Aviation Week & Space Technology

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August 13, 1962

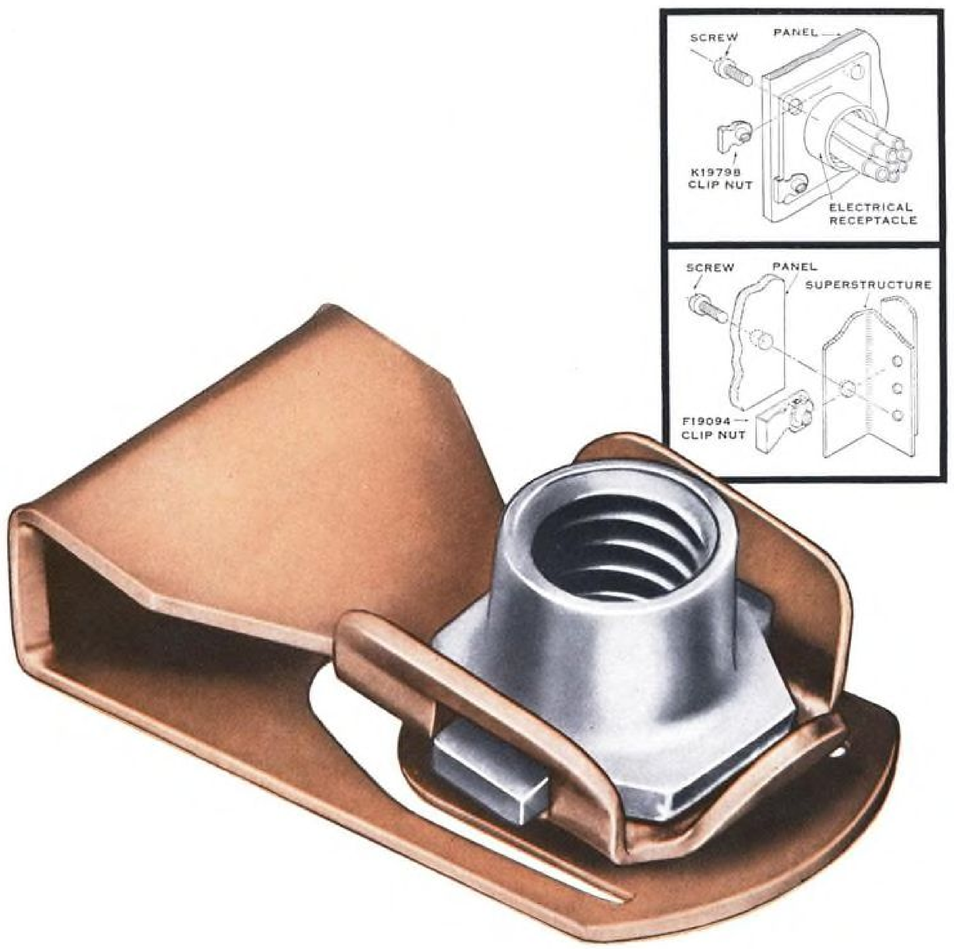
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L-T-V Space Pack Test



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Saturn S-1C Engineering, Manufacturing Program



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AEROSPACE CALENDAR

Aug. 20—Technical Symposium, Precision Potentiometer Manufacturers Assn., Statler Hilton Hotel, Los Angeles, Calif.

Aug. 21-24—Western Electronics Show and Conference, IRE, Los Angeles, Calif.

Aug. 21-24—International Symposium on Far Infrared Spectroscopy, Sheraton Gibson Hotel, Cincinnati, Ohio. Sponsor: Materials Central, Aeronautical Systems Division, Air Force Systems Command.

Aug. 21-Sept. 17—14th Session, International Civil Aviation Organization Assembly, Rome, Italy.

Aug. 23-24—Quarterly Regional Meeting, Assn. of Local Transport Airlines, Westward Hotel, Anchorage, Alaska.

Aug. 23-24—Conference on Thin Films, Colorado Hotel, Glenwood Springs, Colo. Sponsor: Solid State Electronics Laboratory, University of Denver's Research Institute.

