitable, approximate initial cost and operating expenses. It was resolved that further study would be given such a campaign and action taken to institute advertisements in a nationally circulated business magazine.

Rather than allowing a "Let George Do It" attitude to prevail in promoting business aircraft sales, Kennedy urged ADMA members to support campaigns to sell aircraft inasmuch as benefits from increased sales would accrue to members in the form of increased business.

Growth outlook for general aviation was surveyed by H. Webster Crum, Lycoming Division of Avco Corp., who was elected a vice president of ADMA. Total retail sales in 1950, Crum said, amounted to $25.5 million. This increased to $173 million in 1959 and will top $180 million in 1960. Crum estimated that the 1960 figure would double to $360 million by 1965, and double again to $720 million in 1970. Hours flown by business aircraft, he estimated, would increase from 6.3 million in 1960 to 10 million in 1970 and the number of business aircraft would increase from 31,500 to 60,000 in 1970.

Greater utilization of business aircraft can be realized only if ability to operate in instrument weather is afforded the single-pilot aircraft and the Federal Aviation Agency's Bert A. Denicke described a research project under which instrument panels could be standardized. The FAA, Denicke said, has offered to assist business and general aircraft airframe manufacturers in designing an instrument panel which will allow space for all components necessary for instrument flight. Present aircraft, especially single engine, multiplace types, do not have the space within the airframe for electronic installation nor room on the instrument panel for placement of display instruments. If a standard panel were accepted by all of industry, each aircraft could be equipped according to the pilot's ability and desire without having instruments located outside the pilot's reach or view. FAA has offered to fund such a research project jointly with major business airframe manufacturers.

MOOSE, chased into an Ontario lake by Bell 47G helicopter, is tagged by a forester.

Moose Herds Tagged by Helicopter

Ontario Department of Lands and Forests is using a Bell 47G helicopter for large-scale tagging of moose in rugged lake and forest country, eliminating the former hazardous system of roundups.

New system was devised by the department's D. W. Simkin and E. H. Stone, with Ben Kent as pilot. In September, the men—in 11 hr. flying time—tagged 50 moose out of 73 observed from the air. Nine were bulls; others were cows, calves and yearlings.

In addition to the roundup, in which horsemen corraled the animals much like cattle, the helicopter previously had been used to spray paint on animals from a hovering position. However, the marker dye usually washed off and thus was of no research value, particularly in charting herd movements.

The helicopter now patrols lakes, where moose feed on aquatic vegetation in the shallows from early spring until the winter freezup. By flying low, the helicopter frightens the moose into deep water, forcing it to swim. Kent then lands the aircraft, taxis next to the moose, and an officer tags the ear from the pontoon.

Main reasons for the tagging are to chart movements; if moose range only over limited areas, hunters could destroy the entire population in a matter of years.

Ontario Fish & Wildlife Branch will evaluate data on the basis of tags returned by hunters.

PRIVATE LINES

Rollout of the first production Piper Cherokee four-place lightplane (AW Nov. 14, p. 128) will be a feature of the 80th birthday celebration of W. T. Piper, Piper Aircraft president, at the company's new Vero Beach, Fla., plant Jan. 8. Piper also will dedicate the new facility, built for production of the new Cherokee. Open house will be held from noon to 5 p.m.

SIAI-Marchetti Riviero amphibian will be imported to U.S. by Lane Aircraft Co., Dallas, Tex., for marketing at a $35,000 sales price. Four-place plane will be assembled at Love Field by Southwest Airmotive.

Seaflight Corp., designer of a new seaplane at Paoli, Pa., has consolidated its development staff with the engineering staff of Vanguard Air & Marine Corp., which is developing Omniplane VTOL (AW July 18, p. 38). The new Seaflight plane will be designed to be towed by automobile to water resort areas. Manufacturing facilities of Vanguard's Northeast Metals Industries Division will be used for seaplane production. Expanded staff also will work on the Omniplane, which is scheduled for first flight about Mar. 15, 1961. Aircraft now has completed tests at National Aeronautics and Space Administration wind tunnel at Moffet NAS, Calif. Company now is considering a turboprop version to meet military VTOL transport specifications.

Bendix Corp.'s Radio Division has developed a combined audio control panel and isolation amplifier for light aircraft, according to C. I. Rice, avionics manager. New unit is aimed at use in single-pilot, twin engine aircraft equipped for instrument flight operations.

