February 19, 1962

Aviation Week and Space Technology

SPECIAL REPORT:

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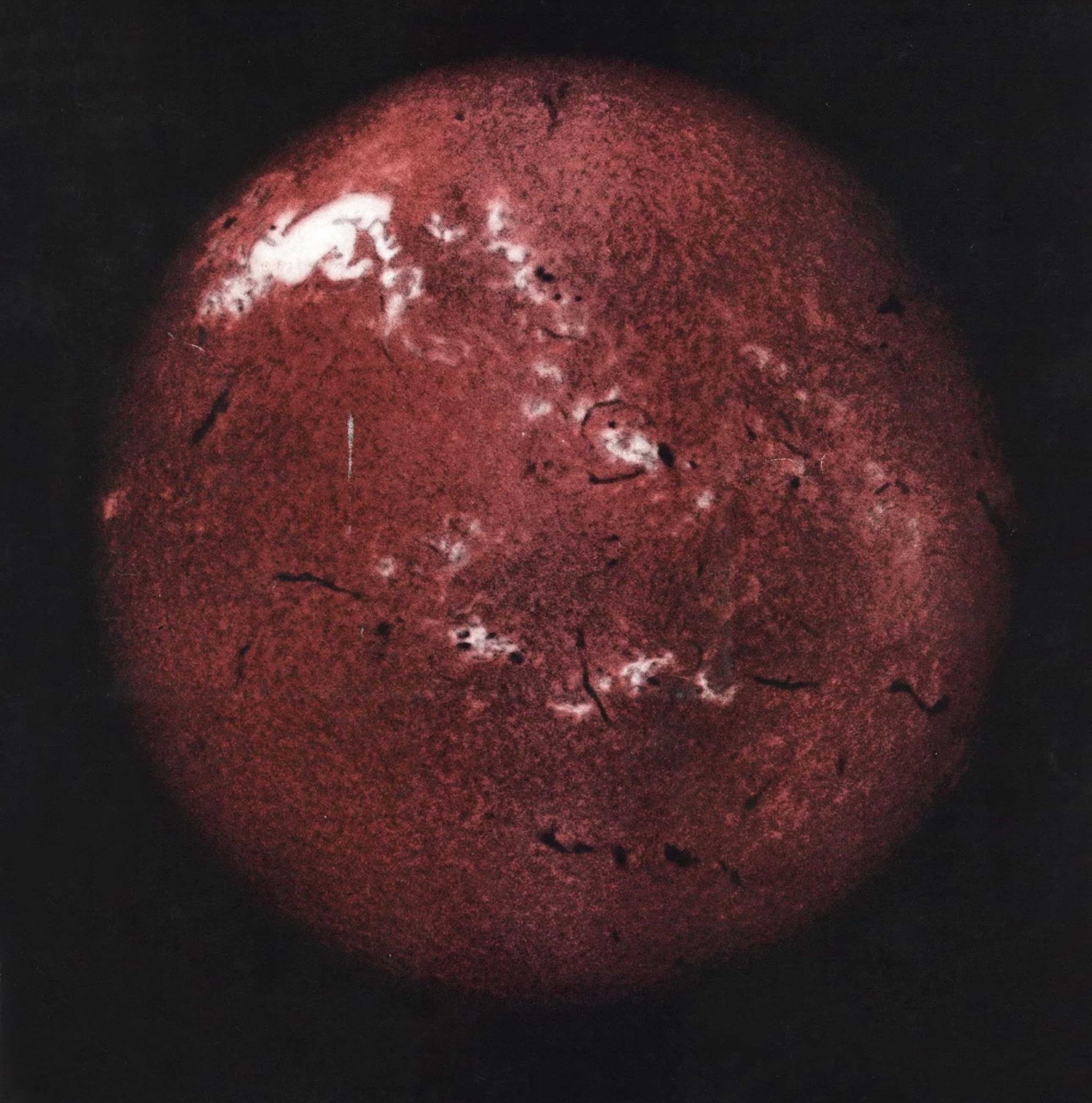

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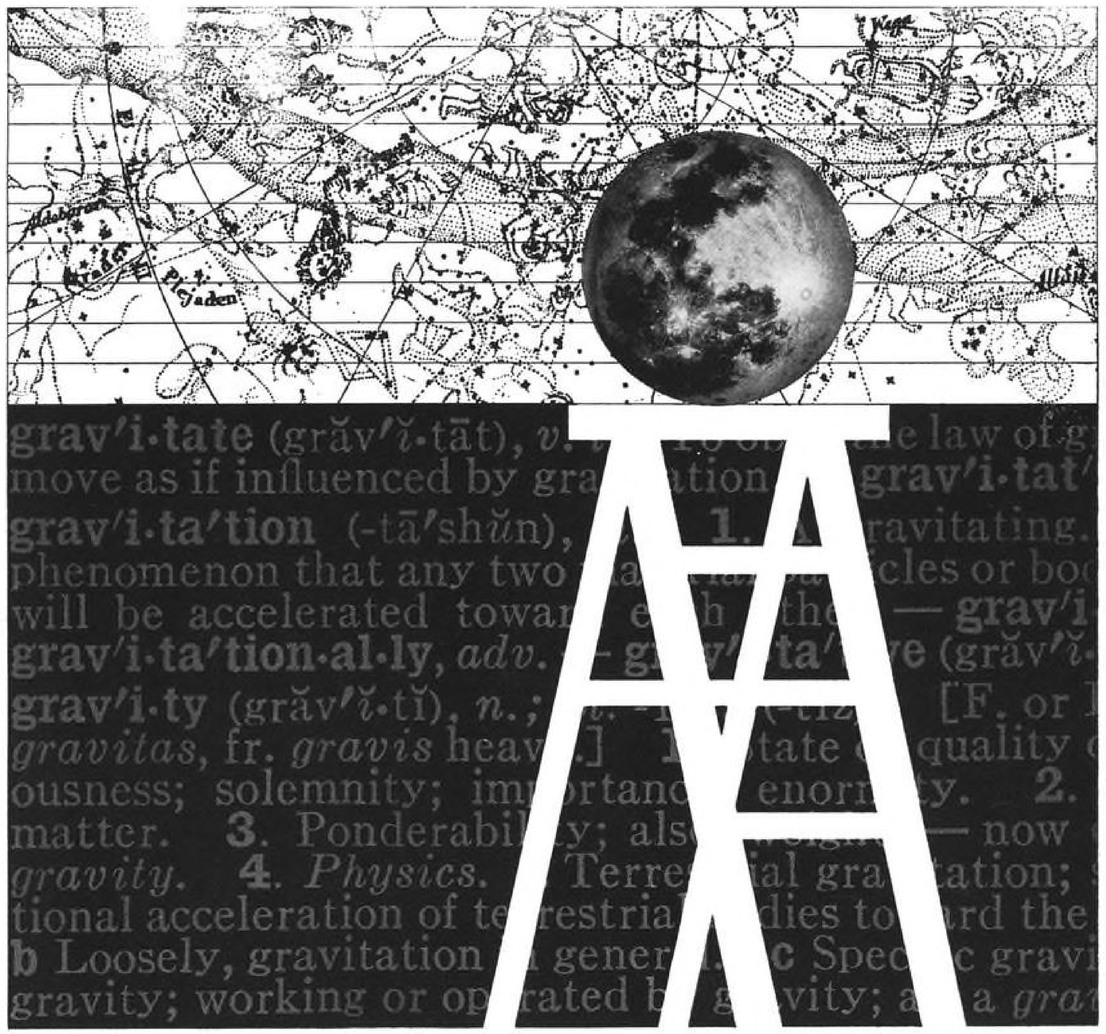

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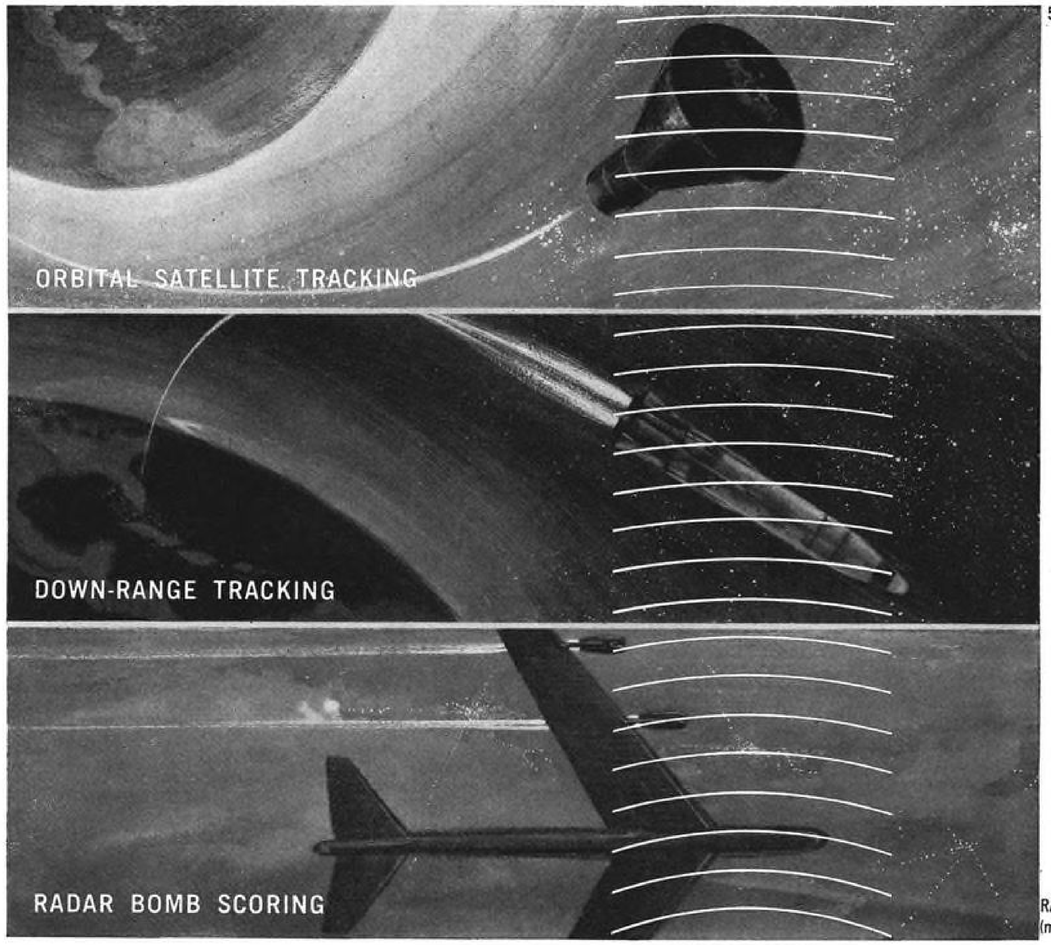

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AEROSPACE CALENDAR

Feb. 27—Conference of aircraft operators and equipment manufacturers with the Federal Aviation Agency to specify airborne equipment requirements of Project Beacon report, Department of Labor Auditorium, Washington, D. C.

Feb. 27-Mar. 1—Third Annual Symposium on Nondestructive Testing of Aircraft and Missile Components (unclassified), Gunter Hotel, San Antonio, Tex. Sponsors: Society for Nondestructive Testing; Southwest Research Institute.

Feb. 27-Mar. 1—Symposium on the Application of Switching Theory in Space Technology, Palo Alto, Calif. Sponsors: Lockheed Aircraft Corp.; AFOSR.

Mar. 1-3—Eighth Scintillation and Semiconductor Counter Symposium, IRE, Shoreham Hotel, Washington, D. C.

Mar. 5-8—Seventh Annual Gas Turbine Conference and Products Show, American Society of Mechanical Engineers, Shamrock Hilton Hotel, Houston, Tex.

Mar. 6-7—Annual Meeting, Society of American Value Engineers, Marriott Motor Hotel, Washington, D. C.

Mar. 8-9—Institute of the Aerospace Sciences' Propulsion Meeting (classified), Cleveland, Ohio.

Mar. 14-16—Electric Propulsion Conference, American Rocket Society, Hotel Claremont, Berkeley, Calif.

Mar. 16—Annual Robert H. Goddard Memorial Symposium, "Torques and Attitude Sensing in Satellites," American Astronautical Society, Washington, D. C.

(*Continued on page 7*)

AVIATION WEEK and Space Technology

February 19, 1962

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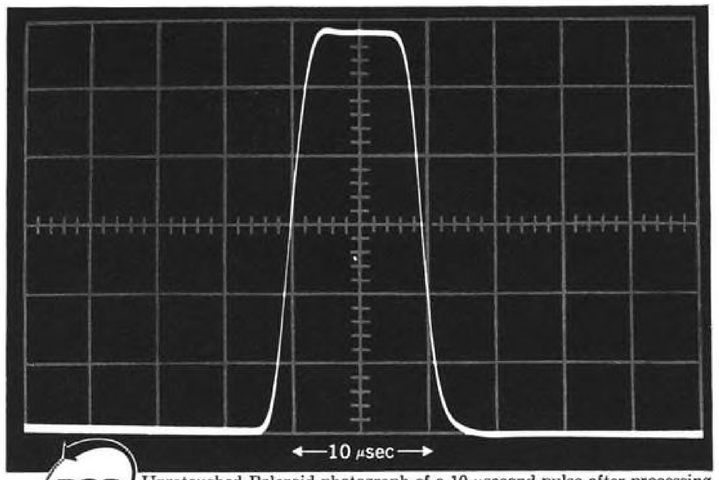

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Unretouched Polaroid photograph of a 10-μsecond pulse after processing through DCS' GOV-3 and GFD-4. Subcarrier frequency: 750 kc ±40% deviation. Output filter: 150 kc Gaussian.

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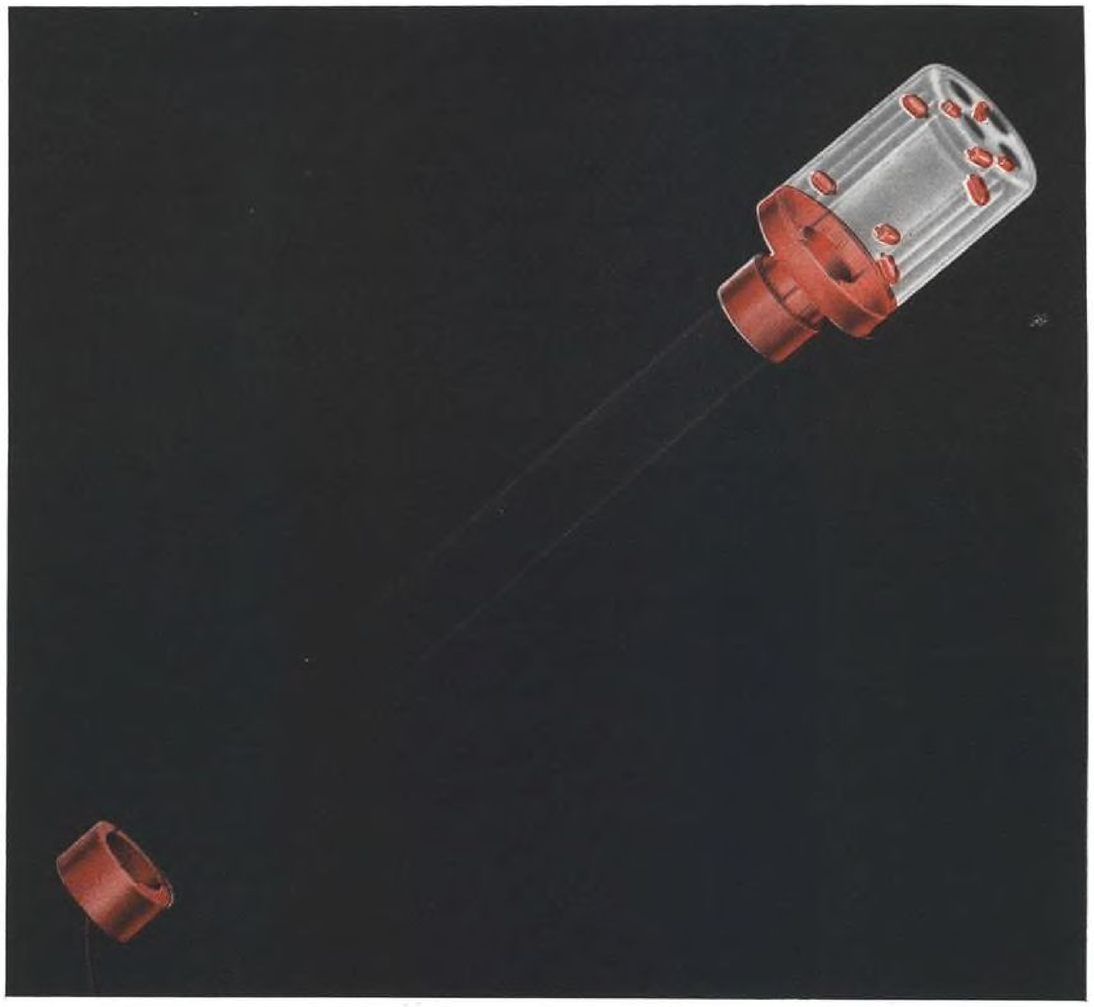

Injection-molded parts of TEFLON® FEP assure accuracy in electronic tank-level indicator

This tank-level indicator measures the level of fuel or oil in military aircraft. Its readings are based on precise measurements of electrical capacitance; its accuracy depends on maintaining exact mechanical tolerances and electrical characteristics in the presence of corrosive fluids, at temperatures up to 375°F. That's why the two-piece electromechanical seal is molded of TEFLON FEP-fluorocarbon resin. The introduction of the new, melt-processible FEP resin permits easy injection molding of these components.

In addition, Du Pont TEFLON TFE resins are used as insulation on the wire. All TEFLON resins offer virtually complete chemical inertness, high insulating properties and resistance to high temperatures. The extremely low coefficient of friction has permitted the easy-sliding assembly more than 250,000 electronic tank-level indicators.

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AEROSPACE CALENDAR

(Continued from page 5)

Mar. 20-21—University of Denver's Second National Symposium on Hypervelocity Techniques, Denver, Colo.

Mar. 26-29—International Convention, Institute of Radio Engineers, Coliseum and Waldorf Astoria, New York.

Mar. 28-29—Third Symposium on Engineering Aspects of Magnetohydrodynamics, University of Rochester, Rochester, N. Y. Sponsors: American Institute of Electrical Engineers; Institute of the Aerospace Sciences; Institute of Radio Engineers; University of Rochester.

Mar. 29-30—Fourth Annual Electron Beam Symposium, Alloyd Electronics Corp., Cambridge, Mass.

Apr. 1-4—Mid-Year Conference, Airport Operators Council, Shoreham Hotel, Washington, D. C.

Apr. 3-5—Launch Vehicles: Structures and Materials Conference, American Rocket Society, Ramada Inn, Phoenix, Ariz.

Apr. 3-6—National Aeronautic Meeting (including production forum), Society of Automotive Engineers, Hotel Commodore, New York, N. Y.

Apr. 10-12—Second Symposium on The Plasma Sheath—Its Effect Upon Re-entry Communication and Detection, New England Mutual Hall, Boston. Sponsor: AF Cambridge Research Laboratories.

Apr. 11-13—Southwestern Conference and Electronics Show, Institute of Radio Engineers, Rice Hotel, Houston, Tex.

Apr. 11-13—Annual Technical Meeting and Equipment Exposition, Institute of Environmental Sciences, Sheraton Chicago Hotel, Chicago, Ill.

Apr. 12-13—Eighth Annual Heat Transfer Conference, Oklahoma State University, Stillwater, Okla.

Apr. 13—Government Contracts Symposium, National Assn. of Professional Contracts Administrators, Ambassador Hotel, Los Angeles, Calif.

Apr. 14-16—Second Conference on Kinetics, Equilibria, and Performance of High Temperature Systems, University of California, Los Angeles, Calif. Sponsor: Western States Section/Combustion Institute.

Apr. 16-18—Second International Flight Test Instrumentation Symposium, College of Aeronautics, Cranfield, England.

Apr. 16-18—Aerospace Systems Reliability Symposium, Institute of the Aerospace Sciences, Salt Lake City, Utah.

Apr. 24-26—Polytechnic Institute of Brooklyn's Symposium on the Mathematical Theory of Automata, United Engineering Center, New York, N. Y.

Apr. 25-29—Western Space Age Industries and Engineering Exposition, Cow Palace, San Francisco, Calif.

Apr. 30-May 2—Meeting on Manned Space Flight, Institute of the Aerospace Sciences, Hotel Chase, St. Louis, Mo.

May 1-3—Spring Joint Computer Conference, Fairmont Hotel, San Francisco.

May 2-4—18th Annual National Forum, American Helicopter Society, Sheraton Park Hotel, Washington, D. C.

May 2-11—International Space Research and Technology Exhibition, London, England. Sponsor: British Interplanetary Society.

(Continued on page 9)

For technical data on the new Bulbed Cherrylock "2000" * Series rivets, write Townsend Company, Cherry Rivet Division, Box 2157 N, Santa Ana, California.

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AEROSPACE CALENDAR

(Continued from page 7)

May 3-4—First International Congress on Human Factors in Electronics, Institute of Radio Engineers, Lafayette Hotel, Long Beach, Calif.

May 7-9—Materials & Processing for Space Environments Symposium, Society of Aerospace Material and Process Engineers, Hotel Statler, St. Louis, Mo.

May 7-11—Annual Conference, Society of Photographic Scientists and Engineers, Somerset Hotel, Boston, Mass. Cosponsor: AF Cambridge Research Laboratories.

May 7-11—1962 Tool Exposition & Engineering Conference, Public Auditorium, Cleveland, Ohio.

May 8-10—12th Annual Electronics Components Conference, Marriott Twin Bridges Motor Hotel, Washington, D. C.

May 14-16—National Aerospace Electronics Conference, Institute of Radio Engineers, Biltmore Hotel, Dayton, Ohio.

May 14-16—Joint Technical Society-Department of Defense Symposium on Thermionic Power Conversion, Antlers Hotel, Colorado Springs, Colo.

May 14-17—21st Annual National Conference, Society of Aeronautical Weight Engineers, Benjamin Franklin Hotel, Seattle.

May 20-24—Annual Conference, American Assn. of Airport Executives, Ambassador Hotel, Los Angeles, Calif.

May 21-25—Eighth Aerospace Instrumentation Symposium and National Telemetering Conference, Sheraton Park Hotel, Washington, D. C.

May 22-24—Conference on Self-Organizing Systems, Museum of Science and Industry, Chicago, Ill. Sponsors: Office of Naval Research; Armour Research Foundation.

May 22-24—National Microwave Theory & Techniques Symposium, Institute of Radio Engineers, Boulder, Colo.

May 24-26—Seventh Region Conference on Space Communications, Institute of Radio Engineers, Seattle, Wash.

June 6-7—Symposium on Standards for Filament-Wound Reinforced Plastics, Naval Ordnance Laboratory, Silver Spring, Md. Sponsors: U. S. Navy; American Society for Testing and Materials.

June 6-8—Eighth Annual Radar Symposium (classified secret), Institute of Science and Technology's Radar Laboratory, University of Michigan, Ann Arbor.

June 8-9—13th National Maintenance and Operations Meeting, Reading Aviation Service, Inc., Reading, Pa.

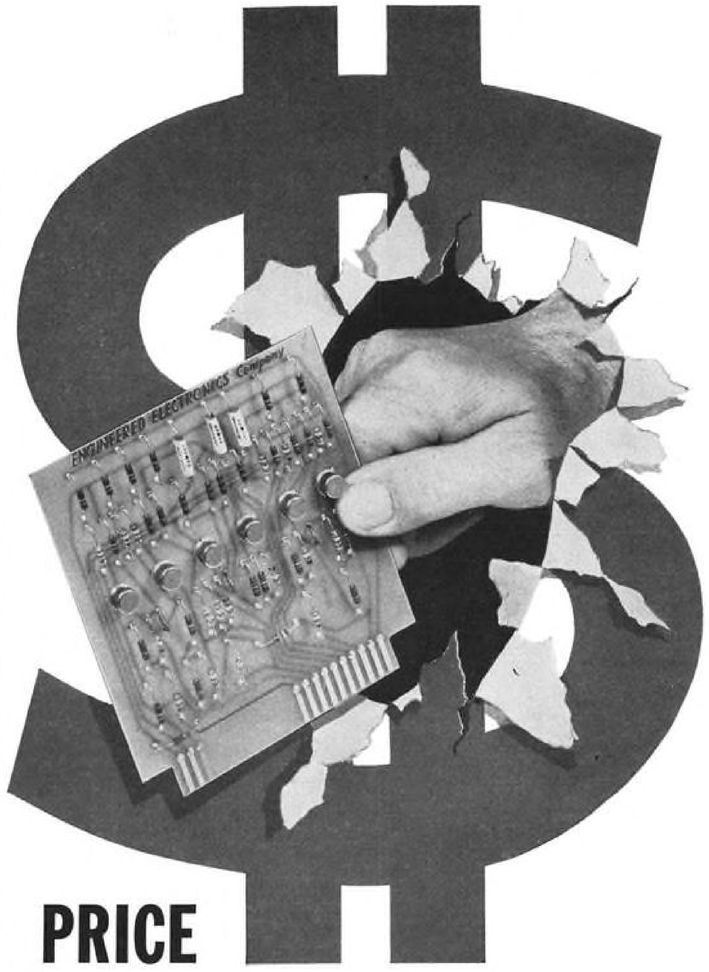
June 13-15—Annual Meeting, Heat Transfer and Fluid Mechanics Institute, University of Washington, Seattle, Wash.

June 19-21—39th Meeting, Aviation Distributors and Manufacturers Assn., Ambassador Hotel, Los Angeles.

June 19-22—Summer Meeting, Institute of the Aerospace Sciences, Ambassador Hotel, Los Angeles, Calif.

June 25-27—Sixth National Convention on Military Electronics, Institute of Radio Engineers, Shoreham Hotel, Washington.

June 25-30—Symposium on Electromagnetic Theory & Antennas, Copenhagen, Denmark. Sponsors: Technical University of Denmark; International Scientific Radio Union.



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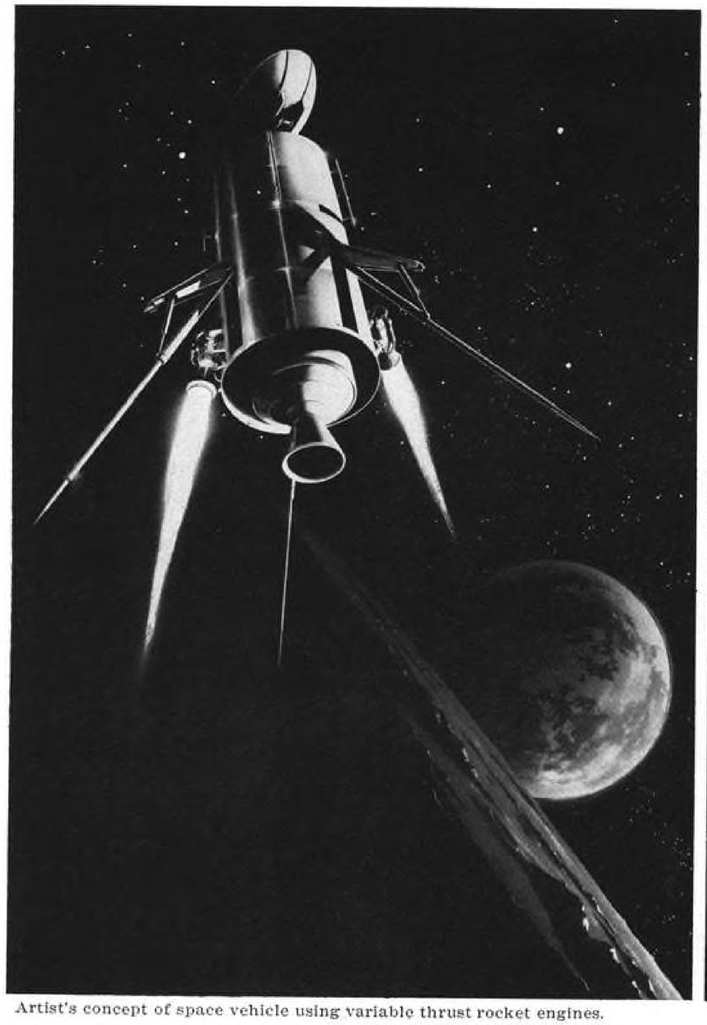
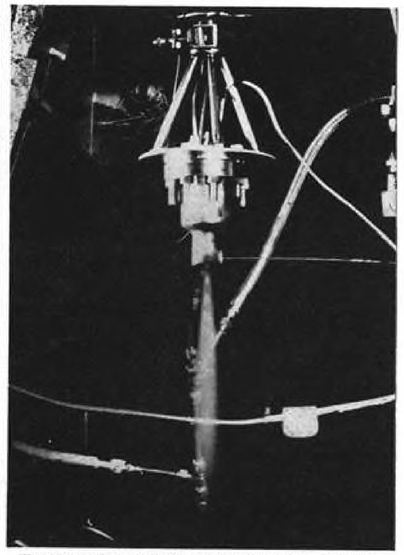


Artist's concept of space vehicle using variable thrust rocket engines.

The scope of Wright Aeronautical activity in the missile and space propulsion field is illustrated in this comparison of a miniature-sized variable thrust rocket engine (in engineer's hand) and a huge 21-foot long rocket motor case fabricated for the Minuteman missile program.



Testing of a variable thrust rocket engine.

Curtiss-Wright Rocket Engines for Space Vehicles—Both Solid Propellant Pulse and Variable Thrust

Solid propellant attitude control pulse rocket engines . . . variable thrust rocket engines providing thrusts from 10 to 1,500 pounds, with a proven throttlability range of 25:1 — these major technological accomplishments demonstrate the growing capability of Wright Aeronautical Division in the space propulsion field.

Solid pulse rocket engines, now under development, are many times lighter than present systems and eliminate problems of fuel storage and leakage.

Successful tests have also been conducted on a family of variable thrust rocket engines suitable for both control and propulsion of space vehicles. They provide high impulse and efficiency, are continuously throttlable over the thrust range and can be shut off and started while in flight.

Further development, fabrication and testing of prototype engines is now being conducted at Wright Aeronautical Division under several contracts from NASA, the U.S. Air Force and the U.S. Navy.

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This coupling can be made in a variety of sizes and different materials, for use on fuel, oil, electronic coolant and pyrophoric systems as well as for fluids with corrosive or low viscosity properties.

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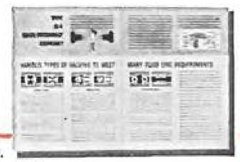

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hallicrafters Publishes "Electronic Warfare Spectrum" Chart—Which Instantly Shows the Newly-Revised ECM Frequency Band Authorizations!

The complex, two-year revision of the defense regulations entitled "Performing Electronic Countermeasures (ECM) in the United States and Canada"—published 7 September 1961—is now available.

All military and non-military government agencies coordinated in the project. Official regulation numbers are:

AIR FORCE REGULATION NO. 55-44

ARMY REGULATION NO. 105-86

OPNAV INSTRUCTION 3430.9A

NAVMC 1180 (REV 8-61)

What the new "regs" cover

They contain the frequency band authorizations, geographical restrictions, alerting requirements, and in-flight procedures that govern the performance of active airborne countermeasures (ECM) in the United States and Canada. They establish a procedure for the local clearance of frequencies for ground and shipboard operations plus additional in-flight frequencies not otherwise authorized.

Vital to all services

The new regulations apply to:

A. All military organizations performing in-flight ECM operations over the U.S. and Canada.

B. Civilian contractors performing in-flight ECM operations over the U.S.—but not Canada—provided the contractor meets the following criteria:

1. The contractor is currently under a military contract that requires performance of in-flight ECM operations.
2. The ECM equipment to be used by the contractor has been contracted for or is owned by the Government; and
3. A military resident representative is available to supervise the contractor on the use of the provisions of the new regulations.

Hallicrafters "Electronic Warfare Spectrum" Chart is 22½ by 34½ inches in size, and is printed in many colors—for rapid visual scanning. It shows the "Electronic Warfare Operational Bands and Channel Codes"; the "International Radio Communication Frequency and Wavelength Bands", as well as "Former Band Designations".

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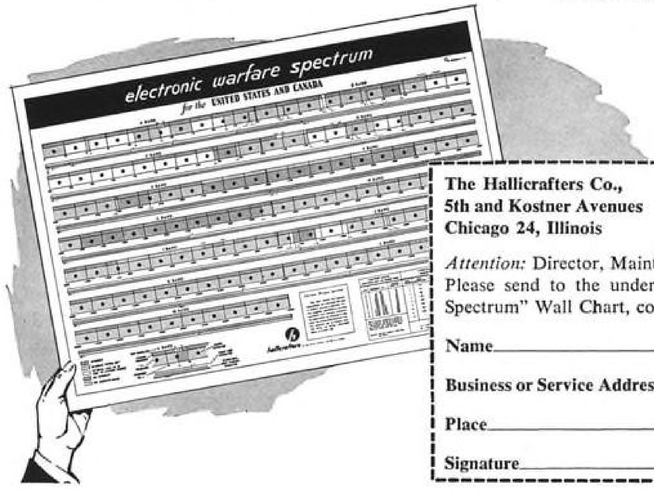

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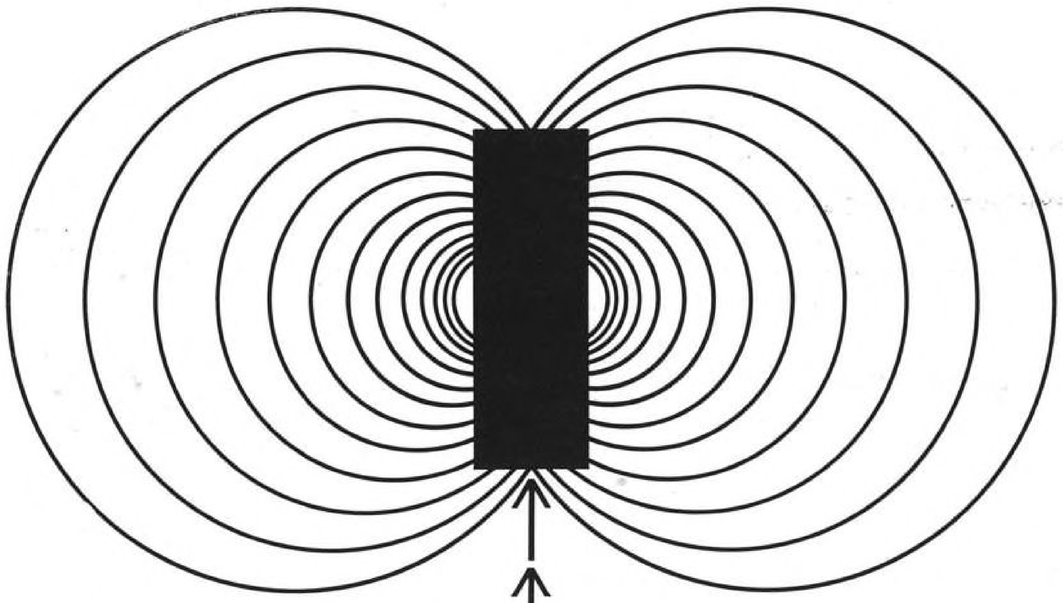

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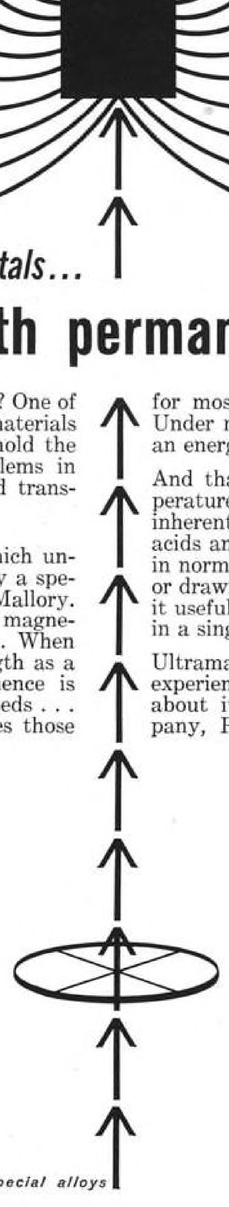

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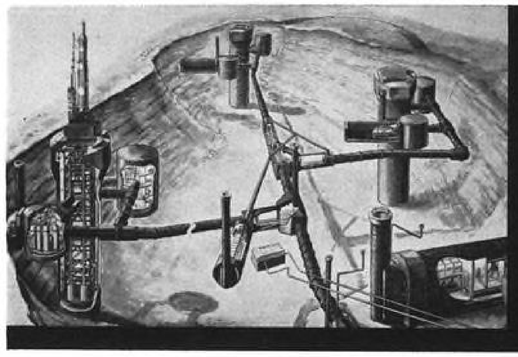

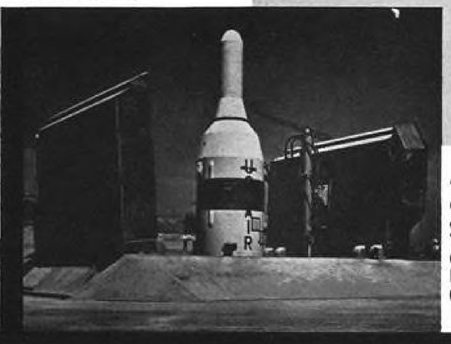

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COVER: Solar prominences, sunspots and "plages" are shown in this unusual photograph of the sun taken at Sacramento Peak Observatory. Dark points are sunspots, which are storms in the sun's atmosphere, and which have temperatures approximating 7,500F. Normal sun surface temperature is about 10,000F. Dark irregular lines are solar prominences, resulting from condensation of material in the corona. Condensate falls back to sun's surface at speeds up to 60 mps., following sun's magnetic field lines. "Plages," from the French word meaning "beach," are the white areas of intense heat, with temperatures reaching 18,000F. Photograph was made at 6,563 angstroms in the hydrogen alpha line with a band width of half an angstrom; all other frequencies were filtered. Sacramento Peak Observatory is operated by Air Force Cambridge Research Laboratories of the Office of Aerospace Research (see p. 34).

PICTURE CREDITS
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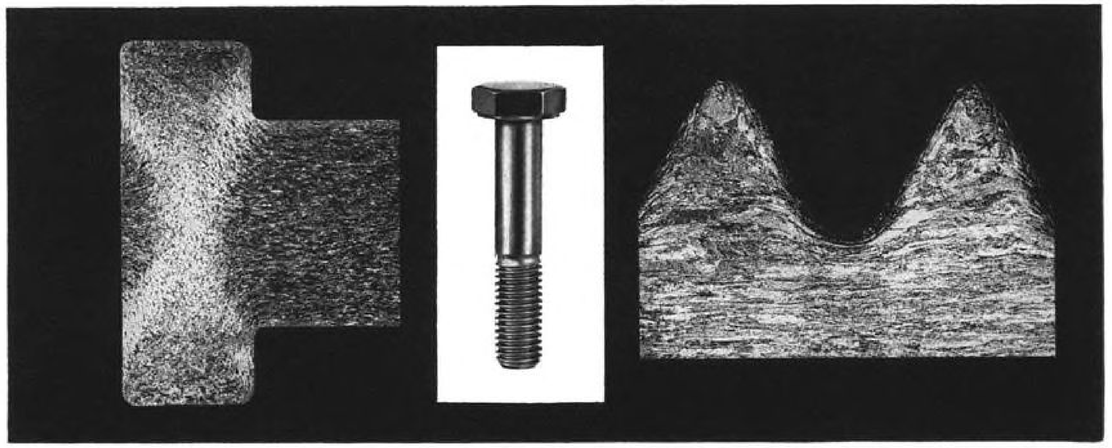

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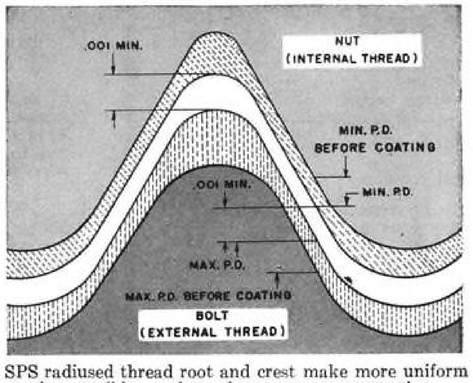

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D-14	—	TZM	—	—

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Molybdenum—.5% titanium (sintered)	2000	50,900
Molybdenum—.5% titanium (arc cast)	2000	69,500
50% molybdenum—50% tungsten	2000	58,700
Pure columbium	2000	20,600
F-48 columbium	2000	60,000
Tungsten (polycrystalline)	2000	53,200

Tensile strengths of refractory alloy bolts tested in inert (argon) atmosphere at the SPS Laboratories for Advanced Fastener Research.

EDITORIAL

The Long Sweat

Project Mercury is in the midst of a grueling ordeal—the long sweat since Dec. 19 to launch its first manned orbital space flight. At this writing, it appears that the ordeal will continue through several more convolutions before MA-6 finally roars off into a cloudless blue Florida sky. Weather is now the critical problem in MA-6, with both the McDonnell capsule and the General Dynamics Atlas booster in excellent condition. The weather problem for MA-6 is vastly different than it was on the two earlier manned ballistic flights of Navy Cdr. Alan Shepard and Air Force Capt. Gus Grissom. It is typical of the enormous increase in complexity that distinguishes the orbital flights from the ballistic trajectories. This is a distinction that NASA spokesmen have failed to convey effectively to the American public, which is following the progress of this event with an interest and avidity that surpasses even World Series fervor.

For the MR-3 and MR-4 ballistic shots, critical weather only concerned the Cape Canaveral area itself, and a narrow slough stretching about 300 mi. downrange. But for the triple-orbit flight plan of MA-6, Mercury operations directors must be concerned with a vast and complex global weather pattern. There is the basic limitation of darkness in the recovery areas, where a minimum of four hours of daylight and good visibility is required for airborne and sea retrieval techniques. This narrows the launch window for a four-and-a-half hour, three-orbit flight to a four- or five-hour morning period at the Cape. With the 15-min. ballistic shots, the launch window stretched almost all day. For an orbital flight, weather must meet Mercury operational criteria across most of the Atlantic from Bermuda to the Canary Islands because this is the portion of the flight path where the possibility of trouble in either the Atlas booster or the McDonnell capsule is the greatest. Consequently, before an orbital flight can be launched, weather conditions must be satisfactory for an emergency recovery in several pre-selected areas across the Atlantic between Florida and Africa. Basically, the recovery area weather conditions require visual sighting of the capsule's main chute at 10,000 ft.; a 2,000-ft. ceiling for aircraft search and helicopter recovery operations, and a moderate wind and sea. These weather conditions also must prevail in the recovery areas where re-entry would be made at the end of any of the three planned orbits. These areas cover an expanse from Bermuda to Grand Turk in the Caribbean. No single weather system can encompass all of these vital Mercury recovery areas, so the combination of variables is formidable.

The tracking and communications network required for Mercury orbital flights expands into similar complexity when compared with the relatively small portion of the Atlantic Missile Range facilities used for the Redstone ballistic shots. In addition to the Atlantic Missile Range facilities, orbital shots will use an 18-station global tracking and communications network. And, of course, the four-and-a-half hour three-orbit flight will require considerably greater exercise of judgment and command decision, both in the capsule and at Mercury control, than did the 15-min. ballistic flights—particularly as each of the first two orbits nears completion. Even when the long sweat to launch MA-6 is over, and its capsule and astronaut are in orbit, there will still be considerably more sweating required for Walt Williams, operations director, and Chris Kraft, flight director, in Mercury control at the Cape.

This long sweat, particularly the series of 24-hr. delays last week, shows in every aspect of the bizarre backdrop that MA-6 has lowered along this strip of Florida beach, from the gantry-studded Cape where 36 vans of television and radio equipment have been keeping rattlesnakes and rabbits company to the Cocoa Beach motels where astronauts, Mercury managers, industry technicians and what is loosely referred to as the press corps mingle in an atmosphere of mass boredom spiced with increasing irritation.

Typical of the air of unreality that has located the most exciting scientific effort of our time in the surroundings of a semi-tropical resort are the daily weather briefings, where Ernest Amman of the U.S. Weather Bureau discusses the 45-kt. winds and 20-ft. seas raging in the Atlantic recovery areas while the hot Florida sun glares out of a clear blue sky.

No matter how thin the NASA spokesmen slice their official ration of salami to the press, the strain must be greatest on Marine Lt. Col. John Glenn. No matter how hardened these astronauts may be as test pilots, they are—NASA to the contrary—mortal men, and the experience of going to bed each night ready to pioneer orbital flight in the morning only to be wakened at 2 a.m. and told to eat breakfast and go back to sleep for a 24-hr. delay, must rasp even the strongest human nerves.

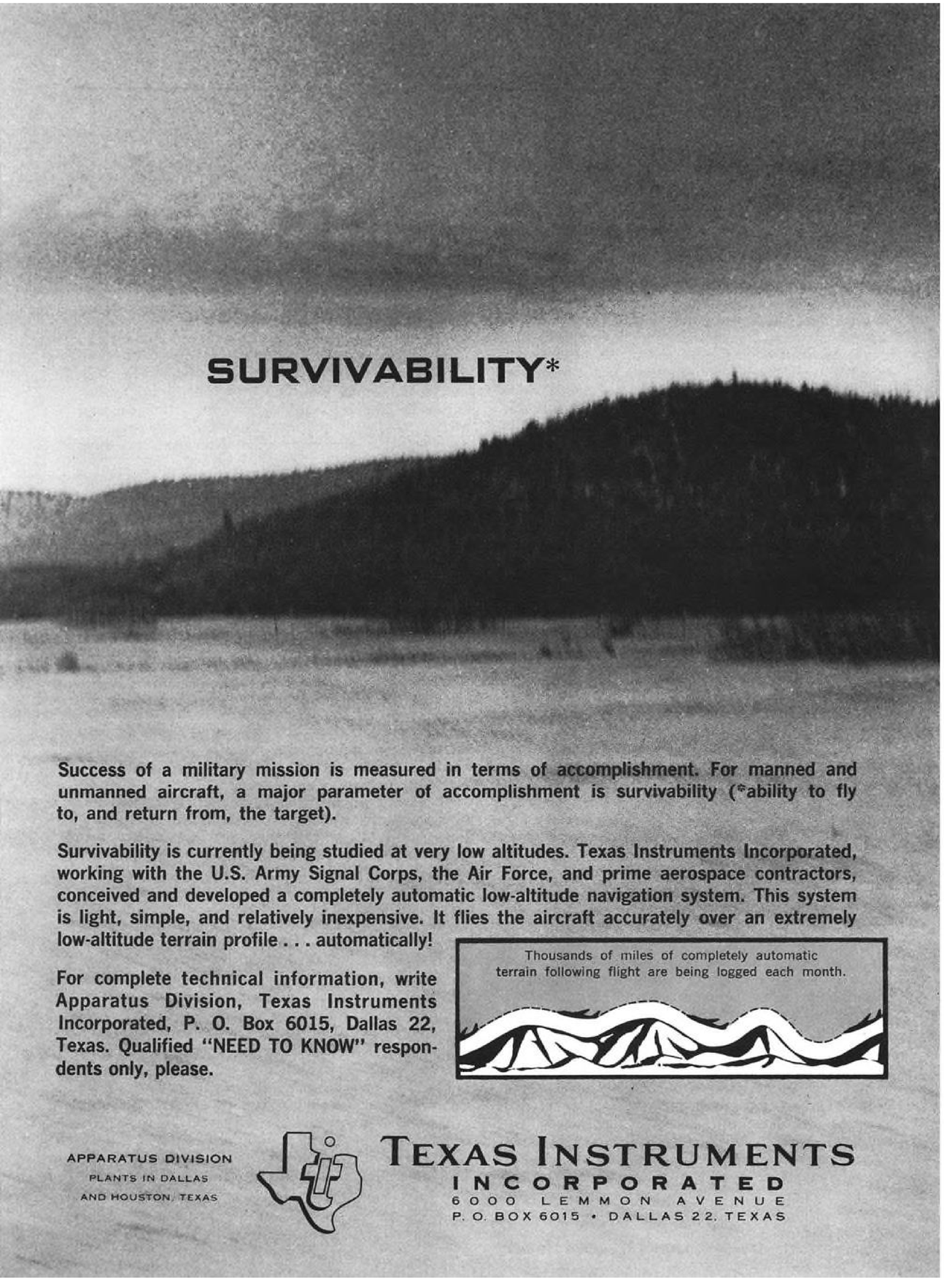
Even the waitresses in the beach motels, who work all night feeding the migratory swarms of press, radio and television people when shots are scheduled, are showing the strain as the whole tempo quickens each evening when the MA-6 countdown begins again, and then dies out as the midnight weather briefing scrubs the shot—plunging everybody back into the boredom from which they thought they had finally escaped.