Aug. 27-29—AIME Technical Conference on Advanced Electronic Materials, Benjamin Franklin Hotel, Philadelphia, Pa.

Aug. 27-Sept. 1—Third International Congress, International Council of the Aeronautical Sciences, New Congress Hall, Stockholm, Sweden.

Aug. 27-Sept. 1—Second International Congress, International Federation of Information Processing Societies, Munich.

Aug. 28-30—Fourth Conference on Maintainability of Electronic Equipment, Electronic Industries Assn. (in cooperation with Department of Defense), University of Colorado, Boulder, Colo.

(Continued on page 7)

AVIATION WEEK and Space Technology

August 13, 1962

Vol. 77, No. 7

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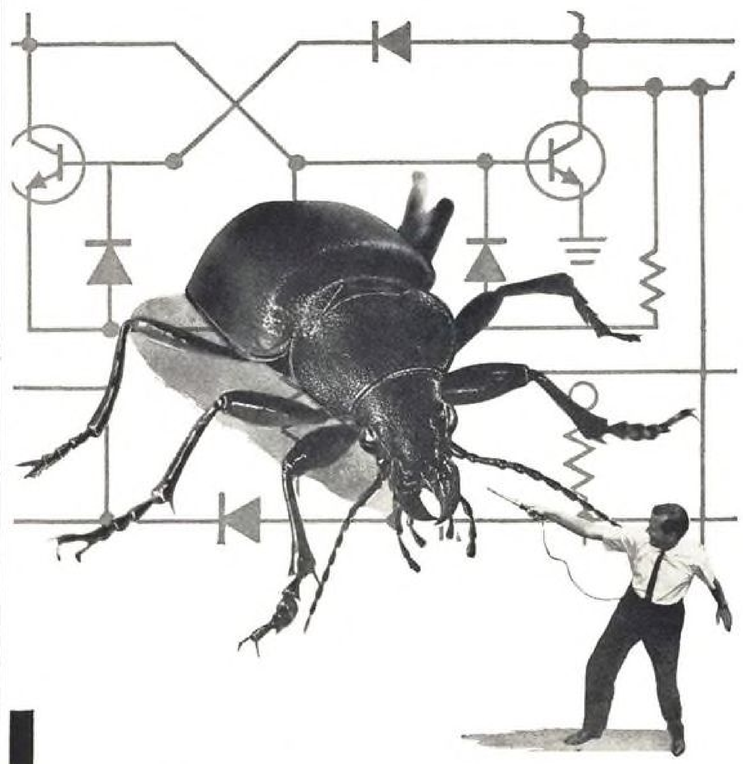
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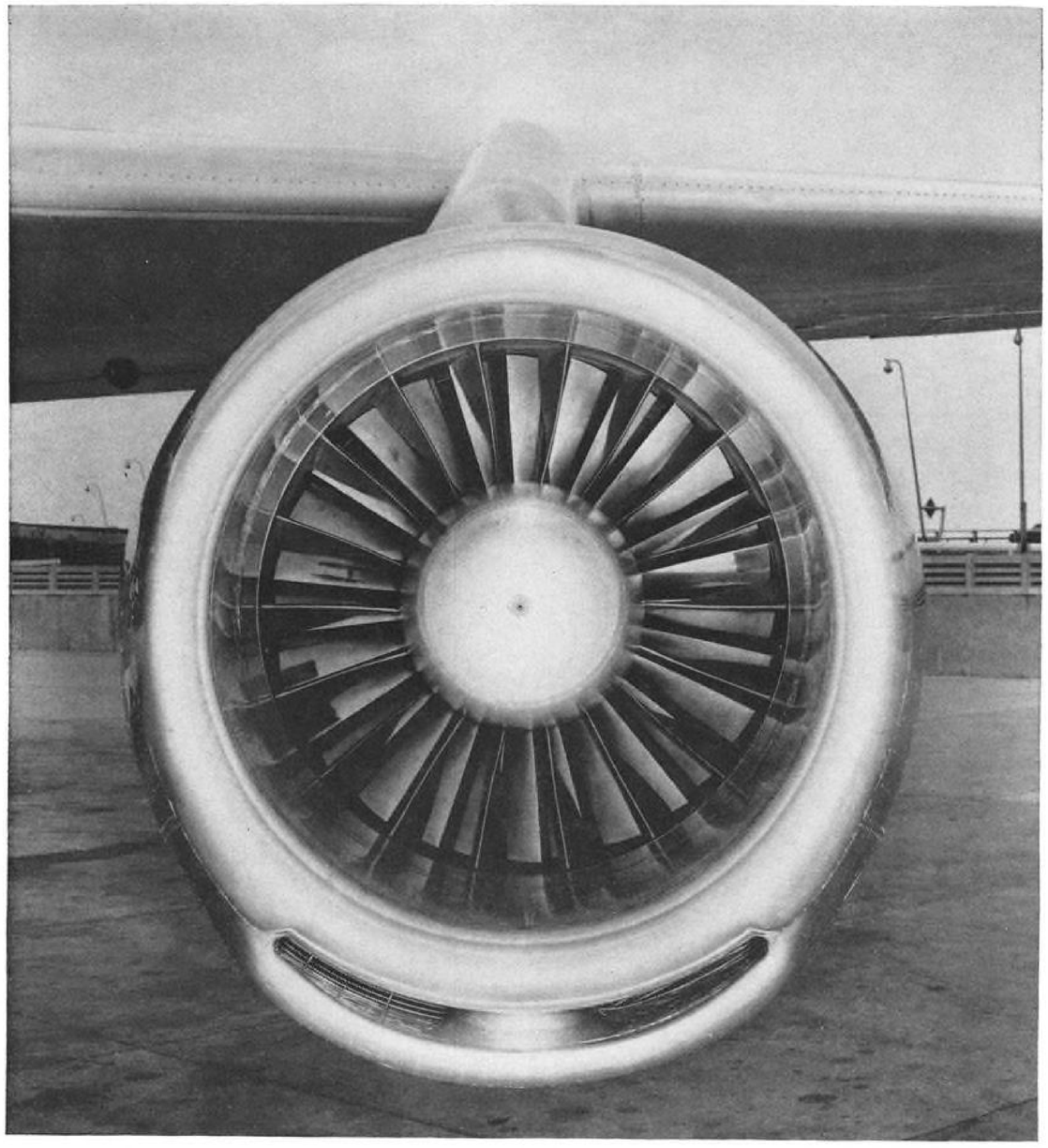
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AEROSPACE CALENDAR