WHO'S WHERE

(Continued from page 23)

Changes

Dr. A. Stuart Denholm, head of the newly established Power Conversion Department, Goodrich-High Voltage Astronautics, Inc., Burlington, Mass., and **Dr. Sam V. Nablo,** head of the newly established Electrostatic Propulsion Department. Also: **Jason Weisman,** manager of operations for GHVA.

Rear Adm. W. C. Chambliss (USN, ret.), director of communications, Space Technology Laboratories, Inc., Los Angeles, Calif.

Daniel Ai has joined the Technical Staff of National Engineering Science Co., Pasadena, Calif.

Milton Rosen, deputy director of Launch Vehicle Programs, National Aeronautics and Space Administration, Washington, D. C.

Eugene L. Woodcock has been appointed to the senior technical staff of the Electro-Optical Division, Perkin-Elmer Corp., Los Angeles, Calif.

John L. Heins, director-defense systems, Servo Corporation of America, Hicksville, N. Y.

Richard B. Uhle, assistant general manager, Electronics & Ordnance Division, Avco Corp., Cincinnati, Ohio.

Dr. Seymour Stein and **Dr. James E. Storer,** senior scientists, Applied Research Laboratory, Sylvania Electric Products, Inc., a subsidiary of General Telephone and Electronics Corp., Waltham, Mass.

Jack C. Monroe, chief applications engineer, Datex Corp., Monrovia, Calif.

Maj. Gen. Richard A. Grussendorf (USAF, ret.) has joined Hazeltine Corp., Little Neck, N. Y.

Robert D. Weber, general manager, Shur-Lok Corp., Anaheim, Calif.

Dr. Samuel Sensiper, director, and **Dr. William Pohlman,** associate director, Space Electronics Corp.'s newly formed Command and Control Laboratories, Glendale, Calif.

Robert Bruce, Jr., general manager, Defense Products Division, Fairchild Camera and Instrument Corp., Syosset, N. Y.

Quentin G. Turner, program manager, B-70 Mission and Traffic Control electronics subsystem, Motorola's Military Electronics Division, Scottsdale, Ariz.

Arthur J. Buchtenkirch, manager-instrument sales, Kollsman Instrument Corp., Elmhurst, N. Y.

Federal Electric Corp., Paramus, N. J., service organization of International Telephone and Telegraph Corp., has appointed **O. L. Shaver,** assistant project manager at the Naval Missile Facility, Point Arguello, Calif., and **T. J. Cameron,** operations manager.

Charles A. Hornell, Jr., supervisor of metallurgical operations, Metals Division, National Research Corp., Cambridge, Mass.

John H. Newland, public relations manager, Boeing Airplane Co.'s Vertol Division, Morton, Pa., replacing Mrs. Marjorie Coale, resigned. **James S. Boynton** succeeds Mr. Newland as assistant manager of public relations, Boeing Transport Division, Renton, Wash.

Herbert D. DeBorde, director of manufacturing, Burrough Corp., Detroit, Mich.

EMPLOYMENT OPPORTUNITIES

NATIONAL COVERAGE

The Advertisements in this section include all employment opportunities—executive, management, technical, selling, office, skilled, manual, etc.