The beach itself is filled every night with tax-paying citizens determined to witness this moment in history when the first American is propelled into orbital flight. Occasionally, an Atlas, Pershing or Minuteman flames into the sky to reward their vigil.

But basically, the atmosphere at the Cape is now weary boredom. All of the technical checks have been run and re-run, ad infinitum. The battery of temporary teletype machines is chattering out to the world the same old pre-flight stories. Only the dates are new. Even the effervescing stock of new space jokes has been exhausted at the poolsides, and the old jokes have become too flat and repetitious to draw even a chuckle.

In the midst of all this bizarre atmosphere, it is difficult to remember that this is really the place and the time for this nation's most exciting technical venture.

—Robert Hotz



WHO'S WHERE

In the Front Office

Elmer P. Wheaton will join Lockheed Aircraft Corp. as a vice president on Mar. 1, and will serve as assistant to President **L. Eugene Root** of Lockheed Missiles and Space Co., Sunnyvale, Calif. (AW Jan. 1, p. 25).

Roy E. Wendahl, executive vice president, Hughes Aircraft Co., Culver City, Calif. **Dr. Allen E. Puckett** succeeds Mr. Wendahl as head of the company's aerospace group.

Joseph F. Engelberger, a director of Consolidated Diesel Electric Corp., Stamford, Conn. Mr. Engelberger is a corporate vice president and president of Consolidated Controls Corp.

R. D. Calvert, vice president, Lear, Inc. Mr. Calvert is division general manager of Lear's Electro-Mechanical Division, Grand Rapids, Mich.

H. Douglas Lowrey, vice president-operations, and **Everett M. Scranton,** vice president-administration and comptroller, Chrysler Corp.'s Space Division, New Orleans, La.

Victor R. Bennett, vice president and general manager, Timmins Aviation, Ltd., Montreal International Airport, Canada.

M. Lamar Muse, vice president-finance, Southern Airways, Inc. Also: **George F. Estey,** corporate secretary; **C. H. D. Tarrer,** treasurer.

Burt C. Monesmith, a group vice president, Lockheed Aircraft Corp., Burbank, Calif., and **James P. Lydon,** vice president-industrial relations. Mr. Monesmith will have responsibility for Lockheed Electronics Co., Puget Sound Bridge & Dry Dock Co. and Lockheed Propulsion Co. He also continues as the company's vice president-manufacturing.

Col. S. W. Towle, Jr. (USAF, ret.), corporate vice president, Northrop Corp., with headquarters in Washington, D. C.

Stuart M. Hauser, president and general manager, Electro-Optical Instruments, Inc., Pasadena, Calif., succeeding **Charles F. Hartel,** resigned.

Honors and Elections

Joseph P. Adams has been elected president of the Aero Club of Washington, (D. C.). Mr. Adams is executive director and general counsel for the Assn. of Local Transport Airlines. Other officers: First Vice President—**Maj. Gen. Lucas V. Beau** (USAF, ret). Consolidated Diesel Electric Corp.; Second Vice President—**W. G. (Dusty) Rhodes,** Cessna Aircraft Co.; Third Vice President—**John Hoving,** Air Transport Assn. of America; Secretary—**Frances W. Nolde,** Defense Air Transport Administration; Treasurer—**Laura T. Zerener,** Federal Communications Commission.

John H. Winant has been elected chairman, and **David H. Scott,** secretary-treasurer, of the General Aviation Council, Washington, D. C. Mr. Winant is president of the National Business Aircraft Assn. and corporate director-industrial relations for Sprague Electric Co.; Mr. Scott is executive vice president of the National Pilots Association.

INDUSTRY OBSERVER

► Major contracts to study needs and requirements of space surveillance and warning systems for the immediate future as well as for the 1975 time period will be awarded soon by USAF's Electronic Systems Division. Proposals were submitted last week by a number of companies including General Electric, Lockheed, Radio Corp. of America and Raytheon. Two contract awards may be made.

► **Navy's BuWeps soon may award a contract for investigation of a radiation device using a coherent infrared light beam generated by an optical maser.**

► USAF Titan 3 guidance system, which may be radio-inertial instead of pure inertial, will be studied in two parallel research and development programs following an industry competition. Single production contractor will be chosen after the R&D programs are completed, following procedure similar to that used for the MMRBM stellar inertial system (AW Dec. 25, p. 11). Work statement was being prepared at USAF's Space Systems Division earlier this month.

► **One aspect of Apollo program considered critical by NASA is development of a shock-attenuation system to supplement parachute recovery of the three-man capsule. Crushable structures, air bags and retrorockets are among the schemes being considered (AW Jan. 8, p. 50).**

► Britain's Royal Navy has ordered 1,000 Martin Bullpup B air-to-surface missiles for the Blackburn Buccaneer, and for flight evaluation on the de Havilland Sea Vixen and Vickers Scimitar. Current negotiations for the sale of the missiles and details of their production are being conducted at government levels. Initial quantities would be bought from Martin; remainder would be built by a production group headed by Hawker Siddeley and including firms in France, Holland and possibly other countries. Warhead definitely would be made in England.

► **Chance Vought F8U Crusader fighter series will be given limited-warfare capability by replacing standard installation of four air-to-air Sidewinder missiles with eight Zuni air-to-surface unguided rockets plus two Martin Bullpup air-to-surface missiles, one under each wing. Frangible nose fairings on the Zuni tube launchers, four on each side of the fuselage, have given some initial problems of retention during early tests.**

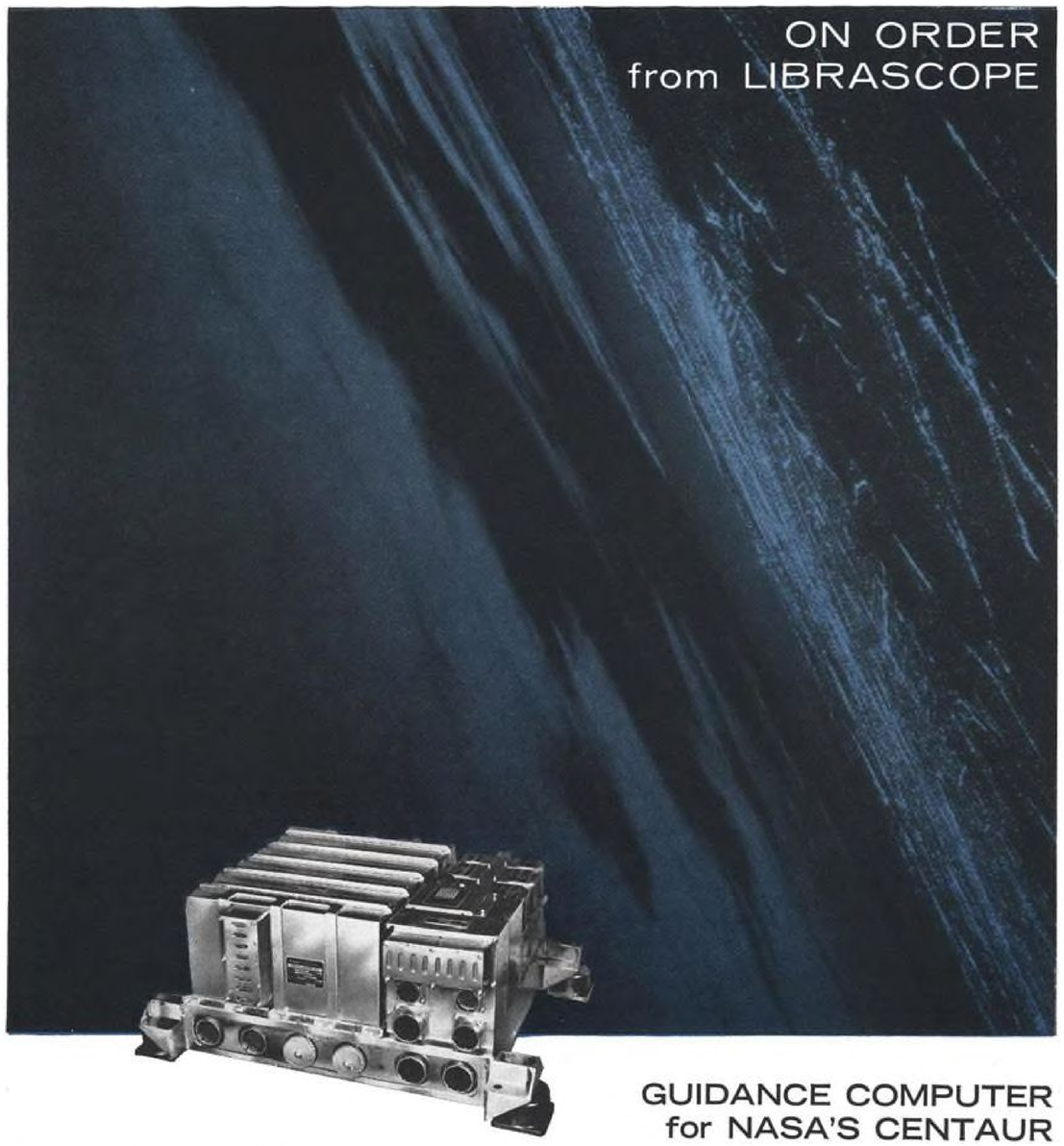
► Saab Aircraft Co. is developing a multi-mission fighter aircraft to meet a Royal Swedish Air Force requirement for an operational aircraft in the late 1960s. Basic performance figures are similar to those laid down for the tri-service TFX competition in the U. S. Designated the Saab 37, the aircraft will have a gross weight in the 25,000-lb. class, be capable of performing intercept, ground support and reconnaissance missions.

► **West Germany and France have signed letters of intent for purchase of the Breguet 1150 anti-submarine warfare patrol aircraft being built in a consortium effort by several European firms under NATO sponsorship. Firm orders are expected to follow successful completion of prototype flight evaluation trials now under way.**

• U. S. Air Force representatives in NATO nations were briefed recently on details of mobile mid-range ballistic missile system program being implemented by AFSC's Ballistic Systems Division, with technical assistance of Aerospace Corp. Requests for proposals to industry to bid on MMRBM were scheduled to be issued last week.

► **Inertial guidance systems similar to those used in Polaris-firing submarines may be installed on larger Navy aircraft carriers, such as the USS Enterprise. Purpose is to provide precise position-heading information for calibration of North American A3J's inertial bombing-navigation systems at takeoff.**

► Program to develop transistors capable of operating well into the microwave region, exhibiting minimum of 20 db. gain at 3,000 mc., will be started soon by Army Signal Corps.



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Sometime this year, CENTAUR will be spaceborne. Already, the projected uses of CENTAUR bear fascinating implications for the future... placing a satellite in an orbit so exacting that it will remain in one spot over the earth's surface... soft landings on lunar and planetary bodies... timed launchings of several satellites from a single vehicle. Several major guidance functions will be performed in CENTAUR by a compact digital computer system from Librascope. It weighs 62 pounds, occupies little more than ¾ cubic foot. A note to Librascope outlining your control problems will bring a prompt answer from the country's most versatile manufacturer of computer control systems.

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GENERAL PRECISION

Washington Roundup

Space Budget Challenge

National Aeronautics and Space Administration, after an unusually long and peaceful relationship with Congress, now is being asked to defend its budget policies. Sen. William Proxmire, who is not a member of the Senate space committee, has asked NASA for a full report on its procurement policies and procedures and has accused it of letting "multi-million dollar contracts . . . without the basic budgetary discipline of competitive bidding or even competitive negotiation."

This has renewed House space committee Chairman George P. Miller's interest in a special investigating subcommittee. He has been studying the one used by the House Armed Services Committee and may establish a similar one soon.

Air Force Systems Command is considering a change under which its Rome Air Development Center would report directly to AFSC headquarters instead of to Electronic Systems Division. This follows criticism of ESD's direction of applied research which was voiced by officials from the Office of Defense Research and Engineering after a recent visit to ESD.

Powers' Testimony

Francis Gary Powers, whose Lockheed U-2 reconnaissance aircraft was downed near Sverdlovsk, Russia, on May 1, 1960, will be available to Congress and the press after he completes discussions with Executive agencies of the government, "and will give whatever information would be in the national interest to give," according to President Kennedy.

The government may well decide that to let Powers reveal details of the flight and what caused his aircraft to come down in Russian territory would not serve the public interest, however. Powers was returned to the U. S. after serving almost two years of a 10-year prison term in Russia. In exchange, the U. S. released convicted Soviet spy Col. Rudolph Abel, who was serving a 30-year sentence for espionage.

Russia's Cosmonauts Yuri Gagarin and Gherman Titov are assured of membership in the Supreme Soviet. Gagarin will represent his home town of Zhatsk and Titov will represent his home town near Alma Ata. Neither has any opposition.

A rumor that Russia is preparing to let Western newsmen cover the next Soviet space shot was denied in Moscow last week by the Foreign Ministry's press department.

Supplementals' Fate

Fate of the supplemental airlines is expected to be decided by Congress in the next few days. House and Senate leaders and representatives from the Civil Aeronautics Board were to meet late last week to try to agree on legislation. Principal issue is whether the supplementals should have individual ticketing authority. Chairman Mike Monroney of the Senate aviation subcommittee argues that such authority is essential. Operating authority of these airlines expires Mar. 14.

Civil Aeronautics Board Chairman Alan S. Boyd and Federal Aviation Agency Administrator N. E. Halaby joined in a bit of airportsmanship last week over Washington's Dulles International Airport. Meeting with Maryland congressmen who fear that Friendship International Airport, between Washington and Baltimore, will lose traffic when Dulles opens, Boyd said bluntly that carriers certificated to serve Washington must use Dulles even though landing fees at Friendship might be less. Halaby said FAA won't use its regulatory powers to favor Dulles but emphasized that FAA is obligated to make sure the government gets a good return on it's $105-million investment there.

Test Preparations

Preparations are almost complete for a first nuclear test blast in the Pacific in the Kingman Reef area between Johnston and Christmas Islands sometime in April. Air Force has rehabilitated the Johnston Island airstrip and a joint task force is being formed to handle tests throughout the summer, possibly lasting as late as October, if the U. S. decides to go ahead. President Kennedy wants to go ahead (see p. 29) but is being opposed strongly by a number of advisers, including Adlai Stevenson, U. S. ambassador to the United Nations.

The White House is concerned about the potential unemployment situation at Republic Aviation Corp., caused chiefly by failure to win the TFX tactical fighter competition and a sharp cut in Air Force programing for the F-105. "We are going to try to see if we can maintain employment as high as it is possible for us to do so, even though some cut . . . will perhaps inevitably come," President Kennedy said last week. Republic, which intends to bid on the VAX close support fighter, has said that "the worst possible situation" might mean a layoff of 9,000 of its 15,000 people by mid-1963.

NASA witnesses will lead off the testimony on a world-wide communications satellite program before the Senate space committee on Feb. 26.

—Washington Staff

GE Named Systems Integrator for Apollo

Task covers both boosters and spacecraft; contract may become largest single one in company's history.

Washington—General Electric Co. has been chosen for an unusual systems integration and checkout role for the Apollo spacecraft and its booster vehicle that will run for the life of the lunar landing project and may become one of the largest single contracts in the company's history. GE was selected without a formal industry competition.

National Aeronautics and Space Administration had been expected to retain the integration and checkout role itself or pass it along to North American Aviation, Inc., builder of the spacecraft.

GE's work will be split into two phases—a six-month, $1-million study phase during which some 75 persons will do detailed planning, and the implementation phase, which will last as long as the project does. No cost estimate for this phase will be made until the study is completed.

NASA's Office of Manned Space Flight Programs will monitor the GE effort. Work will be done by GE's Defense Systems Department at Syracuse, N. Y., which is part of the Defense Electronics Division, but GE is expected to borrow heavily from the talents of its Missile and Space Vehicles Division in Philadelphia, which had been deeply involved in lunar spacecraft studies before GE lost the Apollo competition to North American's Space and Information Systems Division.

John K. Records, who headed design, development and testing of the radio command guidance system for the Atlas missile in 1957 and most recently has been manager of the department's instrumentation and guidance product section, has been named manager for the Apollo work.

Supporting Role

GE's supporting role after the study phase ends will include:

- **Integration analysis** of the complete vehicle, including booster-spacecraft interface.
- **Assuring over-all reliability** of the complete vehicle.
- **Developing and operating** a checkout system for the complete vehicle.

NASA said it selected GE "after considering a number of major corporations with space systems integration and checkout experience." Negotiations on the $1-million contract were under way last week.

NASA said GE will work with the NASA centers involved and with the several major Apollo contractors. Marshall Space Flight Center is building the early Saturn boosters that boost the first of the Apollo spacecraft, and will direct Chrysler Corp.'s work on the Saturn S-1 booster and Boeing's work on the S-1B booster. Lewis Research Center will direct spacecraft propulsion work and the Manned Spacecraft Center will direct capsule work.

GE apparently will not tell contractors what to do to improve reliability, for example, but will advise NASA and let NASA in turn advise the contractors.

There appears to be no direct precedent in NASA's history for the type of job that GE will be doing. It is most common in both military and civilian space efforts for the agency itself or a contractor laboratory—such as the Jet Propulsion Laboratory in NASA's case or the Applied Physics Laboratory in Navy's case—or a non-profit firm, such as USAF's Aerospace Corp., to handle systems work. Space Technology Laboratories, Inc., is an exception to this pattern, but it performed a systems role in several Thor-Able and Atlas-Able boosted space shots chiefly because it was then serving as USAF's systems engineering and technical director on the vehicles used.

NASA might have retained the systems integration function through Marshall, which will direct booster work, or the Manned Spacecraft Center, which will direct the capsule work; or it might have left this function with the spacecraft builder, as has been done in certain cases.

With this contract, GE is believed to be the only private firm holding a systems integration contract even though it will build no part of the launch vehicle or spacecraft. Boeing holds an assembly contract on the USAF Minuteman missile, but it builds interstage connectors and also has the assignment of testing the missile.

Test Mission

NASA has not assigned the test mission for the Apollo project. Whether it will go to the builders of the several boosters, the capsule, or remain with NASA through the Manned Spacecraft Center or the Launch Operations Directorate at Cape Canaveral, Fla., which is a part of the Marshall Center, is not known. So far there is no indication that GE will fulfill this function, even though it will be responsible for integration analysis, reliability and checkout of the booster and capsule.

Tulsa Picked for Apollo Work

Washington—North American Aviation, Inc., will use about 270,000 sq. ft. of Air Force Plant 3 at Tulsa, Okla., to build components and ground support equipment for the Apollo spacecraft. It also has taken an option on 300 acres of land adjoining a planned navigable waterway on the Verdigris River, which flows east of Tulsa, for later use.

The plant now houses Douglas Aircraft Co.'s Tulsa Division. Douglas will retain enough space for existing programs and the expansion expected when such projects as the USAF Skybolt air-launched ballistic missile go into production. It also will administer the facilities contract and act as government custodian, under an agreement with Air Force and North American.

North American's portion of the plant will be under NAA's Space and Information Systems Division, which is building Apollo for National Aeronautics and Space Administration. It will employ an estimated 2,000 persons within a year and will have its own engineering, direct labor and supporting functions.

The Tulsa operation becomes the third large space effort to be located in the southern portion of the U. S. since the Kennedy Administration took office. Others are the Saturn booster assembly and test complex at Michoud, La., and Pearl River, Miss., and the Manned Spacecraft Center at Houston, Tex. These are in addition to a 73,000-acre expansion of the industrial complex and launch area around Cape Canaveral, Fla. There also is a strong possibility that solid propellant manufacturers will locate plants somewhere in the Gulf of Mexico area for the construction of large segmented solids. Most of the major solid companies now hold options on land around the gulf or in Florida.

In another Apollo action, North American chose Lockheed Propulsion Co. to design and build the solid-propellant escape rocket motor for the Apollo. Approximate cost is $5 million. The contract will cover about 50 test motors and about 15 production motors. Lockheed builds the escape motor for the Mercury capsule.

Project Fire Briefing

Washington—Approximately 25 firms attended a briefing at Langley Research Center late last week to hear National Aeronautics and Space Administration's plans for a competition relating to the Project Fire research spacecraft (AW Jan. 22, p. 23).

NASA plans to launch two of the spacecraft on ballistic trajectories within two years, using General Dynamics Atlas D boosters and a velocity package powered by a Hercules-Allegany X-254 solid propellant rocket. Purpose is to measure effect on materials, structures and radio propagation at lunar re-entry speeds of around 24,500 mph. Each spacecraft will use different instrumentation and no recovery is planned.

Defense Asks Funds For Intelligence Units

Washington—New $2.8-million headquarters building for the Defense Intelligence Agency and a $12.9-million expansion of the National Security Agency at Ft. Meade, Md., was proposed to Congress last week in the Defense Department's $1.3-billion Fiscal 1963 construction program.

The program also allocates $6.3 million for expansion of National Security Agency facilities overseas at classified locations.

DIA was created last year by Secretary of Defense Robert S. McNamara through integration of the intelligence activities of the three services. NSA specializes in communications intelligence.

The largest share of the proposed new construction—$744 million—is for the Air Force. Other allocations are: Navy, $206 million; Army, $149 million for expansion of National Security Agency facilities overseas at classified locations.

A total of $663 million of the construction is earmarked for classified locations.

The allocations will be funneled to the following groups:

Defense Communications Agency, North American Air Defense headquarters, Colorado Springs, $1.4 million; Office of the Secretary of Defense, Hawaii, $5.1 million; Naval Radiological Defense Laboratory, San Francisco, $2.5 million; Edwards AFB, Calif., $3.2 million; Naval Research Laboratory, Washington, D. C., $5.5 million; Patrick AFB, Fla., $6.3 million; Atlantic Missile Range, $8 million; White Sands Missile Range, N. M., $8 million; Wright Patterson AFB, Ohio, $10.8 million; Tinker AFB, Okla., $6.7 million; and Arnold Engineering Development Center, Tenn., $2.4 million.

Convair Reorients From Systems To Subcontracting at San Diego

Emphasis at the General Dynamics Convair Division, San Diego, is shifting from the development of complete aircraft and weapon systems to tooling and production subcontracting and aircraft overhaul operations in the wake of a $400-million jet transport loss and termination of USAF F-106 production.

Much of the division's engineering and development talent has been transferred to General Dynamics Astronautics or other divisions of the corporation. Convair still retains specialists capable of developing certain complete systems such as seaplanes and hopes to bid on complete aircraft systems when circumstances allow. However, the new emphasis on subassembly and overhaul work is thought to be more in line with the existing resources of the division.

The practice of employing surplus productive capacity on subassembly and overhaul jobs has frequently been adopted by aircraft companies when their own aircraft programs phased out.

Convair is uncertain about the prospects of subassembly contracts on the Navy-Air Force TFX. If the team of General Dynamics/Ft. Worth and Grumman should win the final design competition, it seems likely that there would be a contract for the Convair Division. If none is received, Convair will soon have 75% of its tooling area and a very large part of its manufacturing assembly area empty and available for new work.

Of the 5 million sq. ft. of covered floorspace at the San Diego facilities:

- **About 849,710 sq. ft.** of assembly and fabrication area are expected to be totally empty by July 1 in Plant 1 which is owned by General Dynamics and is currently engaged in 880 and 990 production and in the manufacturing of spares for commercial aircraft. Rumors of other companies taking over Plant 1 have not been corroborated.
- **In the same plant,** seven fixed manufacturing areas will be from 50% to 90% idle.
- **In plant 2 (USAF Plant 19)** 730,755 sq. ft. of assembly and fabrication area will be partially available. Plant is engaged in Atlas subassembly and in spares fabrication for F-102s, F-106s.
- **Four fixed manufacturing areas** in Plant 2 will be from 45% to 70% available.

More than 440 machine tools will be idle unless tooling subcontracts are found. Convair is circulating brochures to major system contractors and airframe builders to advertise its entry into the tooling and production subcontracting business. Division officials are confident of acquiring a subcontract from McDonnell Aircraft Corp. for subassembly work on the USAF F-110 version of the Navy F4H. Also, both remaining competitors for the TFX development contract are proposing to use a Convair ejection seat.

Convair employment dropped from a peak of 20,000 last May to 11,100.

Convair has nine acres of underwater leasehold in San Diego harbor and a seaplane ramp that will accommodate any seaplane now operated by the Navy.

This seaplane area and a large outdoor manufacturing space adjacent to Lindbergh Field are being offered for the overhaul of aircraft.

Tiros 4 Photographs Canadian Ice Areas

Washington—Tiros 4 experimental weather satellite last week successfully completed the first phase of a joint U. S.-Canadian ice reconnaissance feasibility test, called Project Tiree, and is expected to produce even better photographs in a second phase early in April, the Weather Bureau said.

Although Tiros is experiencing "some of the usual shakedown problems" including setting of the timer system for remote photography, it is producing "very good pictures—the best we've had," a Weather Bureau spokesman said. Both television cameras and the infrared device were working.

Tiros 4 was launched by National Aeronautics and Space Administration Feb. 8 (AW Feb. 12, p. 37). For the next five days it attempted to photograph snow and ice areas in the Gulf of St. Lawrence area. It did not succeed on all of the five days because snow clouds covered parts of the target area. A dozen U. S. and Canadian aircraft also photographed the areas during that time and data from satellite, aircraft and ground station is being correlated.

Early in April, Tiros' orbital path again will carry it over the Gulf of St. Lawrence area. Chances for good satellite coverage should be even better then because the period will be from 10 days to two weeks long and the satellite's attitude will be more favorable.

In addition to the Weather Bureau and the Navy Hydrographic Office, Canada's Weather Service and Defense Research Board and the RCAF are participating in Project Tiree.

Refined orbital information gives Tiros 4's perigee as 471 mi., apogee as 525 mi., period as 100.4 min. and inclination as 48.30 deg.

Titan 2 Slated for Four Space Vehicles

By Evert Clark

Cape Canaveral, Fla.—USAF Martin Titan 2 missile, which will begin flight tests here in a few weeks, is expected to become the basic unit for at least four U. S. space vehicles in addition to its role as a weapon.

Under a new system, launch vehicles that will be used only by National Aeronautics and Space Administration or only by Air Force will be designated Special Launch Vehicles. Those to be used by both agencies will be designated National Launch Vehicles.

Also for the first time, each stage will be given a number designation. This system, far more complex than the previous USAF designation of Standard Launch Vehicle 1 (SLV-1) for Blue Scout, SLV-2 for Thor, SLV-3 for Atlas, etc., produces such designations as NLV-06C09A for the Atlas-Centaur, which both NASA and Air Force will use; SLV-05A07B04B for the Thor-Delta, which only NASA uses.

Current Plans

Current plans for the four vehicles based on Titan 2 may be modified slightly as NASA and USAF continue to follow up on recommendations made by the Golovin Committee on large launch vehicles (AW Nov. 6, p. 26). Before the change in designation systems, the four vehicles tentatively planned were to have been designated Standard Launch Vehicle 4A, 4B, 4C and 4D, as follows:

- **SLV-4A**—Titan 2, modified to carry space payloads. Only specific mission assigned so far is the NASA-McDonnell two-man Gemini capsule. Modifications for this mission probably will include use of a command guidance system rather than the all-inertial system which the weapon system will use.
- **SLV-4B**—Titan 2 with upper stages. One upper stage almost certain to be used with the Titan 2 is the Lockheed Agena D, which will be a standardized version of the Agena, similar to the Agena B now in use on the USAF-General Dynamics Atlas.
- **SLV-4C**—Titan 2 with two segmented solid-propellant boosters strapped to the sides. This is the basic Titan 3 (AW Jan. 8, p. 32), which is expected to become the booster for the USAF-Boeing Dyna-Soar orbital glider—although NASA's Saturn booster still is a possibility for this mission. Titan 3 also may use a command guidance system (see p. 23).
- **SLV-4D**—Titan 2 with segmented solids on the sides and with upper stages. This essentially is the so-called Titan 3 but with one or more liquid-fueled stages added to the Titan. Defense Secretary Robert McNamara referred to this version in testimony before the Senate Armed Services Committee recently as "Space Booster Building Block," and said:

"We visualize this Titan 3 standard launch vehicle as a 'workhorse' booster to place in orbit a broad range of payloads."

Test program for the military version of Titan 2, which has priority over all space versions, will last something more than a year and include more than a dozen missiles. A Titan 2 underwent a complete simulated flight in a static sequence test at Martin's Denver plant last Dec. 28. The first flight model arrived here Jan. 27 (AW Feb. 12, p. 103).

First two or three missiles will be fired from Pad 16 in Martin's group of four launch sites here. Pad 15 also is ready for Titan 2s, and will alternate with Pad 16 for weapon system flight tests.

Pad 19, from which the last Titan 1 to be fired from Cape Canaveral was launched last Jan. 29, already is being modified for the launching of the Gemini capsule, expected some time in 1963. The launch stand also will be able to handle a Titan 2 plus an upper stage, plus a payload, so it could accommodate SLV-4A or SLV-4B.

Martin's Canaveral Division already has approximately 50 people assigned to the Gemini project under Eugene J. Mommer, who headed a small Dyna-Soar project team here until the Gemini booster was ordered. Earlier, Mommer headed the Mace missile research and development program.

Pad 20 was to have been used for suborbital Dyna-Soar flights, boosted by the Titan 2. Now that suborbital flights have been eliminated from the program, Pad 20 is idle. No decision has yet been made on where test flights of the Titan 3, with its solid-propellant boosters, will be made.

Since the Titan 2 will use storable propellants and since its 70-ft. first stage and 32-ft. second stage are quite similar to the Titan 1 stages, the test program will be considerably shorter than the 34-month Titan 1 program. As an example of the greater simplicity of Titan 2, Aerojet-General estimates that its two 215,000-lb. thrust first-stage engines and the 100,000-lb. thrust second-stage engine and their related ground equipment for Titan 2 will have at least 50% fewer control components and moving parts than those in Titan 1.

For use in the Titan 3 configuration, the first stage of the Titan will be modified for altitude starts, since only the solid boosters will ignite at liftoff. Engine for the upper stage of Titan 2 will fire before separation from the first stage—unlike the Titan 1, in which separation occurred first. Large vents ring the bottom of the upper stage to allow the exhaust gases to escape.

The Titan 2 missile is now scheduled to go into six squadrons, with nine missiles and a spare in each squadron. Each Titan 2 silo will have its own command center, whereas with Titan 1, there were three missiles for each command center. Bases are now under construction at Wichita, Kan.; Little Rock, Ark.; and Tucson, Ariz.

Titan 1 Record

Since reliability will be a major consideration when Titan is used to boost manned Gemini or Dyna-Soar flights, the flight history of the Titan 1 and Titan 2 will be watched closely.

When the last Titan 1 was launched successfully here last Jan. 29, the missile had achieved a box score of 37 successes, 9 partial successes and 4 failures in a little less than 36 months of test shots from Cape Canaveral and Vandenberg AFB, Calif. Even when partial successes are not counted in the success column, this gives the Titan a 74% record of successes, several points higher than the percentage for any other major USAF missile so far.

Air Force considers a flight successful if more than 85% of all test objectives are met. Partial successes are those in which 25 to 85% of the objectives are met.

In the 40 research and development firings from the Cape between Feb. 6, 1959 and Dec. 13, 1962, Titan scored 29 successes, 7 partials and 4 failures. Seven other missiles were launched here from last June 23 until Jan. 29 as flying testbeds for the AC Sparkplug all-inertial guidance system that will be used in Titan 2. Of these, five were successful and two were partially successful.

Three Titan 1s had been launched from Vandenberg by Jan. 20. The first was launched from within a silo last May 3 to test the feasibility of launching from underground. The second, last Sept. 23, was launched after being lifted from the silo by elevator and was the first launch test of the entire Titan 1 weapon system. The third, launched Jan. 20, was an operational demonstration launch, with a Strategic Air Command launch crew observing and assisting. All three were successful. AVIATION WEEK incorrectly reported Jan. 29 (p. 35) that the last shot was unsuccessful. Although the second stage shut down seconds too early, the missile flew more than 4,000 mi. and achieved enough of its test objectives to be counted by Air Force as a success.

In 39 flights in which the second stage had a chance to ignite, it ignited and ran 35 times, for an 87.7% score. Ignition in flight was once considered a potential problem.

The USAF-General Dynamics Atlas used the opposite approach, igniting the two booster engines, the sustainer engine and the two vernier engines before liftoff.

Research and development firings of the Titan from Cape Canaveral included four missiles in the A-series, which carried dummy second stages; two in the B-series, which tested two-stage burning but for limited ranges; five C-series, testing both stages and experimental re-entry bodies over limited ranges; seven G-series full-range tests; and 22 J-series vehicles, which tested all systems over full or extended ranges. This was the operational prototype.

President, Dr. Bethe Differ Over Usefulness of Anti-Missile Missile

By George C. Wilson

Washington—Emerging from the current debate over nuclear testing is the paradox of President Kennedy expressing concern about Russian progress in anti-missile missiles while Dr. Hans A. Bethe, an adviser who evaluated the Soviet tests for the President, is discounting the worth of such weapons.

This divergence at the highest level is repeated at lower echelons, where individual politicians are demanding that the U. S. resume tests to keep abreast of Russia while some scientists look beyond the immediate question and argue the policy implications of larger nuclear weapons.

To deepen the paradox, the Atomic Energy Commission—the public agency with the most expertise on nuclear questions—maintains its silence and continues to confine itself to the one-page statement issued last December on the significance of the Russian test series.

Diplomatic Delay

President Kennedy last week said the U. S. would not resume nuclear testing on Christmas Island in the Pacific before the opening of the foreign ministers' conference on disarmament in Geneva on Mar. 14. He added that by the end of this month, "we will have concluded our analysis of our relative positions and we will be in a position to make a decision" on whether or not to resume nuclear tests in the atmosphere.

In his previous news conference, President Kennedy mentioned the relative positions of the U. S. and Russia regarding the anti-missile missile as one of his specific concerns in making his decision on the resumption of nuclear testing.

Chairman Chet Holifield (D.-Calif.) of the Joint Congressional Atomic Energy Committee said one reason testing must be resumed is that "the U. S. today finds itself incapable from a military standpoint of stopping incoming intercontinental ballistic missiles armed with nuclear warheads. . . . The only way you are going to be able to find out whether a Nike-Zeus is effective or not is to explode one with a nuclear warhead and then you will be able to get the weapons effect in the high atmosphere or in space."

Bethe's Views

But Dr. Bethe, Cornell University physicist who evaluated the Russian nuclear tests for President Kennedy, said recently in a speech at Cornell that "effective AICBM is not possible. I believe this because the offense has always many more possibilities than the defense. The offense can choose its target, it can concentrate a lot of fire on one target while the defense has to defend 20, 50, 100 different targets. The offense can always bring in enough missiles to use up all the defensive missiles which may exist near one city. The offense can fire a salvo of many missiles simultaneously and this will saturate the radars so that they can no longer find the right target.

"And most important, the offense can send together with the actual missiles a lot of decoys, gadgets which look to the radars and maybe also the eye, just the same as a missile, and I can assure you because I have worked on this problem."

Dr. Bethe said AICBMs could hit incoming missiles, as proved by recent tests of Nike-Zeus, and that "there is also no problem about providing suitable atomic warheads for anti-missiles. Many opponents of the nuclear test ban have claimed that it is vital to start testing again in order to develop a warhead for an anti-missile, but this is incorrect. We have suitable warheads."

He said the impossibility of developing an effective AICBM system "is good because after all we want the stable deterrent to remain stable. . . . By stable I mean that both sides need no longer be so nervous, that they need no longer react quickly to any supposedly hostile act of the other. . . . The probability of war is greatly reduced once the stable deterrent is established.

"Then restraint can be used in responding to an accidental attack by one enemy missile. Restraint can also be used in the number of missiles deployed on each side. Most important, even should war break out, restraint can be used in the number of missiles actually fired because the remainder will still be secure."

Dr. Bethe said each side must restrain itself, even in war, "to avoid utter catastrophe. We must learn to be satisfied, in case of war as well as in peace, with partial success. This was in fact the rule in wars in the Middle Ages and till the end of the 18th century. Only in the last 150 years have wars generally been fought to unconditional surrender. The power situation no longer permits such a goal, and we must psychologically get used to this."

As for nuclear tests themselves, Dr. Bethe contradicted several recent statements by members of Congress who contend that resumption of atmospheric tests is absolutely vital to enable the U. S. to keep pace with Russia. "The value of nuclear tests has been greatly exaggerated," he said. "We already know so much about atomic weapons that there is not much more to learn. We have weapons of all sizes for all reasonable military purposes. Only relatively modest improvements can be made in the yield of weapons for a given weight.

"After the extensive Russian test series in which they attempted to catch up to our technology, it would however seem reasonable that we also should test those designs which we have developed in the laboratory and which fit into our strategic plans. In particular, I consider it very important to test the planned warheads for Minuteman and Polaris, and I hope this can be done underground. There are some weapons effects tests which we might profitably make. But I do not believe that nuclear testing is the endless frontier that some people seem to see in it."

Other Comment

Similarly, the Federation of American Scientists—which claims a membership of 2,100 scientists and engineers—said in a statement opposing resumption of atmospheric tests that "in the present advanced state of nuclear weapons, no step comparable in terms of weapon yield to the thermonuclear breakthrough is foreseeable." It added that resumption "cannot help but foster the impression that our security can in the long run be maintained solely by military strength" rather than by political agreements.

Weather Again Delays MA-6; Further Postponements Feared

By Edward H. Kolcum

Cape Canaveral, Fla.—Deteriorating weather conditions in the eastern Atlantic delayed the Project Mercury orbital flight of Marine Corps Lt. Col. John H. Glenn Feb. 14 and Feb. 15, with only slight hope remaining that the mission could be flown late last week.

Electrical and mechanical problems which had caused seven earlier delays (AW Feb. 5, p. 29) had been rectified, but the longer the Mercury Atlas-6 launch vehicle remains on the pad, the more chance there is for random component failures in booster and capsule systems.

Weather in the Caribbean and eastern Atlantic is a continuing problem from mid-December through mid-March, with estimates that acceptable weather conditions will prevail only 30% of the time in the three primary recovery areas, the launch abort area, and here at the launch site.

February is the worst month of the year for acceptable weather in the Atlantic, and March was described as not much better.

Unusually High Winds

The worst weather Feb. 14 and 15 was in the abort area, which reaches from Bermuda to the Canary Islands, where an abnormally strong high pressure system was causing trade winds considerably above normal and moderately rough seas.

An intense low pressure trough was active east of Bermuda and a new storm center was moving to Bermuda from Cape Hatteras Feb. 15. These conditions brought high winds and heavy seas to much of the ocean area surrounding Bermuda, particularly in the abort area 600-900 mi. east of the island where the capsule would come down if it failed to achieve an orbit after a successful launch.

Forecast for the area 400 mi. south of Bermuda Feb. 15 was for increasing winds and seas, and for the area off Puerto Rico, gentle winds and slight seas. The area south of Bermuda is the second orbit recovery zone, and after a successful three-orbit mission, the landing point is 225 mi. northwest of Puerto Rico.

Complicating the weather picture is the presence of fog and low clouds at the launch site during the morning, and the possibility that the normal two-week rainy season will hit central Florida before the end of the month. The cloud and fog condition normally clears by 10 a.m., but this hour is too late to fly a three-orbit mission.

About four hours of daylight are necessary in the recovery zone after impact. This will allow a three-orbit flight from 7:30-9:30, two orbits from 9:30-11, and single orbit from 11-12:30.

The Tiros 4 weather satellite, during its first pass Feb. 8, took cloud cover pictures of the recovery areas which showed partly cloudy conditions prevailing over much of the Atlantic. USAF-Martin WB-57 aircraft continually inspect primary recovery areas and immediate weather data is provided by Navy recovery ships on station in these areas.

Revised Schedule

National Aeronautics and Space Administration late last week scheduled the launch on a 24-hr. cancellation basis, which probably could continue with little adverse effect on the Atlas booster or Mercury capsule until about Feb. 21. After that, the need may arise to recycle or replace some of the components, and to repeat readiness checks.

Complete Atlas readiness inspection takes two to three days, but some of the more critical components must be monitored continuously. The flight controller and ASIS (abort sensing and implementation system) are checked daily and a flight profile is run on the booster guidance cams every week. These procedures are more inspections than reconditioning and are considered similar to a preflight inspection of an aircraft that has not been flown for several weeks.

The McDonnell capsule, named Friendship Seven by Col. Glenn, undergoes a split countdown. The initial part is a check of major subsystems at T–48 hr. The second phase on launch day includes loading serviceables such as hydrogen peroxide, oxygen and explosives. After a maximum of six days from the first count, major subsystems will be recycled. The USAF-General Dynamics/Astronautics Atlas, production vehicle No. 109D, has a 390-min. count, which includes a planned 30-min. hold.

The plastic foam insulating blanket in the Atlas fuel tank was removed after kerosene leaked into the insulation through a bulkhead mounting ring (AW Feb. 12, p. 29), but it will not be decided until after the Glenn flight whether the insulation will be removed from the remainder of the Mercury Atlas boosters.

Meanwhile, 24 Navy ships and 63 Marine, Navy and Air Force aircraft remained on station after the Feb. 15 postponement. Although this force deploys for a five-day period, the time is flexible and can be extended. The controlling factor is the operational commitment of its units elsewhere. For example, the patrol squadron on carrier Randolph is involved in exercises with nuclear submarines this week and the operational commander must decide whether to employ this squadron in the Mercury force or in the tactical exercise.

The carrier Randolph is in the prime recovery area off Puerto Rico with two destroyers, three HUS helicopters and six P2V, two SA-16 and two SC-54 aircraft.

In the second orbit recovery area, located south of Bermuda, the carrier Antietam has a force consisting of a destroyer, three HUS helicopters, and three P5M aircraft.

The carrier Constellation heads the force in the first orbit and abort recovery zone. It is made up of six destroyers, three HUS helicopters, two WV, four P5M, four SC-54 and four P2V aircraft.

The pad abort force consists of four HUS helicopters, three Army amphibious vehicles and small boats. The Bermuda off-shore force is made up of four destroyers, two minesweepers, and submarine rescue vessel, and four P2V aircraft.

The eastern Atlantic force includes a fleet tanker, three destroyers and four WV, eight P2V, and four SA-16 aircraft.

Glenn Is Anxious

Col. Glenn was undergoing his extended pre-launch preparation period stoically, and was reported anxious to fly the mission. After the flight was postponed Jan. 30, he visited his family in Arlington, Va., President Kennedy in the White House, and then spent some time on the ALFA (air-lubricated free-attitude) trainer at the Manned Spacecraft Center, Langley Field, Va.

After the second manned Redstone flight, the pilot, Capt. Virgil I. Grissom, said he would like to have spent more time on the ALFA trainer during the two weeks immediately before his July 21 suborbital flight (AW Feb. 12, p. 79).

With the exception of his brief trip following the postponement, Glenn has been in semi-isolation since early January, much of the time on a low-residue diet. He has expressed concern to the President and, through NASA spokesmen to the press, over the lack of news stories about the scientific and engineering significance of the flight, as compared to the large amount of personal publicity he and his family are receiving.

Final Decision on TFX Engine Due Soon

By Larry Booda

Washington—Results of last-ditch efforts by the General Electric Co. and General Motors Corp.'s Allison Division to have their turbofan engines remain in the powerplant competition for the Air Force-Navy TFX tactical fighter, despite actions which favored the Pratt & Whitney entry, are expected this week from an Air Force engine evaluation board which was reconvened to reconsider and clarify its original recommendations.

The board, in following its instructions to more thoroughly document technical evaluation of the three engines and other source selection criteria, last week visited the General Electric Large Jet Engine Department at Evendale, near Cincinnati, Ohio, the Pratt & Whitney Division of United Aircraft Corp. at East Hartford, Conn., and the Allison plant in Indianapolis. The board is composed of personnel from the Air Force Aeronautical Systems Division.

Two of the original six companies in the TFX competition were given paid study contracts Jan. 31 to amend their submissions. The Boeing Co.'s Wichita Division was ordered to change its design to accommodate the Pratt & Whitney TF-30 engine. It had been built around the General Electric MF295 engine.

General Dynamics' Ft. Worth Division, which, teamed with the Grumman Aircraft Engineering Corp., submitted a proposal including the TF-30 as first choice, was told to make other changes (AW Feb. 5, p. 28, and Feb. 12, p. 28).

Allison Engine Ignored

None of the submissions had specified the Allison AR168, a version of the Rolls-Royce RB.163 Spey engine, as its first choice. Of the four companies eliminated from the airframe competition, three favored the MF295 and one the TF-30.

All of the engines as proposed are in the 10,000 to 11,000 lb. thrust class without afterburning and with growth possibilities. Their characteristics are:

• **Allison AR168.** As the Rolls-Royce RB.163 Spey, this engine is operational in the de Havilland DH-121 Trident three-engine transport. Flight time in the Trident is 25 hr. in 19 flights. It was also tested in the Vulcan bomber. Its thrust is listed as 10,100 lb., its weight as 2,200 lb., specific fuel consumption as 0.560. The engine has a 10-stage compressor. The Allison redesign of the engine would increase the performance capability. It meets most of the requirements in the TFX request for proposals.

• **General Electric MF295.** Airframe designers of four companies and Air Force officials considered the MF295 design as meeting the TFX technical requirements closer than any other. As proposed, it would include already developed parts of the J79 engine, which powers the Navy-McDonnell F4H-1 and Air Force F-110 fighter aircraft, and the J93, which will power the North American B-70 Mach 3 bomber. Both engines have been developed.

• **Pratt & Whitney TF-30.** This engine was Navy-sponsored with the intention that it would be installed in the now-canceled Douglas Missileer subsonic fighter, which would carry the long-range Eagle missile. About $30 million has gone into its development. It is heavier by about 300 lb. than the other two engines, four inches greater in diameter and slightly longer, and is more powerful.