(*Continued from page 5*)

Sept. 3-7—National Advanced Technology Management Conference, Institute of Radio Engineers, Seattle, Wash.

Sept. 3-7—International Symposium on Information Theory, Institute of Radio Engineers, Brussels, Belgium.

Sept. 3-9—1962 Flying Display and Exhibition, Society of British Aircraft Constructors, Farnborough, England.

Sept. 4-7—National Advanced-Technology Management Conference, Opera House, Seattle World's Fair grounds, Wash. Sponsors: University of Washington, professional engineering groups and technologically oriented business firms.

Sept. 5-7—Symposium on Measurement of Thermal Radiation Properties of Solids, Biltmore Hotel, Dayton, Ohio. Sponsors: Aeronautical Systems Division, USAF; National Bureau of Standards; NASA.

Sept. 5-7—Seminar on Automatic Checkout Techniques, Battelle Memorial Institute, Columbus, Ohio. Co-sponsors: Aeronautical Systems Division, USAF; Columbus, Ohio, Research Center.

Sept. 6-8—Second Annual Convention, Canadian Business Aircraft Assn., Queen Elizabeth Hotel, Montreal, Canada.

Sept. 10-14—Fourth National Conference on Applied Meteorology, American Meteorological Society, Hampton, Va.

Sept. 10-14—Annual General Meeting, International Air Transport Assn., Dublin, Ireland.