Positions Vacant | **Civil Service Opportunities** | **Employment Agencies**
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DIVISION OF SPERRY RAND CORP.
Administrative & Engineering Center
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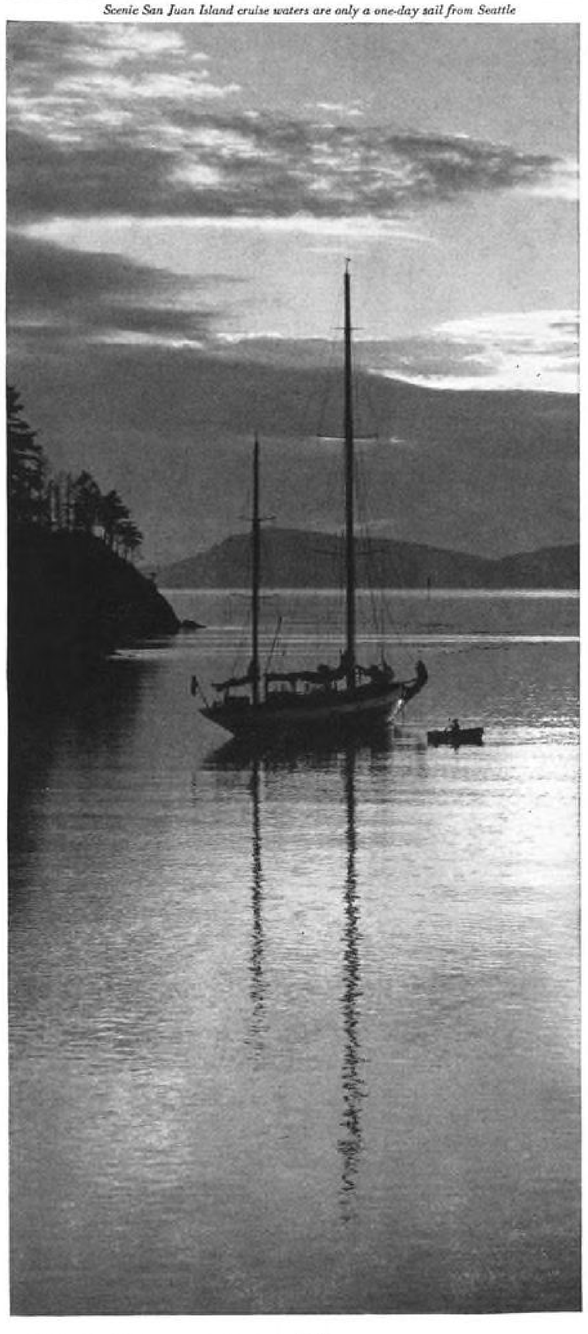

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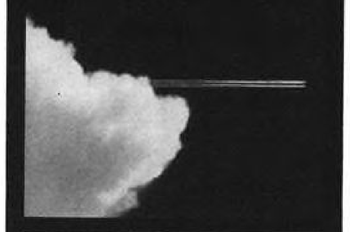

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PBY 5A. This amphibian is converted for cargo—passenger use. FS-3404, Aviation Week.

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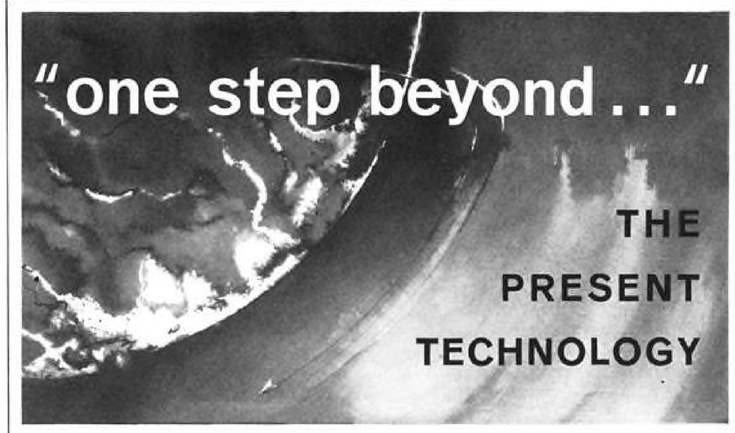

If interested and qualified, please forward your resume to Mr. J. E. Goode, Assistant Chief Engineer, P. O. Box 748A, Fort Worth, Texas.

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LETTERS

Soviet U-2

As we might have suspected, the Russians had a U-2 before we developed our own.

The Russian plane pictured below is officially designated U-2. It was photographed in 1944 by me when I was a member of the U.S. Army Air Force stationed at the American shuttle-bombing base in Poltava (Ukraine).

The Soviet U-2 was designed originally by N. N. Polikarpov as an observation plane (like our own U-2). During the War (Second, not First), it was used for observing behind enemy lines, as a training plane, for air-ambulance work, and also carried light bombs slung on racks under its lower wings.

The Soviet U-2 is described in Jane's All the Worlds Aircraft (1945 edition) as a single-engine biplane with a maximum speed of 150 kilometers per hour (93 mph.) and a maximum ceiling of about 10,000 ft.