In its original TFX effort, which preceded the bi-service project ordered by Defense, the Air Force had encouraged General Electric to design the MF295. Its proposal stated that the engine could be developed in 36 months. This is one point that is believed to be under further study by the engine evaluation board. Normally engine development takes four to five years.

Case for Spey

Allison is basing its argument on the fact that the Spey is operational. Allison engineers have been working at the Rolls-Royce plant in England for about a year, gaining design knowledge on the Spey.

Another factor must be considered by the evaluation board and Defense officials in connection with the Allison entry. The original Air Force TFX project was aimed at fitting the airframe to both the Spey engine and General Electric's new powerplant. Allison is also fighting for its future in large turbine engines.

If chosen, the AR168 would give the United Kingdom little in royalties, but having an operational engine in quantities of U.S. aircraft would afford Rolls-Royce increased recognition.

A factor considered earlier but which has no effect on the present re-examination is a pooling arrangement with the United Kingdom, to prevent waste of talent and funds through duplication of research and development effort. Defense officials deny there is any international pressure being brought to bear in selection of a TFX engine.

There were indications last week that the engine evaluation board will be required to write justifications for a decision that has already been made. The documentation which existed before the board was reconvened was thought to be lacking in explanations which would stand up under critical examination in higher political levels and Congress.

The total TFX program is expected to cost $4-5 billion over a five-year period beginning in 1966. The company whose engine is chosen can be assured of business lasting through at least 1970. Here is an analysis of the current status and future prospects in production of large gas turbines by the three U.S. companies.

• **Pratt & Whitney.** The J57 and J75 series engines and their turbofan versions are currently being produced for a variety of Boeing 707, 720 and 727 transport models, the Boeing B-52 heavy bomber and KC-135 tanker, the Republic F-105 tactical fighter and the Convair F-106 fighter. The B-52 and the F-106 will soon phase out of production. Engine production for the Douglas DC-8 continues. The Lockheed C-141 military transport will assure turbofan production through the next five years.

• **General Electric.** Current production of the J79 engine is going into the North American A3J-1 Navy attack bomber, the McDonnell F4H-1 (USAF F-110) fighter and the Convair B-58 medium bomber which will phase out of production late this year. The CJ-805 turbofan is being produced in limited quantities for the Convair 880 and 990 transports. Limited production is also scheduled for the J93 engine which will power the North American B-70 Mach 3 bomber. The J52 will go in the Douglas A4D-5N Navy attack aircraft.

For the future, General Electric is assured of J79 production in the F4H-F-110 series for about five years. No large production is in sight for the B-70, which is being held to three aircraft.

• **Allison.** Current production centers on the T56 turboprop which powers the Lockheed C-130 series aircraft. This is expected to continue for three years at least. Allison has no other large gas turbine prospects beyond the AR168.

Since the Korean war, the number of manufacturers of large aircraft engines has been reduced from five to three. Although both the Curtiss-Wright Corp. and the Westinghouse Electric Corp. had entered the large gas turbine field, neither became solidly established. Whether further attrition will be permitted in the defense production base for large jet engines is a political decision.

House Group to Explore Salaries Of Scientists in Non-Profit Firms

Washington—Question of how scientists employed by non-profit firms fare in comparison with their counterparts in private industry will be the next subject explored by the House Armed Services subcommittee currently preparing for hearings in the spring.

The Special Investigations subcommittee, headed by F. Edward Hebert (D.-La.), will send questionnaires within the next few days to key employes of non-profit firms which conduct research for the Defense Department.

The questionnaires are being designed to show what these scientists receive both in salary and in fringe benefits. The information will form the basis for the subcommittee's comparison with regular government and privately employed scientists doing similar work.

The salary question is one of the most controversial aspects of the subcommittee's inquiry into the workings of non-profit firms. The House Appropriations Committee last year said it had considered limiting salaries that non-profit firms financed by Defense could pay, but then decided "such drastic action" might delay military programs.

The committee cited the Aerospace Corp. as an example, declaring salaries there "are excessive." The committee further stated that "to a considerable extent the use of contracts with non-profit organizations is merely a subterfuge to avoid the restrictions of civil service salary scales."

The salary questionnaires will follow two others already sent out by the subcommittee. One went to Defense Department consultants and the other to trustees of non-profit firms performing military contracts. However, the focus of these earlier questionnaires is the conflict-of-interest question. President Kennedy, partly as a result of the subcommittee's activity, has issued guidelines to help government consultants avoid breaking conflict-of-interest laws (AW Feb. 5, p. 35).

One question asked of the trustees is whether they have bought or sold any stocks or bonds "in any corporation, organization or entity having any contractual relationship with the military establishment while a trustee or director of this corporation." The trustees are then asked to specify the names and amounts of such stocks.

Another question seeks to determine the authority exercised by the non-profit firms' trustees by asking whether they "approve its contracts with the government or take any other or further action with respect to any such contracts." The trustees also are asked whether they are retired military officers or get compensation from any organization doing business with the Defense Department.

President Kennedy's conflict-of-interest directive covered part-time advisers and consultants, but not trustees of non-profit firms working for such federal agencies as the Defense Department. The directive both interprets what advisers can do under present conflict-of-interest laws and establishes new rules of conduct for these advisers.

Under the Attorney General's interpretation, an adviser or consultant cannot represent others for pay before the government on days he is advising the government. But the consultant can represent his firm on other days unless his government consulting work takes up 40% or more of his time. Then he cannot represent others for pay before government departments and agencies until after he ceases to become available for consulting work.

As for prosecuting the claims of others against the government, President Kennedy's directive states an adviser cannot do this until two years after he becomes unavailable for government consulting.

The White House said President Kennedy's memorandum also "disqualifies any consultant or adviser from performing any governmental duties involving the transaction of business with a business firm or other organization by which he is employed, or to which he renders consultant services, or in which he has a financial interest. Moreover, the consultant or adviser may not render any advice in the course of his government service which will have a direct and predictable effect upon the interests of such firm or organization."

In addition to interpreting present conflict-of-interest laws, President Kennedy's directive establishes rules of conduct for advisers. Under these rules, the White House said, "no consultant or adviser may use inside information for private gain for himself or persons with whom he has family, business or financial ties; nor may he accept any offer or private employment which he has reason to believe is motivated by his connection with the government, unless he resigns from his government position. He may not use his position to coerce, or give the appearance of coercing, any other person to provide any financial benefit to himself or to any person with whom he has family, business or financial ties. And he is not to receive or solicit gifts if he has reason to believe they would not be made but for his government position, or if the acceptance of the gift would result in, or appear to result in, the loss of his complete independence or impartiality."

The President's directive also requires consultants to state their financial holdings at the time they are hired to enable the government to avoid possible conflicts of interest.

U.S. Forms Command To Support Vietnam

Washington—Defense Department has formed the U. S. Military Assistance Command, Vietnam, under a four-star general to aid South Vietnam in its struggle against Communist guerillas which have infiltrated the country.

Gen. Paul D. Harkins, former deputy commander and chief-of-staff of the U. S. Army, Pacific, is the commanding officer and has established headquarters in the capital city of Saigon.

The increased tempo of U. S. support activities there has resulted in four aircraft crashes. The most serious occurred last week when a South Vietnamese C-47 carrying eight U. S. military men and two Vietnamese crashed in mountainous territory, killing the occupants. The plane had been on a leaflet-dropping mission.

The first crash occurred Feb. 2 when a C-123 on a practice run spraying foliage-killing chemicals along a jungle road crashed, killing three Air Force men.

Two Army H-21 helicopters carrying Vietnamese troops crashed in jungle operations, but there were no injuries.

Arcas Probe Will Be Launched in March

Arcas meteorological probe will be towed to sea and launched by a crew from Naval Missile Center, Pt. Mugu, in March as part of the center's in-house Project Hydra to develop and demonstrate the concept of launching solid propellant rockets from the water.

Exact launch date has not been set. Aim of the test is to study the ability of ships at sea to gather weather data with water-launched rocket probes. Earlier tests in the project have indicated that a rocket can be stabilized in the open sea and that firing mechanisms can be made to withstand the corrosive environment of the sea.

Peak altitude of the flight will be approximately 210,000 ft. One test objective is to determine the altitude advantage or decrement caused by water launching. Range support will be provided by Pacific Missile Range.

Aerospace Unions Plan Unified Bargaining

Washington—About 300 leaders of the International Assn. of Machinists and the United Automobile, Aircraft, and Agricultural Implement Workers of America will meet here Feb. 19-21 to work out a single collective bargaining program which the unions are planning to present to the aerospace industry.

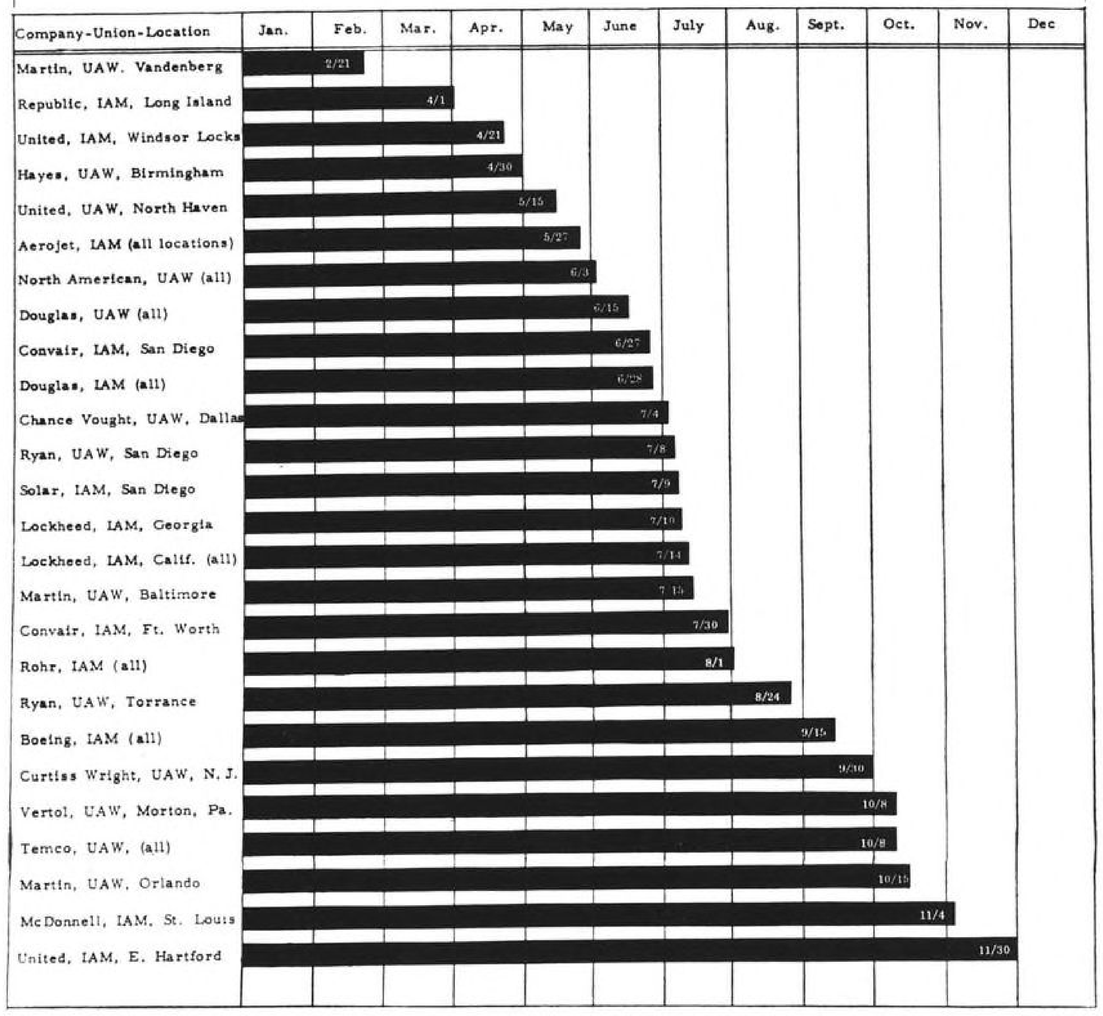
Twenty-six labor agreements, involving half a million aircraft and missile workers in the two unions, are scheduled to expire over the next 10 months (see chart).

The conference will be the second united front approach by the former rival unions.

"The success of the first joint bargaining effort two years ago confirmed our judgment on the soundness of this approach," IAM President Al Hayes and UAW President Walter P. Reuther declared in a joint statement. "For years, the industry has enjoyed a good deal of success in playing off one union against the other with the result that the members of both suffered. In 1960, that practice came to an abrupt end."

The union representatives will establish objectives on insurance, severance pay, layoff benefits, wage policies, and union security.

Hayes and Reuther observed that "if it is proper, and it is, that plane and missile producers be protected by the government against losses suffered as a result of changing defense needs, then the same standard should apply to the hundreds of thousands of men and women who make this material."



Siegler Corp. Buys Lear Family's Stock, Plans to Acquire Company

Siegler Corp. will acquire Lear, Inc., under a stock exchange arrangement which, if approved by stockholders of both companies, would greatly expand Siegler's penetration of the avionics and defense electronics market. The combined firms would have sales exceeding $200 million annually, about 60% of which would be in defense.

The action followed a decision by William P. Lear, founder and chairman of the board of Lear, Inc., to sell his own and his family trust holdings of about 650,000 shares, representing nearly 20% of the outstanding stock. These shares will be retired, and remaining Lear, Inc. stockholders will receive five shares of Siegler stock for each seven shares of Lear.

Swiss Firm

The move will provide capital for Lear's Swiss American Aviation Co., St. Gallen, Switzerland, which he formed several years ago as a private venture to develop and produce a six-to-eight place executive turbojet transport (AW Apr. 17, 1961, p. 121). It also will free him to devote full time to the new aircraft, which is nearing its first flight test.

Lear is reported to have received approximately $13 million for his holdings, with payment spread out over a period of several years. Because of his large holdings in Lear, Inc., and his executive position in the company, he had found it difficult to sell sizable blocks of stock to raise capital for his airplane venture without creating apprehension among other Lear stockholders and depressing the stock price, Lear said earlier.

Lear's decision to sell came as a surprise to many in the industry and within the company, although he has had merger talks in recent years with several firms, including Hoffman Electronics and Lockheed.

Siegler had gross sales of $96.2 million in Fiscal 1961, ending June 30, with earnings of $2.7 million. Sales for first half of current year, ending Dec. 31, were $58.2 million with earnings of $2.2 million. Lear's sales for Fiscal 1961 were $92 million with earnings of $3.1 million.

Series of Acquisitions

John G. Brooks, president of Siegler, will head the combined company, with several top Lear officials expected to join the board of directors. Brooks and his associates, largely through acquisitions, have expanded Siegler from a small privately owned manufacturer of home heaters, which they purchased in 1954, to a large multi-division operation.

In the aerospace and avionics field Siegler's acquisitions include:

- **Hufford,** El Segundo, Calif., producer of heavy machine tools for spinning large rocket motor cases. The firm produces rocket engine cases for first and second stages of the USAF Minuteman ICBM.
- **Hallamore Electronics,** Anaheim, Calif., producer of telemetry, ground support equipment, closed-circuit television and telecommunications equipment.
- **Jack & Heintz,** Cleveland, acquired last year, produces aircraft-missile electric power generation and control equipment.
- **Olympic Radio & Television,** New York City, producer of automatic direction finders, weather stations and cloud height measuring radar, in addition to its consumer products.

In addition, Siegler has several divisions operating in the home heating-air conditioning and audio-high fidelity fields.

Safe Interval Space Travel Being Studied

Prediction of safe intervals for space travel is a major problem under study at the Air Force Cambridge Research Laboratories' Sacramento Peak Observatory. (See cover and p. 19 for other details.)

Safe intervals are time periods when no proton showers occur. These showers can damage sensitive instrumentation and can be exceedingly dangerous to man.

Since last March, the observatory has been making five-day forecasts of proton showers; the group under Dr. John Evans now wants to extend that time period.

Proton showers have been called the greatest hazard to manned space exploration. Compared with the Van Allen radiation belts, whose position is well established and whose influence can be minimized by choice of exit flight path, the proton radiation is intermittent and not easily predicted.

The showers originate from solar flares, arriving at the earth from a half-hour to six hours after the flare has peaked.

Approximately one major flare out of every four produces proton showers. The flares themselves are associated with sunspot activity and follow the same 11-year cycle of activity.

When there is a sunspot maximum, solar flares occur about once per month, and prediction is difficult. Latest sunspot maximum occurred in 1957–1958, and the minimum is expected in 1964 and 1965.

So far, active centers—regions of sunspot groups which can be 200,000 km. in diameter—on the sun have been shown to be originating areas for solar proton showers. But only a small fraction of active centers produces large flares, and even fewer of these centers actually give off the dangerous proton showers. The problem is to predict the dangerous center in advance.

Some indices for prediction include the following:

- **Size and complexity** of the sunspot group.
- **Complex magnetic field** associated with certain sunspot groups will produce about five times as many flares as a center with a simple dipolar or unipolar field.
- **Age of the center.** About three-quarters of the proton showers emanate from centers that are between 15 and 30 days old.
- **Occurrence of peculiar** loop and surge prominences.
- **Coronal hot spots.**

Specialized instrumentation for mapping and exploring the characteristics of sunspot centers is being developed and will be used in the future by AFCRL's observatory. These include a differential photometer, which will determine the differences in brightness of sunspot areas as an aid to characterizing their size and complexity.

The observatory is also building an electronic Zeeman effect magnetometer to map the logitudinal magnetic field of an active center.

New Bergquist Command

Scott AFB, Ill.—Maj. Gen. Kenneth P. Bergquist, former commander of USAF Systems Command's Electronics Systems Division, assumed command last week of Air Force Communications Service here.

Gen. Bergquist replaced Maj. Gen. Harold W. Grant, whose appointment as deputy administrator of Federal Aviation Agency is awaiting Senate confirmation.

No replacement was announced for Gen. Bergquist as ESD commander at Hanscom Field, Mass., a post he had filled since May, 1958. His deputy, Brig. Gen. Charles H. Terhune, Jr., assumed temporary command of ESD last week pending announcement of a replacement.

Gen. Terhune recently was nominated for promotion to major general by President Kennedy.

The promotion is expected to receive Senate approval soon.

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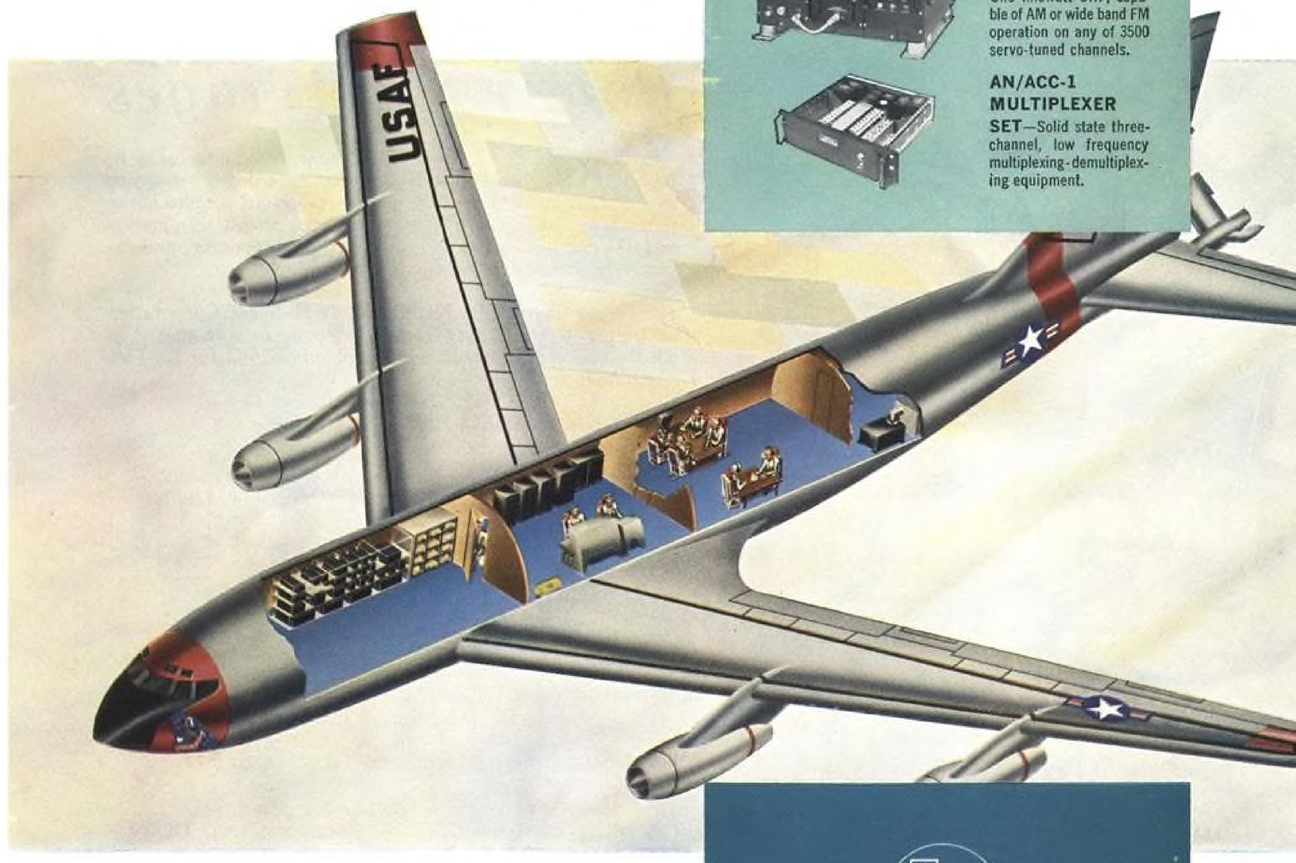

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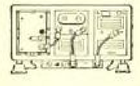
COMMUNICATIONS


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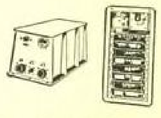
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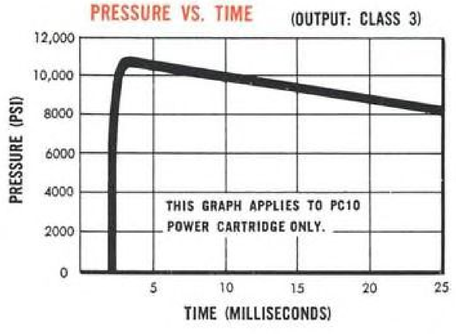
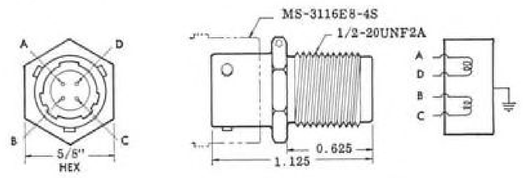


● PHYSICAL CHARACTERISTICS



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C-135s Airlift Troops From U.S. to Europe

Rhein-Main Air Base—All-jet redeployment of about 1,500 troops and personnel equipment from Rhein-Main to McChord AFB, Wash., was completed over a four-day period last week by seven Boeing C-135s of the Military Air Transport Service.

Averaging three round trips each, with crew changes in between and four hours on the ground at each terminal point, the aircraft ferried the 1st Battle Group of the 4th Infantry Division to McChord, after NATO maneuvers in West Germany.

Facing adverse winds on the return flight, and taking off at near maximum gross weight, the aircraft averaged approximately 10 hr. 45 min. on the Rhein-Main/McChord leg. Flying almost empty from McChord, however, and with favorable winds, one C-135 made the 5,160-mi. transpolar flight in 8 hr. 52 min., another in exactly 9 hr.

Redeployment of the battle group marked the culmination of exercise Longthrust Two, planned primarily to demonstrate MATS' increasing airlift capability.

The operation provided it with an opportunity to give the C-135s a tactical test under semi-operational conditions and to evaluate the effectiveness of stockpiling infantry equipment and weapons in Europe for assignment to any combat troops that may be airlifted into the area on an emergency basis without arms or logistic support.

The exercise began in mid-January with the airlift of three 4th Division battle groups from McChord to Rhein-Main aboard about 100 aircraft, including 10 C-135s.

Two of the groups are remaining in Europe to strengthen NATO forces during the Berlin crisis.

Allies Insist on Right To Use Berlin Corridor

Frankfurt—Big Three Western Allies last week rebuffed Soviet attempts to curb the flow of air traffic over the three guaranteed air corridors into West Berlin.

The Soviets, protesting that numbers of Russian military transports needed to have exclusive use of the corridors, made at least two attempts to have them blocked to Western aircraft during special periods of given days. The U.S., France and Britain, whose military and civil transports use the corridors on a regular, daily basis, with Frankfurt as a primary terminus, rejected both pleas, and traffic has continued on an uninterrupted basis.

Western spokesmen said the requests apparently marked attempts by the Russians to assert some sovereignty over the corridors. In a similar effort in 1959, the Russians warned that any Allied aircraft flying above an altitude of 10,000 ft. would be in danger of colliding with Communist military aircraft. Despite some protests from military quarters, the edict has been tacitly observed, and Western aircraft remain below the 10,000-ft. level.

Missile Site Strikes Increased in January

Washington—Secretary of Labor Arthur Goldberg acted promptly last week to halt a sharp increase in work stoppages at missile bases.

Twenty-two strikes during January, involving 2,210 man-days lost, compared with a December record of nine strikes involving 550 man-days lost. Sixteen of the 22 stoppages occurred at two bases: Larson AFB, Wash., and Lincoln AFB, Neb. Julius Kuczma, executive secretary of the President's Missile Sites Labor Commission, said most of the stoppages were "quickie walkouts" by locals.

Goldberg admonished leaders of five construction trades unions responsible for 97% of the stoppages at a session last week.

Goldberg has summoned 20 contractors for a similar session this week. The unions involved were the Millwrights, the Pipe Fitters, the Iron Workers, the Electricians, and the Operating Engineers.

Airport Helicopters' Subsidy Is Opposed

Washington – Civil Aeronautics Board's Bureau Counsel last week notified parties in the Washington, D. C. Helicopter Service Case (AW Oct. 23, p. 36) that at this time the department would oppose any certification of helicopter service in the area which required subsidy.

Bureau Counsel said it could find no need for subsidized helicopter service on grounds of national, civil defense or for postal reasons.

The counsel said whatever helicopter need might exist could possibly be fulfilled by non-subsidized helicopter air-taxi operators operating under exemption authority.

Eight applicants are seeking authority to conduct helicopter service between Washington and National, Friendship and Dulles International airports.

The opening of Dulles International due later this year, is expected to create a demand for transportation on a triangular route between the three airports and the city.

News Digest

Army-Western Electric Nike-Zeus was destroyed in flight by an automatic range safety system at approximately T+20 sec. in a night launch from Pt. Mugu, Calif. Fault triggering the automatic destruct has been located in the second stage of the missile.

Astronautics Foundation, Inc., with Dr. Theodore von Karman as chairman of the board of trustees and James E. Knott of General Motors' Allison Division as president, has been formed in Washington, D. C. One of its chief purposes is to support activities of the International Academy of Astronautics, founded two years ago by the International Astronautics Federation.

Norman P. Hays will become Eastern representative for North American Aviation, Inc., with headquarters in Washington, D. C., on Mar. 1, replacing E. W. Virgin, who has been NAA's Eastern office representative since 1950. Virgin will become special assistant to L. L. Waite, senior vice president for engineering and planning. Hays has been Eastern region representative for NAA's Autonetics Division.

Vice Adm. William F. Raborn, director of the Polaris project since its inception, will relieve Vice Adm. John T. Hayward as deputy chief of naval operations-development. Raborn will be replaced by Rear Adm. Ignatius J. Galantin (AW Jan. 22, p. 25).

Aerospace Corp. has entered into a conditional agreement to buy about nine acres of land on Route A1A in Cocoa Beach, Fla., contingent on annexation of the Brevard County site by the city of Cocoa Beach and zoning to permit construction of an office and laboratory building.

General Electric will build the electrical generating system for the first five USAF C-141 turbofan jet transports under $115,000 subcontract from Lockheed-Georgia.

Last Atlas E Flight

Cape Canaveral, Fla.—Last Atlas E successfully flew 7,000-mi. down the Atlantic Missile Range Feb. 13.

Box score for the Atlas E was 10 successful, 7 partially successful and 2 unsuccessful flights. Atlas E is equipped with an all-inertial guidance system and is designed to be launched vertically from a coffin emplacement.

F-series Atlas, also guided by an all-inertial system, will be silo launched. Of four F model launches here, two were successful, two partially successful.

United Surmounts Post-Merger Problems

Profit in 1961 dispels pessimism over Capital venture; early operational tangles have now eased.

By Robert H. Cook

Chicago—United Air Lines, knee deep in the costly problem of rebuilding traffic over the old Capital Airlines system, feels that its respectable $3.6 million net profit in 1961 is evidence that it has successfully weathered the initial impact of absorbing the smaller carrier.

Only a few months ago there was deep concern within the company that United may have miscalculated its ability to economically integrate Capital's predominantly short-haul route network without damaging United's powerful competitive strength.

Today, most of this concern has been replaced by optimism, generated by early indications that United was correct in its philosophy that the 7,000-mi. Capital system has a high profit potential, given sufficient scheduling with high performance aircraft and backed by an aggressive sales program.

There has been widespread assignment of former Capital employes into posts with United, a phasing out of piston aircraft as turbojet equipment is received and a heavy concentration of jet schedules placed in the most favored market areas acquired through the merger. Economies have been realized by a consolidation of duplicate services in cities formerly served by both airlines; realignment of sales regions and completion of most training programs for maintenance and management personnel.

The result of United's efforts has produced some surprising traffic growth at several key points on the Capital system. As an example, passenger boardings for the last six months of 1961, compared with the previous period under Capital operations, were up 20.5% at Atlanta, 40.4% at Miami and 12.2% at Minneapolis. In general, United has made significant traffic gains at points formerly served only by Capital, while managing to retain, or increase slightly, traffic volumes in still competitive market areas.

Financially, the merger produced a heavy, but expected, influence on United's profit and loss sheet, as indicated by a comparison of 1961 operating results to the previous year. United's net profit of $3,693,000 last year included $1,673,000 from the sale of surplus aircraft and produced earnings of 70 cents per share of common stock, after the payment of preferred dividends. Net profit for the previous year was $11,171,000, including $4,527,000 from the sale of aircraft. Stockholders' earnings were $2.77 per common share.

Operating revenues for the airline for 1961 totaled $502,219,000 for a gain of 33% over the previous year, while operating expenses of $488,853,000 were up 34%.

The significance of these figures is that United succeeded in earning a profit in a period of generally poor industry earnings, and during seven months operation of the Capital system. A high percentage of the cost increase was accounted for by nonrecurring expenses such as personnel transfers and training programs.

Merger Benefits

Curtis Barkes, executive vice president-finance, finds the merger was beneficial to United in many ways. By means of its stock arrangement for Capital shareholders, United was able to improve its equity base by $30 million, he noted, while its heavy revenue gains greatly increased the company's working capital position. To date, United has also called in $10.6 million of a $12 million issue of convertible subordinated debentures issued by Capital.

On the other hand, Barkes said, an expected gain of $15 million in tax writeoffs from Capital failed to materialize. This was anticipated during early stages of the merger talks, but a legal interpretation of the tax laws later indicated the tax loss benefit will be less than $1 million. Key to the problem is a provision that tax loss benefits collected by the surviving company in a merger must be in relation to the amount of equity held in the surviving firm by stockholders of the absorbed company.

Operationally, the merger temporarily threatened to destroy United's carefully built reputation for service and dependability, causing President William A. Patterson to remark that United was experiencing its worst record of service dependability and reliability in its history. This period was most crucial for four months beginning last July when operations of the two route systems were actually combined.

The major reasons behind this problem, which resulted in great confusion in the airline's scheduling, reservations and passenger services, were traced to the initial lack of enough aircraft to serve the Capital routes; the need to train Capital maintenance workers to service United's variety of aircraft; difficulties in operating with two different communications systems and labor problems on seniority listings.

Most of these problems, with the exception of integration of Air Line Pilots Assn. seniority lists of the two carriers, have been overcome.

United retired all of Capital's piston engine equipment, and replaced it with a heavy schedule of Douglas DC-8, Boeing 720, Caravelle and Viscount service on the Capital route system. Satisfied with the Viscount's reliability and performance, the company also recalled six additional Viscounts from 15 that it had returned to Vickers-Armstrongs, Ltd.

George E. Keck, executive vice president-operations, found that training time necessary for former Capital maintenance employes, the rebidding of various maintenance jobs and shifting of personnel created a serious operational problem, slowing both maintenance and operational schedules.

Communication problems also arose, with flight information to the public delayed, he said, because of a time lag in connecting long line telephone connections between the two airline systems. Also, he said, teletype systems with different codes confused the operators. At the time of the merger, Capital was using American Telephone & Telegraph Co.'s teletype network, while United used Western Union. The Western Union system was later expanded to cover the combined systems.

In addition, Capital employed a Remington Rand Univac computer reservations system, while United used an International Business Machines Co. Ramac system. Both systems were gradually phased out in favor of United's new Instamatic reservations system, which has been operational on the old United routes for several months and will be extended to its entire system by Apr. 1.

Keck pinpointed failure of the Air Line Pilots Assn. to integrate the seniority lists of United and Capital pilots as a prime reason for much of the company's merger difficulties. Crew scheduling and on-time performance were particularly affected, he said, since the company faced union opposition on several occasions when it attempted to substitute United crews for Capital personnel in cases where the Capital crew's monthly flying time had expired.

"We're still operating two separate airlines, as far as flight crews are concerned," he said.

Illustrating the impact this and other merger issues had on United's operations, Keck noted that the airline's record of arrival within 15 min. of on-time was at 80% in mid-May, just preceding the merger. This fell to a low of 62% in August, but climbed back to 75% by mid-October.

While Keck was optimistic that ALPA would soon settle the seniority issue by arbitration, he emphasized that the problem would have a far-reaching effect on the airline.

"Until they settle this matter," he said, "we can't really get into any extensive training program or detailed planning for the future." Outcome of the union's arbitration could mean that a high percentage of pilots will have to re-qualify on different types of aircraft, he said.

United's aircraft fleet has undergone an extensive reshaping as a result of the merger and the delivery of Caravelle and Boeing 720 turbojets. Current tally of the company's fleet includes 38 Douglas DC-8s; 23 Boeing 720s; 19 twin-engine Sud Aviation Caravelles; 47 Vickers Viscount turboprops; 39 Douglas DC-7s; 78 Douglas DC-6s and 26 Convair 340s.

Last of the airline's order of 20 Caravelles is scheduled for delivery this week, and the balance of its order of 28 Boeing 720s is due by mid-summer. On order for delivery beginning in 1964 are 45 Boeing 727 three-jet transports.

With the exception of the Viscounts, most of the Capital equipment has been phased out or sold. Eleven DC-6s leased by Capital have been returned; 10 DC-4s, 5 Lockheed Constellation L-049s and 2 DC-3s have been sold. The Constellations were sold at junk prices. Last of the DC-3s, now in service on the Buffalo-Elmira-Williamsport route, will be replaced by a Viscount on Mar. 1.

Phase out of DC-7s, which United considers inefficient, is well under way with 15 already out of service and another five scheduled for phase out within the next few months. Gradual reduction in the DC-6 fleet is also under way with five of the aircraft slated to become operationally surplus by Apr. 1.

As the Boeing 727s are received, they will be placed on routes now being served by Caravelles. Retirement of remaining piston aircraft will be accelerated to a point where United expects to retain no more than 35 piston engine aircraft from the present fleet of 143.

The airline has not decided whether it will exercise its option to purchase an additional 20 Caravelles. Expansion of the Caravelle fleet could mean utilizing the Washington maintenance facilities for overhaul, but because of the relatively small number of aircraft now on hand, United has decided for the present to ferry the French-built turbojets to the San Francisco overhaul base. First of the Caravelles is scheduled into San Francisco on Sept. 1.

Viscounts, which are overhauled at the Washington maintenance base, will be retained indefinitely in the United fleet, according to Patterson, who gave the British-built turboprop a strong endorsement.

Patterson explained his initial lack of enthusiasm for the Viscount, which was followed by a decision to call back 6 of 15 Viscounts returned to the manufacturer under the merger terms, saying that the aircraft was originally misjudged on the basis of its uneconomical performance against DC-7 equipment by Capital. Flown at lower power settings, in strict accordance with the manufacturer's recommendations, the Viscount has proven to be one of the most economical and mechanically reliable aircraft in the United fleet, he emphasized.

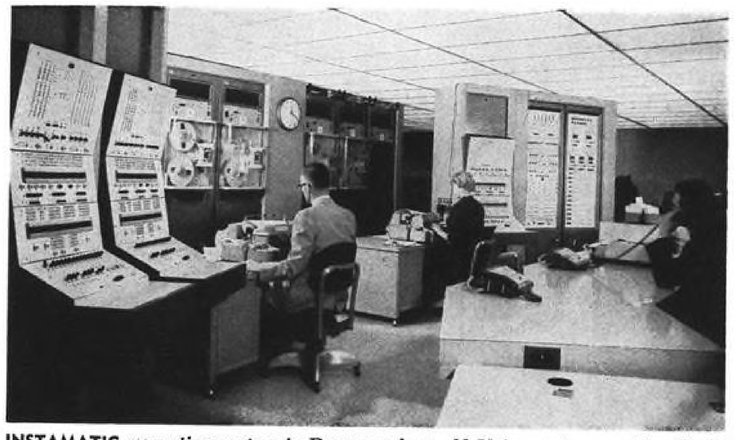
Former Capital maintenance specialists explained that the aircraft had been flown at higher power settings, but they were later lowered, on the advice of Rolls-Royce, after a series of turbine blade failures. Efficiency of the aircraft improved, but the change was not noted in the operational manuals and was thus unknown by United at the time of the merger. United is now bringing these manuals in line with the Viscount's actual performance ability. With a time between basic overhaul of 3,300 hr. on the Dart engines and 4,380 hr. on the airframe, the Viscount now has longest TBO of any United aircraft, they added.

Three of the DC-8s now in operation are turbofan-powered and while United once studied the possibility of converting all DC-8s and Boeing 720s to turbofan, the idea was abandoned because of the high cost. The airline is now studying the advisability of ordering more DC-8s and will re-examine the turbofan conversion question, Patterson stated.

Patterson is confident that having surmounted most of the problems of merger, United will reap a significant profit on the old Capital system this year. He noted that he has publicly stated that United wanted the Capital system "because we think we can make money with it." In his opinion, he said, Capital's serious financial problems probably caused the company's management to "lose their courage and initiative" and with them the ability to develop traffic from the most heavily populated section of the United States.

He pointed out United has asked to withdraw a pre-merger request by Capital to Civil Aeronautics Board to drop service at several "marginal" traffic points. United, he said, intends to study city traffic potential, in the belief that most can be made to produce a profit if given adequate service with competitive aircraft. He cautioned that his criticism of Capital was directed only at its top

ALL VICKERS VISCOUNT turboprop transports which United Air Lines acquired from Capital Airlines have now been repainted and reconfigured at a total cost of $500,000. Changeover required an average of five days and 1,500 man hours per aircraft.



INSTAMATIC reservations system in Denver replaces old Univac system used by Capital Airlines and Ramac utilized by United. New system is fully operational over old United route system and will be expanded to cover the carrier's complete route system by Apr. 1.

management level, and added that he is "amazed at the high caliber" of former Capital people retained by United.

A. M. de Voursney, executive vice president-administration, said United will have an accurate idea of just how many former Capital points will be retained by the end of this year.

"At this time," he explained, "it's just too early to tell. We need more time to study the over-all traffic potential." Two months ago, United began a point-by-point marketing study of the entire Capital system, and it is expected that a year-end analysis of the study will form the basis of a final decision on which points will be retained or dropped, he said.

Bright Future Predicted

Actually, de Voursney is highly confident that most, if not all, of the Capital points will be retained, for two reasons. One is that United is concentrating on improved scheduling on the theory that so-called marginal points have been so only because Capital failed to provide the service demanded by the public at these points. Secondly, he is a strong believer that air travel growth is generally tied directly to business travel and the growth rate of the gross national product. On this basis, de Voursney predicts that this year will be better than normal for the industry with a traffic growth of 2-3 points above that of the gross national product.

The possibility that the airline industry's operational costs may be increased considerably by the eventual imposition of a user charge system, tied to fuel taxes, is cited by de Voursney as a major reason for another fare increase. If applied to United's planned operations this year, he explained, the added cost of fuel alone would go up $13 million. The new 3% fare increase approved by CAB is expected to increase United's revenues by $14 million, but would nearly be canceled out by the extra taxes, he said. To offset this situation, he estimated that United will need another fare increase of at least 3%.

H. E. Nourse, executive vice president-economic planning, pinpointed scheduling as one of the largest problems during initial stages of the merger. Several months before the merger was actually consummated in June, city pairs, schedules and equipment of both airlines were carefully shifted about to provide for practical operation beginning in July.

Early experience with the new combined scheduling indicated a need for further refinement, since it developed that some areas appeared over-scheduled and others under-scheduled. At the same time, Nourse said, United found that its problem had been further aggravated by a lack of sufficient aircraft to cover the Capital system.

Further revisions to the scheduling pattern, aided by the recall of the six Viscounts, produced a scheduling pattern more nearly in line with United's expectations, he said.

Scheduling Objectives

The basic strategy was to provide new jet service, wherever possible, to major traffic points on the former Capital system, increase flight frequency and capacity and provide added service to many points, Nourse explained.

As an example, where Capital had been providing service with only DC-6 or Viscount equipment, United introduced jet service in such important market areas as Minneapolis to Chicago, Detroit and New York; New York to Pittsburgh; Pittsburgh to Atlanta and Tampa; Jacksonville and Tampa to Miami; Cleveland to Tampa and Cleveland to Atlanta and Jacksonville.

United has been unable to take full advantage of the Buffalo market, where it competes against Electra turboprops, because the city's airport cannot handle jet equipment, Nourse said. United expects it will not be able to surmount this problem until the first Boeing 727 short-range turbojets are delivered.

Capital schedule frequencies and seat capacities just prior to the merger, compared with those of United this month in the same markets, show an increase of 31% in departures and 76% in seat capacity at Minneapolis. The figures are 22% and 34% at Buffalo; 40% and 58% at Norfolk; 150% in both departures and seats at Bristol-Johnson City-Kingsport, which formerly had only two departures daily but now has five. United has also doubled frequencies and capacity at such smaller points as Greensboro-High Point, Charlotte and Raleigh-Durham.

Where Capital had reduced service prior to the merger in such areas as Michigan, United restored second nonstop service to New York at Flint, Saginaw, Grand Rapids, Lansing and Muskegon. Pittsburgh-Birmingham regained its only non-stop, as did the New York-Norfolk market, and a fourth frequency was restored to the Rochester-Buffalo to Chicago area.

Promotion Needed

Introducing these schedule changes also brought an added problem to United's sales and advertising. Areas where Capital had once offered good schedules, but withdrew after experiencing low load factors, required a heavy promotional program to support United's efforts, according to J. Misslehorn, special assistant to B. B. Gragg, vice president-sales services.

To overcome this problem, United adopted a new sales program emphasizing the "now we are one" philosophy and the theme of winter fun either at United's Pacific Coast points or the Great Lakes and Florida areas acquired from Capital, Misslehorn said.

Total advertising costs increased an estimated 25%, he said. The program, heavy on newspaper space, concentrated primarily in the old Capital market, but also spread west of Chicago to make all travelers aware of the new territory acquired. Additional costs were also incurred in a complete change of timetables and permanent identification at consolidated city and airport ticket offices. Extensive training courses were also provided to acquaint former Capital sales personnel with United's procedures.

United also expanded its sales regions by a realignment to seven regions, adding a Southeast region in Atlanta and a Great Lakes region in Pittsburgh.

Actual savings from the consolidation or closing of various duplicate sales facilities have not been fully calculated, nor has the process been completed, Misslehorn said. So far, 34 city ticket offices, sales offices and reservations offices and 16 airport ticket facilities have been consolidated.

Attrition solved most of the problem of absorbing Capital's 7,110 employes. All were offered employment, and only 510 rejected the offer, United states. At the management level, 706 Capital people were employed and 68 resigned, primarily because of their reluctance to leave Washington, D. C., the company feels.

On the pilots' roster, United said that because of the merger, 189 new pilots were hired and an additional 73 Capital pilots were recalled from furlough. It is not anticipated that the pilot force will be expanded any further.

United points out that not only did it absorb the Capital personnel, but was required to hire an additional 4,933 employes last year.

To date, an estimated 40 persons have been transferred from the Washington maintenance base to San Francisco and 150 to the Chicago headquarters. At one time, United considered sending 500 Washington maintenance personnel to San Francisco, but later rejected the idea. Announcement of the proposed move brought strong objections which United met by opening a special "San Francisco Room" at the maintenance base to provide all information about the city.

In addition to the ALPA seniority problem, United had difficulty with International Assn. of Machinists members of both airlines and Capital's clerical employes who belonged to the Brotherhood of Railway Clerks. Pay scales of former Capital IAM members were increased 15 cents per hour to reach the United level. An agreement on seniority was also reached, satisfying Capital IAM members who were on a system seniority basis, as opposed to United's point seniority system.

The Brotherhood of Railway Clerks has no representation at United and Capital members of this union are being employed as non-union workers at United. The company says a court case filed by the union will determine the outcome of this matter.

Under the final merger terms, United also agreed to purchase the home of any Capital employe who could not sell the property in a reasonable time after being transferred. United estimates it has paid the costs of moving nearly 900 Capital people, a high percentage of whom sold their own homes. So far the airline has acquired about 90 homes under the merger terms. Most of the properties are still in the process of being sold.

Dassault Spirale 3 Wins Transport Competition

Paris—French air force design competition for a small transport aircraft has been won by Avions Dassault's twin-turboprop design, the Spirale 3.

FAF has earmarked $36 million for the program. About 35 production aircraft are expected to be built. First prototype is expected to fly in 1963.

Spirale 3 is a high-wing aircraft powered by two Turbomeca Turmo 3 turboprops developing 1,265 hp. on takeoff. Maximum weight is roughly 11 metric tons. Capable of carrying 32 passengers, or 24 combat-equipped soldiers, Spirale 3 will cruise at 280 mph. Use of boundary-layer control will permit STOL performance.

Dassault transport was selected over designs submitted by a number of leading French companies. Nord Aviation submitted a military transport version of the Super Broussard. Breguet, an early favorite in the competition, hoped to win with its 945, a smaller version of its 941 cargo design which uses the vectored slipstream principle for STOL performance.

Dassault also has designed a Navy version of its Spirale. This carrier-based aircraft would be equipped with a piggyback radome like that installed on Grumman Tracer and Hawkeye aircraft. French navy, however, has earmarked no funds as yet for procurement. Dassault says at least one U.S. company is interested in license rights.

ICAO Group Agrees On Survival Frequency

Seventh session of the International Civil Aviation Organization communications division agreed to the establishment of 121.5 mc. as the eventual worldwide survival frequency, opening the way to the use of the new, miniature VHF survival beacons for life rafts as a replacement for the long-used Gibson Girl, which operates at a lower frequency (AW Dec. 25, p. 61).

A second survival frequency, 243.0 mc., which is used by military aircraft, was adopted as a recommended practice in addition to the 121.5-mc. frequency, in recognition of the fact that military aircraft often participate in search-rescue operations.