Sept. 13-14—10th Annual Engineering Management Conference, IRE, Hotel Roosevelt, New Orleans, La.

Sept. 17-18—Hydrofoil & Air Cushion Vehicles Meeting, Institute of the Aerospace Sciences, Shoreham Hotel, Washington.

Sept. 18-20—Ordnance Environmental Research Symposium, El Tropicano Hotel, San Antonio, Tex. Sponsor: Environmental Research Office of the Office of the Chief of Ordnance. Arranged by Southwest Research Institute.

Sept. 18-23—16th National Convention & Aerospace Panorama, Air Force Assn., Las Vegas, Nev.

Sept. 19-20—Technical Manpower Utilization Meeting, Institute of the Aerospace Sciences, Hotel Commodore, New York.

Sept. 19-20—Operations & Maintenance Symposium, Airwork Corp., Millville, N. J.

Sept. 19-21—Sixth National Conference on Tube Techniques, Western Union Auditorium, New York, N. Y. Sponsor: Advisory Group on Electron Devices.

Sept. 19-22—Second International Agricultural Aviation Congress, National Superior Agronomy School, Grignon, France.

Sept. 24-28—13th International Astronautical Congress, American Rocket Society, Sofia, Bulgaria.

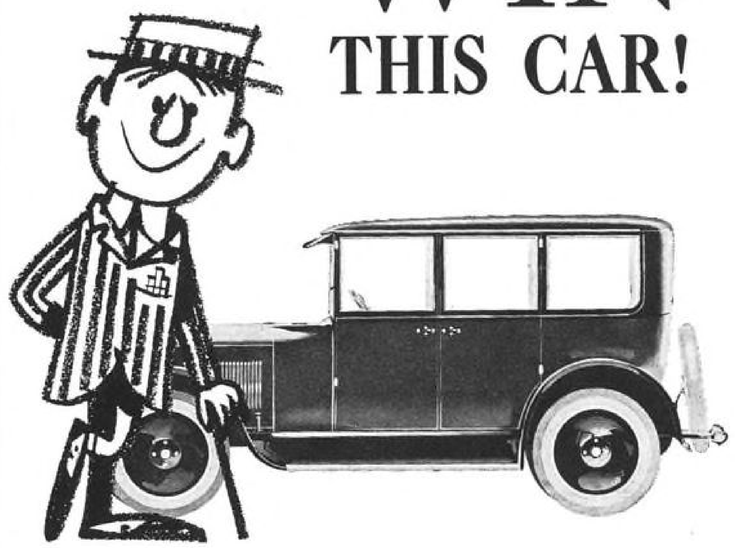
Sept. 24-Oct. 12—International Air Transport Assn. Traffic Conferences, San Marcos Hotel, Chandler, Ariz.

Sept. 25-27—Third Annual Symposium on Helicopter Open Sea Rescue, Kaman Aircraft Corp., Bloomfield, Conn. Sponsor: Naval Air Material Center, Air Crew Equipment Laboratory.

Sept. 25-28—Space Power Systems Confer-

(*Continued on page 9*)

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What does it take to win? No slogans, puzzles or box tops—just your name in the bowl from which we'll draw the winner's name on the final day of the Eighth National Communications Symposium of the I.R.E. at Utica, N.Y., October 1 through 3.

How do you get into the Chowder Bowl? Easy. First of all, *members of the Budd Electronics Chowder and Marching Society will automatically receive entry forms.* If you are *not* already a member, write to Chowder Bowl, Budd Electronics, 43-22 Queens St., Long Island City 1, N. Y., giving your name, organization, business address, title and brief description of job responsibilities . . . or give this information to any Budd Electronics Field Representative. If you're actively engaged in some aspect of specialized data handling or display, RF systems, environmental control or heat exchange systems, earth sciences, spacecraft testing or fields related to these . . . you're in!

This offer is not good in localities where prohibited by law.

You don't have to be present at the drawing to win . . . and you don't have to worry about delivery costs if you win—we'll pay them within the continental U.S.