While the Russians despise our U-2, they speak very warmly of their own:

"This September night was cold and dark in Stalingrad. Everything had grown confused in these two weeks during which fighting had been going on in the city itself. The front shifted so fantastically from block to block, and from building to building, that the Germans were afraid to bomb at night for fear of hitting their own men. Only our little U-2 "Jewelers," as they were called, could be ordered to destroy the left wing of a building while our own soldiers were occupying its right wing. They did their jeweler's work at night, and it was a local joke to say that they could stand at anchor all night long over the Germans and drop their little bombs one by one." (From Konstantin Simonov, Days and Nights, p. 68.)

FRANKLYN D. HOLTZMAN
Prof. of Soviet Economics
University of Washington
Seattle, Wash.

Amphibian Concept

I was surprised and pleased to note that the president of a well-known company would answer a comment in your Letters section (AW Oct. 3, p. 126). However, I was amazed at Mr. Robert M. Berns' (President, Air Craft Marine Engineering Co., Van Nuys, Calif.) facetious approach to my past military affiliations.

Aviation Week welcomes the opinions of its readers on the issues raised in the magazine's editorial columns. Address letters to the Editor, Aviation Week, 330 W. 42nd St., New York 36, N. Y. Try to keep letters under 500 words and give a genuine identification. We will not print anonymous letters, but names of writers will be withheld on request.

If I am aiding and abetting Red aggression, as he implied, some FBI investigators will be [are] shivering in their boots, having investigated and cleared me for a secret clearance involving a current defense contract. However, this secret clearance should relieve Mr. Berns' mind as far as revealing to me [the public] facts of his company's "confidential" proposal to the Army.

Mr. Berns did concede my first two points in that no "one" is yet able to control the weather. These points alone put a severe limitation on seaplane operations and quite strongly nullify his company's waterborne concept. Battle plans, in which an invasion from the sea is contemplated, require months of planning and it is a well-known fact that D-day isn't very flexible. Matching D-day and a satisfactory sea state will require the effort of the "one" able to control the weather.

Since the initial article (AW July 18, p. 23) implied that ACME proposed an amphibian capable of unusual and exotic seaplane capabilities, I took exception, submitted what I considered "constructive criticisms," and even offered a source of information to aid in preventing the possibility of stumbling into "pitfalls." I am certain that all readers of the original "small item" in the Industry Observer column will agree that no mention was made of "a high performance, STOL, turbofan-powered, small transport with amphibious versatility." It will concede that an amphibian can be manufactured without wheel wells, but must assume that the wheels are housed elsewhere [structural problems?] to permit "high performance."

After the buildup in the aforementioned Industry Observer column, I was amazed at Mr. Berns' comments that his company's amphibious seaplane operations were of a minor portion of its "capabilities." I am now critical of the entire proposal. Why should we consider an amphibious type airplane to be the major method of delivering "four tons of personnel and cargo to an inaccessible clearing 3,000 mi. away in less than seven hours?" For its primary mission, I question the need of an aircraft with the strength/weight requirements of an amphibious type airplane to accomplish the mission of a landplane with the added [possible] versatility of a seaplane.

After Mr. Berns conceded my first two "pitfalls," he stated that his company will "encompass with our advanced design" the last three and will "aim to solve them." More power to him! I still retain the right of my conviction regarding my last two pitfalls, plus the following:

(1) The problem of water injection which frequently puts the fire out.

(2) Action taken after possible water injection to prevent corrosion and possible incipient engine failure.

(3) Directional control during precise water-based manuevering.

(4) Possible engine change at sea vs. hoisting aboard or abandonment at sea.

(5) Fueling from the "cargo" ship. Submarines have been used; however, the old song that the need for a mild sea state is still a requirement.

(6) Possibility of programing of flap position during landing or takeoff.

I observed with pleasure that Mr. Berns was cautious to emphasize that the ACME A-2 is capable of operating out of "any small body of water" and did not push the open sea concept. Small bodies of water are universally surrounded by a land mass and normally the waters encompassed are considered to be quite calm.

CMDR. T. E. MAURER, USN Ret.
Palo Alto, Calif.

Rocket Noise Case

May I compliment you on your excellent article on the case of Magnus Berg et al. vs. Thiokol (AW Nov. 28, p. 30). The material is accurate, it reads smoothly, and though depressing, it points up the problem well to the whole industry.

It has been decided in the last hour to go ahead with the appeal, and the government is seeking the advice of the Solicitor General to come in as amicus curiae.

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