The recent, month-long meeting in Montreal, attended by 35 contracting states plus the non-member Soviet Union, also took the following action:

• **Updated ILS specifications** to provide for several categories of instrument landing system performance to permit use of improved facilities where lower weather minimums are desired and traffic justifies.

• **Adopted compatible sidelobe** suppression technique (three-pulse) for use with secondary surveillance radar, more commonly known as air traffic control radar beacon system. Previously adopted specifications were updated to provide for additional transponder interrogation modes, many more identification reply codes and technical standards for transmission of aircraft height information.

• **VOR-DME channel expansion** technical standards were agreed to for those few areas in the world, such as the U.S., where high concentration of facilities requires added channels.

• **Discussed long-distance** navigation needs, including impact of new airborne Doppler navigation systems, and recommended that ICAO hold meeting in 1964 to examine operational requirements for long-distance navigation aids and the possible need to standardize on a new ground-based, long-distance navigation system.

• **Agreed that minimum** performance specifications are necessary for airborne equipment to assure the integrity and improvement of air traffic services, and initiated the first steps to develop such standards.

Appeals Court Backs Board on Charters

Washington—U.S. Court of Appeals here has reaffirmed the Civil Aeronautics Board's right to grant supplemental and cargo airlines seasonal blanket exemptions to conduct transatlantic charter flights (AW May 8, p. 39) during 1962, but expressed doubt about their legality beyond this year.

Pan American World Airways and Trans World Airlines, two carriers affected by competition from supplemental airlines in the transatlantic charter market, took CAB to court over the issue. Both carriers contend the blanket exemption is a misuse of the Board's powers.

Under the blanket exemption, certain supplemental and cargo airlines can fly as many transatlantic charters as they wish without prior CAB approval during the 180-day period ending Sept. 30. Prior to 1961, those carriers had to get an individual exemption for each flight.

Pan American and TWA said the blanket exemption amounted to certificate authority, and as such, CAB did not have the right to grant by exemption what it could not by certificate.

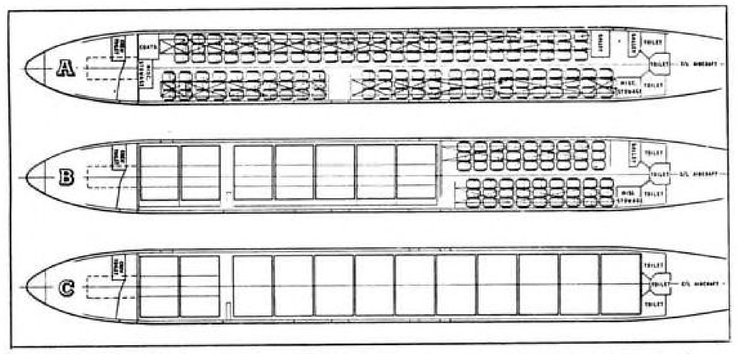
The court, while approving CAB's authority to grant blanket exemptions for 1961 and 1962, questioned its legality beyond this year, presumably because continued use of the authority might outstrip CAB's exemption powers as outlined in the Federal Aviation Act.

What makes one pilot different from another?

TWA Captain George C. Duvall, like other senior airline pilots, counts his experience in miles and hours. But flying for TWA has deeply enriched his experience with a dramatic difference that's important to you. He has flown a vast network of cities across the U.S. as well as in Europe, Africa and Asia. To him, and other TWA pilots, French farmlands, Swiss lakes, African deserts and rivers of India are as familiar as our Great Lakes and Western plains. Only TWA pilots bring you this unique experience. These men prove every day—nationwide, worldwide, you can depend on TWA.

Nationwide Worldwide depend on

TWA



THREE VARIANTS of the Vickers VC.10 cargo version ordered by British United Airways range from pure cargo use (C) to full 150 passenger version (A) and part cargo/passenger configuration (B). Side door for loading will be installed on forward port side.

Four BUA VC.10s Redesigned For Mixed Cargo-Passenger Utilization

By Herbert J. Coleman

London—Four Vickers VC.10 jet transports ordered by British United Airways for its African long-haul routes have been redesigned to include a side-loading door for BUA utilization as combination cargo/passenger transports.

Aircraft, a standard VC.10, can be converted from passenger to cargo configuration in three hours. Main cabin floor can be loaded to a maximum of 57 psf. over-all.

Airplane for British United has been designated VC.10 CPF-2 and is based on the Vickers pure cargo aircraft design, the VC.10 F-2. Latter version is fitted with an extruded light alloy plank floor containing a 20-in. grid of 5,000 lb. capacity lashing points. Maximum takeoff weight is increased to 322,000 lb. and peak payload is 64,045 lb.

British United's aircraft, the CPF-2, has facilities for 150 tourist class passengers. Mockup for the side-door addition is now being built at Vickers-Armstrongs plant at Weybridge, where the first VC.10 is in advanced production stage (AW Feb. 12, p. 39).

Powerplants for the BUA cargo/passenger version will be four aft-mounted Rolls-Royce Conway Mk. 550 engines (the Conway 42/3), of 22,500 lb. thrust each. First cost of the airplane is about $7.2 million, and initial cost of one engine is about $256,000.

Another version, still in design stage, is the VC.10 CPF-3, which is an adaptation of the Super VC.10 with a modified wing and landing gear to allow operation at the higher weights involved. Maximum payload of this version would be 71,724 lb.

British United's airplanes will be engineered for three basic configurations; 150 passengers in all-tourist class; 54 passengers and seven freight pallets, and all-cargo, with 12 pallets.

Freight loading door, installed on port side, is 84 in. x 140 in. and opens to a near vertical position to allow crane loading of freight. Door is fitted on forward fuselage and includes six VC.10-type windows. Bulkheads dividing passenger and freight sections may be located at varying positions along the cabin length to permit varying ratios of the total load.

The door is hinged along the top edge and is hydraulically actuated. In the closed position, the bottom edge of the door is locked to the sill by seven toggle latches, linked by a torsion bar. This bar is rotated by a hydraulic jack which can be controlled from either inside or outside the airplane. Bolts, latches and door actuating mechanism are all interlocked.

Two main longitudinals and two main vertical members which form the door fitting are machined, light alloy forgings. Sill includes a detachable, non-structural external rubbing strip and a hinged plate.

Flooring of the standard passenger plane has been replaced by 9-in. wide planks of 75ST material, extruded to provide a sectional thickness of 0.8 in.

Floor and supporting structure have been designed to meet these standards:

- **Unit local loading of 1,000 psi.** on any one square inch.
- **Unit area loading of 300 psf.** on any one square foot, or 75 psf. uniformly spread over the whole floor area.
- **Maximum vehicle axle unit load,** without spreaders, of 5,000 lb.

Seat rails have been retained in their existing positions. For loading of palletized freight, removable panels containing a pattern of ball and socket fittings are attached to seat rails in the threshold area, immediately inside the main freight door.

Other than the threshold, the floor is fitted with removable roller tracks; four tracks are mounted on panels which are attached to the seat rails. Overhead luggage racks also will fold upward for flush storage.

E. E. Marshall, Vickers assistant chief engineer in charge of the VC.10 project, emphasized that the company is building the side-loading freighter as a customer requirement, but is convinced that the nose-loading version under consideration for some time will be the ultimate answer in high-speed cargo flights.

Marshall said the swing-nose version results in a 200 lb. cut in payload, but advantages of faster and more flexible loading offset this. On this version, door would swing forward of the nose wheel and aft of the flight engineer's station.

Full capacity payload in the pure freighter version—77,085 lb.—can be transported 3,629 stat. mi. With 150 passengers, the distance can be stretched to 5,280 stat. mi.

BEA Cuts Frequencies, Unprofitable Routes

London—British European Airways last week decided to eliminate several unprofitable routes and reduce frequencies of other routes in anticipation of losses which will follow direct competition by independent airlines.

First to be dropped were BEA flights to Budapest and Belgrade, followed by the route to Ajaccio, Corsica. Frequency of some of BEA's Scottish routes will be reduced. Other cancellations are under consideration.

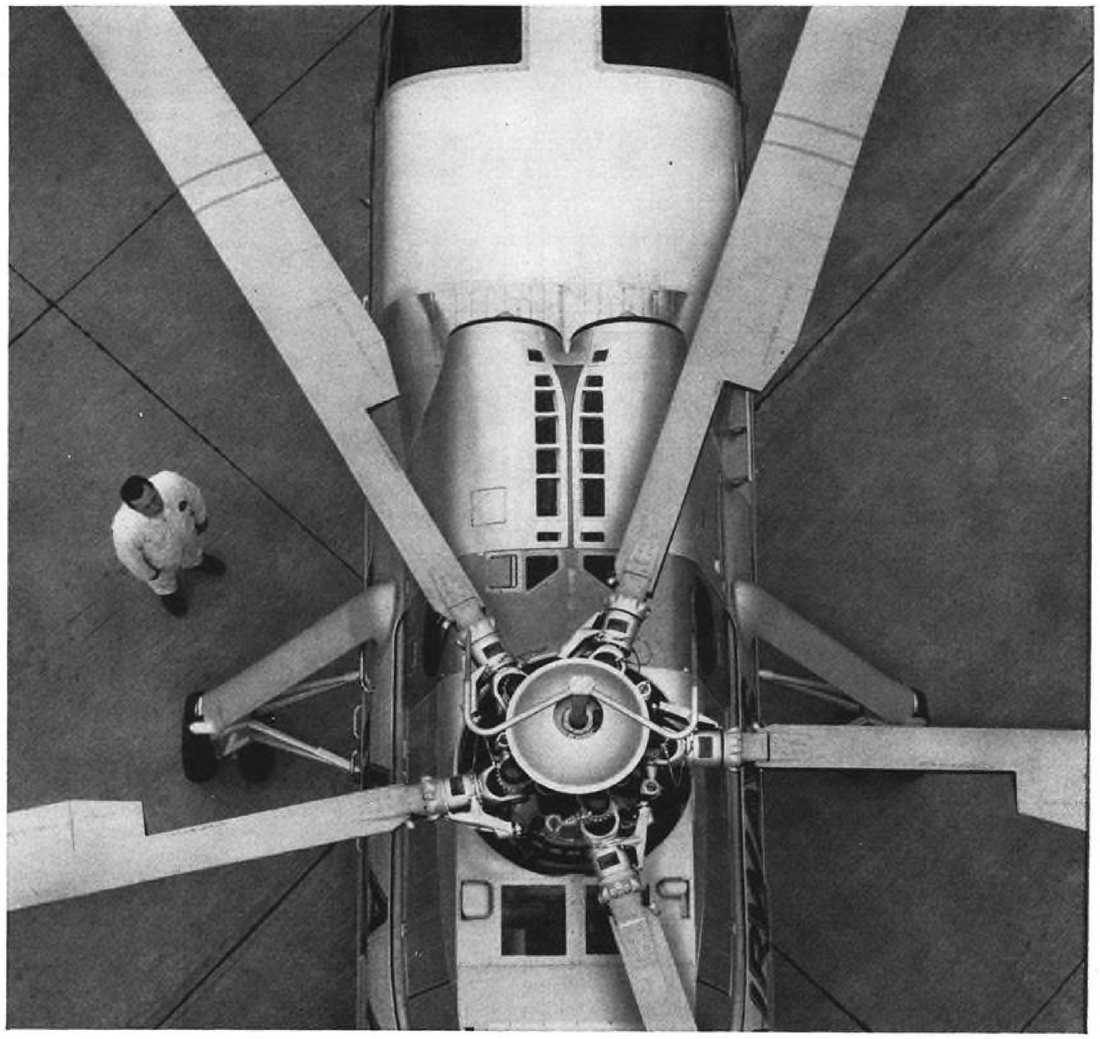
Airline said the decision to allow independent airlines to compete on 22 routes made its decision necessary. BEA is appealing against the decision. If approved, the independents would start flying the routes in April, 1963.

Los Angeles Airports Show Record Income

Los Angeles, Calif.—City Department of Airports here had a record income of $5,913,553 and a net profit of $1,100,870 during the fiscal year ending June 30, 1961.

This was despite bond redemption and interest payments totaling $2,135,661 and $1,902,159 in increased operating expenses.

Potential revenue of the Los Angeles International Airport's new $70-million jet age terminal opened last August is not expected to be realized before Fiscal 1962-63. The department also operates Van Nuys Airport.



10-second blade inspection

Sikorsky's Blade Inspection Method (BIM) positively establishes blade condition in just 10 seconds.

Even better, BIM virtually ends blade replacement due to accumulated service life. With integrity positively and instantly established, good blades remain in operation indefinitely.

This concept allows the equating of blade life with aircraft life. Result: major savings in blade installation and maintenance costs.

Like most successful ideas, Sikorsky's Blade Inspection Method is simple, safe, and sure. Main rotor blades are filled with compressed air at the Sikorsky plant. If the blade is later damaged, pressure loss operates a warning gauge. Blade condition can be determined by one quick glance at the pressure gauge.

BIM typifies the emphasis on engineering leadership that characterizes Sikorsky designs. It is one of the many reasons Sikorsky is first in vertical flight.

Sikorsky Aircraft DIVISION OF UNITED AIRCRAFT CORPORATION

Disputes Quieted in Halaby's First Year

By David H. Hoffman

Washington—Aviation industry declared a truce with the Federal Aviation Agency during Administrator N. E. Halaby's first year in office. But its final judgment of the man is being withheld until the impact of decentralization and task force reports—his own biggest projects—mold FAA's new image.

Sworn in Mar. 3, Halaby has quieted most of the controversy that seemed to surround his predecessor, Elwood R. Quesada. A regulatory agency cannot exact obedience from those it must regulate if their relationship is one of hatred and resentment, Halaby told AVIATION WEEK. In his analysis, such a situation prevailed early last year.

Conflict had replaced law and order, and so "we had to re-establish lines of communications to regain the aviation community's respect," Halaby said. To achieve this personal goal, he has leaned heavily on outside study groups plus informal group meetings with pilots, mechanics and controllers across the nation.

At least 11 task forces, advisory boards or panels—each staffed wholly or partly by aviation experts with no FAA affiliation—have been appointed since Halaby took office.

Open Study Groups

Horizon, Beacon and Tightrope task forces—which dealt respectively with national aviation goals, air traffic control and FAA rulemaking and enforcement—generally were open to all organized facets of aviation, and listened patiently to their often antagonistic proposals.

As a result, the reports that stemmed from these confrontations probably reflect the majority industry opinion on each problem area tackled by each task force. Although preparation of the reports dragged on for seven months, industry greeted them with either solid praise or endorsement tempered by skepticism.

Thus, by last fall, Halaby had healed a number of old wounds, achieved a measure of agreement on basic issues and collected three broad blueprints to guide his agency during the months ahead. He had also committed FAA to fresh starts on a number of vastly complex projects, such as how to automate the air traffic control system.

Many observers feel that Halaby paid for these assets with valuable time. Industry's consensus is a hope that the Horizon, Beacon and Tightrope reports will end the era of report-writing on aviation problems. Although the flow of reports probably has been halted, one airline expert on air traffic control pointed out, there still exists wide differences of opinion within FAA on what weight to accord Beacon. Some Agency officials look on it as gospel, others feel it is only a basic guide, he said.

Acceleration Needed

It follows that FAA must proceed at a faster pace this year than in 1961 if it is to overcome what Congress, the White House and the Agency acknowledged to be past neglects. Even so, examination of what Halaby has accomplished during 12 months in office indicates FAA was not paralyzed while Horizon, Beacon and Tightrope were being drafted.

Here is a partial list of projects initiated under Halaby:

- **Decentralization** and reorganization of FAA's structure. Under Quesada, regional decisions were reversed or upheld by the appropriate bureau—air traffic management, flight standards, facilities and materiel or research and development—in FAA's Washington headquarters. Under Halaby, the chain of command runs directly from the deputy administrator to each region.
- **Appointment** of the three big task forces. Quality of the Halaby appointments has not been subjected to serious challenge. But more important, the administrator has staked his reputation on fulfilling a pledge that the Beacon and Horizon reports will not be shelved alongside the earlier Harding and Curtis studies. A system design team for Beacon already is at work.
- **Formation** of a Federal Airport Service to administer the three-year aid to airports program approved by Congress. In addition, FAA is drafting a set of airport safety standards which local authorities must observe in order to qualify for federal funds on a matching basis. Airport supervision formerly was entrusted to a division of the bureau of facilities and materiel.
- **Drafting** of a Federal Aviation Service bill under which almost all civil and military ATC facilities would be operated by a corps of controllers, maintenance men and flight check specialists who could be pressed into military service during national emergencies. The FAS bill is scheduled for congressional committee consideration this spring.
- **Recodification** of FAA's voluminous civil air regulations. This project will rearrange all regulatory material into one body of rules to be called the Federal Aviation Regulations. Sections will be dictated by subject matter. Old rules will be edited, but their substance will remain unchanged. The project also will produce a simplified, narrative digest of rules governing general aviation.
- **Organization** of a civil supersonic transport development program. National Aeronautics and Space Administration and Defense Department have acceded to FAA leadership in this program, which Congress funded at $11 million in Fiscal 1962. Earlier efforts to examine the transport's feasibility in a systematic manner were held back by inter-agency bickering.
- **Enactment** of legislation giving FAA stronger penalties to levy against hijackers of airline transports. After five such incidents took place between May and August of last year, Halaby sought and got legislation making it a federal crime to assault or threaten an aircraft crew member, making hijacking equivalent to piracy and prohibiting passengers from carrying concealed weapons on airline aircraft.
- **Formation** of a National Flight Data Center. This center will be the single approved source of raw data used to prepare aeronautical charts after it becomes operational this year. Publication of standard references such as the Airman's Guide and Notices to Airmen (NOTAMs) will be consolidated under it.

Share Responsibility

Halaby feels that because hijackings have not occurred recently, the industry has been lulled into complacency and is neglecting precautionary measures. The drama and publicity potential inherent in aerial crime will always attract the psychotic mentality, and thus the problem demands constant attention. Airlines, in this area, must share responsibility with FAA, he said.

Despite the Beacon report and vastly increased expenditures on ATC in recent years, Halaby is aware that the system still permits such questionable practices as the mixing of high performance jets with light planes in terminal areas, the filing of VFR-on-top clearances and high altitude operations outside the range of radar. In terms of the new technology it has absorbed, the ATC system is still at a standstill, Halaby said.

One reason for this, he believes, is that Quesada and his director of research and development, James Anast, could not see the forest for the trees. The trees, in their case, were a mass of separate projects, according to Halaby. At least $6 million worth of old research and development contracts were canceled after Halaby took office and an-

Saudi Arabian 720Bs Put Through Crew Training Flights

One of the two Saudi Arabian Airlines' medium-range Boeing 720B transports is shown during crew training flight near Kansas City, Mo. Aircraft were delivered to the Arab carrier earlier this year but returned for crew training. Aircraft will soon be introduced into Middle East service, with particular utilization on the Cairo and Beirut runs. Saudi Arabia's King Saud used one of the aircraft on a flight to Florida during his stay in the United States, although he flew here on a TWA charter. He returned to Saudi Arabia aboard one of the aircraft. Saud is reported to have purchased both aircraft for cash. Saudi Arabian Airlines, established in 1946 and receiving technical assistance from Trans World Airlines, serves major points throughout the Middle East.

other $15 million worth of additional funding was withdrawn.

Transition to jet power has changed airline maintenance radically, he said. Mechanics now pull out packaged components from jets and substitute new ones. Because in-flight reliability hinges on how well these components are inspected or repaired, Halaby intends to increase the quantity, quality and training of FAA's force of maintenance inspectors this year.

Halaby attaches far more importance than do his skeptical critics to the committee, of which he is chairman, appointed by President Kennedy to review international aviation policy. Asked what significant steps in aviation will be taken during 1962, Halaby cited this group's forthcoming report, which, he said, will contain recommendations on capacity and competitive route awards to foreign carriers, international ATC compatibility, technical aviation assistance to underdeveloped nations, as well as the U. S. government's policy on the merger of its own flag airlines.

On the negative side of the ledger, many professionals in aviation generally frown on such Halaby predilections as parachuting from an airplane so, he insists, he can learn first-hand whether rules are needed to control the sport of sky-diving. Flying Lockheed's Electra to prove its airworthiness and flying the Sud Caravelle on jet noise tests at Washington National Airport also were classed by some as grandstanding.

But Halaby, who holds a commercial pilots license and is a former Navy test pilot, shrugs off these charges with the comment, "flying airplanes is the frosting on the cake for me."

Probably the least noticed of Halaby's major decisions involved Agency decentralization. Under Quesada, who sought to instill an immediate sense of force and purpose in the new FAA, operating authority had accumulated in Washington. Halaby elected to splinter this authority and to parcel out large portions to the Agency's seven regions.

Elevating the title of regional manager to that of assistant administrator, Halaby dispatched some of FAA's most highly regarded second-echelon officials from Washington to take charge of the regions. First to go was Oscar Bakke, then director of the Bureau of Flight Standards. He was followed by Arvin Basnight, deputy assistant administrator of management services and Joseph H. Tippets, director of the Bureau of Facilities and Materiel.

The reasoning behind this shakeup underscores Halaby's background in corporate management. "We were breeding idea-less and indecisive people who looked to Washington for all the answers," Halaby told AVIATION WEEK. No effort toward developing executives had been made, he said, and although there were thousands of competent technical specialists, there were almost no managers. This development of well-rounded executive talent is to proceed through what Halaby calls a "kind of farm system" in which assistant administrators exercise delegated power.

Before decentralization, paperwork piled up in Washington, according to Halaby. He said a 370-case backlog of unfinished enforcement actions confronted him when he took over FAA. As a result, Halaby claims, it was often impossible to ascertain the precise facts of a given case. By decentralizing, "we put the authority back where the facts are," he said.

One result of this shift is that the backlog of pending cases has nearly dried up. But another is an element of confusion at the regional and district levels, a confusion generated by officials trying to decide just how much authority they have to plug the vast gaps that still exist in FAA policy documents and civil air regulations.

Mixed Reaction

Aggravating this problem is the attitude of airlines and organized aviation groups, which appreciate the speed with which decisions are made under the new system, but which are quick to charge "inconsistency" when angered by an adverse ruling. At times, since decentralization was ordered, interested parties have tried to reverse one region's decision on an issue by pointing out that another region had decided the same issue in a more favorable manner.

Halaby looks upon the problem as one of communications. In an effort to ensure internal consistency, he has strengthened the network of wire and phone lines that link headquarters and the regions. Illustrating the far-flung operations of the Agency is the fact that FAA staffs 27 air carrier district offices, 88 general aviation district offices, 26 airport district engineering offices, 22 engineering and manufacturing district offices, 17 facilities checking district offices, 10 maintenance bases, 4 international district offices, 8 international field offices, a Paris engineering office, two overseas flight checking offices.

Several times a week, when Halaby is in Washington, the assistant administrators are asked in a conference call to exchange data on current problems. Halaby also requires monthly, quarterly and semi-annual reports from his regional lieutenants, which describe how headquarters policy directives are being implemented at the local levels. FAA's major services—the old bureaus under Quesada—review these reports.

Additional communication is gained by summoning the assistant administrators to Washington periodically for "program status evaluation conferences." The first of these consumed most of last week; others are planned at quarterly intervals or as dictated by events. Service directors are present if the subject concerns them.

Although this system appears workable, at least under Halaby, it already has produced several sizable blunders to embarrass the administrator. For example, one of Halaby's early acts in office was to persuade the Civil Service Commission that certain air traffic controllers should be promoted one GS grade. Coordinators and radar controllers were eligible for this promotion.

In distributing the higher GS grades, however, the FAA regions came up with widely varying definitions of a coordinator. The liberal view taken by some held that since senior controllers coordinated the flow of air traffic, most senior controllers qualified for pay raises. Other regions felt that only duly-appointed coordinators were eligible.

This double standard gave rise to a hodge-podge pattern of promotions that aroused the ire of Civil Service authorities. And, because too many GS grade increases were handed out, Halaby may be forced to retract a group of promotions, thus alienating his controller corps just before the Federal Aviation Service bill is debated by Congress.

Halaby displays irritation when it is suggested that the new rapport within the industry is the product of a general easing up on violators of the civil air regulations. He will not elaborate on the subject, but FAA statistics show that during 1960, the last full year of Quesada's administration, the agency processed 3,934 violation cases and levied $159,000 in civil penalties.

In 1961, 4,241 cases cost violators about $163,000, indicating that the tempo of enforcement activity has not slowed under the new administrator.

The fact that FAA still orders airline pilots to retire at age 60, still pre-empts the "third seat" in DC-8 and 707 cockpits for its air safety inspectors, still forces private pilots to call on FAA-licensed doctors for their bi-annual physical examinations, and still requires that light aircraft landing at busy airports be equipped with two-way radio, is evidence that Halaby sided with Quesada on issues of 1959 and 1960.

Hughes Suit Accuses Lenders Of Conspiring to Gain TWA Control

By Glenn Garrison

New York—Charging "conspiracy" by lending institutions and their officers to gain control of Trans World Airlines for their own special advantage, Hughes Tool Co. last week asked damages totaling more than $366 million for itself and for TWA.

The damages were sought through a defense and counterclaims document filed in U. S. District Court here in response to TWA's suit against Hughes Tool. The move came as TWA President Charles C. Tillinghast resumed his testimony in pre-trial depositions connected with the TWA suit, which was filed last June. The depositions began and were recessed last month (AW Jan. 29, p. 41).

One of the Hughes counterclaims is in behalf of TWA and seeks $135 million for alleged violations of anti-trust laws from the additional defendants other than TWA.

Toolco said it made no demand on the directors and stockholders of the airline to bring the claim for reasons that ". . . the directors are under the domination and control of the additional defendants, that more than 78.2% of the stock of TWA is held in the voting trust, that a majority of the voting trustees of such stock are subject to the control of the additional defendants and that demand would be futile."

TWA's reaction to the defense and counterclaims action was to call it "a long expected move to delay prosecution of TWA's $115 million damage suit . . . against Howard Hughes and the Hughes Tool Co." The airline called any assertion that it was controlled by anyone but its independent board of directors "utterly ridiculous," and said since the voting trust was set up, TWA for the first time in many years has not been a "captive" of Howard Hughes.

Other Defendants

In addition to TWA, defendants in the Hughes action were Equitable Life, Metropolitan Life, Irving Trust, Ernest R. Breech, Dillon Read, Ben-Fleming Sessel, James F. Oates Jr., Harry C. Hagerty and Tillinghast.

The Hughes action also seeks to end the voting trust situation and return control of TWA to Hughes. It asks that Equitable, Metropolitan and Irving be enjoined from accelerating the maturity of any TWA debt because of termination of the voting trust, and it seeks to eliminate the 22% penalty Hughes now would be required to forfeit and to pay off the loans from the institutions.

The suit also seeks to void the provisions in Tillinghast's contract which would provide an income upon separation from the airline. According to the claim, the contract assures Tillinghast of five years' employment as president of TWA. It assures that upon his retirement after five years, or after discharge or retirement on termination of the voting trust, he will receive a pension for 10 years at $50,000 annually to age 65 and $30,000 thereafter.

According to the Hughes charges, an understanding and conspiracy was entered into about March, 1960, by Equitable, Irving and other lending institutions, Dillon Read and Oates, Sessel and others. The "conspirators" allegedly decided to use "all economic and other power at their disposal to obtain and maintain control of TWA for their mutual advantage, including the use of TWA as a market for the supplying of senior financing upon terms advantageous to the lenders." Efforts would be made, it is charged, to prevent any lenders from participating in TWA senior financing without the consent of Equitable as to long-term senior financing and Irving as to short-term senior financing "and then only on terms satisfactory to Equitable and Irving."

Furthermore, it is charged, the "conspirators" would among them fix the interest rate TWA would have to pay for senior financing.

The counterclaim describes various discussion between Hughes Tool and the lending institutions in late 1960, prior to setting up of the voting trust, as to possible financing plans. Pressure was brought to bear, the suit alleges, so that the tool company ultimately had to accept the terms of the lenders. At one point, Irving and certain members of the banking group began offsetting TWA and Tool Co. balances against TWA's debt to the banks.

Further pressure was brought by false and misleading publicity, it is charged, emanating from Irving and Sessel. This was designed to preclude TWA or Hughes Tool from finding any other jet financing.

The suit charged that Metropolitan, Equitable and Prudential control had dominated the market for major airline financing. Since 1955, it is alleged, none of the five largest U.S. airlines have arranged any senior financing other than bank financing without participation of one or more of these companies.

As of Dec. 31, 1960, according to the

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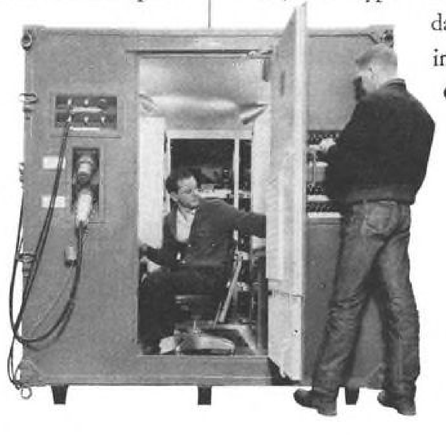

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claim, Metropolitan held obligations of the carriers amounting to $288 million in principal; Equitable held obligations in excess of $188 million. As of that date, it was asserted, Metropolitan held more than 46% of the five largest carriers' senior long-term debt and Equitable held more than 28%.

Hughes charges that TWA, Equitable, Metropolitan and Irving have violated Section 408 of the Federal Aviation Act by the lenders' acquiring and maintaining control of TWA, and consolidating that control by giving Metropolitan and Equitable power to accelerate TWA indebtedness upon termination of the voting trust.

'Unlawful Conspiracy'

In seeking $135 million for TWA, the Hughes suit claims the airline suffered as a result of the "unlawful conspiracy." Its jet program was disrupted and delayed; financing was obtained only on unfavorable terms and high interest rates; the airline's assets were wasted; it has lost valuable opportunities; and its business affairs have steadily deteriorated, it is charged.

The $135 million represents a damage claim of $45 million, which is tripled under the anti-trust laws. Hughes Tool asks $77 million in damages for itself, also tripled to a total of $231 million. In addition, it asks $72,089.55 from TWA alone, alleging failure to pay sufficient interest on an interim note to Hughes Tool for $100 million.

The taking of depositions in the TWA suit resumed here last Tuesday with the addition of a court-appointed special master, J. Lee Rankin, former solicitor-general of the U. S. Considerable time was spent in argument between counsels as to whether TWA and Breech had produced all the documents and records sought and subpoenaed by Chester Davis, the Hughes Tool general counsel who is conducting the case for Hughes.

John F. Sonnett, representing TWA, accused Davis of carrying out a delaying strategy. But the time will come inevitably, Sonnett said, when he would be examining Howard Hughes. Davis has been trying to delay this appearance, Sonnett contended.

According to a schedule set up by the court, Hughes is scheduled to appear for deposition late in April at Beverly Hills, Calif.

Also under discussion was the arrangement between TWA and Dillon Read, which handled the jet financing program for TWA. Dillon Read was paid by the airline on a job by job basis, Tillinghast said, and received a fee of $750,000 for handling the 1960 jet financing program. Fee for the 1961 additional program was $200,000.

Asked about the difference in fee for the two programs, Tillinghast said the 1960 negotiations had been long drawn out and more tortuous than the 1961 work. However, the 1961 program still was difficult and complex, Tillinghast said. One reason was the withdrawal of Prudential, leaving the airline $39 million short of its needed financing.

Another area of discussion in the proceeding was why TWA did not acquire the additional four Convair 880 jets originally contemplated. Tillinghast denied that he had discussed with anyone the desirability of sticking Hughes Tool with these aircraft, for which it was financially responsible.

Tillinghast said he had never really known whether the aircraft were available to TWA. Even after the additional Boeing order, he said, the 880s might have been attractive to TWA as "a desirable plus." But a firm proposition from Hughes Tool never came.

He had a conversation with General Dynamics President Earl D. Johnson some time last year, Tillinghast said, in which Johnson said Convair had "cut the umbilical cord" from Hughes and the 880s were free for sale to TWA. But subsequent reports from a TWA official who investigated, Tillinghast said, still indicated that there was some doubt as to whether the aircraft were available.

Possible out-of-court settlement of the TWA suit against Hughes was discussed at a meeting last July, it is understood, with a proposal forthcoming from Hughes. However, this subject is off the record as far as the deposition proceedings are concerned.

Pan American Ordered to Repay U.S. $2.2 Million in Subsidy

Washington—Pan American World Airways was ordered by the Civil Aeronautics Board last week to refund more than $2.2 million in subsidy paid for certain operations since 1946.

The CAB opinion requiring the refund in the 12-year-old Pan American mail rate case becomes final this week unless Pan American objects.

The case, which generated 7,000 pages of testimony and numerous exhibits, involved controversy over subsidy paid for:

- **Atlantic Division** operations from Jan. 1, 1946 to Dec. 31, 1953. Pan American had claimed $103.2 million was due it. The government actually paid $79.4 million and further adjustment by CAB, using new auditing procedures, reduced Pan American's claim until the airline now owes $5.47 million for this period.
- **Latin American Division** operations for 1952. Pan American had claimed $17.3 million for this period. The government had paid the carrier $10.4 million before CAB reduced the carrier's claim by $5 million. Pan American is credited with $1.8 million for this period after CAB adjustment.
- **System operations** for 1954. The airline had asked $31 million for this period, while the government actually paid $28.3 million for the service. CAB further reduced the carrier's claim until Pan American now owes the government $10 million.
- **System operations** from Oct. 1, 1956 to Dec. 31, 1958. Pan American had asked $65.8 million and the government had paid $37.7 million. CAB reduced the carrier's claim but left it with $11.3 million due.
- **American Overseas Airlines** operations prior to 1950. American Overseas, acquired by Pan American in 1950, had asked $23.6 million. The government had paid American Overseas and its successor, Pan American, $22.3 million. CAB again reduced the carrier's claim, which still left it with $83,000 owed by the government.

When subsidy amounts due Pan American are reconciled with what it owes the government, the airline must pay $2,207,000.

CAB said the controversy started when it conducted an exacting investigation of Pan American's subsidy claims for 1954 with the aid of an enlarged auditing staff. The investigation opened questions of whether the airline had added non-transport costs—which are not underwritten by subsidy—to its regular transport costs.

As a result of the intensive study made simultaneously of Pan American's four divisions—which CAB had never been able to do before because of an inadequate auditing staff—the Board developed new criteria for determining Pan American's subsidy. The criteria involved adjustments for certain non-operating costs and in rate making.

With its new criteria, CAB got the District of Columbia Court of Appeals to remand to CAB Pan American's case in which it sought review of CAB's 1946-53 and 1954 subsidy payments. After the case was returned to CAB for investigation, it became apparent after three years of testimony that it would not be settled in the foreseeable future unless the parties reached some settlement informally.

Early this year, the parties agreed to end the case by Pan American's refunding the $2.2 million.

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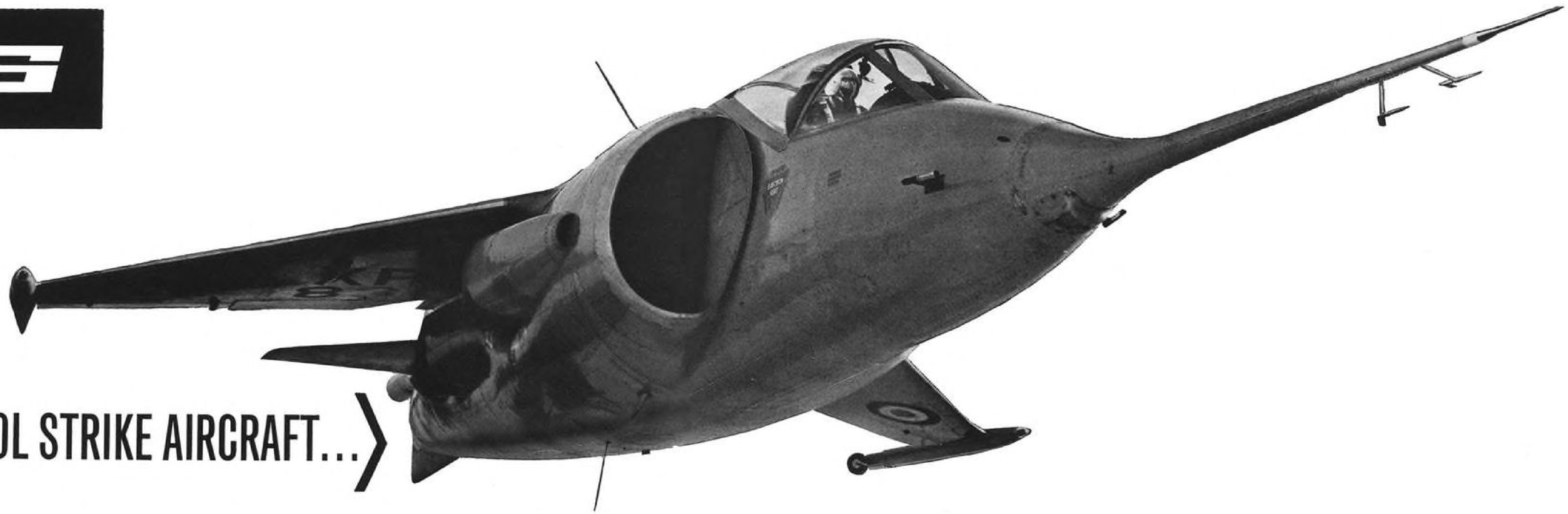

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Bristol Siddeley Proteus gas turbines power Mr Stavros Niarchos's 100-ft yacht, "Mercury," which has accommodation for 5 passengers and a crew of 11. Delivering 10,500 hp, the engines give "Mercury" a top speed of over 50 knots and a cruise range of 400 miles.

...AND THIS

Bristol Siddeley diesel engines power the 95 Hymek locomotives now entering service with British Railways. British Railways have ordered over 300 of these diesel engines and those already in service are averaging 14,000 miles a month over a variety of routes.

AIRLINE OBSERVER

► Domestic trunkline traffic climbed 11.5% in January over the same period in 1961, the third consecutive month that revenue passenger miles have increased more than 10% and the highest monthly increase since January, 1960. However, available seat miles rose to 4.81 billion to reach the second highest monthly level in airline history. The 17% increase in available seat miles pulled the monthly load factor down 2.63% to 54.26%. All but United Air Lines failed to show an increase in total revenue miles in January, but only three of the eleven carriers showed an increase in first-class traffic. All carriers reported increases in coach traffic but, again, a 34% hike in available seat miles dropped coach load factors down to 57.4% from the 59.5% recorded in January, 1961.

► John C. Carroll, first vice president of the Air Line Pilots Assn., has notified the union's board of directors that he will run for the presidency of ALPA. He is expected to get strong support from members who are opposed to the policies of incumbent Clarence L. Sayen. While Sayen has said he intends to resign, most ALPA members feel he will run for re-election if drafted during the union's May convention in Miami. Anti-Sayen factions within the union fear that the numerous other candidates suggested so far face certain defeat and believe Carroll has the best chance of winning.

► Aeroflot's newly inaugurated Moscow-Rangoon-Djakarta service is on a one round-trip weekly basis. Flying time for the Il-18 turboprop transport making the 6,500-mi. run is 17-18 hr., and total scheduled time is slightly over 24 hr. First return trip to Moscow carried official Burmese delegation headed by the minister of information, secretary of transportation and communications and representatives of the Burmese national airline.

► Trans World Airlines' application to sell Nevada Automotive Corp. 25 Lockheed 049 Constellations for $700,000 has been tentatively approved by the Civil Aeronautics Board. In its order, the Board noted that the 25 aircraft represented a "substantial portion" of TWA's fleet but concluded that the sale would be in the public interest since they were being replaced by jet aircraft. The 049 fleet is included among the aircraft written down to a residual value of 3% (AW Feb. 12, p. 47).

► Domestic trunklines have agreed to a no-show plan which was filed with the CAB last week. No-show passengers will pay 50% of the value of their tickets' first remaining flight coupon, subject to a $5 minimum and a $40 maximum. Passengers who are not provided service for which reservations have been confirmed will be compensated by the carriers under the same formula.

► Hearing in the New York-Florida Renewal Case (AW Jan. 15, p. 42), in which Northeast Airlines seeks permanent Florida operating authority, has been postponed until after CAB settles the question of whether Hughes Tool Co. should be allowed to control Northeast. Examiner Walter Bryan postponed the case to prevent needless duplication in presenting evidence after it became doubtful that the record in the control case could be stipulated in the renewal case.

► Federal Aviation Agency will phase out its El Paso air route traffic control center in a move to consolidate centers under a plan to realign ARTC area boundaries. Previously, FAA moved to phase out centers at St. Louis, Phoenix and Detroit and combine their operations with other center areas. The four consolidations will result in annual operating savings of $3.5 million.

► Aeroflot expects to place a new version of the medium-range twin-turbofan Tu-124 transport in operation during 1963. Engines on the new version, the Tu-124A, will be mounted on the sides of the rear section of the fuselage, Caravelle style. The Tu-124, which is slated for regular service shortly, has its turbofan engines conventionally mounted in the wings.

SHORTLINES

► **American Airlines** will put its recently delivered Convair 990 jet transports (AW Jan. 8, p. 48) into service on its New York-Chicago route Mar. 18. The aircraft will make two round trips daily between O'Hare and Idlewild airports.

► **British European Airways** reports it carried 4.35 million passengers during 1961—a 13% increase over 1960. During the same year, BEA's capacity increased by 21%.

► **British West Indian Airways, Ltd.,** has an amended foreign air carrier permit allowing it to operate between Antigua, W. I., and New York until Oct. 1, 1962, unless further extended.

► **Central Airlines** has asked Civil Aeronautics Board for permanent extension of its youth fare plan set to expire Feb. 28. Central, contrary to trunkline experience, reports the 7,554 youth fare passengers carried during the 116-day period ending last Dec. 31 have accounted for as much as 10% of passenger boardings.

► **Flying Tiger Line** and Seaboard World Airlines are obtaining structural modification kits for their Canadair CL-44 airfreighters. The modification increases the aircraft's payload 5,000 lb. and extends its range 350 mi.

► **Lake Central Airlines** reports it carried over 400,000 passengers during 1961—a 75.5% increase over the preceding year. Lake Central attributes the increase to route expansion during the year which added 17 cities and the District of Columbia to its system.

► **Merger of Alaska Coastal,** Ellis and Marine airlines has been approved by a CAB examiner in a recommended decision. Since Ellis has foreign operating authority, presidential approval will be required. The new airline will be called Alaska Coastal-Ellis Airlines.

► **Northeast Airlines** reports it flew 65 million revenue passenger miles during January—a 30.5% increase over January, 1961. Northeast attributes a large part of the gain to increased Convair 880 jet scheduling this winter.

► **Pan American World Airways** has been authorized by CAB to conduct nonstop flights between New York and Jamaica. CAB limited the authority to flights using New York-Newark and Montego Bay or Kingston, Jamaica as terminals.

The Douglas Skybolt gives an aggressor reason to pause. It is being developed as a missile with nuclear capability that can be launched from a mobile hiding place in the sky a thousand miles from its target.

To date, several successful tests have been made and the aircraft-to-missile compatibility has been demonstrated. With modifications, Skybolt can also be used with supersonic aircraft of the future.

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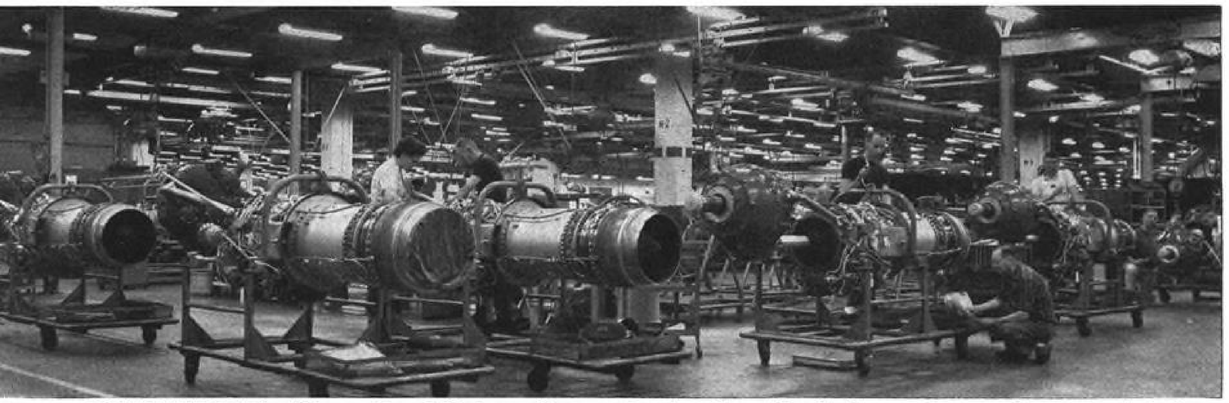


POWER SECTIONS for 501 move through final assembly preparatory to mating with reduction gear box preceding test stand checkout. Engine entered domestic airlines' service on American and Eastern airlines' Electras in 1959. Military designation of the 501 is the T56.

Allison Seeks Removal Rate Cut in 501

By Larry Booda

Indianapolis—Relatively high but not unsatisfactory premature removal rate for the Allison 501 (military T56) 4,050-hp. turboprop engine, due to delays in installation of major engineering fixes, is expected to continue dropping gradually until next summer when it will level off at the completion of the program.

To some extent the delays have been due to the increased time between overhaul period (TBO) which now runs from 2,000 to 2,200 hr. for most domestic airlines which operate the Lockheed Electra in which most of the commercial engines are installed. Measures have been taken to correct all but small deficiencies that are of a continuing nature.

Allison says that because only minor problems are now being encountered in the engine, the service organization here at the Allison Division of General Motors and in the field is smaller than when the engine was new in airline and military service. This growth and reduction cycle is expected to be repeated again in about a year when a new, more powerful version of the engine, producing 5,250 hp., will be introduced into operational service.

As of last month a total of 1,052 of the Model 501 engines, including the inventory of spares, were in service in Lockheed Electra and Convair 340 and 440 airframes with domestic and foreign airlines, corporations and individual owners. This total breaks down into 798 in domestic airlines service, 202 with foreign airlines and 52 in Convairs.

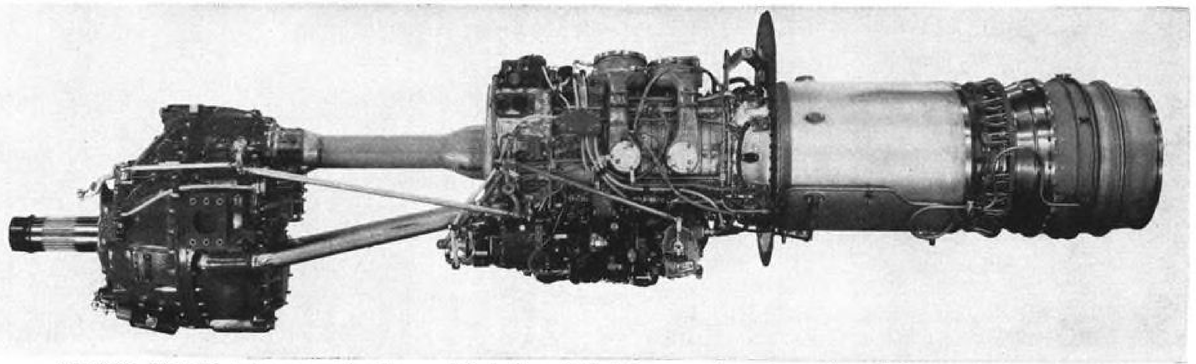
Military Engines

Engines operating in, or due for installation in, Lockheed C-130 airframes for the U. S. Air Force and Navy total 2,141, plus 392 spare power sections for a total of 2,533. Navy-Lockheed P3V-1 will account for another 76 engines and the Navy-Grumman W2F-1 will absorb 29 engines under present contracts. Foreign C-130 aircraft take up another 81 engines out of 108 required for 27 foreign aircraft. Remainder will be made up through procurement from U. S. military sources. Overall total for the T56 thus is 2,719 engines and power sections.