So 23 Skiddoo! Hop in! Write now for your entry form!

Note: Contrary to rumors, we *will* be open for business between now and the Utica I.R.E. Show, in spite of all the excitement over the big giveaway. Since members of our own staff are not eligible for the drawing, they will be prepared to discuss your requirements in their usual calm manner.

Note #2: In case you're curious, we're giving away this particular car because it incorporates the all-steel body pioneered, developed and produced by Budd 'way back in the flapper days. You may have seen the car at recent I.R.E. shows, where we displayed it fitted out as a space vehicle. The lucky winner will get it completely refitted for earth travel. Giving it away is our way of reminding you that Budd's tradition of leadership goes a long way back . . . and continues today.

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Maximum Duty: 5.2 H.P., 12,500 RPM, 24 Volts, 208 Amps, 78% Efficiency.
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D-1302 (Third Stage)
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AEROSPACE CALENDAR

(Continued from page 7)

ence, American Rocket Society, Miramar Hotel, Santa Monica, Calif.

Sept. 26-27—Symposium on the Physics of Failure in Electronics, Illinois Institute of Technology, Chicago, Ill. Co-sponsors: Rome Air Development Center, USAF Systems Command; Armour Research Foundation.

Sept. 26-Oct. 2—1962 General Conference, Federation Aeronautique Internationale, Athens, Greece.

Sept. 27-28—Symposium on Dynamic Behavior of Materials, University of New Mexico, Albuquerque, N. M. Sponsors: University of New Mexico; American Society for Testing and Materials.

Sept. 28-29—Society of Experimental Test Pilots' Sixth Annual Awards Banquet & Symposium, Beverly-Hilton Hotel, Beverly Hills, Calif.

Oct. 1-3—Seventh Annual Exposition & Symposium, Air Traffic Control Assn., Flamingo Hotel, Las Vegas, Nev.

Oct. 1-3—National Communications Symposium, Institute of Radio Engineers, Hotel Utica, Utica, N. Y.

Oct. 2-4—Symposium on Physics and Nondestructive Testing, Granada Hotel, San Antonio, Tex. Arranged by Southwest Research Institute.

Oct. 2-4—Third Symposium on Advanced Propulsion Concepts, Cincinnati, Ohio. Co-sponsors: AFOSR, General Electric.

Oct. 2-4—National Symposium on Space Electronics and Telemetry, IRE, Fontainebleau Hotel, Miami Beach, Fla.

Oct. 2-4—15th Annual Meeting and Convention, National Business Aircraft Assn., Penn-Sheraton Hotel, Pittsburgh, Pa.

Oct. 8-12—National Aeronautic & Space Engineering & Manufacturing Meeting & Display, Society of Automotive Engineers, The Ambassador, Los Angeles, Calif.

Oct. 9-11—National Airports Conference, American Assn. of Airport Executives, University of Oklahoma, Norman, Okla.

Oct. 10-12—Ions in Flames & Rocket Exhausts Conference, American Rocket Society, Palm Springs, Calif.

Oct. 10-12—20th Annual Aerospace Electronics Exposition/Report, Aerospace Electrical Society, Pan Pacific Auditorium, Los Angeles, Calif.