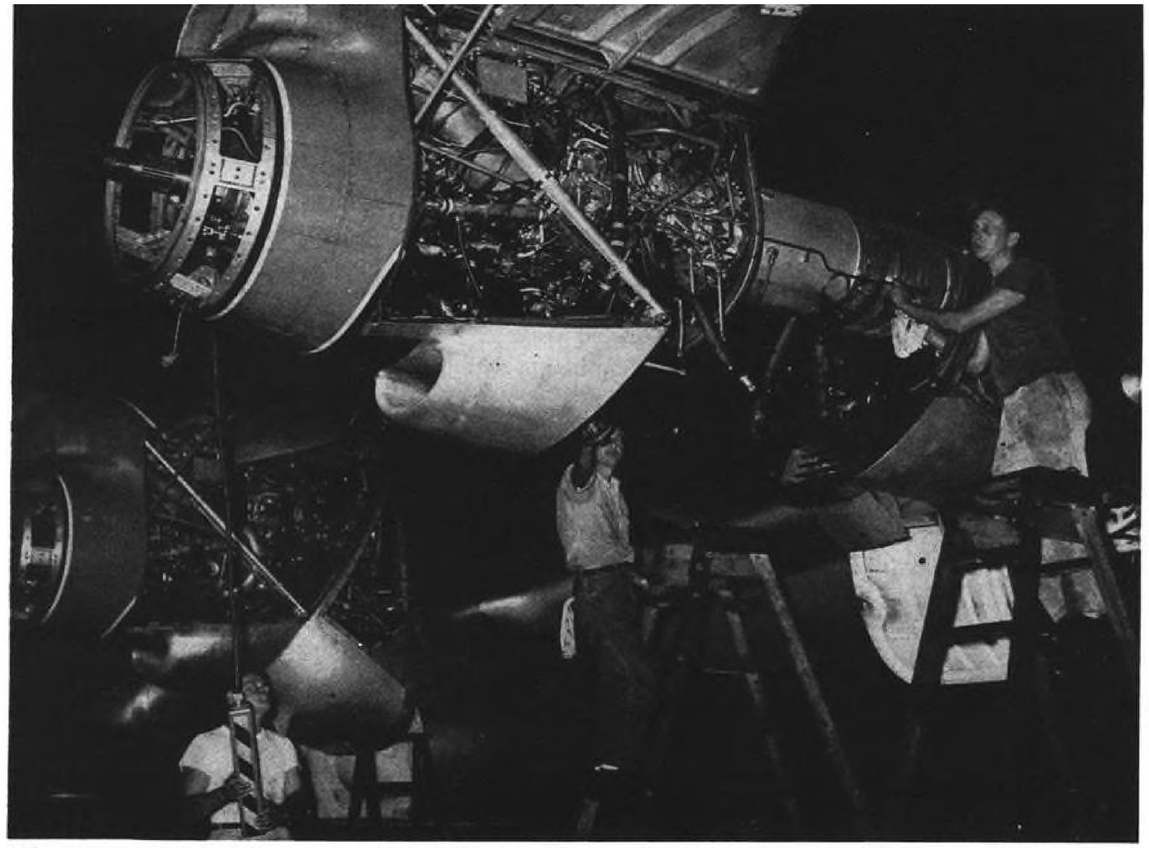
At present there are no orders for the 501 from either foreign or domestic carriers. U. S. military contracts for the engine total 855 engines and 113 power sections. There are no unfilled foreign military orders.

The figures given above do not represent the total production of the 501 and T56 engines. They exclude test engines made for plant use and USAF, and engines lost in seven crashed Electras.

Prospects for continued production of the T56 are based on military planning which involves ordering a total of 136 Lockheed C-130E long-range cargo transports for the Air Force and more Navy aircraft in Fiscal 1963. Additional orders will account for a total of 3,100 engines from Fiscal 1963 through Fiscal 1967.



ALLISON 501-D13 turboprop engine has a relatively long shaft between engine and gear box. Early in engine's service, shaft sometimes moved out of alignment and cut through casing. Roller bearing between shaft and casing and other changes solved this problem.



ALLISON MODEL 501 turboprop engine, with 1,000 hr. of commercial service completed, is removed from Eastern Air Lines' Lockheed Electra at Miami, Fla., by EAL mechanics. Substitute engine was ready for immediate positioning in the aircraft's nacelle.

It is anticipated that scheduling of production for the future will be aided by the Defense Department's package program concept which gives anticipated schedules of increased, decreased or level production for periods of up to five years. In the past, purchases were contracted in yearly increments which could subject programs to abrupt changes.

In backing its product, Allison has kept its service organization flexible to meet changing demands. The personnel assigned to this group are experienced in the manufacture and maintenance of the engines and in addition have sufficient engineering background to spot trouble and alert the plant so that a fix can be planned and then executed.

Allison representatives have been sent all over the world. They have conducted training schools in the Far East, the East Indies and Australia, and have helped the airline users of the 501 in numerous ways depending on individual circumstances.

The 501 first entered airline service in 1959 when Eastern and American airlines began regularly scheduled runs with the Electra. Prior to that time, Allison engineers had been busy with training programs. When the engine entered operational service, and for more than a year afterward, the service group was at its peak strength. Peak program employment level was 511 persons, divided between 283 here and 228 in the field. Last month the total was 312, with 175 here and 137 in the field.

Before the domestic airlines and the larger foreign airlines, such as KLM and Qantas, began regular operations with the Electra, they sent their key maintenance personnel to the plant for thorough familiarization of the engine operation and its maintenance procedures. After completion of the indoctrination these key personnel then went to their company shops to set up training courses.

Allison technicians were present during this training period in each instance. There were fewer service men in attendance at the larger airlines, because their organizations were better able to take on such a program.

Smaller foreign airlines posed another problem, however. Smaller organizations and limited resources did

STATOR VANES are being installed on third-stage turbine wheel on Allison's turboprop assembly floor. As of last month, a total of 1,052 Model 501 engines, including the inventory of spares, was in service with Electras and Convair 340 and 440 transports with domestic and foreign airlines, corporations and individuals. Total breaks down into 798 in domestic airline service, 202 with foreign airlines plus an additional 52 in Convairs.

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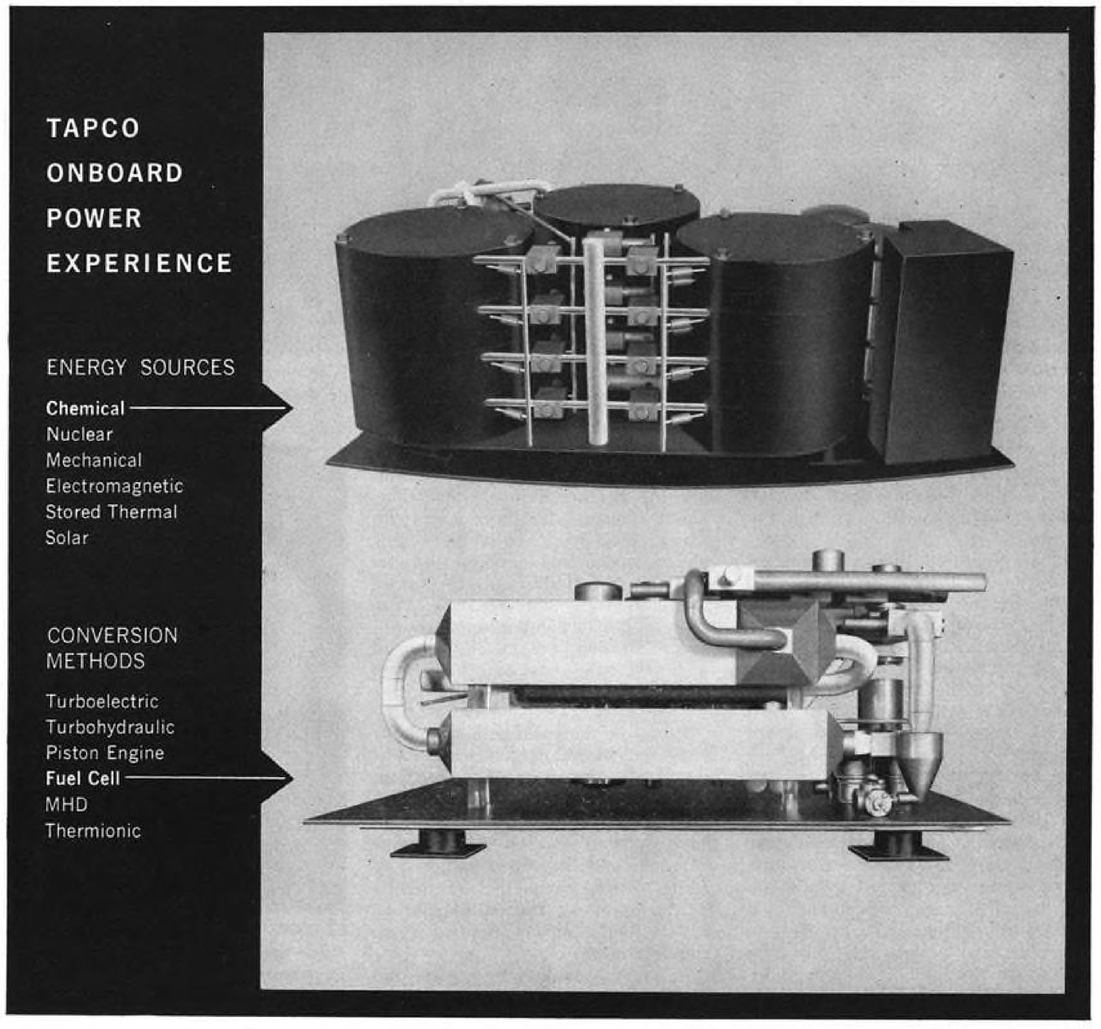

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not permit the small operators such as Ansett, TEAL, TAA, Cathay Pacific and Garuda to organize formal schools for their operations, maintenance and supply personnel. Their operating points are scattered in the Far East and the antipodes. Their stops include remote locations where maintenance facilities are minimal and spare engines and parts are not readily available.

Initial Phase

After the initial phase of indoctrination of pilots and support personnel, the Allison representatives remained at each airline overhaul and maintenance headquarters to spot problems as they occurred and to transmit them to the home office for solution. After a fix was designed, the representative advised the airline in its installation. In the domestic area, the field representatives are no longer permanently located with individual airlines. This situation also holds true with the smaller overseas airlines.

Task of integrating Allison activities in regard to customer service falls to Fred H. Steuber, parts and service manager. His organization is divided into four parts with R. W. Sherk, parts manager, L. W. Stear, operations engineering supervisor, R. E. Tripplehorn, technical services general supervisor and C. E. Dixon, service manager reporting to him.

Allison philosophy in dealing with customers, according to Steuber, has been to go to the airlines with a problem that has been discovered and its solution before the airline itself encountered the problem. This has been accomplished by applying an elaborate system of reports from the test facilities at the plant and the representatives with the airlines to the process of analysis and then solution. This will be described later.

Contracts with airlines have been worded in such a way that Allison is required to provide technical support. There is no provision in writing saying that the company would assume the responsibility for costs incurred in making fixes.

In practice, it has turned out that Allison has made a majority of the fixes from its own funds, determining in each instance whether the company was ethically, if not legally, responsible for backing its product.

Costs Shared

As the engine progressed in terms of time in service, Allison considered that it should be logical that engineering fix costs be shared with the airlines. Agreements were made to share the cost on a 50-50 basis for correcting problems that Allison thought it was not directly responsible for.

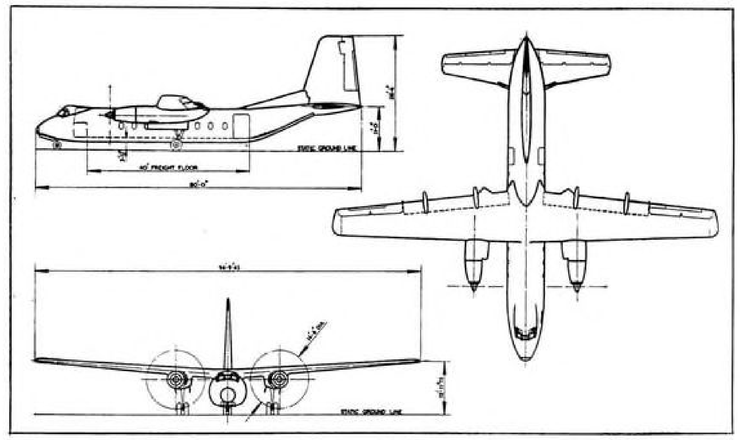
An example of a problem in this category centered around the cabin air compressors. Each inboard engine (numbers two and three) has such a compressor attached to it. The original design of these pumps provided for a steady load of 85-hp. each to keep the cabin pressurized under all flight and altitude conditions. In actual service, the airlines discovered that steady loads of 120 hp. and peak loads of 150 hp. were imposed, a condition that did not originate with the engine manufacturer. The result was a series of failures.

These failures were reported by the field men and soon a fix operation was under way at the plant. A redesign of the compressor permitted it to take the heavier loads.

One of the major problems encountered early in the service experience of the engine centered around the relatively long shaft which extends from the engine to the reduction gear box located behind the propeller. In operation, the shaft would move out of alignment, causing it to whip inside the casing. Eventually this whipping would cut through the casing.

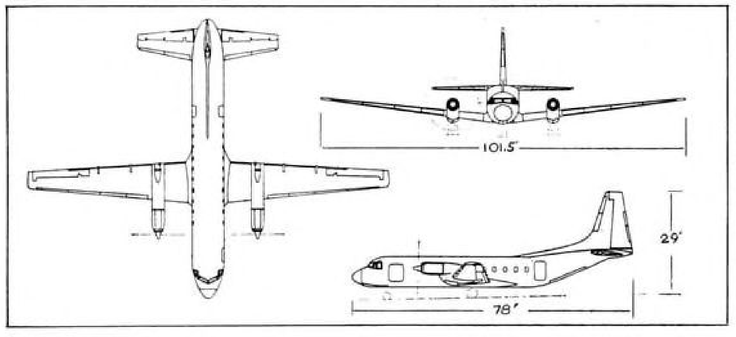
This problem was solved by redesigning the casing and installing a roller bearing between the shaft and casing shell half the distance between the engine and the gear box.

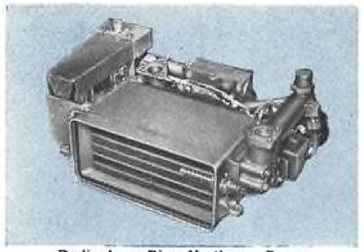
A running record concerning performance in terms of premature engine removals due to various causes is kept in



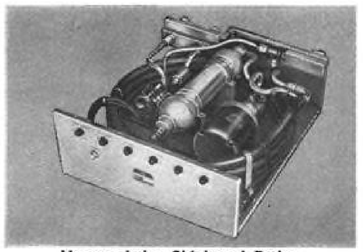
British Turboprops Vie for RAF Order

Two turboprop transport aircraft competing for a Royal Air Force Transport Command order for 48 planes have demonstrated rough field handling characteristics for RAF and Ministry technical teams. Airplanes are the Handley Page Dart Herald (above) and the Avro 748, built by a member of the Hawker Siddeley Group. Both are powered by Rolls-Royce Dart engines and feature aft-loading door which drops to form a vehicle ramp. Selection has political overtones, in that Handley Page has resisted efforts to merge with either of the two big British airframe manufacturers, Hawker Siddeley and British Aircraft Corp. Government policy has been to place orders with the firms which followed its suggestions to regroup the industry. Dart Herald is pushing STOL characteristics and the fact that about 80% of the jigs used for the civil version can be employed for the military model. Powerplants are two Dart RDa. 10 turboprops, replacing the Dart 7s on the civil Herald. Cabin floor has been beefed up and some local strengthening has been added. The Avro 748, using Dart 12s, was demonstrated on rutted surface at Martlesham Heath airfield, taking off and landing on a single engine. It also made two takeoffs and landing with 12 and 23 passengers respectively. Demonstrations also included Figure Eight taxiing pattern.

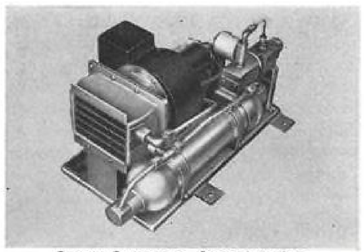




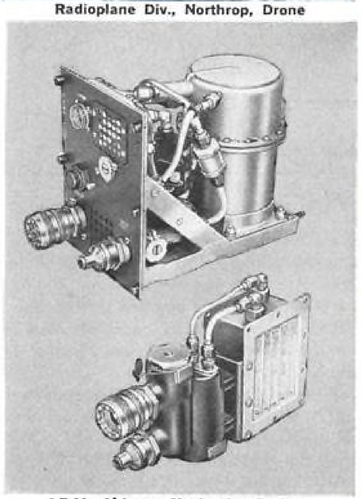
Radioplane Div., Northrop, Drone



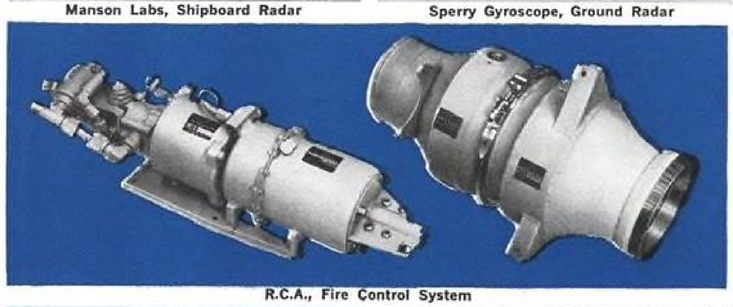
Manson Labs, Shipboard Radar



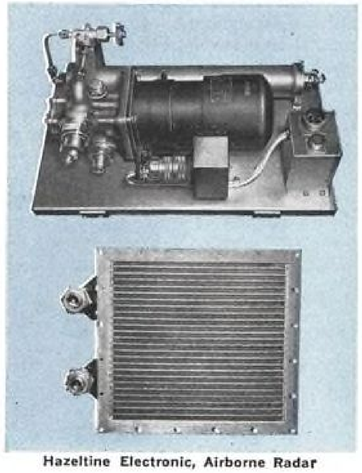
Sperry Gyroscope, Ground Radar



I.B.M., Airborne Navigation System



R.C.A., Fire Control System



Hazeltine Electronic, Airborne Radar

DuMont/Fairchild Camera, Shipboard Radar

W. L. Maxson, Development

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the form of a monthly summary report for the 501-D13 engine and the 606 reduction gear box for domestic and foreign airlines. A similar compilation of military T56 engine field service reports is kept. Both are compiled by the reliability department.

Material funneled into tables and charts of these publications is obtained from aircraft flight operations reports and component removal reports sent in by field representatives. They are sorted and tabulated by electric accounting machines.

Report of a typical month contains breakdowns going back to 1960 of Allison-responsible premature major unit removals, charts and tables on the power section, gear box and torquemeter premature removals, and detailed tables by item for the same time period of major field maintenance items which were reported. Tables covering the 606 propeller section complete the publication.

Weekly summaries supplement the monthly reports. They are limited to charts covering premature major unit, power section, gear box and torquemeter removals which are Allison-responsible.

Reliability Report

For company use only, a monthly product reliability report is published. A typical summary in the beginning of this publication spotlights the premature removal rate and daily utilization rate, a statement that one airline received a 2,000 TBO authorization from FAA, another airline received its first 2,000 hr. engine for overhaul, remarks about TBOs of non-domestic airlines and the most troublesome items on the engine operation.

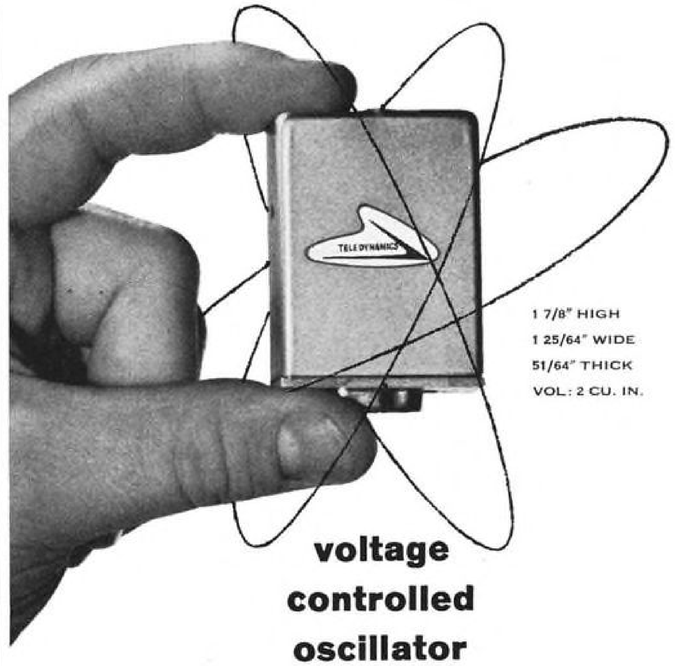
A chart of critical premature removal parts shows the order of their occurrence rate, the relative position of each item compared with the previous month, individual item percentage of total failures, the six months total of occurrences and consecutive months of occurrence.

A similar breakdown is presented for parts and components causing in-flight propeller featherings, followed by an analysis which shows feathering rates for individual domestic airlines. It is these rates which have the principal effect of influencing the FAA to increase the time between overhaul for an airline.

Further analyses deal with modification effectiveness, teardown discrepancies, number of engines returned for analysis and repair, status of fixes and premature removals, and teardown problem assignment status.

Monthly and weekly summaries are distributed internally and are available for perusal by interested individuals outside the company. The reliability re-

TELEMETRY BY TELE-DYNAMICS



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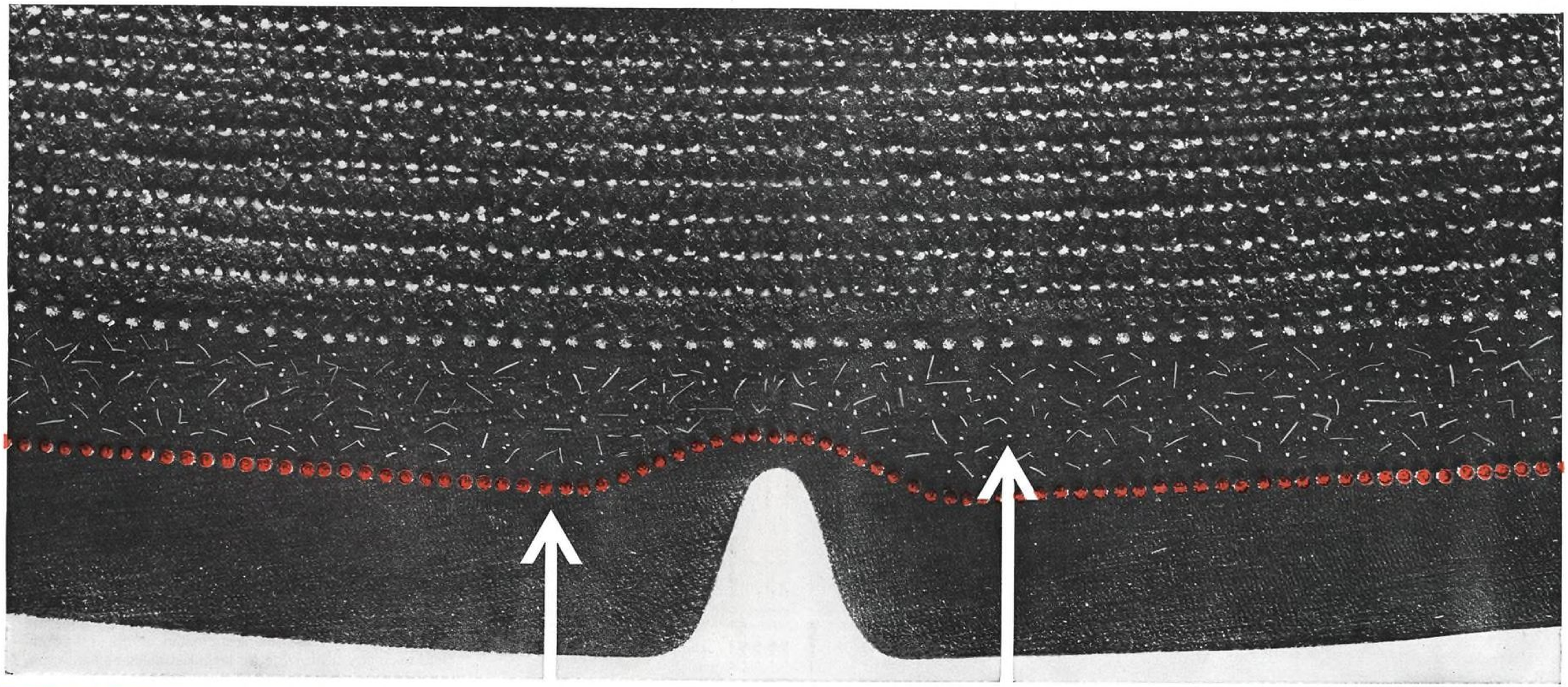

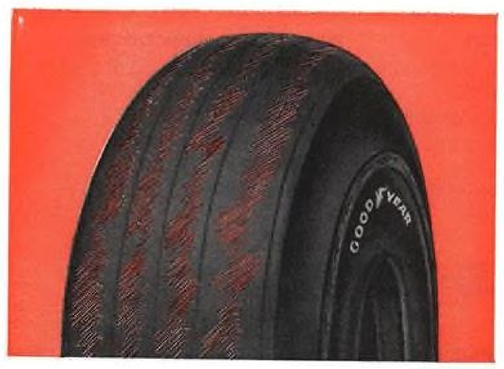

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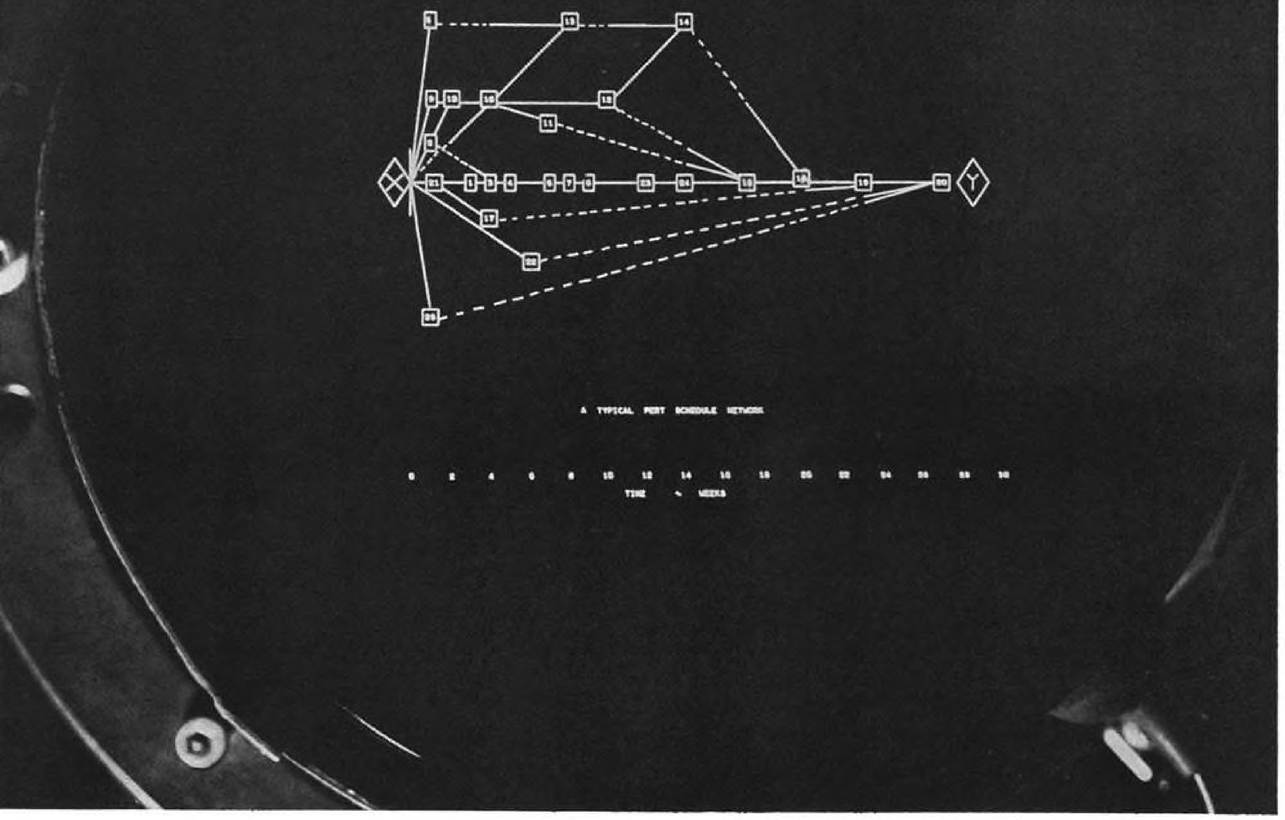

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port just described, however, is considered a company-restricted publication and its distribution is limited to about 50 Allison officials.

Premature major unit removals since early in 1960 have ranged from 0.91 removals per 1,000 engine hr. to 0.45, which was reached in April of 1961. The most recent peak was in August, 1961, when the rate was 0.74. From September until now, however, the rate has fluctuated narrowly between 0.55 and 0.46. As stated earlier, this trend is expected to continue downward as more engines are overhauled at routine intervals when the major engineering fixes will be installed.

One of the most common problems which developed early in the service life of the 501 centered around the front compressor seal. Leakage around this seal resulted in high oil consumption. It was determined that the reason for this leakage was the formation of coke on the seal. This in turn had been caused by excess temperatures and the amount of time the oil remained on the area, or dwell time.

Tests were run with the seal baffle removed, allowing greater oil flow across the seal surfaces. A reduction of 50F to 80F was accomplished for the various seal components. The Phase 1 fix consisted of removing the baffles and modifying the seal.

Allison realized that the Phase 1 fix would improve seal performance but that by its very nature the rubbing seal has certain life limitations. So a Phase 2 program was initiated to develop a labyrinth seal with unlimited endurance potential. Incorporation of this fix began April, 1961, and should be completed in almost all engines this year.

Another early problem was failure of the front turbine scavenging pump. It was determined that radial movement of the turbine in relation to the compressor coupling shaft caused axial movement of the pump gears, resulting in excessive wear. Larger internal clearances were provided and improved riveted bronze separators for the bearings were installed.

The fix installation will be completed in engines this year.

Next most common problem was cracking of the rear turbine support. The cracking was noticed under the hat section stiffener around the outer cone skin and in the front and rear face welds of the hub and spider portion of the support. The cracks were caused by turbine vibration and inadequate weld penetration.

The fix consisted of strengthening the area by the addition of a Hastelloy X doubler to the rear turbine bearing supports, and a support configuration which makes use of a heavier gage material. Hub weld cracks were eliminated by reducing cold start vibration with the installation of a two piece structure which eliminates the distortion in the area of the front turbine bearing support.

Fixes were made for component troubles which occurred less frequently, such as leakage of the rear compressor seal, front compressor ring, rear compressor bearing, front compressor bearing and cracking of the third stage turbine wheel.

Many of the failures were one time occurrences and no fix was undertaken.

Time between overhaul periods now authorized by FAA for domestic airlines for the 501 vary between 1,800 hr. and 2,200 hr. These figures apply to the reduction gear, torquemeter, turbine and compressor. Essential engine accessories TBOs run from 2,000 hr. to 3,000 hr. The propeller times vary narrowly around the 2,500-hr. mark.

The future of the engine lies with an increase of power. Recently a T56 power section was run at 6,770 shp. for five hours. The power section was modified by an increase in size of the compressor and the addition of hollow air-cooled blades to the power turbine, permitting turbine inlet temperatures of 2,020F.

Tests were conducted as part of the increase in power program. In this instance the air-cooled blades were undergoing evaluation.

This modified power section produced 5.3 hp. per pound of engine weight compared with 3.2 hp. for the production T56. In addition, specific fuel consumption during the test run was 0.486 lb./hp. hr.

The development program is being sponsored by the Air Force and Navy through product-support funds.

Russia Expects Volume Exports of Hydrofoils

Moscow—Russia expects to begin volume exports of hydrofoil boats this year. It says "numerous" orders for hydrofoils are being received from foreign firms by its Ministry of Foreign Trade.

Two hydrofoil boats recently were completed for Cuba at the Batumi Shipbuilding Yard on the Black Sea and four more are to be built for Cuba "shortly." Another is being readied for Czechoslovakia.

Rostislav Alekseev, chief designer of Soviet hydrofoil boats, said in a recent interview that Russian craft are far superior to those being built in Italy, England and West Germany. Development of powerful new gas turbines has made speeds of 200 kilometers per hour (124 mph.) "entirely practicable," he said.

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Rocket Case Team

Douglas Aircraft Co.'s Missile and Space Systems Division and Newport News Shipbuilding and Dry Dock Co. have formed a team to bid on contracts for the production of very large solid propellant rocket cases.

Motor cases up to 300 in. diameter and 200 ft. long are being considered. Douglas has no facilities large enough to manufacture cases of this size. The cases would be produced at the Newport News, Va., shipyard using the advanced motor case technology developed by Douglas in the Nike Zeus and Skybolt programs. The roll-and-weld manufacturing process used by Douglas can be applied on a large scale by tooling already available at Newport News. A completed case of the largest size anticipated may weigh as much as 180 tons. A joint ring for a 154-in. segmented rocket would weigh over 1,000 lb.

Radioplane to Be Renamed Northrop-Ventura Division

Northrop Corp. will change the name of its Radioplane Division to Northrop Corp.-Ventura Division effective Apr. 2.

The change reflects the expanded variety of products and the broadened technical capabilities of the division, Northrop officials said.

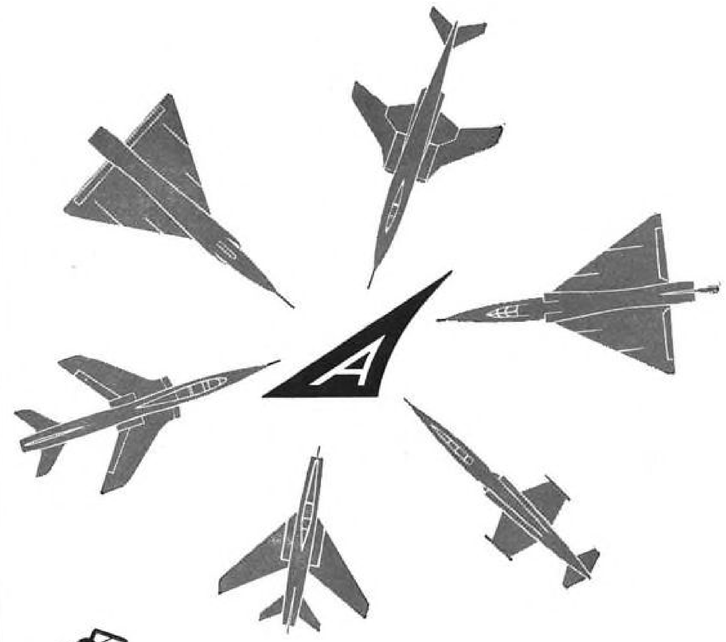
The division is scheduled to move from Van Nuys, Calif., to new facilities at Rancho Conejo in Ventura County, Calif., in December.

PRODUCTION BRIEFING

Bendix Radio Division and Radio Corp. of America Service Division will share a $10-million contract to operate and maintain Project Mercury tracking stations at Bermuda, Grand Canary, Zanzibar and Guaymas, Mexico, and Kano, Nigeria, for two years beginning in 1963. Bendix will operate the stations until December.

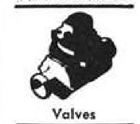
Boeing Bomarc B successfully intercepted a Lockheed QF-104 pilotless target drone at 35,000 ft. following a sharp diversion of target's course just prior to intercept. Bomarc was launched on command and guided by Air Defense Command Sage Center, Montgomery, Ala.

Thiokol Chemical Corp.'s Redstone Division has successfully static fired at −50F a number of 40-in.-dia. solid propellant motors which had been road-tested and subjected to temperature variations between −50 and 135F. Burning time was reported to be in excess of 30 sec.




Floatation Systems


Pitot Disconnects


Valves


Float Switches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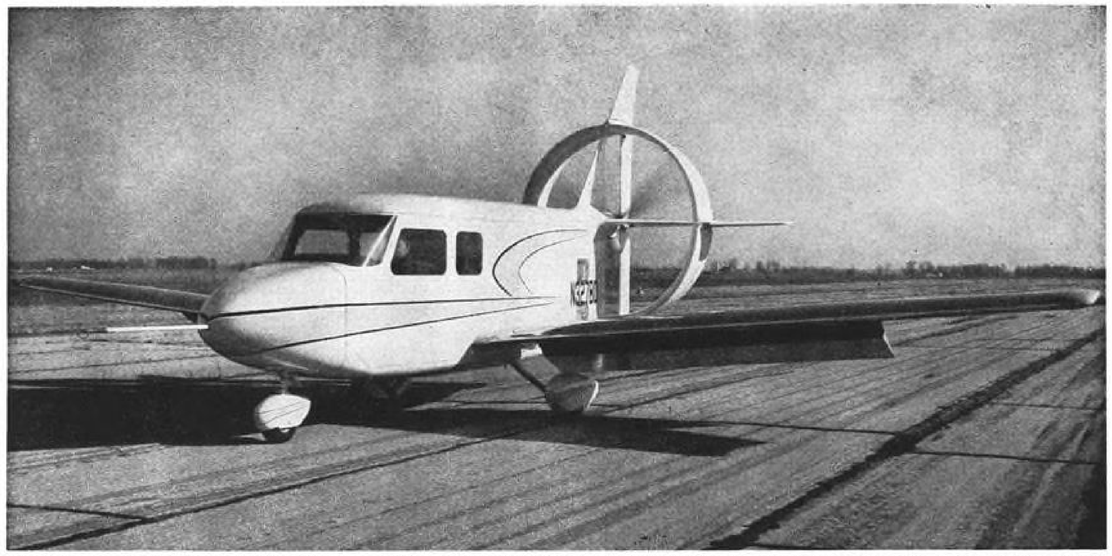

BEDE AIRCRAFT XBD-2 prototype uses twin piston engines to drive a single propeller and to power its boundary-layer control system.

Bede XBD-2 Utilizes Marvel BLC Concept

By David A. Anderton

Early flight tests of the Bede Aircraft XBD-2 prototype point toward confirmation of the effectiveness of the boundary-layer control system pioneered at Mississippi State University.

The prototype, which will be developed to a six-place executive aircraft, reflects other advanced aerodynamic concepts which were combined earlier in the design of the MSU Marvel and Marvelette (AW Nov. 30, 1959, p. 59).

In addition to the BLC system, it features twin engines which are belt-coupled to drive a single pusher propeller. The propeller is shrouded to increase its thrust. Major difference between the XBD-2 and the Marvelette is in wing placement; the Bede design is a low-wing aircraft, and the Mississippi State University design has a high wing.

Credit for the over-all design of the XBD-2 and much of its detail design goes to the staff of the Aerophysics Department of MSU, according to James R. Bede, vice president of Bede Aircraft, Inc. But the production version, designated the BD-3, is an original development by Bede, still using the basic aerodynamic concepts of the MSU team.

Mockup and master tooling of the BD-3 have been completed at the company's Springfield, Ohio, plant. Bede engineers are now working on detail tooling and design. What comes out of this, they hope, will be a six-place STOL executive aircraft, powered by a pair of Lycoming IO-540-B1A5 piston engines rated at 290 bhp. each. The BD-3 is estimated to weigh 4,300 lb. and to carry a useful load of 2,254 lb. off a runway after a roll distance of less than 300 ft. Performance calculations show a projected range figure in excess of 1,200 mi. with 50% engine power, including a 45-min. reserve. Stalling speed is calculated at 42 mph.

At the root of the performance of both the prototype and its projected development is the boundary-layer control system. In both designs, the BLC system is always on; its blower is coupled directly to the propeller shaft, and as long as the propeller is being driven, so is the BLC system.

For the prototype, control of the flow over the wing starts with 164,000 holes drilled by hand through the wing skin. These holes, which start at 5% of the chord and go right to the trailing edge, are either 0.029 or 0.020 in. in diameter. A 14-in. Joy blower sucks boundary-layer air through these holes and into the interior of the wing, which acts as a large plenum chamber. From here, the air passes through the blower and is then discharged into the engine compartment. This provides cooling-air pressure boost for the submerged twin engines.

Bede said one measure of the effectiveness of the system as a cooling aid

BD-3 MODEL shows layout of six-place executive aircraft now under development.

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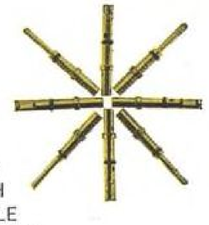

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PUSHER PROPELLER SHROUD increases static thrust and efficiency. Ring is formed of unidirectional glass fiber cloth.

was obtained during taxi tests at their former plant in Boca Raton, Fla. "We ran the engine as long as 45 min. on the ground in idling and low power during taxi tests on a 95-deg. day in the Florida sun," he said. "Not once did the engine temperatures get out of the green."

Current flight testing has not progressed to the point where a detailed and complete evaluation of the system as a BLC device is possible. But Bede emphasizes that all evidence so far points to very high lift coefficients, perhaps as high as five in the final design.

Low-cost, simplified methods were the basis of the first prototype construction by Bede. A glance at the photographs shows a slab-sided fuselage with a smoothness of finish that looks as if complicated tooling were used. Actually the fuselage sections were fabricated from commercial honeycomb panel bought from Goodyear's stock sizes, and cut to shape with a portable powered sabre saw.

Top and bottom fuselage panels and the propeller shroud were formed of glass fiber layup. The main landing gear is also glass fiber, fabricated from Minnesota Mining & Manufacturing's 3M unidirectional fiber cloth. Weight of each landing gear leg is 16 lb.

Powerplants for the prototype are two Continental O-300 piston engines, rated at 145 bhp. each. They are mounted in an over-and-under arrangement, submerged in the fuselage behind the cabin. Cooling air intake is from the boundary-layer control system, and the outlets are flush, rectangular openings near the tail.

Ten Goodyear wedge belts couple each engine to the propeller drive shaft through Formsprag overriding clutches.

The propeller on the Bede prototype is a constant-speed, three-bladed Hartzell.

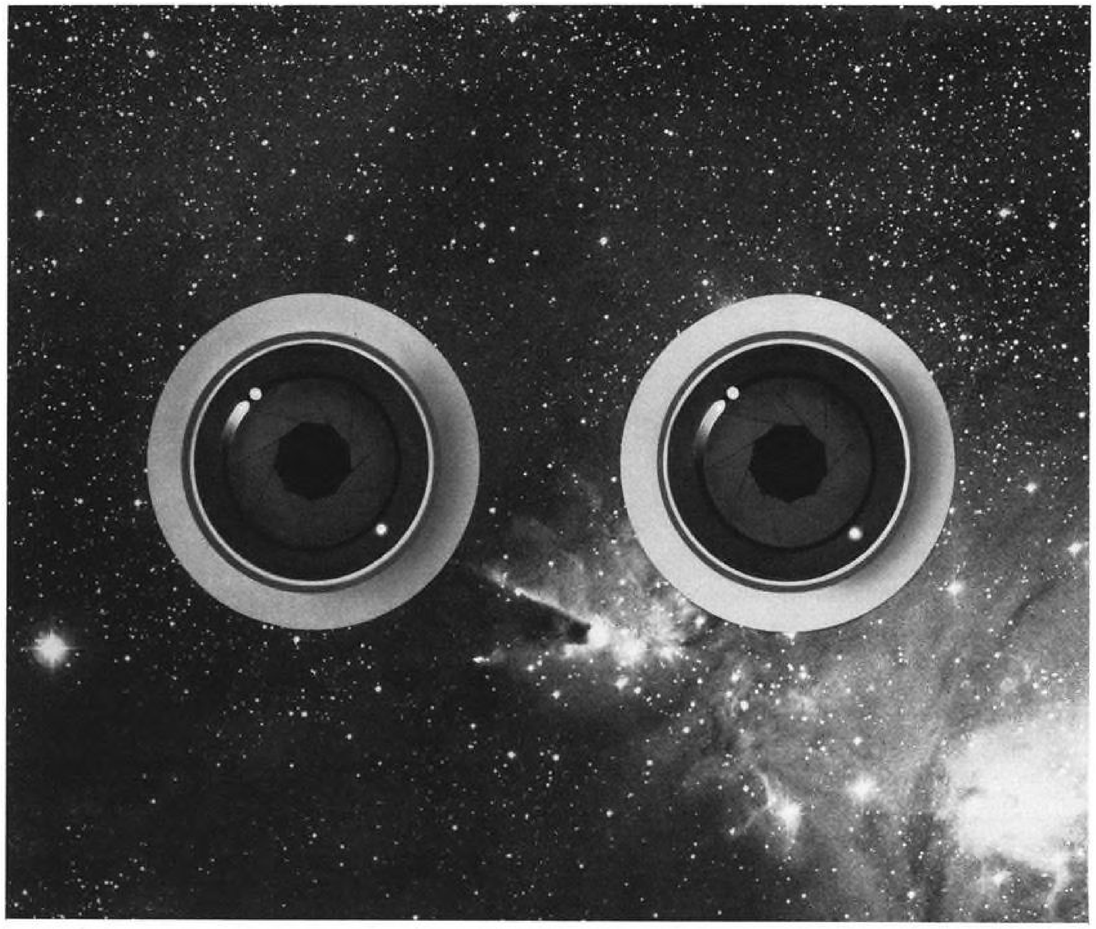
Bede has no illusions about the type of market the company will enter with the BD-3. Tough competition and good airplanes, already certificated, from Aero Design, Beech, Cessna and Piper make any future selling job a difficult one. The company believes there is enough market for everybody in the field, either now or in the discernible future, and is planning to carve out a territory of its own.

One of Bede's strongest philosophies is that any business or executive aircraft has got to be a complete transport; it has to be able to carry its full seat capacity of passengers plus enough baggage to be useful (on the order of 200 lb.) plus a full blind-flying panel and navigation and communication aids. This is the formula under which the BD-3 will be developed.

Design Specifications and Computed Performance

	XBD-2	BD-3
Gross weight, lb.	3,300	4,300
Useful load, lb.	.....	2,245
Wing area, sq. ft.	150	192
Over-all length, ft.	23.7	30.8
Wingspan, ft.	37.5	38.5
Over-all height, ft.	12.4	12.4
Fuel capacity, gal.	.....	116
Max. cruise at 65% power, mph.	179	300
Max. cruise altitude, ft.	9,000	9,000
Normal cruise at 50% power, mph.	.....	280
Normal cruise altitude, ft.	.....	10,500
Range, max. cruise, mi.[1]	.....	1,080
Range, normal cruise, mi.[1]	.....	1,270
Service ceiling, ft.	21,000	28,000
Single-engine absolute ceiling, ft.	14,500	21,000
Rate of climb, fpm. at S.L.	1,050	2,260
Single-engine rate of climb, fpm. at S.L.	720	1,200
Stall speed with BLC, mph.	42	42
Stall speed without BLC, mph.	64	74
Takeoff ground roll, ft.	under 300	under 300
Over 50-ft. obstacle, ft.	under 500	under 500

[1] Includes 45-min. reserve based on percentage power indicated in cruise configuration listed. No auxiliary tanks. Maximum gross weight.



Siegler puts eyes into orbit to televise space "live"

Siegler's almost incredibly miniaturized television cameras, slightly larger than a camper's flashlight, are now designed into critical areas of space vehicles—let man *see* what happens in space, *as* it happens.

Through Siegler "eyes," ground observers can *see* fuel operation from blast-off throughout stresses of shock, acceleration and under zero gravity conditions...*see* a final stage detach or a balloon inflate and follow its performance in space visually...*see and locate* malfunction, such as a first indication of structural failure. These high reliability systems will be used more and more in missile and space programs.

In the success *or* failure of a missile or space vehicle launching, Siegler space television adds the *indispensable visual dimension*—vital *continuous* information that cannot be gained through data analysis alone.

The vital area of space television is only one phase of Siegler versatility in many fields. To today's major aerospace programs, Siegler supplies meteorological electronics including completely automatic weather stations; launch check-out; electronic communications; major space vehicle structures and many other contributions.

January 15 Echo balloon shot seen in action through Siegler "on the spot" TV

Siegler developed and produced the entire TV video system for the Echo project—camera, transmitter, receiver, monitor, kinescope, tape recorder. Observers state the TV Echo pictures were the most striking ever relayed from space.

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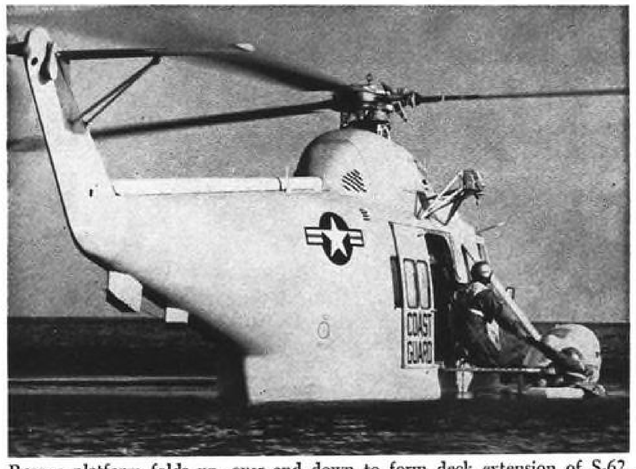
Sikorsky S-62 (HU2S-1) turbine-powered helicopter selected by Coast Guard is amphibious and has operated from 8-10 ft. seas. A company-funded project, it is powered by a General Electric T58-8 gas turbine engine.

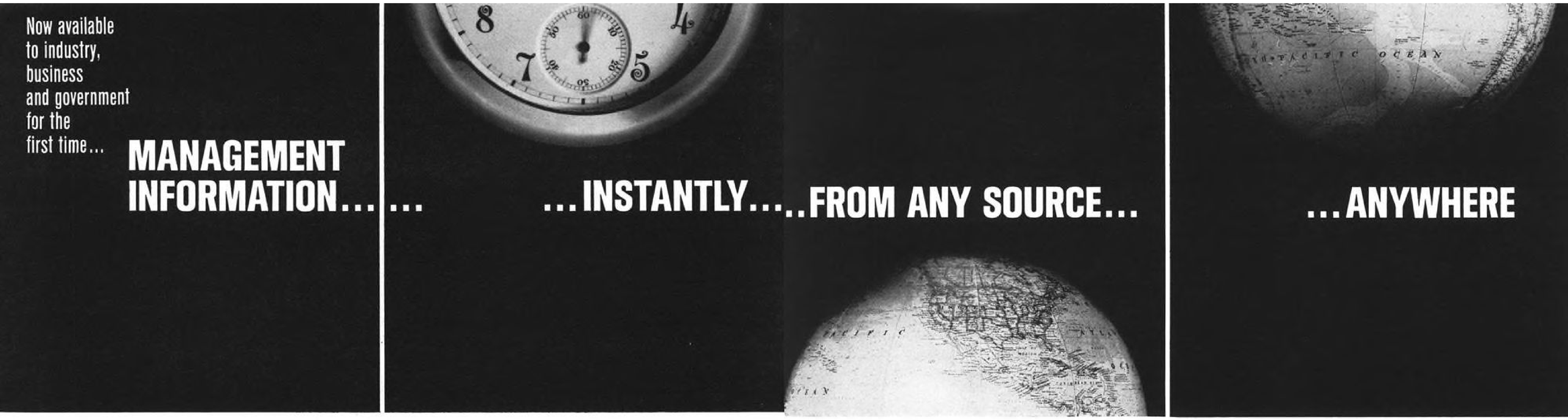
U.S. Coast Guard S-62 To Speed Sea Rescues

Amphibious capability and unique rescue platform weighed heavily in Coast Guard selection of Sikorsky S-62 (HU2S-1) as its next search and rescue aircraft (AW Feb. 12, p. 37). The service recently lost two helicopters within minutes during a rescue mission in Tampa (Fla.) Bay and as a result insisted on amphibious capability in its next rescue aircraft. Both of the helicopters lost experienced power failure while attempting to rescue downed Navy pilots. Rescue platform was developed by Sikorsky after the Swiss requested a similar innovation on a helicopter they were considering purchasing. The development since has been extensively modified. Tests have shown that rescues of downed airmen, particularly those entangled in parachutes or unconscious, can be made up to five times as fast as by the previous method of lowering a sling from a hovering helicopter.



Rescue platform folds up, over and down to form deck extension of S-62. Crew chief can rapidly pull victim aboard.

Rescue platform is being modified to fit flush with interior decking. Sikorsky originally developed the idea to meet Swiss requirements.



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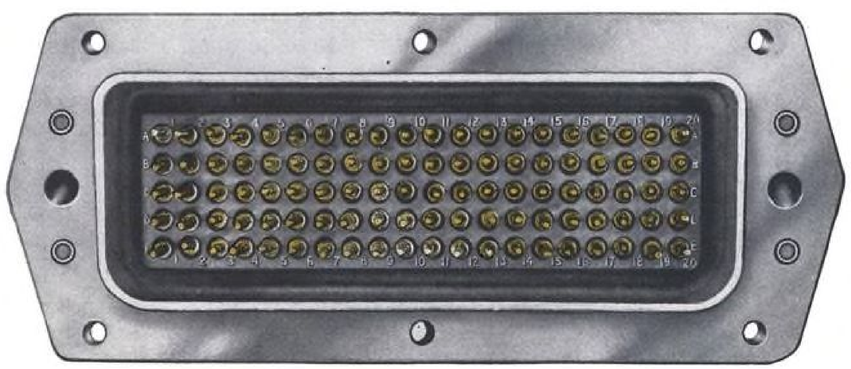

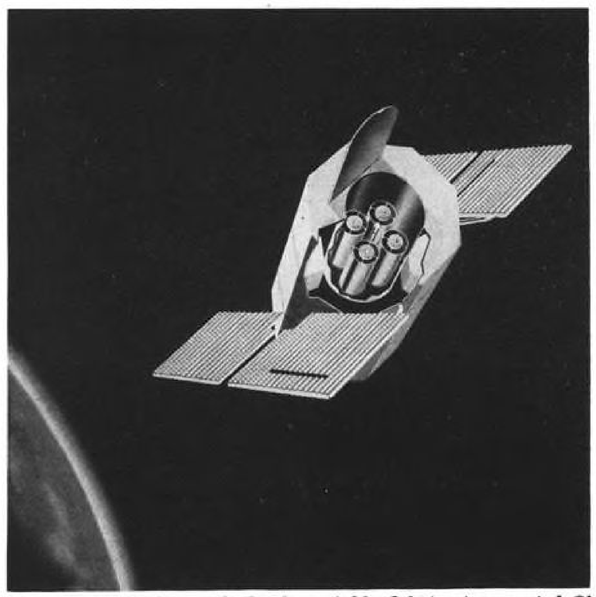

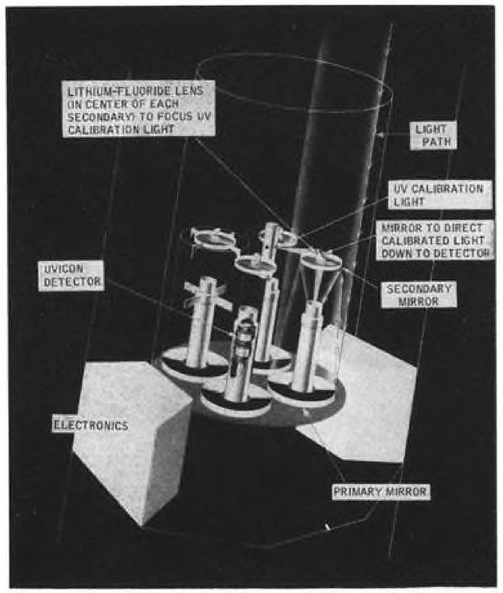

PROJECT CELESCOPE, payload to be carried by Orbiting Astronomical Observatory, will provide televised photos of distant galaxies as seen in ultraviolet portion of spectrum otherwise masked by earth's atmosphere. Close-up of Celescope payload (right), to be built by Electro-Mechanical Research, Inc., includes four Schwarzschild telescopes with ultraviolet videcons plus related electronics packages.

OAO May Penetrate Ultraviolet Curtain

By Philip J. Klass

Project Celescope, a new satellite payload intended to give astrophysicists their first fine-grained look at distant galaxies in the revealing ultraviolet portion of the spectrum now masked by the earth's atmosphere, will be built by Electro-Mechanical Research, Inc., Sarasota, Fla.

The project, under a million-dollar contract recently awarded by the Smithsonian Astrophysical Observatory, is part of a larger program which SAO is conducting for the National Aeronautics and Space Administration.

The Project Celescope package, slated to go into space aboard an Orbiting Astronomical Observatory (OAO), will contain three sensitive telescopes capable of mapping the sky in three adjacent portions of the ultraviolet spectrum, ranging from 1,100 to 3,000 angstroms. A fourth telescope will serve as a slitless spectroscope in the 1,100 to 2,200 angstrom band, to provide ultraviolet spectra for thousands of stars. Observations will be relayed to earth by a special analog-digital television to be developed by Electro-Mechanical Research (EMR).

Automatic data processing equipment on the ground, also to be supplied by EMR, will print out a star catalog expected to total some 100,000 or more stars during the 12 month period the OAO is slated to remain operational. From this and the ultraviolet spectra data, Smithsonian and NASA scientists hope to learn much about the composition of interstellar dust, about hot star atmospheres, planetary nebulae and to gain improved understanding of the hot outer atmosphere that surrounds cool stars.

Four Telescopes

The Project Celescope package which EMR's Systems Division is to provide will contain four telescopes, four ultraviolet videcon cameras for converting telescope images into electric signals, analog and digital data processing equipment for converting these signals into form for telemetering to earth, and associated camera and program controls plus power supplies for converting solar cell voltages to those required for equipment operation.

The complete package is expected to weigh about 400 lb., including supporting structure supplied by Grumman, which is building the OAO under NASA contract. Present contract calls for delivery of both a prototype and a flight model, with the latter scheduled for the spring of 1963.

The optical portion of the package, expected to weigh nearly 200 lb., or half of the total figure, will be produced for EMR by Ferson Optics, Inc., Ocean Springs, Miss., a specialist in precision optics and interferometers. The 12-in. Schwarzschild telescopes must be designed to withstand both the high-acceleration loads of launch and the wide temperature range in orbit, yet retain their precision optical alignment. (Telescopes are named for their inventor, Dr. Martin Schwarzschild of Princeton University.)

Each telescope will contain a Westinghouse Electric Corp. ultraviolet videcon tube upon whose sensitive surface the ultraviolet stellar radiation will be focused. The videcon scans the image, electronically intensifies it, and transforms it into a video signal which is telemetered to the ground.

The 15 kilovolt videcon power supply will be pulsed on-off to serve as an electronic shutter for making "still pictures." At periodic intervals, an artificial ultraviolet star field will be imaged for calibration.

The EMR system will be designed to provide either analog or digital type television pictures. The analog read-out will be used primarily for qualitative viewing and scanning nebulosities, EMR says. The digital read-out will provide quantitative data on radiant intensity and enable scientists to block out clutter from low-intensity sources, if desired. Digital data will be stored

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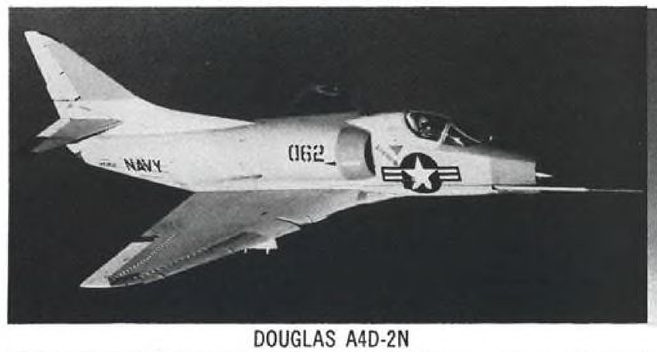

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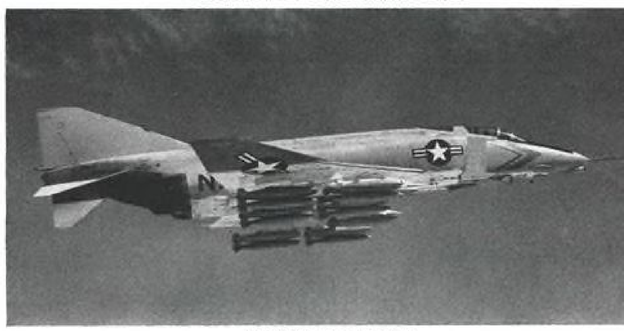
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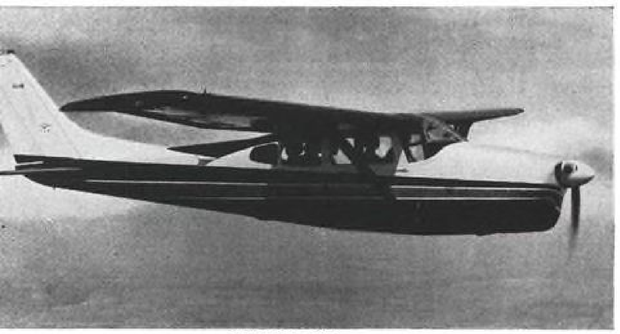
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In Minuteman second stage

Titanium rocket case reduces weight 30%, boosts rigidity and reliability

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Light-weight titanium (density 0.163 lb./cu. in.) can be used in section sizes which prevent buckling failures. To achieve equal buckling resistance, use of steel would impose a 30% weight penalty.

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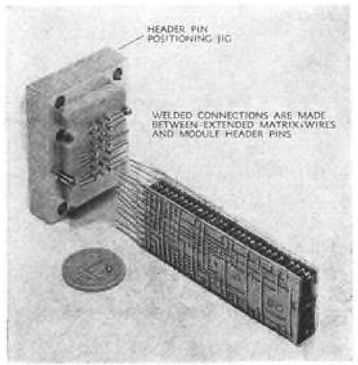


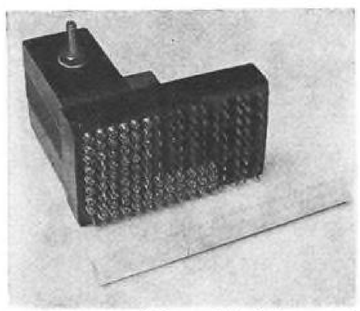
WELDED CORDWOOD type construction will be used in Project Celescope avionics circuitry. The Sippican Corp., Marion, Mass., which pioneered welded construction, will design and fabricate modules to EMR specifications.

on board the OAO and transmitted in a high-speed burst when the vehicle passes over the ground station.

In the analog mode, the ultraviolet videcon will be scanned in a non-interlaced raster at one frame every two seconds using a variable aperture scanning beam. For a 512 line raster, this corresponds to an analog bandwidth of 62.5 kc.

In the digital mode, the scanning beam will be stepped along in equal increments from one picture element to the next, with the beam current turned off during travel between elements. Each of the 512 lines will be scanned in 512 increments. When the beam reaches the next element, it is turned on for five microseconds and the value of the integrated video signal at the end of this interval will be compared with a preselected threshold value, established by command signals from the earth.

When the signal is above the required threshold, its magnitude will be encoded into digital format, together with the position coordinates of the picture element, and stored in the OAO's data processor memory, provided by International Business Machines Corp. (AW May 22, p. 83.) The beam is then advanced to the next picture element and the process is repeated.



WIRE WRAP will be used to interconnect individual modules into larger assemblies. Technique, pioneered by Bell Telephone Laboratories for switchboards, is finding increasing avionics use.

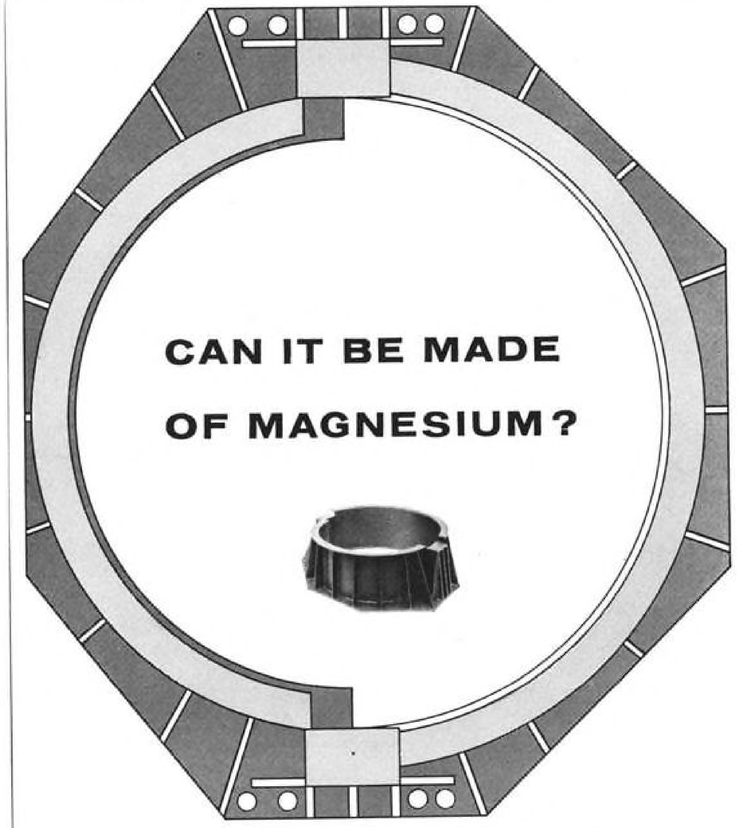
Command and Program Unit

When the orbiting astronomical observatory passes over a ground station, commands can be telemetered to the vehicle which call for changes in adjustment or "execute-event" type actions to be performed on board either immediately, or at some prescribed later time in the OAO's orbit.

These commands are received in binary form by a command and program unit, part of the package which EMR is supplying, and converted into suitable control signals. The system provides for control of 21 on-off type events or adjustments and 24 different parameters which can be set at any one of eight different levels of adjustment.

These include such parameters as beam current, sweep speed, exposure time and target voltage.

The Electro-Mechanical Research contract also calls for providing two ground support systems for Project



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Celescope. One system will be built in portable form for system checkout during pre-launch and launch operations; the other will be installed at the Smithsonian Astrophysical Observatory for preliminary data evaluation.

The portable system will be designed to accept OAO telemetry data and display it on a real-time basis on a storage-type cathode ray tube which will reconstruct the image as seen by the ultraviolet telescope and hold the display as long as required.

The equipment intended for the Smithsonian Observatory will operate from magnetic tapes on which the telemetered information has been recorded. The EMR-built equipment will convert data into a form suitable for operating television monitors and for subsequent processing by an IBM 7090 computer.

One of the major hurdles to the success of the OAO is to achieve a high level of reliability. The design objective is a year of useful operating life. To have a reasonable positive assurance of achieving such life, it would be necessary to operate all of the OAO subsystems in simulated space environment until each of them had operated for three years without failure. This would delay the program considerably, and consume much of the equipment's useful life in the process.

Instead, EMR, IBM and other OAO subsystem contractors will employ a variety of techniques intended to increase reliability. In the EMR Celescope package alone there will be several thousand transistors and diodes. The inherent difficulty of achieving the one-year life in orbit objective can be compared in a gross sense to purchasing several hundred table model radios, turning them all on and coming back several years later to find that every one of them was still operating.

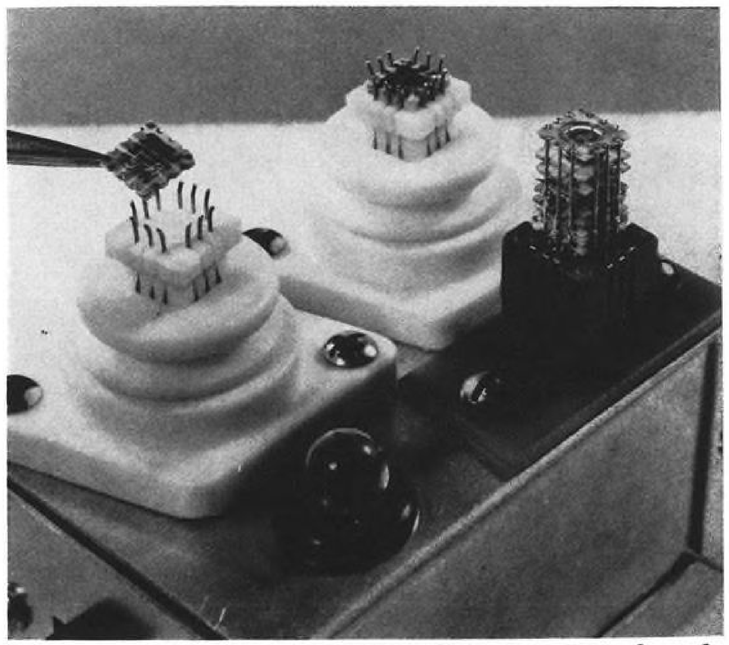
To maximize the reliability of the Celescope package, EMR will employ several techniques. For example, the latest, high-reliability components developed for Minuteman and Polaris missile programs will be used, wherever practical. EMR also proposes to use redundant logic circuitry or whole subsystems, where redundant circuits are not feasible.

Individual circuit modules will be fabricated using welded-wire techniques and encapsulated. Individual modules will be inter-connected by means of wire-wrap process to avoid use of soldered joints and connectors, according to EMR.

A more fundamental approach to reliability, EMR says, is the use of what it calls "micropower solid-state circuits." Using its own funds, the company has developed high-efficiency digital and analog circuits in which the transistors and other components are operated at extremely low power levels. Here are some of the important advantages which EMR claims for its micropower circuits:

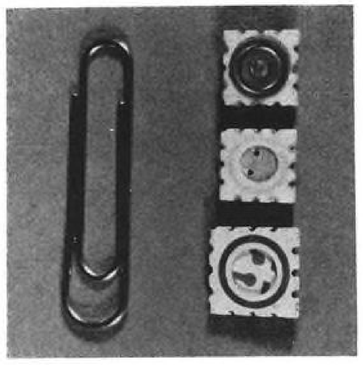
- **Higher reliability,** because components are operated at very low stress levels.
- **Reduced drain** on satellite's limited power source.
- **Higher density packaging** is possible because of low power consumption and heat dissipation.
- **Redundant circuits** can be used without serious penalty in size, weight or power consumption.

Present company estimates of power consumption for the entire Celescope package are only 13.5 watts peak and 6.4 watts average. These figures are approximately half the power consumption which had been allocated for the Celescope package in the original Smithsonian specifications, according to EMR.



Integrated Microelectronic Circuitry Developed

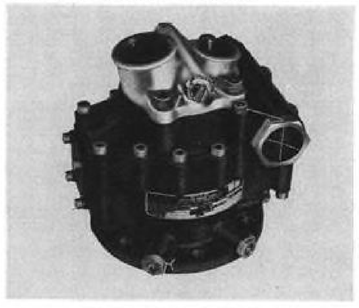
Integrated microelectronic circuitry, which uses deposited or printed passive components and transistor or diode pellets mounted on tiny ceramic wafers (bottom right) similar to those used in Army Micro-Module construction technique, has been developed by Radio Corporation of America. Construction of new RCA "solid ceramic circuits" on 0.3 in. square wafer is shown at three stages in the process (bottom left). Bottom wafer shows deposited resistors and capacitors before being fired. Middle wafer shows them after firing with transistor and diode pellet mounted. Top wafer shows complete assembly after it has been sealed and is ready for mounting. Experimental counter using two RCA solid ceramic circuits as a flip-flop is shown on white supports (top). Unencapsulated Micro-Module (right) serves as oscillator. RCA Semiconductor & Materials Div., Somerville, N. J. expects to be in pilot production on circuits later this year.



Kellogg Hydraulic Pumps Designed for Special Duties

"Aerospace hydraulics" sounds like a field for specialists—and is. Not only are the requirements for air- and spaceborne pumps, fluid motors, etc., far more exacting than for their earthbound counterparts, but, according to the Kellogg Division of American Brake Shoe Company, many different kinds of aircraft and missiles' specifications demand hydraulic components that are specialized even further. For example, the Kellogg Series AP6V pump has become a standard on high-performance, high-altitude military aircraft and on the Saturn missile because of its built-in supercharging function. The AP6V's self-priming two-stage, pintle-ported design permits excellent suction characteristics even at inlet pressures below 14" of mercury absolute.

Another pump — Model AP10V-7 was specifically developed by Kellogg to meet the requirements of high-speed passenger and cargo jets. One of the AP10V-7's most outstanding features is a depressurizing and blocking valve which permits unloaded operation during the periods of reduced demand that constitute the majority of commercial air hours. This feature greatly extends pump service between overhauls.



Other Kellogg specialties expressly designed for airborne operations include fluid motors, surge valves, and complete hydraulic systems. In the development of systems, Kellogg cooperates with other members of American Brake Shoe Company's Hydraulics Group, such as the Raymond Atchley Division (manufacturers of servoamplifiers, torque motors, etc.); and Jarry Hydraulics Ltd. (manufacturers of landing gear, power flight controls, valves, and actuators). Also available for consultation are Brake Shoe's Hydrodynamics laboratory in Columbus, Ohio, and the corporate Research Center in Mahwah, New Jersey.

The Kellogg Division is at 3151 W. 5th Street, Oxnard, California.

FILTER CENTER

▶ **More Headaches for Avionic Component Makers**—Several major aerospace companies, which do not have semiconductor component subsidiaries or departments, are building up semiconductor capability to put themselves into a position where they might internally satisfy future needs for integrated circuits. Autonetics and Martin Marietta are recruiting semiconductor engineers and scientists for internal efforts. Lockheed, which continues its extensive thin film program (AW Oct. 17, 1960, p. 54) also has a semiconductor integrated circuit effort under way. Litton Industries, which passed up frequent opportunities to buy semiconductor component companies in recent years and which is a large potential user of integrated circuits, may also move heavily into the field.

▶ **Probing Aurora Borealis**—Instruments for studying the aurora borealis from polar-orbiting Discoverer satellites are being produced by Lockheed Missiles & Space Co. under an Office of Naval Research contract. With a goal of learning more about charged particles from space, particle ionization of atmospheric gases, and arrival of the particles at lower altitudes, Navy, Air Force and University of Alaska will jointly study the auroras of the northern hemisphere. Satellites equipped with proton and electron detectors and optical photometers will make three orbital passes, around 90 min. apart, over the zone each night. Aircraft, which can fly directly under satellite orbit, and ground stations at University of Alaska, near Fairbanks, also will make optical observations and receive and record satellite observations. Satellite radio signals received by aircraft also will assist in determining amount of signal distortion that occurs in passage through the auroras.

▶ **Liquid Optical Masers**—Space Technology Laboratories is the leading contender for a $150,000 USAF Space Systems Division contract in liquid optical masers. Air Force program will explore possible liquids and liquid solutions which may be suitable as active media for optical masers (AW Jan. 15, p. 92).

▶ **Mariner R Data Conditioning System**—Unusual lightweight, low-power data conditioning system which will accept both analog and digital data from Mariner R instruments and put them in proper format for transmission from the spacecraft back to earth was built by Computer Control Co., Los Angeles and Framingham, Mass. The company was incorrectly identified in an earlier story on Mariner instrumentation (AW Feb. 5, p. 57).

▶ **GE Developing Laser Correlation Radar**—The random spikes which are characteristic of radiation emitted by an optical maser (laser) during pulsed operation may provide a distinctive signature for each pulse which will permit use of new correlation processing techniques in an optical maser radar, according to scientists at General Electric's Light Military Electronics Dept. An experimental laser radar is now under construction at LMED. It will be used to investigate such correlation techniques and to determine whether the target's material, texture and/or incidence angle provide a distinctive smearing of the returned echo which would provide additional information about the target.

▶ **Soviets Show Laser Interest**—A Yugoslavian correspondent in Moscow, reporting on latest Soviet scientific achievements, reports the USSR has built "an apparatus which [makes it] possible to illuminate objects at great distances—even the moon." This suggests the correspondent may have been referring to an optical maser, and prompts speculation that the laser may soon be added to the long list of "Soviet inventions."

▶ **Higher Laser Outputs Reported**—Trion Instruments, Inc., Ann Arbor, Mich. reports that it has achieved peak spike power of 100 kw. from a ruby optical maser with a nominal output of 30 joules per pulse. The device is pumped by a 15,000 joule capacity six-turn helix flash tube with a new configuration to eliminate high voltage. The ruby rod is four inches long, one-half inch square with roof-top geometry, company says, which is cooled by liquid nitrogen to about 90K. Recycle time is 15 sec. at 8,000 joule input. Company says it expects to be in production on the new LS-4 laser by Mar. 1. Quantatron, Inc., Santa Monica, Calif., announces that it has attained 20 joules output from a ruby laser operating at room temperature. The radiation has a very uniform subpulse structure having about a 200 kc. repetition rate. Company predicts outputs up to 50 joules and more using liquid nitrogen cooling.

▶ **High-Power Millimeter Oscillator**—Watkins-Johnson Co., Palo Alto, Calif., is developing a three millimeter backward wave oscillator to be capable of generating one kilowatt of average power, 100 kilowatts peak power. Development is sponsored by the Air Force.

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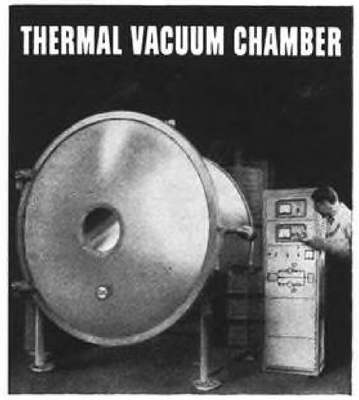

A recent addition at Aerotest is the thermal vacuum chamber illustrated. Six feet in diameter and five feet long, it is being used to test complete satellites and space probes. The chamber can be pumped down to 10^{-6} Torr. Also available are smaller chambers for economical testing of sub-systems and components.

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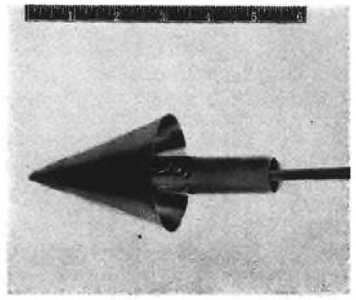
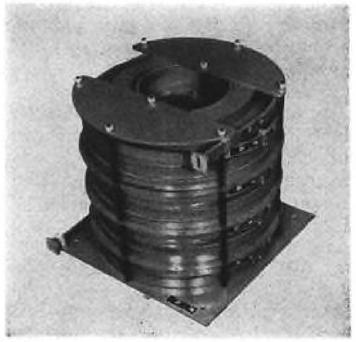
• **Ferrite switch,** Model SC-1, provides minimum of 40 db. isolation, maximum 0.2 db. loss over 6,175 to 6,425 mc. frequency range and 50 db. isolation and 0.1 db. loss at midband. Unit is designed in RG50/U and can be switched in less than 100 microsec. Similar switches can be obtained for use in S and K_a band. Manufacturer: Hyletronics Corp., Burlington, Mass.

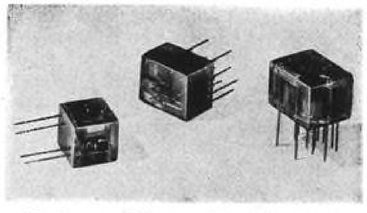


• **Angle of attack indicator,** Model 2521, measures pitch and yaw of aerospace vehicles to a resolution of 0.1 deg., a linearity of ±1% and a repeatability of ±0.1 deg. Cone-shaped instrument with potentiometer pickoff was tested to withstand 1,000F in continuous operation. Pitch and yaw are sensed by two separate potentiometers. Units are designed to sell at less than $1,000 with specific price depending on requirements. Manufacturer: Giannini Controls Corp., 1600 S. Mountain Ave., Duarte, Calif.

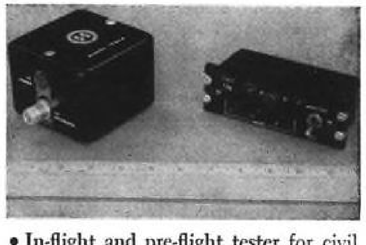
• **Noncontact magnetic encoders,** Models 887-18 and 893-18, employing ferrite readout cores arranged in a U-scan configuration, are designed to replace standard size 18 brush-type encoders. Models 887-18 and 893-18 have 7 and 13 bit full-scale capacity, respectively, and weigh 5 and 8 oz., respectively. Both models meet MIL-E-5272C requirements, have seven-bit resolution per input shaft turn, maximum shaft speed of 10,000 rpm. Manufacturer: Librascope Division, General Precision, Inc., Glendale 1, Calif.



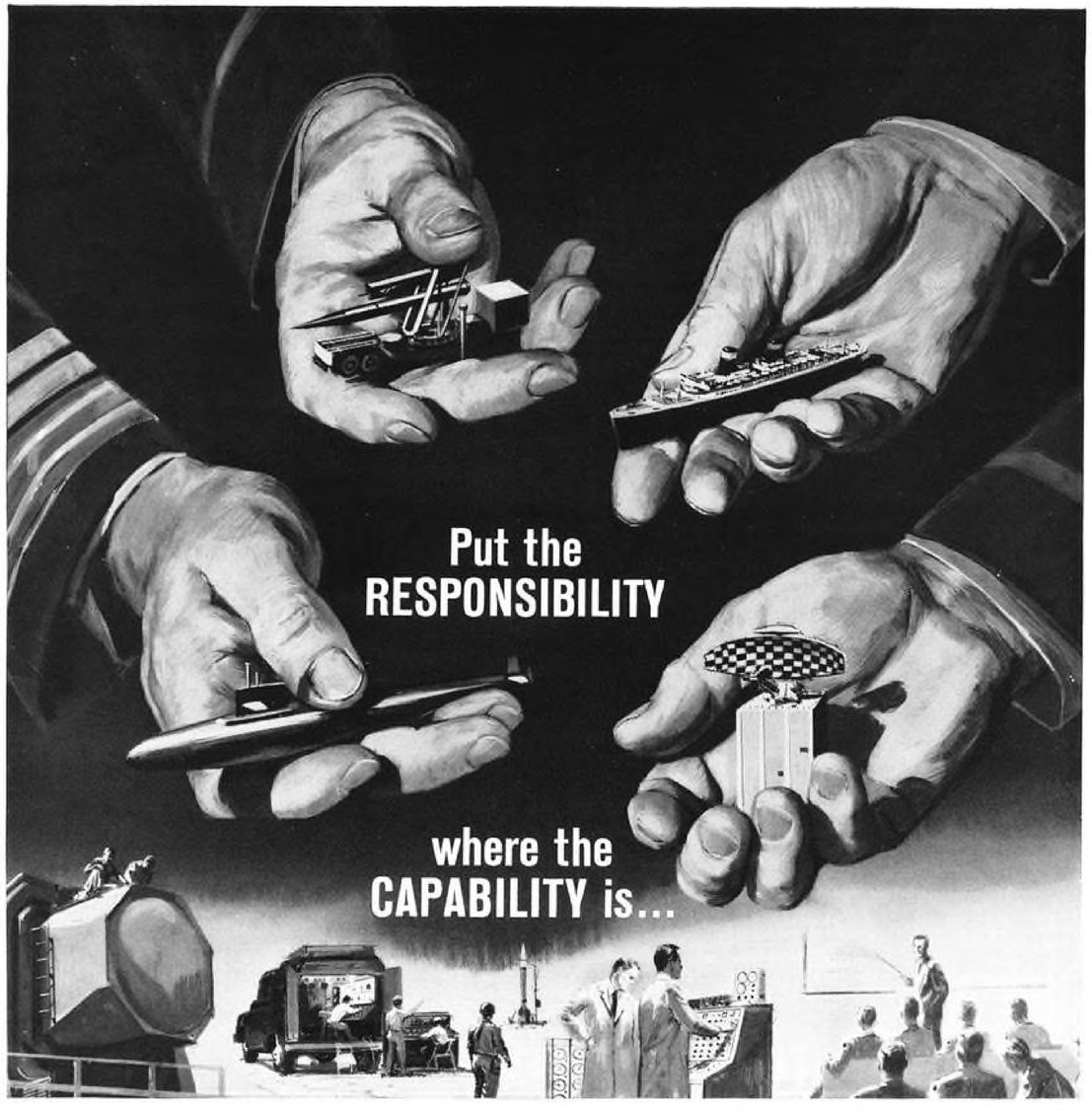
• **Delay lines,** X-band waveguide lines in coiled configurations up to 40 ft. in length and capable of being stacked without special interconnections. A 40-ft. section is 16 in. in diameter, an inch thick not including flanges. Attenuation of half-size X-band aluminum waveguide is less than 10 db./100 ft., vswr less than 1.2 Manufacturer: ITT Federal Laboratories of International Telephone and Telegraph, 320 Park Ave., New York 22, N.Y.



• **Logic modules,** a line of encapsulated circuits, require only a 1.5 volt supply and have high fan-outs up to 1 mc. Six circuits available are flip-flop, shift register, clock, half-adder, indicator and "nor" gate, each one weighing less than 12 grams, and occupying less than ½ cu. in. Manufacturer: Electronic Packaging Co., 1325 Gaylord St., Long Beach 13, Calif.



• **In-flight and pre-flight tester** for civil air traffic control radar beacon or military IFF equipment, provides pilot with "go, no-go" type indication of equip-



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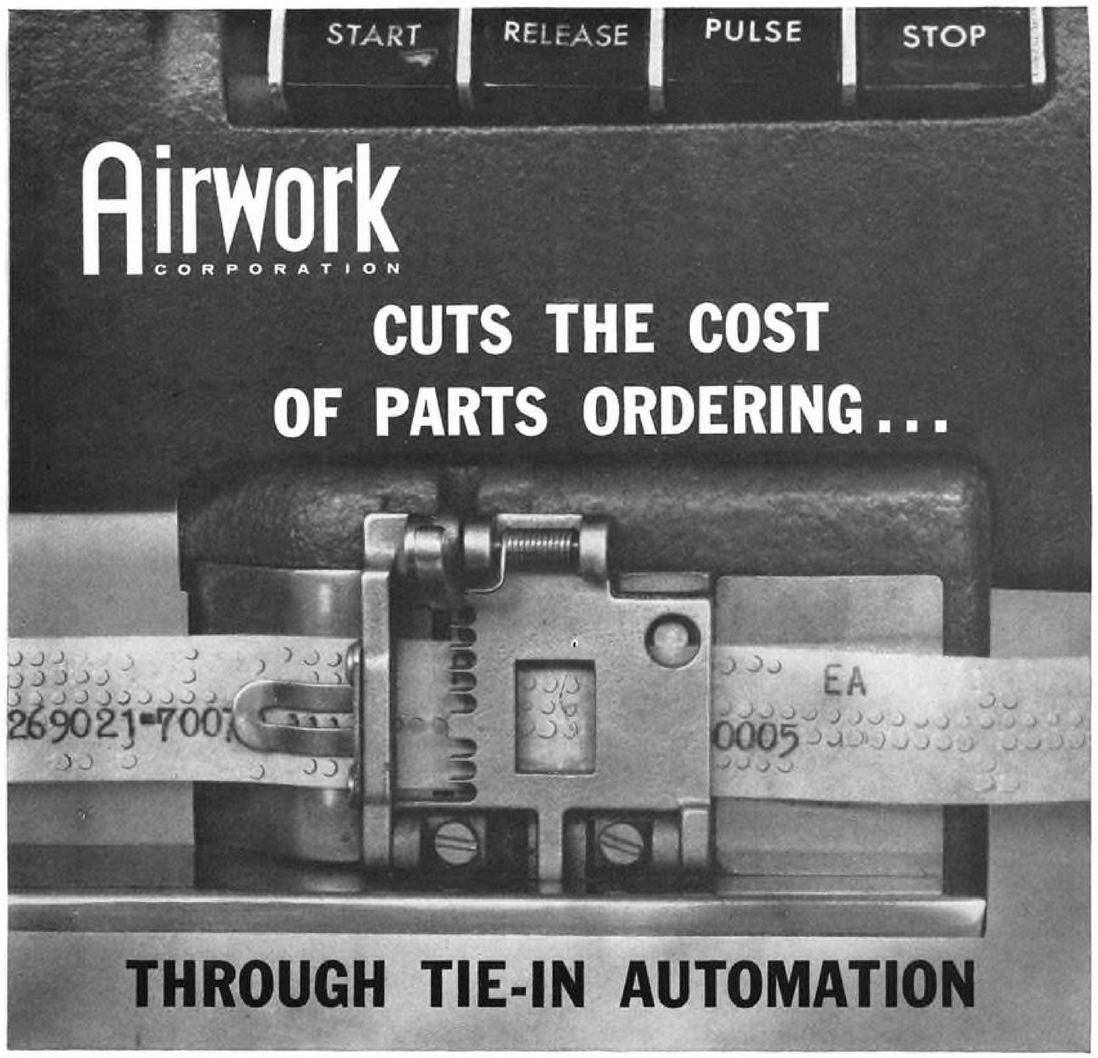

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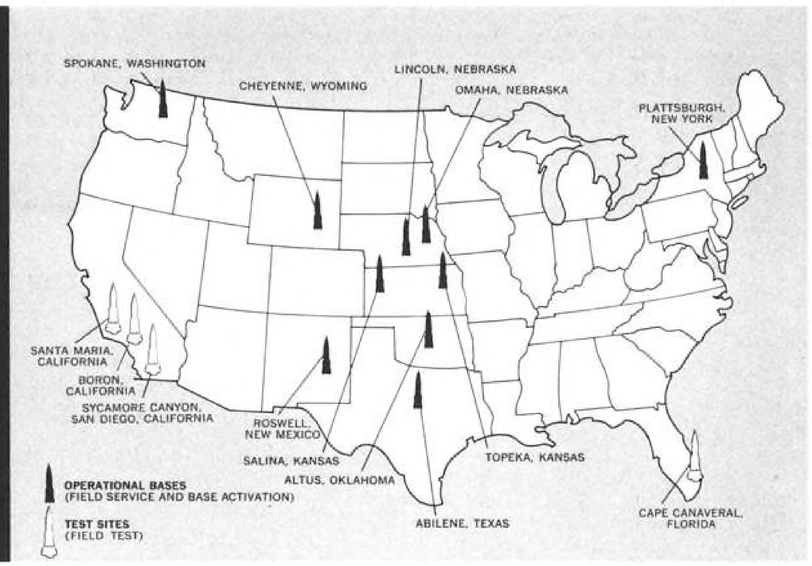
ENGINEERS FOR BASE ACTIVATION

Atlas ICBM operational bases and field test sites are shown in the map on the right. Operational bases are Fairchild AFB, Spokane, Washington; Warren AFB, Cheyenne, Wyoming; Offutt AFB, Omaha, Nebraska; Lincoln AFB, Lincoln, Nebraska; Plattsburgh AFB, Plattsburgh, New York; Schilling AFB, Salina, Kansas; Forbes AFB, Topeka, Kansas; Dyess AFB, Abilene, Texas; Altus AFB, Altus, Oklahoma; Walker AFB, Roswell, New Mexico. Test operations are conducted at Pacific Missile Range, Santa Maria, California; Missile Static Test Site, Boron, California; Sycamore Canyon, San Diego, California; Atlantic Missile Range, Cape Canaveral, Florida.

Immediate openings exist for assignments at Lincoln, Nebraska; Altus, Oklahoma; Abilene, Texas; Roswell, New Mexico and Plattsburgh, New York.



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BSEE, AE, or ME, with field test or design experience in the following:

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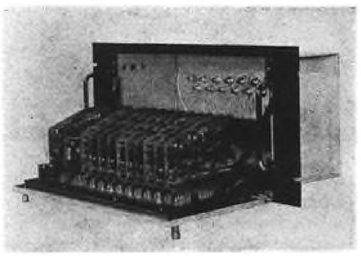
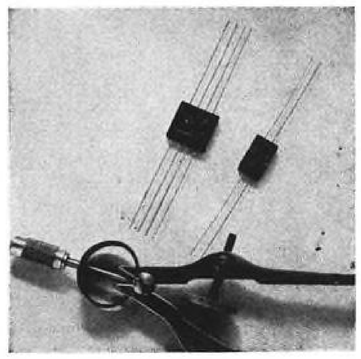
ment operation. The transistorized device, called Tiny Tim, weighs only 1½ lb. and measures approximately 4 x 4 x 3 in. Manufacturer: Hazeltine Electronics Division, Hazeltine Corp., Little Neck 62, N. Y.

• **Cathode ray tube,** Type M1013, a 1¼-in.-diameter electrostatic CRT with a minimum resolution of 500 lines per inch and minimum spot size of 2 milliinch. Tube weighs 8 oz., shielded, potted and equipped with 4-ft. wire leads. Low current heaters can be incorporated for portable or battery applications. Manufacturer: Electronic Tube and Instrument Division, General Atronics Corp., 1200 E. Mermaid Lane, Philadelphia 18, Pa.

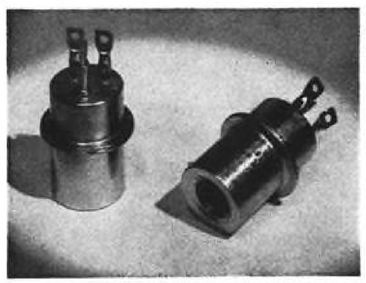


• **Analog-to-digital converter,** AD-10A, which can provide serial output of 5 million bits/sec. or parallel output of 500,000 words/sec. with an accuracy of 0.097% ±½ the least significant bit. The converter can be operated internally or externally for sampling command. It has 12 plug-in panels with 10 logic panels directly interchangeable and is priced, with power supply, at $6,800 on 60 to 90 day delivery. Manufacturer: Raytheon Co., Communications and Data Processing Operation, 1415 Providence Highway, Norwood, Mass.