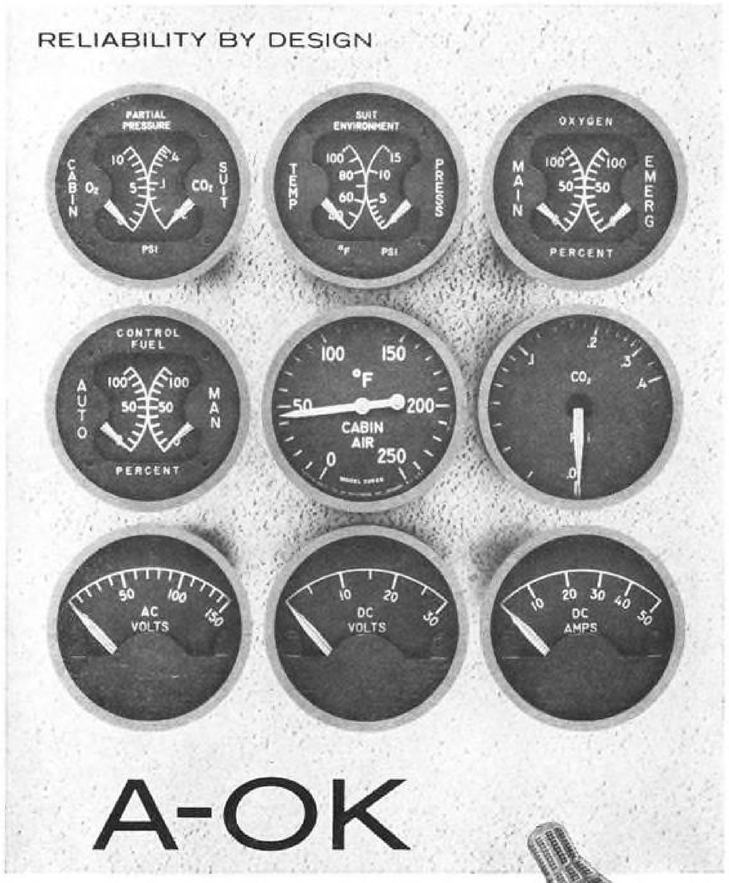
Oct. 15-17—Fall Meeting, International Scientific Radio Union & Institute of Radio Engineers, Ottawa, Canada.

Oct. 15-17—ASW Meeting, Somerset Hotel, Boston, Mass. Sponsors: Institute of the Aerospace Sciences; U. S. Navy.

Oct. 15-18—International Symposium on Space Phenomena and Measurement. Statler-Hilton, Detroit, Mich. Ninth Annual Meeting: Institute of Radio Engineers, co-sponsored by NASA and AEC.

Oct. 29-30—Meeting on Large Rockets, Institute of the Aerospace Sciences, El Dorado Inn, Sacramento, Calif.

Oct. 29-31—Symposium on Dynamics of Manned Lifting Planetary Entry, Philadelphia, Pa. Attendance limited; for information: Sinclaire M. Scala, General Chairman, Room M7023A, General Electric Co., MSVD, Valley Forge Space Technology Center, Box 8555, Philadelphia 1, Pa. Co-sponsor: AFOSR.



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Gemini — As a result of the proven reliability of Weston instrumentation in Mercury, Weston dual indicators have been selected to monitor similar variables for Gemini.