• **Analog-to-digital converters,** 2500 series, guaranteed to maintain basic accuracy of ±0.01% for six months and built for mounting in 19 in. rack. Conversion speed is 14,000 per sec. for a four-digit binary coded decimal instrument with maximum drift of 0.0025% of full scale. Digital codes available include binary (to 14 bits +), binary coded decimal (coded either 8421 or 4221), or any restricted range of the two basic codes, according to manufacturer, Systems Division of Beckman Instruments, Inc., 2400 Harbor Blvd., Fullerton, Calif.



• **Matched diode assemblies,** MP 1 and 2, MQ 1 and 2, containing matched pair (MP-1 and 2) and matched quad (MQ-1 and 2) diodes for use in chopping, modulation and gating where matched characteristics are needed. Assemblies use controlled conductance planar epitaxial passivated silicon switching diodes. Diodes are matched within 10 millivolts over current range from 100 microamps to 10 milliamps and to within 20 millivolts from 10 milliamps to 50 milliamps. Manufacturer: General Electric Co., Semiconductor Products Department, Electronics Park, Syracuse, N. Y.



• **Germanium power transistors,** Types 2N156, 2N158, and 2N158A, pnp devices within TO-13 welded packages which, manufacturer says, will cut thermal resistance characteristic by 30%. Specially selected I_{CBO} ratings up to 200 volts and I_{CEO} to 100 volts can be provided. Manufacturer: Kearfott Division, General Precision, Inc., 1150 McBride Ave., Little Falls, N. J.

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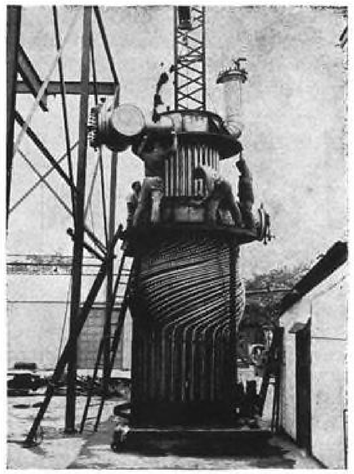

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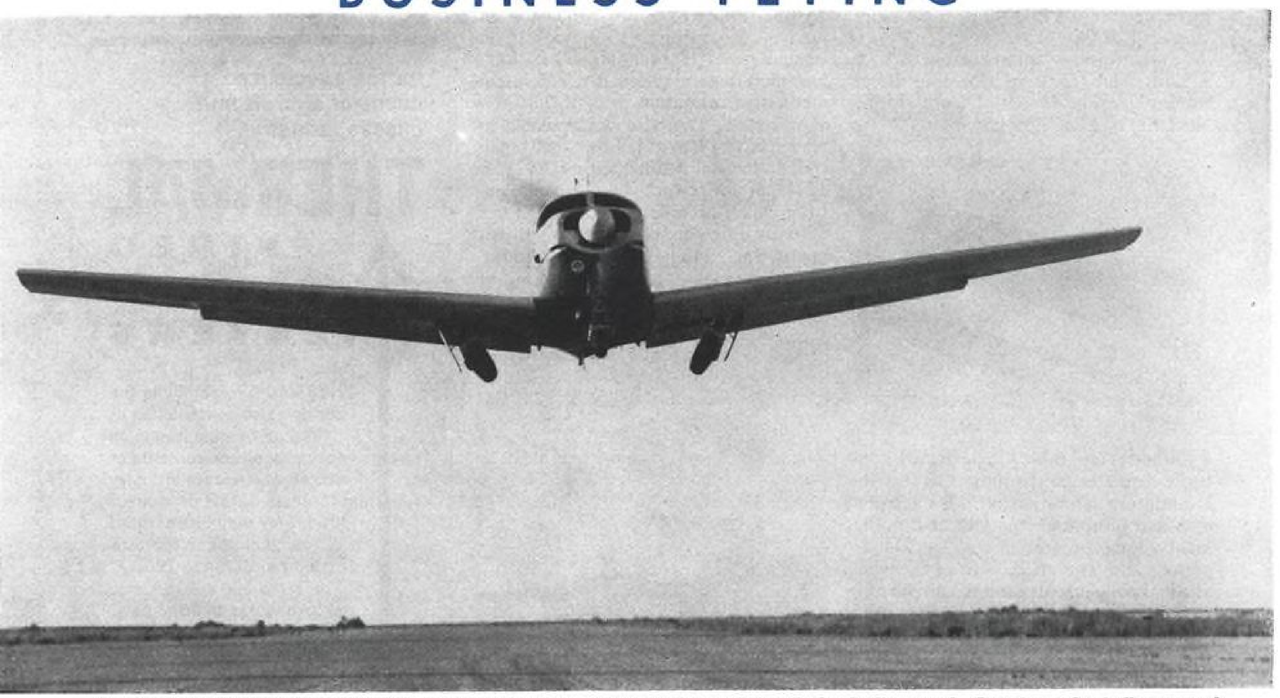


MOONEY MARK 21C FOR 1962 has flap deflection increased to 33 deg. and flaps hydraulically moved. Gear is mechanically operated with spring assist. Wider blade Hartzell propeller is standard on new models.

Aviation Week Pilot Report:

Flying Ease Stressed in 1962 Mooney 21

By David A. Brown

New York—Design changes in the 1962 Mooney Mark 21C emphasize ease of flying and increased load capacity to bring the aircraft more competitively into the business market.

Extensively redesigned and converted to all-metal configuration in 1961 (AW Jan. 16, 1961, p. 108), the Mark 21 retains the basic design features of the earlier wooden wing Mark 20. In addition to previous changes, the 1962 Mark 21 has increased useful load and gross weight, hydraulic flap actuation and increased flap travel and other refinements (AW Nov. 13, p. 105).

To determine flight characteristics of the new Mark 21C, this AVIATION WEEK pilot flew N 75754 from Westchester County Airport, White Plains, N. Y. with Mooney dealer Jack O'Neill of Darien, Conn. in the copilot's seat.

The aircraft was the 10th off the production line in 1962, out of a programed production total of 425. Approximately 70 aircraft had been delivered by Feb. 1. In 1961, the company produced 280 units and delivered 286, the extras being leftovers from 1960 production.

A walk-around inspection revealed these changes from previous models:

- **Gross weight** is up from 2,450 lb. to 2,575 lb. and useful load has been increased from 950 lb. to 1,050 lb.
- **New Hanlon & Wilson exhaust** system provides more cabin and carburetor heat. Longer engine cowl flaps open only three degrees for decreased drag and proper cooling.
- **Hydraulic flap actuation** has been added with flap travel increased from 23 deg. to 33 deg. for improved landing approach characteristics and shorter landing capability. Flap and trim indicators have been added to the cockpit.
- **New instrument panel arrangement** has instruments packaged according to function. System, designed and engineered by Garwin Instruments, includes a pictorial gyro horizon with converging grid system for easier attitude reference. Electric turn and bank indicator has a built-in volt-meter.
- **Hartzell HC-C2YK/7666-2** 74-in. constant-speed, controllable-pitch propeller with a slightly wider blade chord than the previous McCauley model is now standard equipment. The new propeller is said to be more efficient with the amount of horsepower available. The aircraft retains the 180-hp. Lycoming O-360 of previous years.
- **Interconnected controls,** using a light spring arrangement, provide coordinated flight using rudder or aileron only.
- **Rudder travel,** increased from 18 deg. to 23 deg. provides more effective crosswind control.

Counting both major and minor changes, Mooney lists a total of 44 improvements in the 1962 model.

Weather conditions for the flight were good to excellent, with an overcast at 10,000 ft. and visibility exceeding 15 mi. Wind was from the north-northwest at 4 mph. and gusting gently. Altimeter setting was 30.19 and the temperature was approximately 20F.

Starting procedure of the 1962 Mark 21C is not markedly different from previous models, except that the re-arranged panel has the master switch and automobile-type magneto-starter switch in the upper left corner. Priming was accomplished by alternately opening and closing the throttle. After four priming shots and with the mixture full rich, the almost cold engine fired smoothly after approximately four revolutions by the starter.

The engine accelerated smoothly to 1,000 rpm. and was held at that speed during taxi.

Taxi characteristics of the Mark 21C are good with a short turning radius and excellent visibility, particularly of the wingtips and horizontal stabilizer. The ride is smooth, even though the aircraft uses rubbed-disk shock absorbers on all three gear struts.

Runup and pretakeoff checks are simple and should offer no problems for the non-professional businessman pilot.

For convenience, takeoff and landing checklists are placarded near the radio microphone.

Instrument Grouping

A check of the engine instruments was simplified by the grouping of the instruments in a package on the right side of the panel, but easily visible from the left seat. The package includes fuel quantity gages calibrated in pounds for both main tanks, oil pressure and temperature, cylinder temperature and ammeter. Above the package are the engine rpm. gage and a single gage containing both fuel pressure and manifold pressure indicators.

Runup was completed at 1,700 rpm. and the engine was checked for rpm. drop on each magneto and with carburetor heat on. Maximum drop encountered was 125 rpm. on the left magneto.

The propeller was exercised twice and operated normally in the sub-freezing outside air temperature. All critical control knobs—propeller pitch, carburetor heat, mixture and flap retraction knob—have push-button locks in the center of the knob. This prevents inadvertent operation of any of them, but the locks can be easily disengaged with one hand.

While holding for traffic, a quick panel check was completed and flaps were lowered approximately seven degrees.

The manually actuated hydraulic flaps are the most drastic change encountered on the 1962 Mooney and the change is the one most likely to increase the case with which the businessman pilot can fly the aircraft.

A hand pump now moves the flaps down by tapping hydraulic fluid off the braking system. Each full up-down cycle of the pump lever, which is located adjacent to the gear retraction lever, lowers the flaps approximately seven degrees, with less than full cycles lowering the flaps a correspondingly smaller angle.

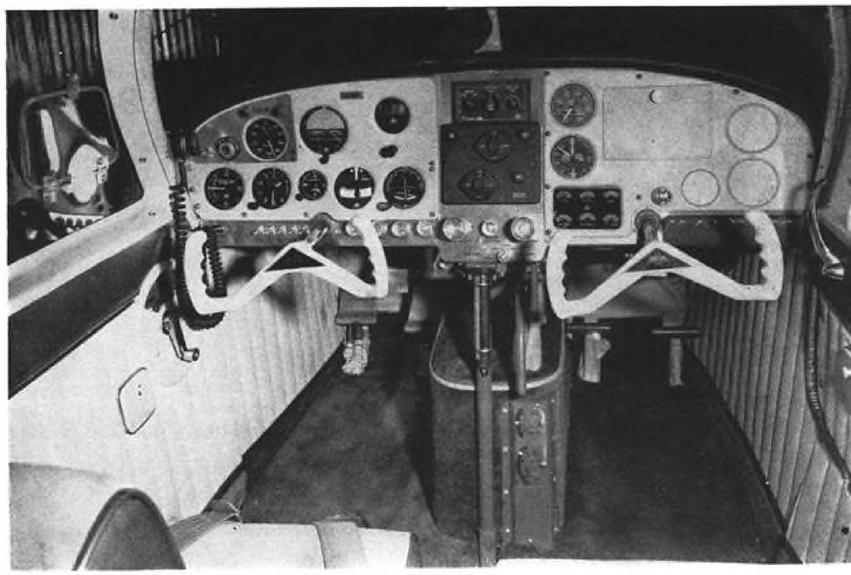
Operation of the flap pump was found to be simple and easy. Moreover, there is no chance of inadvertently operating another subsystem, the landing gear for example, since no other cockpit control is similar to the flap pump handle.

Power was applied a little too rapidly on the first takeoff with the result that a fair amount of rudder displacement was required to overcome torque. Subsequent takeoffs were less affected by torque, since power was eased on more slowly. Torque was noticeable on all takeoffs, but was easily overcome with rudder.

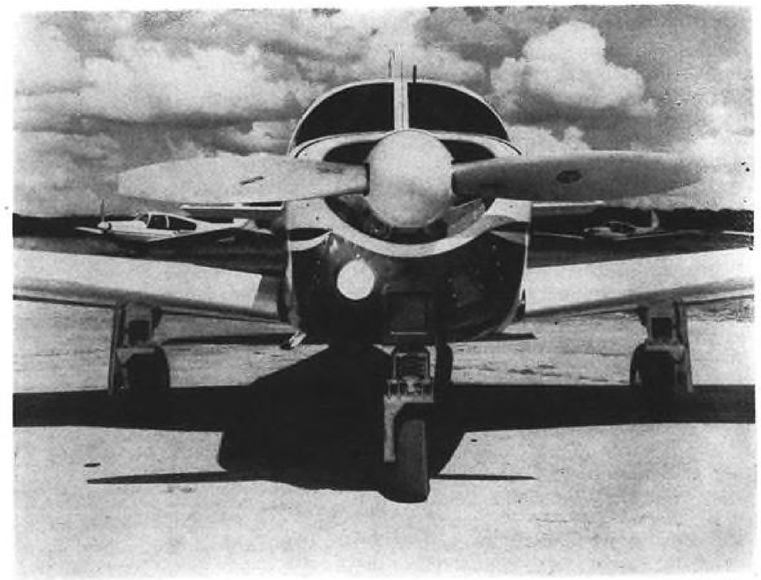
The aircraft was held on the ground until 70 mph. IAS was reached, with the result that the Mark 21C jumped into the air. Smoother takeoffs were found to result by rotating the aircraft sooner and letting it fly itself off.

Speed build-up was rapid and the aircraft settled into its climb speed of 110 mph. IAS at 2,500 rpm. and 25 in. Hg.

Flap retraction is simple. A flap retraction knob is located on the instrument panel just above the flap hydraulic hand pump. When the knob is pulled, hydraulic pressure is released and the flaps return to the full up position. A



REDESIGNED INSTRUMENT PANEL has flight instruments grouped in front of pilot, engine gages in a package to the right of the radios. Area to right side of the panel is designed for additional radio gear. Note grid lines on gyro horizon.



GEAR HAS RUBBER DISK shock absorbers on knee-action struts to give a smooth ride. Landing light has been increased to 250 watts. Hartzell propeller is constant-speed, variable-pitch type and is said to be more efficient with amount of horsepower available.

MARK 21C has low-drag, laminar-flow wing and cleaned up frontal area to increase speed without increasing power requirements. Entire tail cone is mounted on bearing and swivels when trim control wheel is moved. The aircraft has all spaces between stationary surfaces and movable control surfaces sealed.

restrictor valve limits the rate of movement of the flaps and, in effect, relieves the pilot of the worry of easing the flaps up.

When the flaps are full up, the flap retraction knob is pushed in to ready the system for operation.

Gear retraction is the same as on previous models, with a quick tug backward and down needed on the gear lever to raise the wheels easily. The reverse action of this system—pulling the gear lever down to get the wheels up—may be momentarily confusing to military-trained pilots, but should not be a hindrance after several landings. A red-green light arrangement located above the airspeed indicator and almost at the pilot's eye level indicates gear position. A slide lock holds the gear lever in either position and prevents inadvertent retraction or lowering of the gear.

The 1962 Mark 21C, like its predecessors, is quite responsive to trim. A redesigned trim control system has been installed in the airplane in hopes of striking a happy medium between relatively insensitive trim controls on some former Mooney models and modifications of these controls which tended to be overly sensitive. The new trim control was found to make possible rapid and precise trimming of the aircraft without overtrimming and without the pilot having to furiously work the trim wheel.

OIL FILLER NECK has been lengthened and battery access door added to the cowling.

In level flight, the Mark 21C rides on a definite and noticeable step, so that it appears at first to be in a shallow glide to the pilot unused to flying it. O'Neill recommended climbing slightly above the desired level-off altitude and trading off several hundred feet of height to get the aircraft in cruise configuration most easily.

At 7,000 ft. with the outside temperature −4F, the Mark 21C maintained 165 IAS or 177 TAS. Power setting was 2,450 rpm. and 22.5 in. Hg.

Buffeting Noted

A gentle buffeting—noticeable as a warning, but not severe—preceded stalls. With gear and flaps up and partial power, the Mark 21C stalled at approximately 62 mph. IAS and recovered rapidly either with power addition or slight forward pressure on the stick. Hard back pressure and full power off were required to get a stall in which the nose fell through.

With gear and flaps down, the aircraft stalled at approximately 56-57 mph. IAS. Slow flight was possible with good stability and control right down to the stall buffet, although recommended slow flight speed is 80 mph. IAS.

The Mark 21C stalled straight ahead in all configurations, even when stalled in a steep turn. Aileron control was such that S-turns could be made with ailerons alone while the aircraft was in the stall buffet.

The 1962 Mark 21C incorporates in its control system a light spring interconnect which permits coordinated flight using either rudder or ailerons alone. The interconnect system is easily overridden and isn't noticeable when the pilot is using both controls.

The interconnect arrangement has eliminated the yaw sometimes noticed in earlier Mark 20 and Mark 21 models when the aircraft was trimmed to hold a heading hands off, especially in choppy weather.

The relatively stiff controls on the Mark 21C give it a big plane feel, but may be somewhat distracting to light aircraft pilots used to somewhat looser control movements. An hour's air time, however, should dissolve this feeling. The Mark 21C is quite responsive to control movements and without the stiffness probably would be overcontrolled with regularity.

Flap travel on the 1962 Mark 21C has been increased from 22 deg. to 33 deg., a design change which noticeably changes the aircraft's attitude on approaches. The new model has a more nose-down attitude than the 1961 Mark 21 (AW June 5, p. 102) and is similar to other business aircraft of its class.

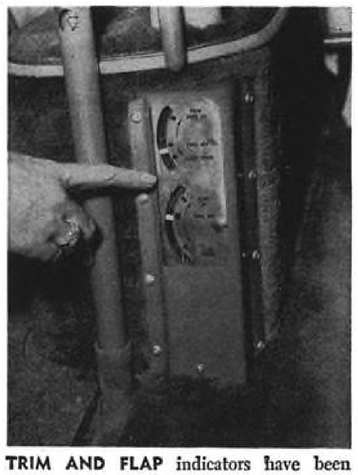
Flap area remains the same as in previous models, 17.2 sq. ft., but the greater degree of travel possible will aid short field landings.

Gear-down limitation speed is 120 mph. IAS. and gear was lowered on the base leg of the approach while holding 110 mph.

Flaps were started down as the base leg was begun. Experience showed that by pumping in a few degrees of flap, then trimming out the resulting pitch, the Mark 21C would hold the desired glide angle nicely.

Base leg was flown at 95 mph. IAS and final at 85 mph.

The flaps lower gently and do not cause abrupt changes in the Mark 21C's attitude. The flap pump handle is located next to the gear retraction lever and adjacent to the throttle.



TRIM AND FLAP indicators have been added to the cockpit and are located on the nosewheel well covering. Gear retraction lever is at left and flap pump handle is above indicators.

Spanish Executive Aircraft Under Development

Model with aerial background dubbed in, shows general configuration of the HA-230 twin-jet executive aircraft under development in Spain by Hispano Aviacion. Range is expected to be more than 1,600 mi. and cruise speed 420 mph. (AW Nov. 13, p. 115).

The 1962 Mark 21C flares a bit more than did previous models and failure to flare sufficiently resulted in a bump landing the first time. The second landing was fast over the fence and the aircraft tended to float, but exhibited good rudder and aileron response through the stall and settled nicely as speed dissipated. The Mark 21C is an exceptionally clean airplane for its type and does not lose excess airspeed rapidly.

On the third and succeeding landings, proper speed coupled with adequate flare brought about gentle touchdowns. Mooney experience has been that five or six landings usually are sufficient to transition the average business pilot to the 1962 Mark 21C.

Braking is exceptional. On the final landing, hard braking was used to make a taxiway turnoff and the Mark 21C stopped smoothly with only a moderate nose down pitch and without any shudder or vibration. Toe brakes have been redesigned in the 1962 model to provide positive distinction between rudder and brakes control.

The Mark 21C cabin is well arranged and there are no controls which are not within easy reach from the left seat. Fuel tank switches are located on the floorboard in front of the pilot and radio gear is centered on the panel. Area has been provided on the right side of the panel for a map compartment or additional radio gear.

The cabin was comfortable, although slightly smaller in total cabin area than some similar aircraft. The trim is of nylon material dielectrically attached to sound absorbent backing. The cabin is quiet enough to permit ordinary conversation even during takeoff. Cabin heating is more than adequate.

Mark 21C Performance

Gross weight	2,575 lb.
Speed	
Maximum (sea level)	190 mph.
Cruise (75% power)	180 mph.
Cruise (69%) power	172 mph.
Economy Cruise (60% power)	165 mph.
Range	
170 mph. at 9,000 ft., no reserve	900 mi.
148 mph. at 12,000 ft., no reserve	1,130 mi.
Rate of Climb	
120 mph. at 2,550 rpm	600 fpm.
Service ceiling	18,000 ft.
Takeoff run, sea level, 10 mph. wind	650 ft.
Landing roll, sea level, 10 mph. wind	600 ft.
Wing loading	15.4 psf.
Power loading	14.3 lb./hp.

PRIVATE LINES

Federal Aviation Agency has compiled rules for certification and operation of amateur-built aircraft into a single publication available free of charge at FAA district and regional offices. The new publication, Flight Standards Service Release 456, is designed to help prevent unintentional violation of Civil Air Regulations by amateur builders.

FAA will study the effectiveness of satellite aviation repair stations, operating under a certificated parent organization, for a trial period of six months. During the trial period, Barfield Instrument Corp., of Miami, Fla., will operate branches at Indianapolis and Atlanta under a common managerial system.

Federal Aviation Agency has instituted trial-type hearings for airmen facing suspension or revocation of their pilot's licenses. Regional hearing officers have been appointed. Move follows recommendation made in the Project Tightrope report. Pilots have the right to appeal revocations to the Civil Aeronautics Board.

Mexican government has taken delivery of a second Fairchild Stratos F-27F for use by President Adolfo Lopez Mateos and his staff. F-27A, purchased by Mexico in 1959, currently is undergoing modification at the company's plant in Hagerstown, Md. and will be brought up to F model performance standards.

SAAC 23 jet executive aircraft under development by Swiss-American Aviation Corp. will incorporate automatic cabin pressure system developed by Astek Instrument Corp., Armonk, N. Y. System will maintain desired cabin pressure at altitudes up to 40,000 ft.

Cessna Aircraft Co. reported sales of $23,581,000 for first quarter of Fiscal 1962, ending Dec. 31. After-tax earning for the first quarter amounted to $1,441,000 or 44 cents per share. This compares with sales of $24,353,000 and earning of $1,698,000 or 52 cents per share for a similar period in Fiscal Year 1961.

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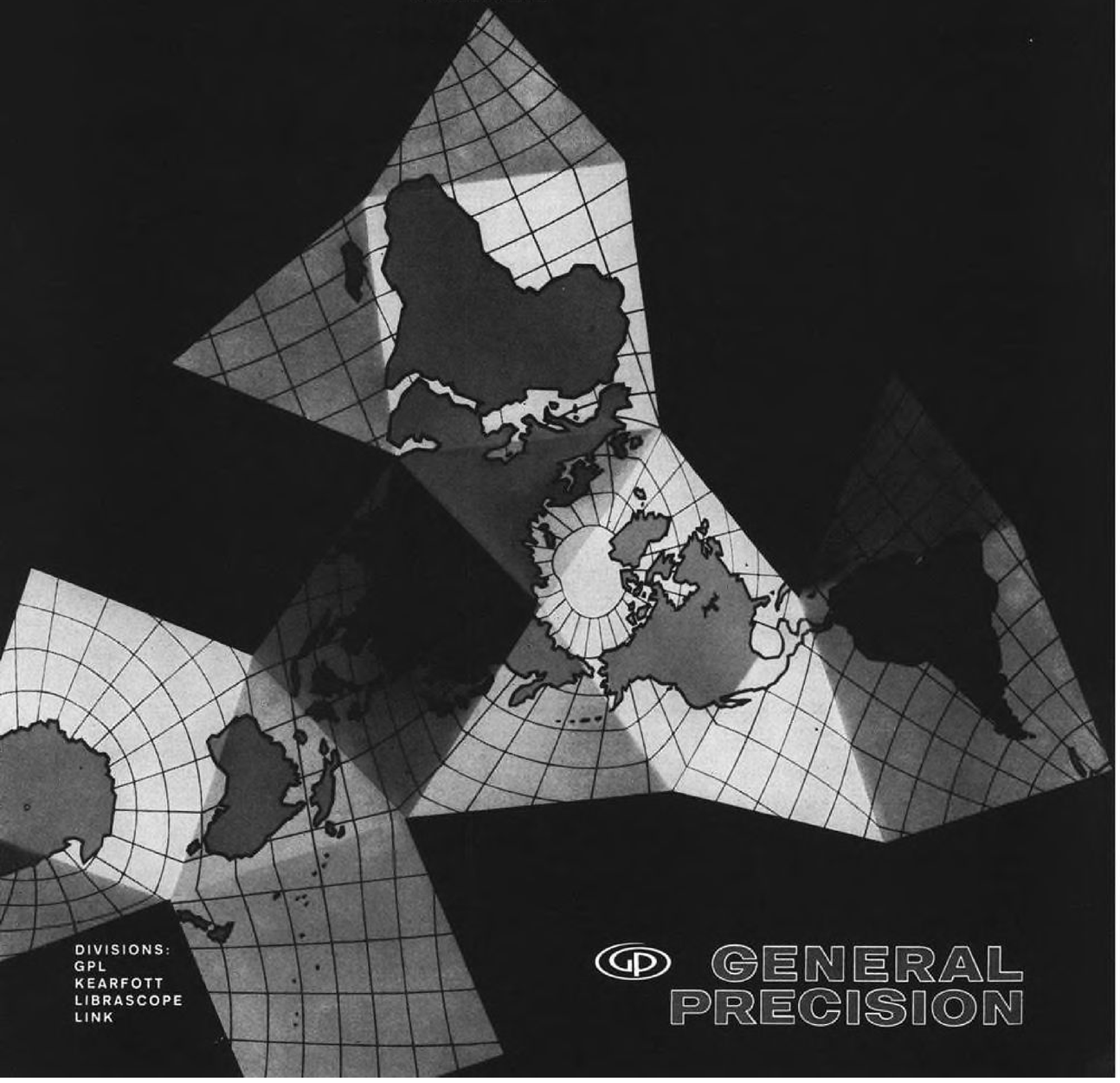

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CAB Accident Investigation Report:

Crew Confusion Cited in Imperial Crash

On Nov. 8, 1961, at 2124 EST, an Imperial Airlines Lockheed L-049 crashed and burned during an attempted landing at Byrd Field, Richmond, Virginia. Seventy-four passengers and three flight crew members died as a result of carbon monoxide poisoning. Two members of the flight crew escaped from the burning wreckage. The aircraft was totally destroyed.

The flight was en route from Baltimore, Maryland, to Columbia, South Carolina, when in the vicinity of Richmond the crew as a result of fuel mismanagement allowed the Nos. 3 and 4 engines to run the No. 4 fuel tank dry. When they were unable to restart the two engines, they feathered the propellers and elected to land at Richmond. As the flight approached the airport for its intended landing on Runway 33, Captain Greenlee, who was acting as copilot, without warning to the captain in command, turned the aircraft to attempt a landing on Runway 02 and put the landing gear selector in the down position.

When the landing gear did not extend due to crew mismanagement of the hydraulic system, a go-around was attempted with only the Nos. 1 and 2 engines operating. During the go-around, which was poorly executed, the No. 1 engine failed as a result of overboosting. With only one engine remaining in operation it was impossible to maintain flight. The crew also misjudged the aircraft flightpath, overshot the extended centerline of Runway 33 and crashed one-half mile to the left of the final approach path and one mile from the runway threshold.

The Board determines the probable cause of this accident was the lack of command coordination and decision, lack of judgment, and lack of knowledge of the equipment resulting in loss of power in three engines creating an emergency situation which the crew could not handle [AW Dec. 18, p. 103].

Investigation

Imperial Airlines Flight 201/8 was scheduled as a common carriage flight to transport newly inducted members of the U.S. Army to Columbia, South Carolina, for training. The aircraft, a Lockheed L-049, N 2737A, was to depart Columbia, South Carolina, enplane passengers at Newark, New Jersey, Wilkes Barre, Pennsylvania, and Baltimore, Maryland, and transport them to Columbia.

In preparing for the flight several aircraft discrepancies required maintenance. The aircraft was serviced to 3,180 gal. of fuel and the necessary flight papers prepared. The crew consisted of Captain Ronald H. Conway, Captain James A. Greenlee, Flight Engineer William F. Poythress, Student Flight Engineer Peter E. Clark, and Stewardess Linda Johns. Captain Conway testified at the public hearing that although Captain Greenlee was the senior captain, it was agreed between them that Conway could command this flight and Greenlee would act as copilot.

At 1514[1] EST, after changing the flight plan from IFR to VFR[2], the flight departed Columbia for Newark to pick up the first of its passengers. Flight Engineer Poythress testified at the hearing that as the aircraft broke ground, he noticed a drop on the No. 3 fuel pressure gauge. Poythress then said he inquired of the trainee Clark, who was occupying the Flight Engineer's station, "What are you going to do?" Clark replied "I am going to go 3 and 4 crossfeed to assure positive pressure on the right side." Poythress said the crossfeeds were opened and the pressure drop did not occur again. He also stated that the captain was not informed of the drop in fuel pressure or that the crossfeeds were opened. Poythress testified that the crossfeeds were closed when the aircraft reached cruise altitude of 9,500 ft.

The remainder of the flight segment was routine, landing at Newark at 1737. Twenty-six passengers were boarded during the 45-min. layover. Neither service nor maintenance was performed during the stop and according to the surviving crew members the aircraft had 2,300 gal. of fuel remaining.

Flight Departure

At 1822 the flight departed Newark for Wilkes Barre, Pennsylvania, on a VFR flight plan to cruise at 4,500 ft. At the public hearing, Flight Engineer Poythress stated that he opened the Nos. 3 and 4 crossfeed valves prior to takeoff to keep from having the drop in fuel pressure which occurred out of Columbia. A fifteen-minute passenger stop was scheduled at Wilkes Barre, and the aircraft was on the ground about 16 min. while 31 additional passengers were boarded. During this stop engines Nos. 1 and 2 were shut down and Nos. 3 and 4 were kept operating.

The flight then departed for Baltimore at 1912, VFR at an altitude of 4,500 ft. The calculated takeoff weight was 82,176 lb. Maximum allowable takeoff weight for N2737A was 98,000 lb. Mr. Poythress again, according to his testimony, opened the Nos. 3 and 4 crossfeeds for the takeoff.

The flight then landed at Baltimore and again only engines Nos. 1 and 2 were shut down while 16 additional passengers were boarded. The aircraft then left the gate and proceeded to the run-up area. However, it was recalled to the terminal to pick up one additional passenger. After this additional delay, takeoff was made at 2030. As Mr. Poythress testified later, in anticipation of a drop in fuel pressure he again opened the Nos. 3 and 4 crossfeeds.

About 2035, Greenlee contacted Washington area radio and filed a flight plan: direct to Columbia, South Carolina, at 4,500 ft. VFR, true airspeed 218 kt., estimated time en route 2-hr. 10 min. with 5-hr. 30 min. fuel on board; 74 passengers and crew of five.

Captain Conway testified that he flew the entire flight from the left pilot's seat and that Greenlee was acting as copilot. He also stated that Mr. Clark had acted as flight engineer and had occupied the seat at that station throughout the flight, including the takeoff from Baltimore. Poythress denied this by stating that he, not Clark, had been at the flight engineer's station during takeoff from Baltimore.

Congested Area

Captain Conway testified at the hearing that after departure from Baltimore he proceeded west of Washington, D.C., to avoid the congested area, and to intercept Victor airways 3. He said his usual route for this segment was by way of "Brookville", (presumably he meant Brooke Omni) Flat Rock, Raleigh—Durham, Winston, Chesterfield, and Columbia. Captain Conway said he recalled passing the "Brookville Omni" after reaching flight plan altitude and establishing cruise power. He asked Greenlee to make a notation of this so as to be able to get an accurate groundspeed check on the next log.

Sometime after passing "Brookville," he did not know how long, he said the airplane yawed to the right and the fuel pressure warning lights for engines 3 and 4 came on. At this time, according to Mr. Poythress, he had gotten up and student Flight Engineer Clark was at the panel. Clark shouted to Poythress concerning the fuel pressure warning lights, and Poythress immediately assumed the flight engineer's station. Poythress testified that when he took over the engineer's station the Nos. 3 and 4 fuel pressure warning lights were on and No. 3 engine had stopped rotating. No. 4 engine rpm. was surging between 1,500 and 2,000 rpm. Conway said he advised Mr. Poythress "you have got a fuel problem." He said he saw Mr. Poythress open all four crossfeed valves and check to see that fuel selectors were positioned for tank to engine feeding. In addition, he said Poythress turned on all four fuel boost pumps and advised he was going to try to start Nos. 3 and 4 engines. At this time both Poythress and Conway stated that the fuel gauges were all in a position which indicated fuel. However, they could not recall the exact amount.

A few moments later Captain Conway said he told Poythress to concentrate on one engine. He said "No. 4 appeared to be partially running, so I told him to feather No. 3 engine and concentrate on No. 4." Poythress testified that he had received these orders from Greenlee. According

[1]All times herein are Eastern Standard based on the 24-hr. clock.
[2]IFR—Instrument Flight Rules
VFR—Visual Flight Rules

to Conway, Poythress then said he was unable to restart No. 4 and he was going to try No. 3 and shut down No. 4.

Poythress said that about this time he ordered Clark, the student engineer, to go back to the passenger cabin and open the midship fuel crossfeed valve. Poythress testified that Clark came back to the cockpit and said he would have to have a screwdriver to get at the valve. At that time Greenlee said "don't open that valve. You have good pressure on 1 and 2; leave it there." With that, the crossfeed valve was not opened. Conway testified that he knew nothing of this until after the accident and assumed that the valve had been opened. In the meantime; Poythress attempted to restart engine No. 3. Poythress then told Conway he had tried every procedure he knew and that he did not believe he could get 3 or 4 started, and that they should get the airplane on the ground.

Conway said he was in agreement and turned toward Richmond to land. He said he checked to make sure both Nos. 3 and 4 engines were feathered and the feathering checklist was completed. He said he noted that there was no rpm. indicated on Nos. 3 and 4 engines; both tachometers were indicating zero. Captain Conway said at this time he retrimmed the aircraft and got a good speed out of it and that Poythress had reported the temperatures on Nos. 1 and 2 were normal. Conway then said he told Greenlee to advise Richmond tower of the situation and that they were going to land. The stewardess was advised of the engine difficulty and the decision to land at Richmond. She relayed this information to the passengers over the public address system. The crew did not anticipate a crash landing and therefore did not instruct the stewardess to give emergency evacuation instructions.

The first call from N 2737A was recorded at Richmond at 2110. The controller advised the flight that all runways were available and that the wind was north-northwest at 15 kt. with gusts to 22 kt. He requested that the flight advise him on base leg for the runway chosen, and asked if standby emergency equipment was desired. Greenlee replied in the affirmative. Conway testified that he asked Greenlee to fly the airplane so he could check over the flight engineer's station.

Conway then advised the Richmond controller when the flight was passing south of the city and that they would use Runway 33. He said the aircraft was maintaining altitude and that they had a "healthy airspeed." He said their heading was about 90 deg. and the in-range check had been started, when Greenlee suddenly remarked "let's land on this runway."

Simultaneously, Greenlee, who was still flying the aircraft, turned left to Runway 02, and lowered the landing gear handle. Conway said he looked down and saw a lighted runway, but thought they were too high and possibly a little too fast to be able to land on it. He said he then looked at the landing gear lights and shouted "the gear is not down." He then said he looked back at the flight engineer's panel and saw Mr. Poythress either putting the hydraulic crossover switch into the emergency position or checking that it was in the emergency position. He said, however, that when he saw the switch it was in the emergency position. Conway then said he reached down and "recycled the landing gear up." Again there was no change in the indicator. About this time it was apparent the landing attempt would have to be abandoned and Coway said both he and Greenlee called for full power on engines Nos. 1 and 2. He said at this time he felt that the airspeed and altitude were still sufficient to make Runway 33 but that they would have to make a right turn to the runway.

According to testimony of the controllers, just prior to the time the airplane started its right turn, a transmission was received in the tower, "Tower get everybody off. We're losing another one here and we can't get our gear down." Conway said he then took over the controls and started the right turn. He said he lost sight of the runway and again turned the controls over to Greenlee who was in a better position to see the runway out of the right side.

At this time the student engineer, Clark, was requested to assist with the landing gear in the event it would have to be pumped down. A continuous right turn was made until Captain Conway could see the runway again when Mr. Poythress stated again that they were losing engine No. 1. Captain Conway said that he got back on the controls again with Greenlee and the turn was continued. Mr. Poythress announced again that there was a continuing decrease in power on No. 1 engine. Conway testified that somewhere in this turn, again without his knowledge, the landing gear handle was placed in the down position and that he recalled Clark assisting to pump the gear down with the hydraulic hand pump. He said during the final approach he remembered seeing two green lights indicating two of the three landing gears were down.

Conway said the aircraft was slightly to the left of the extended runway centerline on final approach when the airspeed began to decay rapidly. He said he realized they would not make the runway and pulled back on the control column. His last recollection of airspeed just as the aircraft stalled into the trees was that it indicated between 90 and 95 kt.

Conway said the aircraft decelerated rapidly when it hit the trees but that the impact was "cushioned". He realized immediately that the airplane was on fire and got out of his seat.

Mr. Poythress opened the door to the airplane cabin and the cockpit immediately filled with dense smoke. Then as Mr. Poythress opened the crew exit door on the right side of the cockpit, Captain Conway said he opened the pilot's sliding window and exited from the airplane. He said as he left the aircraft Mr. Poythress and Greenlee were at the crew exit door presumably preparing to jump. He said that after clearing the aircraft it was completely engulfed in flames and he did not think it possible that anyone else could have gotten out of the aircraft.

Investigation of the wreckage pattern area, which was approximately 250 ft. long, indicated that the aircraft was in a right bank of approximately 10 deg. when it first contacted trees, 50 ft. above the ground. The aircraft then passed through a clear area about 100 ft. in length, then into a section of larger trees which brought the aircraft to a stop in approximately 100 ft. The angle of descent from the first contact with trees to ground impact was about 10 deg. From all indications, the aircraft struck the ground in a level longitudinal attitude. The final heading of the fuselage was 14 deg. magnetic although wreckage path was along magnetic north.

Both wing tips, a portion of the right aileron, and the right empennage were severed in the first group of trees; and the wings were cut into several sections at and following ground impact. The aft fuselage, center vertical fin, and the left empennage suffered light impact damage.

The entire fuselage forward of Fuselage Station 1037 and the major part of the left wing were destroyed by fire. With the exception of the portion attached to the fuselage, outboard of wing station 90, the right wing was only slightly damaged by fire. This damage was confined to approximately two feet of the leading edge of the separated wing section containing the No. 4 fuel tank.

There was no evidence of fire at any point along the wreckage path prior to where the fuselage came to rest. The nose gear was in the retracted position, but the uplock was in the "release" or "open" position. The two main landing gears were down, due to destruction of the locking system, no determination could be made as to whether the locks were engaged. The landing gear selector handle in the cockpit was in the down position. The wing flaps were in the "up" position. There was no evidence to indicate a failure of the primary or secondary flight controls.

Except for the seat structures, the fire which occurred after impact had completely destroyed the entire cabin area. All the seats except two of the more forward were found in the normal position and had not been dislodged by impact. Only one of the seat belt buckles found showed indication of being fastened during the fire. The grouping of bodies in the passenger cabin indicated that many of the passengers had left their seats after impact and had attempted to evacuate the aircraft.

The student engineer, Clark, apparently had gone to the cabin immediately before the crash to assist as a cabin attendant. Both Clark and the stewardess were found in the cabin with the passengers. The largest group of bodies was found near the main cabin entrance door, which either had been jammed by the ground impact or by trees and debris which were piled up against the fuselage. There was no evidence to indicate that attempts had been made to use any of the emergency over-the-wing window exits. The charred remains of what appeared to be the emergency escape slide retaining bar were found lying across the bottom of the main cabin door opening. No positive evidence of impact injuries to

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the passengers was found. The cause of death in all cases was established as suffocation caused by carbon monoxide poisoning.

All four engines, with propellers in place, separated from their nacelles at the firewall upon ground impact. The ensuing ground fire resulted in complete disintegration of the rear accessory, supercharger housings and rear-mounted accessories. Numerous cylinder heads of engines 1, 3, and 4 had been burned away. No. 2 engine suffered light fire damage in comparison to the other engines. Only the rear-mounted accessories on this engine were heat damaged. Examination of the engines after disassembly revealed complete internal failure of No. 1 engine prior to the crash due to failure of the master rod and bearing followed by complete disintegration of the connecting rods. There was no evidence of in-service failures or malfunctions of engines 2, 3, and 4. No evidence was found of any inflight fire on any of the engines.

Examination of the four propellers revealed that each assembly remained on its engine at impact. There was adequate lubrication of the reduction gear assemblies up to the time of ground impact and no evidence of operating distress was found. Blade angle and prop governor rpm. settings at initial impact were found as follows: No. 1 was on the low-pitch stop at 17 deg. and 2600 rpm.; No. 2, 28 deg. and 2563 rpm.; No. 3, and No. 4 were fully feathered.

The main oil screens, except that of No. 2 engine, were consumed by ground fire. The No. 2 screen and sump were free of any foreign material.

All engine fuel injection nozzles were removed and examined for presence of foreign matter. The majority of the nozzles of all 4 engines contained foreign material in small amounts, some of it black and nonmagnetic, whereas other material was magnetic and reddish-brown in color. Ferrous material was also found in the passages of the No. 2 fuel injection pumps, master control, and the No. 2 booster pump.

Fuel System Damage

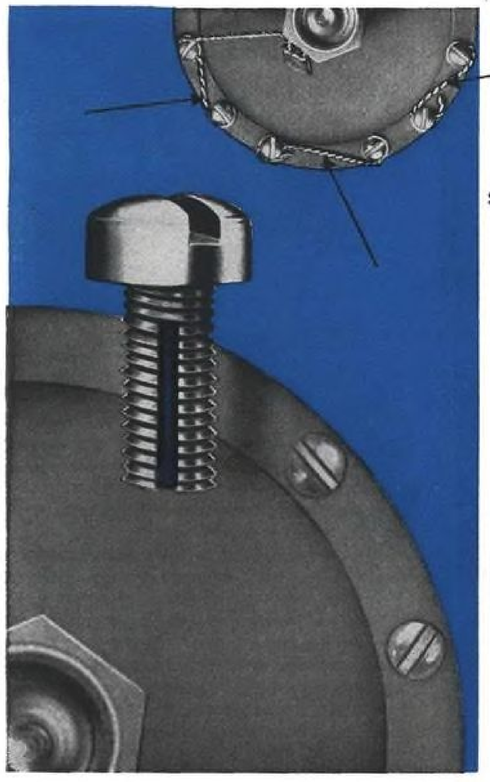
The entire fuel system was extensively damaged as a result of ground impact and fire. The left wing fuel tank area was completely consumed. The outboard portion of the No. 3 fuel tank was free of any fire damage and, as stated before, the No. 4 tank had very little fire damage.

The cable operated fuel tank shutoff valves for Nos. 1, 2, and 3 were closed. The position of the valve for No. 4 tank could not be determined. The electrically operated emergency fuel shutoff valves were found in the open position. Only the No. 2 crossfeed valve was recovered and it was jammed in the ¾-closed position. The position of all cable operated valves is unreliable due to valve control cable movement at impact. The position of the midship crossfeed shutoff valve could not be determined.

All of the fuel boost pumps were destroyed by fire except No. 2; however, inspection of the remaining steel parts to these pumps revealed no evidence of rotor or shaft failures prior to impact. The entire No. 2 boost pump unit was intact. The pump motor brushes were in place, but one brush was not of the proper type for the motor assembly. At the public hearing Poythress testified that this brush had been manufactured from an electrical brush obtained from Imperial's Chief Flight Engineer, John Mayfield.

Fuel filters for engines 1 and 2 were not recovered due to fire. Fire damage to Nos. 3 and 4 Purolator filters was in evidence but there was a brown discoloration of the cartridge bowl and the filter element of these two cartridge filters. Magnetic inspection also revealed the presence of foreign material in the cartridge filters. The No. 3, C-5 fuel filter was free of any contamination.

A functional check of No. 2 engine-driven hydraulic pump revealed that the pump produced normal pressure and normal output. This is a positive indication that hydraulic pressure was available to the primary system. The selector valve on the hydraulic hand pump was in the aft position for emergency gear operation. The nose gear emergency extension isolation valve was in the full open position. The hydraulic crossover valve was in the fully closed position. This valve, when opened, permits pressure from the primary system to be utilized to operate the entire secondary system including the landing gear and flaps. No evidence of malfunction or dam-



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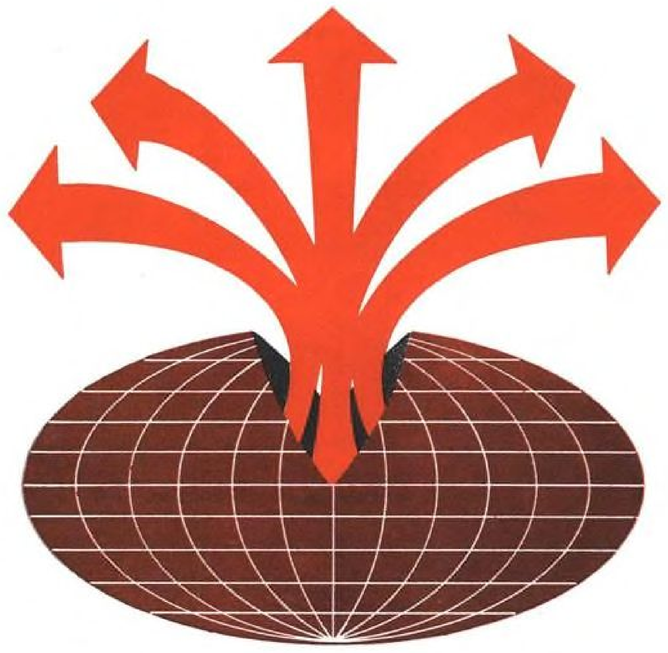

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age, other than from ground fire, was found in this valve and its electric motor.

During the investigation the possibility of fuel contamination as a causative factor was thoroughly explored. Fuel injection reciprocating engines are among the most susceptible to fuel contamination.

The fuel injection pump plungers on these engines, because of their extremely close tolerances, would be expected to bind or stick upon introduction of any large amount of foreign matter. When any such binding occurs, the tappet faces would be battered by the wobble plate. There was no evidence of any such battering. This type of malfunction would most likely result in slight engine roughness initially, increasing in magnitude, followed by fluctuation of engine power and engine surging over a considerable period of time.