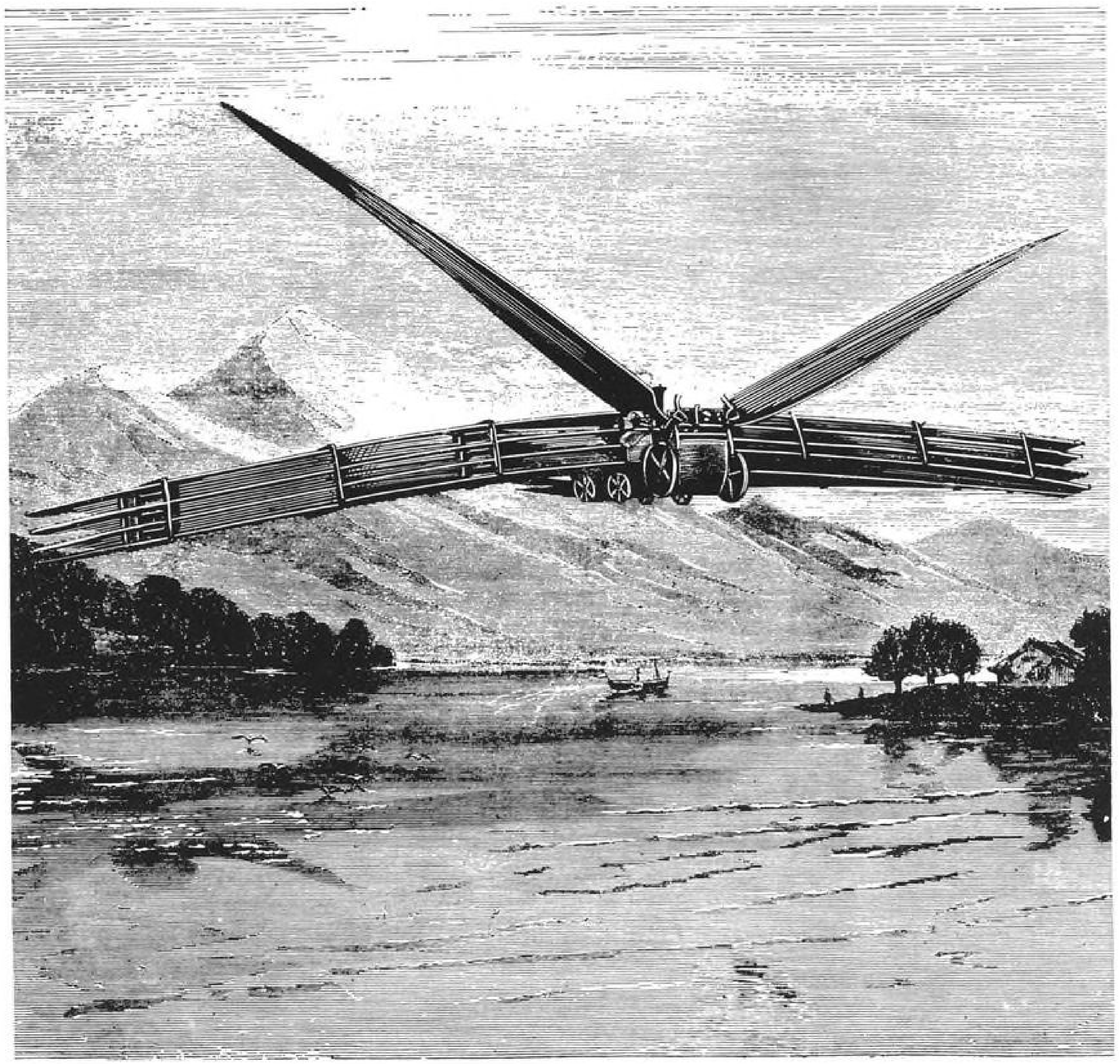
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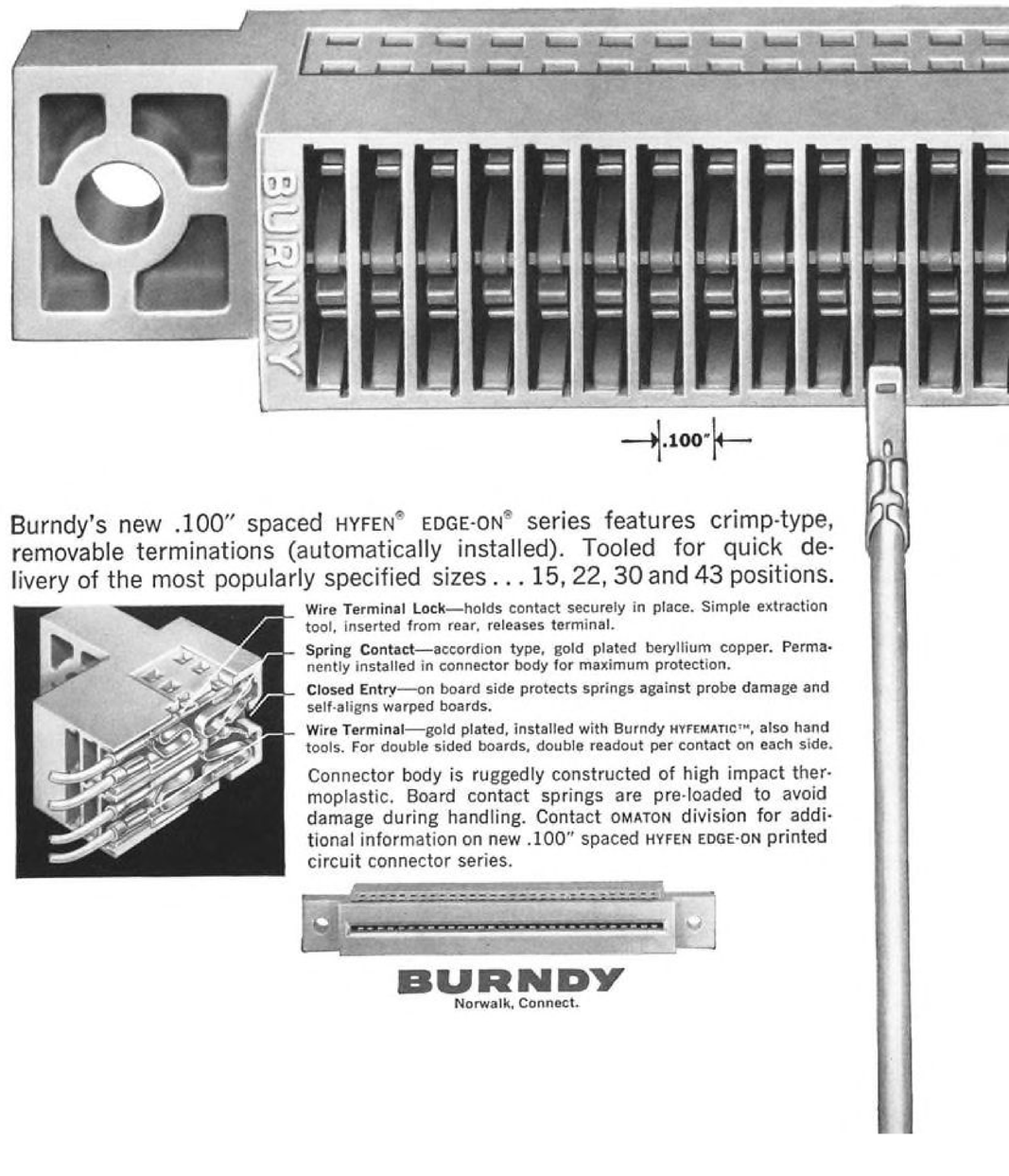
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MB Hydraulic Shakers cut vibration-testing costs for large payloads