It was found that N 2737A had been serviced with 1,852 gal. of fuel prior to departure from Columbia, South Carolina. Captain Greenlee had instructed that both inboard tanks were to be filled and the outboard tanks were to be fueled to 800 gals. each. Two refueling trucks were utilized to accomplish the refueling. Both of the trucks were examined and samples of fuel were taken for analysis. It was found that the truck which had serviced the Nos. 3 and 4 fuel tanks did have considerable contamination, sufficient to be classed gross contamination. The filter assembly from the truck was disassembled and found to contain large amounts of rust deposits. In adition, it was found that two of the 20 elements in the filter were not properly seated and were allowing some unfiltered fuel to pass.

Refueling Records

Refueling records revealed that a number of airplanes, including N 86532, a Lockheed L-049 also owned by Imperial, had been serviced from the contaminated truck. All of these airplanes were checked. Although significant contamination was found in one of them, there had been no operating difficulties attributable to fuel contamination. The substantial contamination found in the fuel sumps of the one aircraft was mostly of a different nature than that found at the Columbia airport fueling facilities.

For a considerable period of time prior to this accident, the Federal Aviation Agency conducted many extensive inspections of Imperial's operations and maintenance practices and procedures. Many discrepancies were found in the company's methods of keeping its records. Numerous errors were found in computations of overhaul time periods for airplane component parts. It was found in many cases that crews were not reporting aircraft discrepancies on the flight logs. Many of these matters were brought to the attention of the carrier. It was found that the carrier did correct those specific items pointed out by the FAA.

However, it was also stated by an FAA witness that the company corrective action was slow and confined only to those areas mentioned specifically.

An inspection of Imperial's operations and maintenance practices and facilities was conducted by the Board following this accident. This investigation revealed that company manuals were not kept current and, in some instances, were not initialed as approved by FAA. Company policies were not accurately reflected in the manuals and in some cases required procedures set out in them were not being followed.

Several instances were found where aircraft inspection periods were exceeded or where the records of the inspection were missing. In several instances it was found that an aircraft had been operated for a considerable period of time, as much as 70 hrs., with no writeups whatsoever. Then on the final flight immediately before a periodic inspection as many as 40 or 50 discrepancies would be noted.

In at least one case it was found that a flight was made without correcting a discrepancy affecting the aircraft's airworthiness. In some cases repairs were made to airworthiness items but were not signed off or did not indicate that the work had been conducted, supervised, or inspected by a certificated mechanic. An additional intensified safety inspection by FAA of Imperial Airlines started on Sept. 19, 1961, and was in progress at the time of the accident, but had not yet been completed.

At the public hearing, considerable testimony was taken concerning Imperial's operations procedures, training methods, and maintenance practices. This information and the data collected during the investigation have been carefully examined and analyzed and the Board's conclusions are set out below.

The testimony of Imperial's Chief Flight Engineer, John Mayfield, is both contradictory and vague concerning the maintenance work done on N 2737A prior to its departure. First he testified that he personally had obtained from another airline two electrical brushes for installation in the Nos. 2 and 3 fuel boost pumps. He said that one of the brushes had to be cut down to fit. The other brush he said was an approved type for this unit. He later testified that this second brush "appeared" to be of a suitable type. After hearing testimony which denied that he had been given two brushes, Mayfield again changed his testimony and said he had gotten the second brush from Mr. Clark.

Testimony Confirmed

It will be recalled that the No. 2 boost pump was recovered and found to be fitted with a brush of improper type. This confirms testimony by Mr. Poythress that he had manufactured the brush. It is also believed that this brush was the only brush obtained. It is believed that either no repair was made to the No. 3 boost pump or that only temporary repair was effected so as not to delay the flight. This is further confirmed by the fact that Mayfield had ordered a fuel boost pump to be shipped to Columbia from Miami. At the hearing, again, Mayfield testified that this fuel boost pump had been ordered as a spare for the airplane "fly away" kit. It is significant that a spare boost pump was not normally carried and that spare boost pumps were not ordered for the other two Imperial aircraft.

The momentary fluctuation of fuel pressure on the takeoff from Columbia on the No. 3 engine is symptomatic of a boost

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pump failure. Such failure would not cause the engine to stop because the engine-driven fuel pump will continue to supply sufficient fuel to the engine. When this fluctuation occurred the student engineer opened both No. 3 and No. 4 crossfeeds. In this configuration fuel from the No. 4 tank would be supplied to the crossfeed manifold under pressure by the No. 4 boost pump. Even though the No. 3 fuel tank selector valve remained open, no fuel could flow from the tank. The higher pressure in the crossfeed manifold supplied by the No. 4 boost pump would hold closed a check valve between the manifold and the No. 3 fuel tank. Thus engines Nos. 3 and 4 would both be operating on fuel exclusively from the No. 4 tank provided the No. 4 boost pump remains operating.

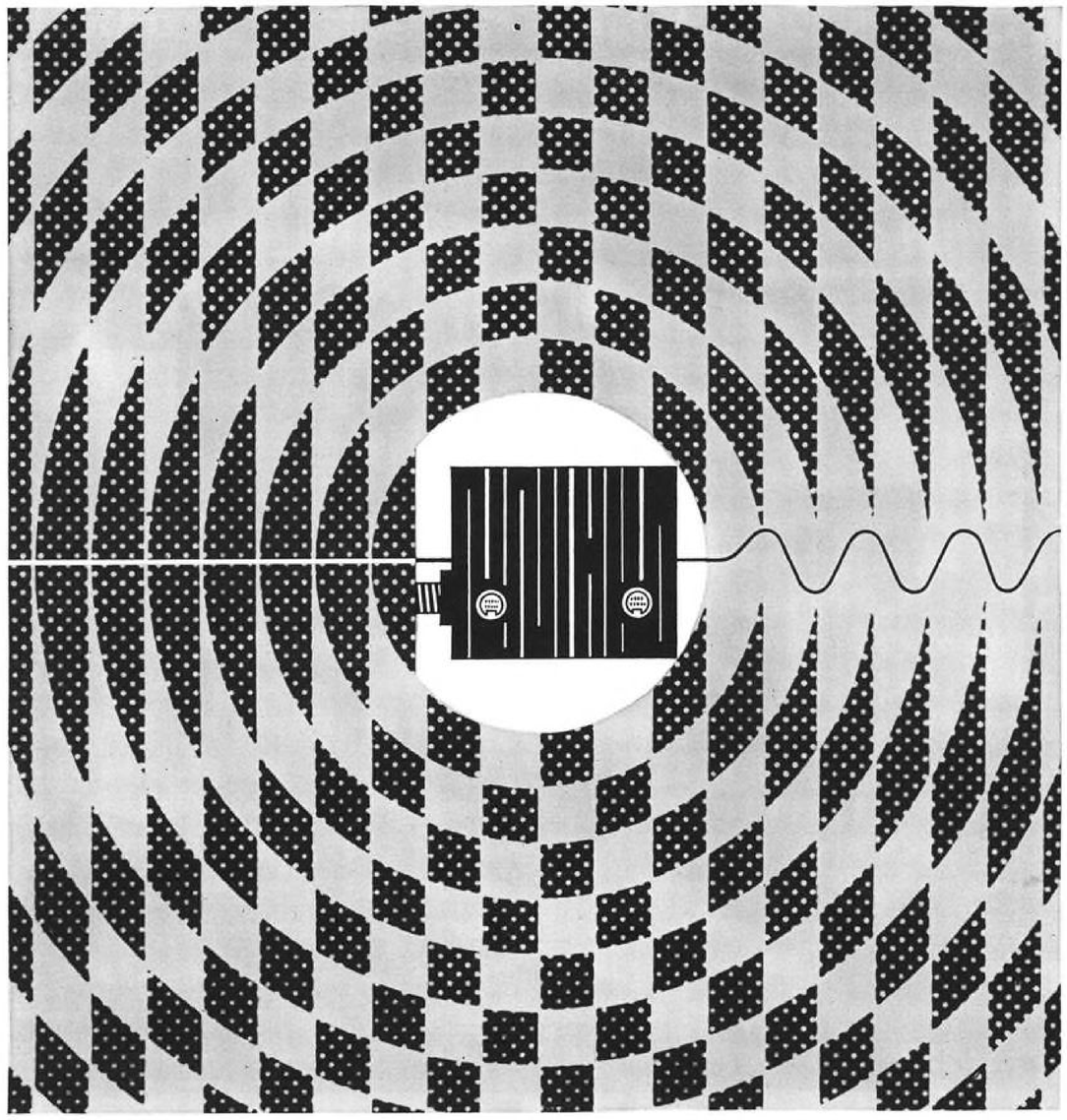
The testimony of Mr. Poythress indicates that on each takeoff the crossfeeds were left opened in anticipation of a fluctuation in fuel pressure similar to that experienced out of Columbia. He further stated very positively that the fuel system was returned to the normal tank to engine configuration after reaching their cruising altitude. It is the Board's opinion that the greater part of the flight was conducted with the crossfeeds open and the boost pumps on. Such opinion is based upon an analysis of the conduct of the entire flight and also the testimony of the various witnesses.

CAR Violations

The Board, in its investigation, noted several company practices which were not in compliance with Civil Air Regulations. First, making non-standard repairs affecting the airworthiness of the aircraft. Second, operating an aircraft wherein repairs were made which were not in accordance with Civil Air Regulations. Third, operating an aircraft in excess of the required maintenance inspection periods. Fourth, not reporting inflight discrepancies on aircraft flight logs and others. These and other actions describe a pattern of practice which indicates the type of substandard operation which Imperial conducted.

In an attempt to visualize what degree of contamination might mean to an engine, the amount of foreign matter found in four representative samples of fuel taken at Columbia was converted to pounds per engine per hour of cruise operation. These were (1) .002 (2) .002 (3) .004 and (4) .03 lb./hr./eng. The amount of contaminant found in each of the two fuel filters recovered from Nos. 3 and 4 engines amounted to only about one-third of the amount that would be contained in one hour of fuel flow per engine according to the concentrations indicated by (2) and (4) above. It is believed that the samples of fuel tested were of considerably higher contamination concentration than the fuel which actually went into the airplane's fuel system.

In view of the Board's findings it is felt that the amount of contamination was not sufficient to cause a complete loss of fuel pressure as reported. It is not likely that following several hours of normal operation, contamination would, either by restricting the flow or causing malfunction of a component, without warning and simultaneously, cause the loss of fuel pressure in two separate fuel systems. It also should be noted that none of the other air-



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craft serviced at Columbia, including Imperial's other aircraft, reported any trouble whatsoever from fuel contamination.

Using the same engine powers and rates of fuel consumption as outlined in the carrier's operating manual relative to flight planning, and operating engines 3 and 4 on crossfeed from the No. 4 tank the majority of the flight, it was calculated that 800 gals. of fuel in the No. 4 tank would have been exhausted approximately at the time which the crew indicated the loss of power occurred.

The indications of operating difficulties described by the crew, namely a sudden yaw to the right and sudden loss of fuel pressure on Nos. 3 and 4 engines simultaneously, are also indicative of fuel exhaustion or starvation. Engine surging soon followed by complete power loss such as occurred here would also be expected.

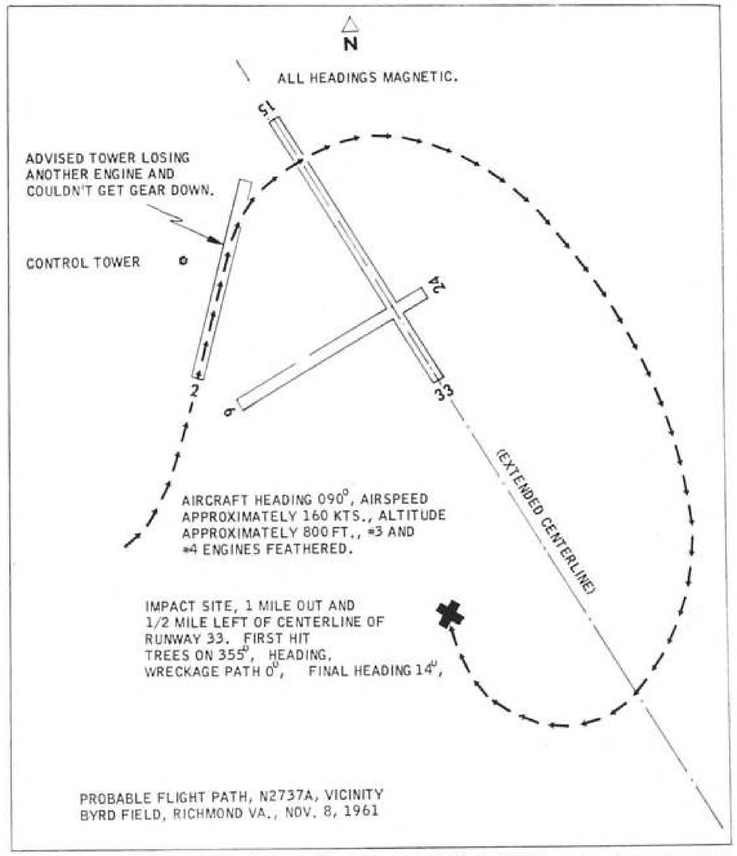
From all of the foregoing, it is clear to the Board that the loss of power on engines Nos. 3 and 4 was not the result of a malfunction or mechanical failure of the engines. It is equally clear that fuel contamination was not a cause of the engine stoppage. It is the Board's conclusion that fuel exhaustion brought about by improper fuel management caused the stoppage of engines 3 and 4.

The procedures followed by Flight Engineer Poythress in attempting to restart the two engines indicate the lack of knowledge and the inability to diagnose the results of the inoperative fuel boost pump and determine appropriate corrective action. Had the proper procedures been followed, there is no reason why the Nos. 3 and 4 engines could not have been restarted. When the No. 4 fuel tank was run dry, the No. 4 fuel tank shutoff valve remained open. The No. 4 fuel boost pump continued to operate pumping air into the crossfeed manifold and thus to both engine fuel supply lines. Since the No. 3 fuel boost pump was inoperative, fuel by gravity and suction of the No. 3 engine-driven fuel pump would have to displace the air in the fuel lines. It is believed that the No. 3 engine would have restarted had the No. 4 fuel boost pump been turned off, and had enough time been allowed to prime the No. 3 engine-driven pump. It is also believed that it would have started had the crossfeed valves been closed.

The engines could also have been restarted by opening the midship crossfeed valve. This valve would have allowed fuel from tanks Nos. 1 and 2 and under boost pump pressure to be supplied to engines Nos. 3 and 4.

The first contact with the Richmond tower was made at 2112. At this time Nos. 3 and 4 engines had been feathered and the decision had been made to land at Richmond. According to testimony the crew was experiencing no unusual problems in operating the aircraft on its two remaining engines. In point of fact the aircraft flew satisfactorily for at least eight minutes after this call was made.

The Lockheed L-049 aircraft was designed in accordance with the requirements of Part 4b of the Civil Air Regulations. Among the many capabilities the aircraft must demonstrate for certification is the ability to sustain flight satisfactorily with two engines on the same side inoperative. N 2737A obviously met this criterion.



PROBABLE FLIGHT PATH of Imperial Airlines' L-049 N 2737A prior to crash shows missed approaches to Runways 2 and 33. Aircraft was heading approximately 90 deg. prior to turning onto final for Runway 2.

As the aircraft was proceeding to Byrd Field the decision was made to land on Runway 33. The tower was so notified and it must be assumed that both pilots were aware of this intention. It is clear that both captains were issuing orders and both were attempting to command the flight. Greenlee, although senior with the company, had elected to act as copilot. Yet, during the emergency he issued orders to the other crew members as captain. From all of the testimony the Board concludes that confusion prevailed in the cockpit due to lack of crew coordination and the issuing of conflicting orders. Greenlee's sudden turn to attempt a landing on Runway 02 is a clear indication that a division of command and lack of coordination existed. His actuation of the landing gear selector handle was equally rash. Conway testified that when this turn had been made and the gear handle lowered he did not see any indication of the landing gear extending. He then "recycled the landing gear up."

Normally on the L-049 hydraulic power for landing gear actuation is supplied by the Nos. 3 and 4 engine-driven hydraulic pumps. Consequently the loss of engines Nos. 3 and 4 would result in total loss of hydraulic power for this operation. However, N 2737A was equipped with a hydraulic crossover valve (normally operated from the cockpit by a switch) which would permit hydraulic pressure from Nos. 1 and 2 engine-driven pumps (the primary hydraulic system) to be supplied to the landing gear. Imperial's other two Constellations were not equipped with this type of crossover valve.

As noted above, this valve and its motor were recovered and showed no evidence of malfunction. The valve was in the closed position. In addition, the No. 2 hydraulic pump was operable. Based on all this evidence, it is the Board's conclusion that the crew did not open the hydraulic crossover valve. Notwithstanding their testimony, it is further concluded that the crew was unaware that the aircraft was equipped with this valve. Had this valve been opened the landing gear would have extended in 20 to 25 sec.

When the landing gear did not extend, it became apparent that the landing on Runway 02 would have to be abandoned. According to testimony both pilots called for full power on engines Nos. 1 and 2. Apparently Conway took over the flight controls again and started a right turn to Runway 33. He then again passed control of the airplane to Greenlee because Greenlee could keep the runway in sight.

From the location of the wreckage it is apparent that the landing pattern was poorly

executed. It is believed that when the airplane was on its base leg the bank angle was steepened in an attempt to avoid overshooting the extended centerline of the runway. This increased angle of bank and increased rate of turn bled off airspeed and the aircraft began to sink. To try to arrest the sink rate Greenlee called for . . . "all the power you got." By this time the No. 1 engine was destroying itself as a result of the over boosting during the emergency. It failed completely.

With only one engine delivering power it was impossible to maintain flight and the aircraft stalled into the trees.

It is apparent that few, if any, traumatic injuries to the occupants were incurred by the impact. The distribution of carbon monoxide levels found in the blood describes a normal biologic curve, with some succumbing at fairly low levels and others attaining 80% saturation. This range is to be expected due to variance in individual tolerance, variance in source of blood analyzed, variance in carbon monoxide and oxygen concentration in inspired air, and variance in the cardiorespiratory systems of the individuals.

Certain portions of the cabin were evidently ruptured during impact with the trees permitting smoke and flame to fill the cabin immediately. The threshold of useful consciousness of occupants exposed to carbon monoxide is a function of the concentration of CO, the rate of consumption of available oxygen by the fire, the physical condition of the subjects, individual tolerance factors and the total exposure time.

Estimates of the expected elapsed time from impact to loss of mobility of cabin occupants are from as little as 30 sec. to as long as two minutes, under such extreme conditions. It would be expected then, that with known available escape routes, time would have permitted at least a small number of occupants to escape. Possible limiting factors include dense smoke, rising ambient heat, radiation, shock, panic, no preparation for emergency evacuation, and the possibility of jammed or blocked exits.

From a study of all the information available to the Board it is concluded that this flight crew was not capable of performing the function or assuming the responsibility for the job they presumed to do. The Board further concludes that the management personnel of Imperial Airlines should have been aware of the manner in which company operations were being accomplished. It is believed that the sub-standard maintenance practices of Imperial's employes were condoned by management. The manner in which maintenance and personnel records were kept by the company confirms this conclusion.

The Federal Aviation Agency, which is charged with the responsibility of inspection for compliance with Civil Air Regulations and minimum safety standards by all air carriers, conducted extensive inspections of Imperial's operations and maintenance practices and procedures over a period of almost a year prior to the accident. Numerous improper operational procedures, and maintenance practices were found. It is indicated that Imperial did take some corrective action when specific items were pointed out. However, it is also evident that Imperial's management did not make satisfactory efforts on their own to improve the overall operations and maintenance standards of the company, but only corrected those items which the Federal Aviation Agency pressed.

Probable Cause

The Board determines the probable cause of this accident was the lack of command coordination and decision, lack of judgment, and lack of knowledge of the equipment resulting in loss of power in three engines creating an emergency situation which the crew could not handle.

By the Civil Aeronautics Board:

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Chairman
ROBERT T. MURPHY
Vice Chairman
CHAN GURNEY
Member
G. JOSEPH MINETTI
Member
WHITNEY GILLILLAND
Member

Supplementary Data

The Civil Aeronautics Board was notified of this accident at 10:00 p. m., on Nov. 8, 1961. Investigators were immediately dispatched to the scene and an investigation was initiated and conducted in accordance with the provisions of Title 702(a)(2) of the Federal Aviation Act of 1958. A public hearing was ordered by the Board and held at the John Marshall Hotel, Richmond, Virginia, on Nov. 21 and 22, 1961. The hearing was continued at the Barcelona Ho-

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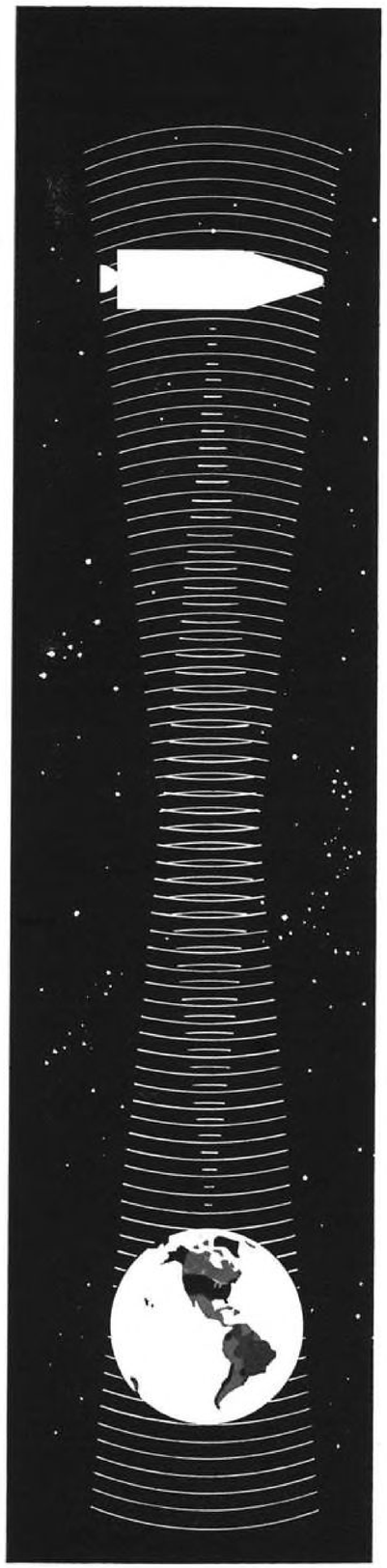

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- Development of new and flexible ground-based detection, demultiplexing and decoding devices.
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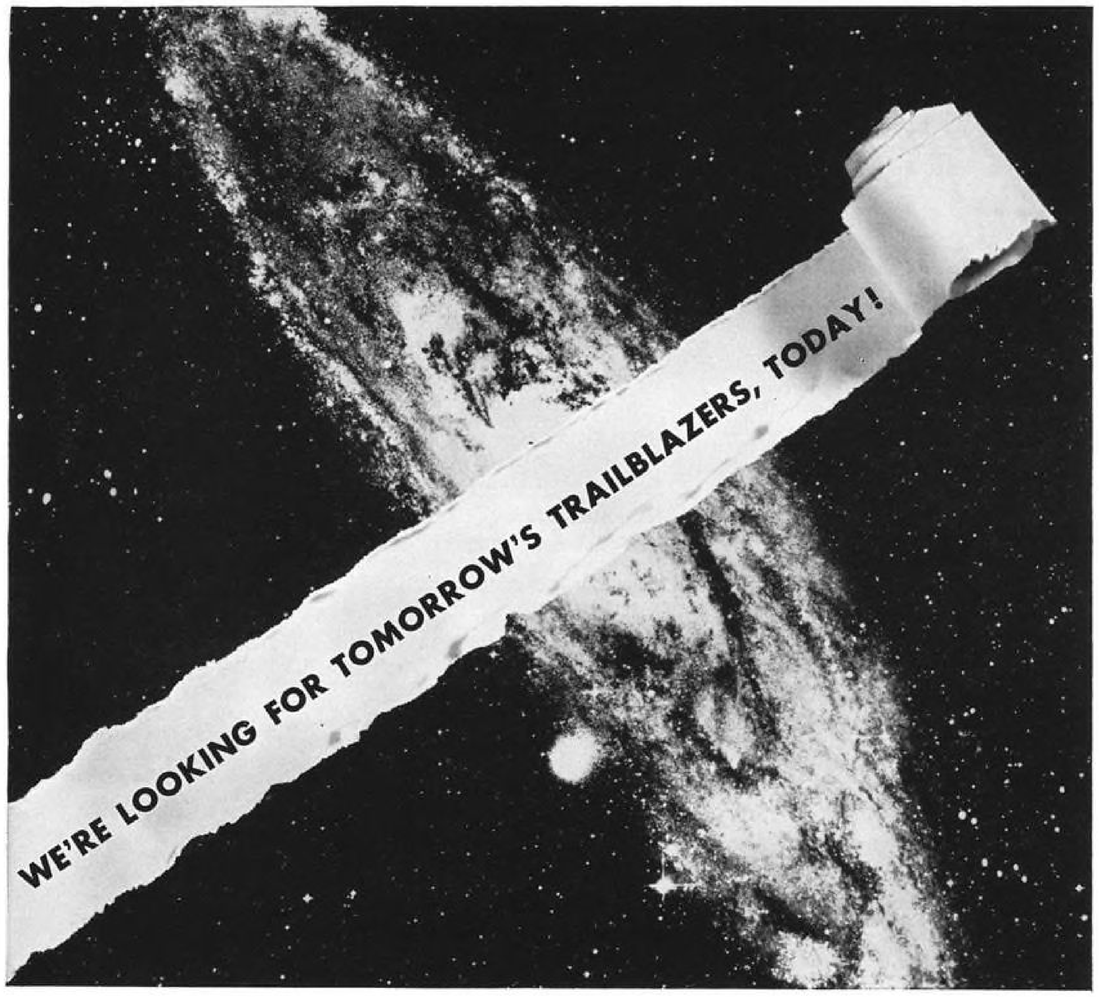

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Transistor Circuit Design Engineers
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Milwaukee
Military Defense Systems, Program and Project Engineers
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Radar Systems Engineers
Radar Test Engineers
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tel, Miami Beach, Florida, on Dec. 5 and 6, 1961.

Imperial Airlines, Inc., is a New York corporation with headquarters at Miami Springs, Florida, and holds a temporary certificate of public convenience and necessity. This certificate was reissued from Regina Cargo Airlines, Inc., on June 6, 1960. Regina's change of name to Imperial Airlines, Inc., was approved by the Board on Feb. 2, 1960. As a supplemental carrier, Imperial Airlines, Inc., is authorized to conduct up to ten individually ticketed or individually way-billed flights per month in each direction between any pairs of points within the United States. It is also permitted to conduct domestic charter flights without numerical limitations. Pursuant to an exemption, Imperial Airlines was authorized, until Sept. 30, 1960, to carry transatlantic passenger charters. Imperial also has authority to transport cargo to foreign nations as well as authority to transport both passengers and cargo in overseas transportation.

Imperial also possesses a valid air carrier operating certificate issued by the Federal Aviation Agency. At the time of the accident, Imperial Airlines was operating three L-049 Constellations and one C-46 aircraft. As of June 30, 1961, Imperial had a negative net worth of $40,006.92. For the first half of 1961, Imperial had sustained losses of $35,154.90.

Crew Members

Captain Ronald H. Conway, age 29, was employed by Imperial Airlines, Inc., in March, 1960. He holds a valid airline transport pilot certificate with type ratings for the C-46 and L-049 aircraft. His L-049 rating was issued May 15, 1961. Captain Conway has accumulated 4,433 hr. of which 293 hr. were in the L-049. His last Class I physical examination was given Aug. 16, 1961, and his proficiency check flight May 15, 1961.

Captain James A. Greenlee, age 45, was employed by Imperial Airlines, Inc., in June 1960. He held a valid ATR certificate with type ratings in the C-46, DC-4, DC-6, DC-7 and L-049. The L-049 rating was issued Mar. 17, 1961. His total flying time as of Nov. 1, 1961, was 17,841 hr. of which 352 hr. were in the L-049. The date of Captain Greenlee's last physical examination was Oct. 6, 1961.

Flight Engineer William F. Poythress, age 30, was employed by Imperial Airlines for the last two years both as a flight mechanic and a flight engineer. He was issued a flight engineer's certificate in the L-049, Sept. 6, 1961. Mr. Poythress also holds an A&P certificate issued Nov. 20, 1956, and a private pilot certificate issued Apr. 30, 1958. He has flown approximately 200 hr. in the L-049.

The other two members of the crew were Student Flight Engineer Peter E. Clark and Stewardess Linda Johns.

The aircraft, a Lockheed Constellation model L-049, U. S. Registry N 2737A, was owned by the Miami Aircraft and Engine Sales Company, Miami Springs, Florida, and was leased to Imperial Airlines, Inc., on an exclusive-use basis. The aircraft was manufactured on Apr. 30, 1946, with manufacturer's serial No. 1976. Originally owned by Capital Airlines, it was later purchased by Miami Aircraft and Engine Sales, and placed

PROBLEMATICAL RECREATIONS 106

Using one 4 only, and any symbols, construct expressions to equal all the numbers from 0 to 100. *—Contributed*

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ANSWER TO LAST WEEK'S PROBLEM: If the castle is on one of the 4 center squares, it threatens 14 squares and is threatened diagonally by 13 squares for a total of 27. This total is 25 for the squares bordering the center, 23 for the squares bordering these, and 21 for the outer border. The probability is therefore $4/64 \cdot 27/63 + 12/64 \cdot 25/63 + 20/64 \cdot 23/63 + 28/64 \cdot 21/63 = 13/36$.

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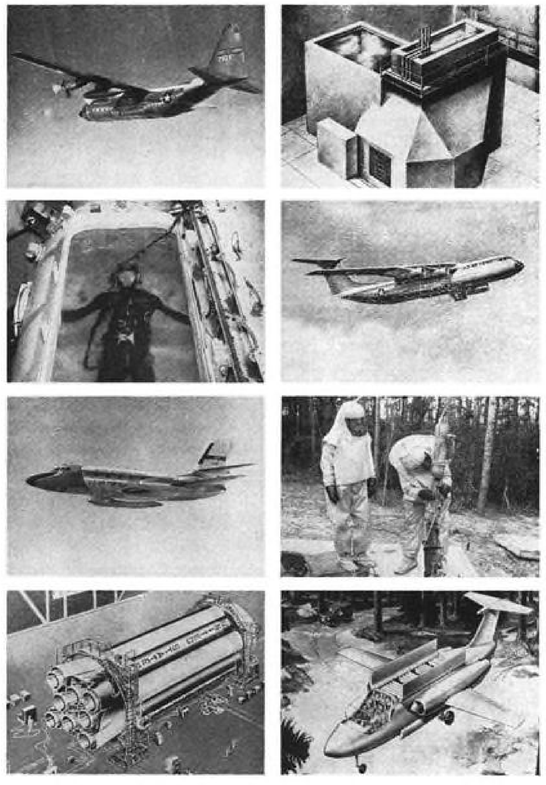

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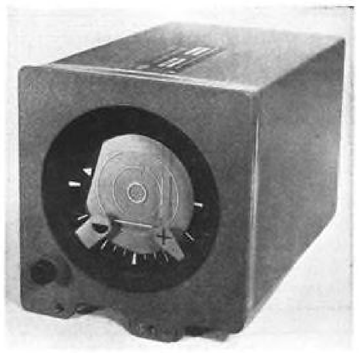
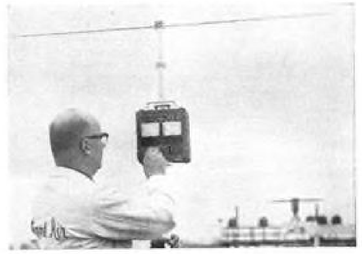


DH-121 Attitude Display

Sperry Gyroscope Co. attitude director for the de Havilland Trident jet transport is a remote indicator which replaces conventional artificial horizon. Pilot applies pitch and bank to fly the center ring of the pitch scale under a whitened middle portion of each director wire. When flight demands are met, director wires form a white cross within the center circle.

in service by Imperial Airlines, Inc., on May 2, 1961, with 32,000 hr. on the airframe. The total time on the aircraft as of Oct. 31, 1961, was 32,589 hr.

The last major overhaul was a 12,000-hour accomplished by Capital Airlines; completed June 30, 1958. The time on the airframe at the completion of overhaul was 28,290 hr. The last service accomplished by Imperial Airlines was a 600-hr check. The time since this check was 47 hr. to the date of the entry of the last available flight log dated Oct. 31. The last available preflight entry was dated Oct. 31, at Columbia, South Carolina, signed by John Mayfield, and accepted by Captain Conway. The aircraft was reported to have been operated on Nov. 2, 3, 6, 7, and 8 but the records of these flights have not been made available. The Constellation was equipped with Wright 745-18BA-3 engines and Hamilton Standard 33E60 propellers. As of Oct. 31, 1961, engine times since overhaul were as follows: Engine No. 1—1,164:30; Engine No. 2—47:22; Engine No. 3—1,360:02; Engine No. 4—47:22.



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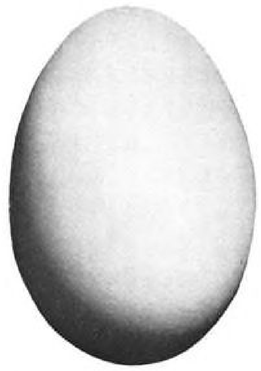
ENGINEERS & SCIENTISTS — No. 1 in a Series Prepared to Give Insight Into the Scope of R&D Opportunities with Hercules Powder Company at Allegany Ballistics Laboratory



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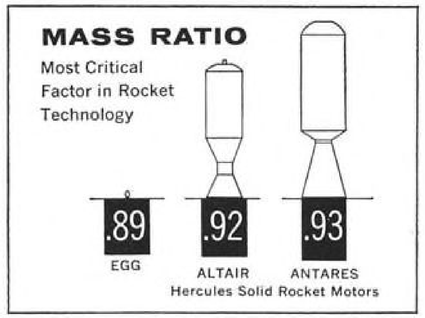

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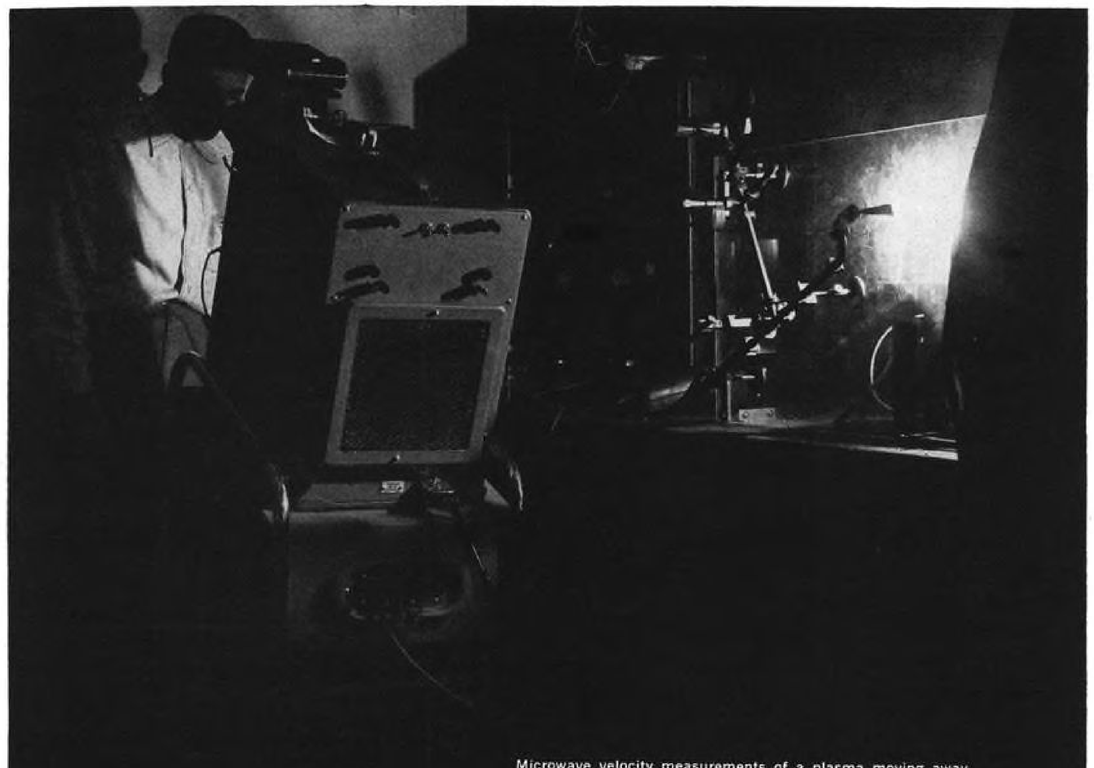

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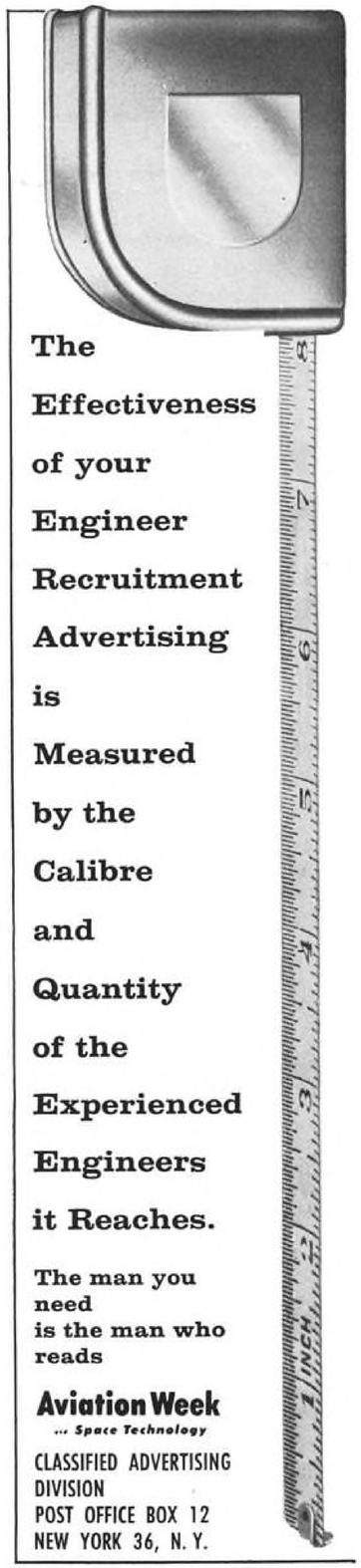

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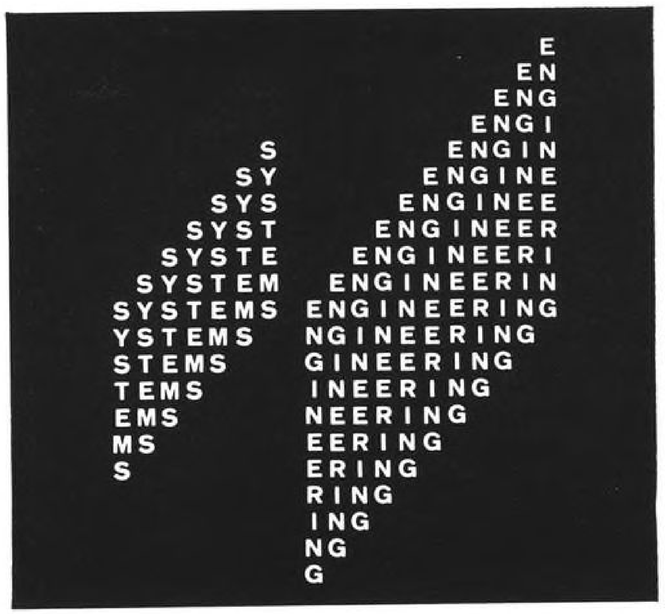

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AVIATION WEEK, FEBRUARY 19, 1962

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LETTERS

ARS Merger Comment

I am gratified by the detailed coverage which AVIATION WEEK recently gave to the contemplated consolidation of the American Rocket Society and the Institute of the Aerospace Sciences.

There would appear, however, to be aspects of the story that may tend to cause some confusion in the minds of those who are interested in these proceedings and which may convey an impression that is not quite in keeping with the facts. In the interests of objective coverage I am requesting you to bring the facts of the matter to the attention of your readers.

It is true that considerable discussion did take place during the recent annual meeting of the IAS on the question of a possible consolidation. Both President Root of the IAS, myself and other members of both organizations were involved in many of these discussions, and as might be expected differing viewpoints were expressed in many instances. At the joint meeting of the boards of the two societies all aspects of the proposed consolidation were critically examined and I can report to you that while there were honest differences of opinion in regard to the detailed means on how the object of a consolidated organization might be best attained, there was complete unanimity on the decision to proceed with consolidation studies. Neither President Root nor I could discern any serious political arguments directed against the exploration of a possible consolidation or could we detect any significant amount of dogmatic viewpoints which would indicate that such differences as may exist would be irreconcilable.

Both President Root and I are, through personal letters to our memberships, striving to keep each and every member of both organizations fully and factually abreast of the developments taking place during these exploratory proceedings. Both of us welcome serious and objective discussion of the question at hand and I can assure you that consolidation is not "going to take place over a lot of dead bodies." It is our intent that when the question of a consolidation has been fully and dispassionately explored and a plan has been rationally developed and reviewed by the constituted authorities of both organizations, the question will be submitted to the full voting memberships. Their decision as to whether or not consolidation is in the best interests of the profession represented by the two organizations, and the national welfare will, of course, determine the future course of both organizations.

I might add that there has been an overwhelmingly favorable reaction from the memberships of both the IAS and the ARS to the decision to seriously explore and develop a plan for a consolidated organization. Responses received to date by President Root and myself indicate that approximately 90% of both memberships endorse the plan for seriously contemplating a consolidation of the ARS and the IAS.

W. H. PICKERING, President
American Rocket Society

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.

IAS Merger Comment

In the interest of forestalling any possible misunderstanding that might arise in connection with your recent article, I would like to request that you carry the following message in your letters to editor section. I am informed that Dr. W. H. Pickering, American Rocket Society president, is sending you a similar letter. My message is:

We appreciate the prominent coverage which AVIATION WEEK accorded in its Jan. 29 issue (p. 26) to the IAS 30th Annual Meeting and to the current Institute of the Aerospace Sciences/American Rocket Society consolidation negotiations.

We hasten, however, to allay your fears regarding serious dissension within the membership of either the IAS or ARS. To be sure, there was and is honest difference of opinion, free and unrestricted discussion, and a realistic facing of potential problems. All of these are good, necessary, and in the best American tradition. As the responsible executive officers of our respective organizations, Dr. Pickering and I have fully informed our entire memberships, by personal letter, regarding the consolidation matter under consideration. Furthermore, each of us has made his letter available for dissemination to the entire membership of the other organization. Both these letters sincerely solicit our members' views and opinions. You will be pleased to know that the overwhelming majority of responses in both societies continues to be favorable.

As you so aptly described, from information we jointly supplied to all news media, we are now at work, defining more explicitly the nature and ramifications of this proposed consolidation. Dedicated members of both groups have rolled up their sleeves, assembled, correlated, and disseminated the great amount of detailed data so necessary for the exercise of calm and rational judgment in the assessment of all important matters to be considered in this consolidation of two well established and respected professional groups.

The combined memberships continue to have every opportunity to be heard, and ultimately will vote on this important joint venture. We are confident that, if unhampered by outside influences, the American processes of free expression, free choice, and free vote will ultimately result in a unified, strengthened, more professional, and more respected voice for a very important segment of the U. S. engineering and scientific community.

To set the record straight on two points in your article, we reiterate here the data furnished to all news media which clearly indicated:

1. Latest membership figures are 19,962 for IAS, and 19,750 for ARS.
2. IAS fixed assets are $3.25 million, not $3.5 million which you labeled "liquid cash reserves."

We will welcome your objective reporting and continued interest in our joint venture. We are confident it can make increasingly significant contributions to our profession, to the aerospace industry, and to the national aerospace programs.

L. EUGENE ROOT, President
Institute of the Aerospace Sciences

(AVIATION WEEK is glad to give Dr. Pickering and Mr. Root the opportunity to comment on the coverage of the 30th annual meeting of the Institute of the Aerospace Sciences and the proposed consolidation of that organization with the American Rocket Society.

The information cited by Mr. Root on the membership of ARS differs from figures supplied by ARS headquarters. As of Jan. 25, the date of the Board meeting, membership in the ARS was 20,450, including 1,218 pending members who, as a matter of ARS policy, are counted in the membership totals. Information supplied to this magazine by IAS official spokesmen showed an ARS total membership of 19,232, which does not agree either with the data in Mr. Root's letter or that available from ARS.

Official IAS spokesmen also told AVIATION WEEK that the liquid cash reserves of the IAS approximated $3.5 million, and when questioned about the use of the term "liquid cash reserve" replied that it was considered to be that by IAS accountants who believed the amount could be realized within 90 days, should liquidation ever become necessary.

AVIATION WEEK supports the move to investigate consolidation of professional societies in those cases where the original technologies have expanded to common ground. As a corporate member of ARS, and with engineering editors whose membership in the IAS dates back almost a quarter-century, AVIATION WEEK is interested only in objective reporting on the progress toward consolidation.—Ed.)

Honeycomb Structure

Your article describing the new Beechcraft Musketeer (AW Dec. 4, p. 94) points out that this is believed to be the first business airplane having bonded aluminum honeycomb construction in the wings.

This may be correct if you limit it to the U.S.A., but in Sweden the MFI-10 Vipan has been flying more than one year with bonded aluminum honeycomb employed not only in the wings but also in the fuselage and control surfaces. Vipan's sandwich structure consists of Hexcel aluminum honeycomb bonded to .012-016 aluminum sheet (6053).

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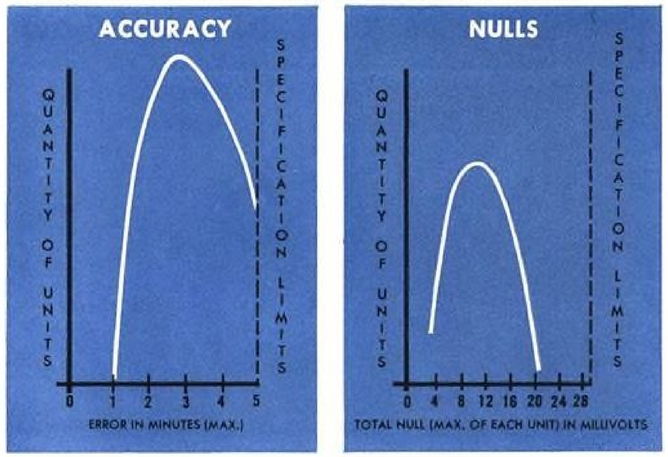

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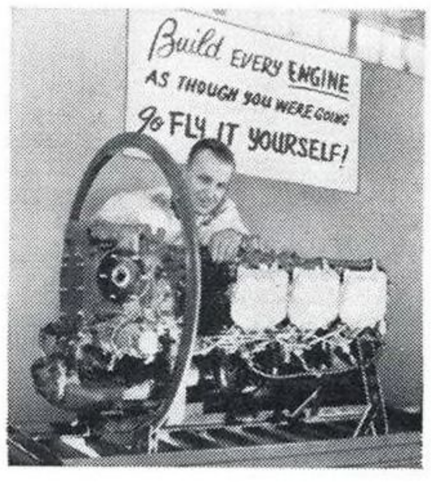

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