Vibration or shock testing of very large payloads—such as missile sections, or complete missiles—usually requires extremely high forces at moderate velocities and frequencies. It is not unusual for force levels to be in the order of 100,000 lbs.

In this force range, MB's electro-hydraulic shakers may cost as low as 1/5th the price of comparable electro-dynamic units. What's more the electro-hydraulic shaker is much smaller and more compact. For example, a hydraulic actuator with a 100,000 lb. force rating is only 18" square by 13" high!

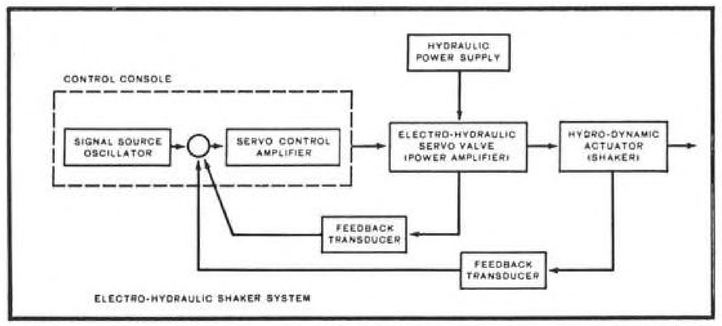
MB's hydraulic shakers complement our line of electro-dynamic exciters and extend the limits of vibration, shock and fatigue testing. The electro-dynamic exciter fills the need for testing at high frequencies and relatively low forces and amplitudes, whereas hydraulic shakers are most advantageous for tests requiring extremely high vibratory forces and long strokes in the low to intermediate frequency range.



View of typical MB hydraulic actuator with a force rating of 100,000 lbs. Measures only 18" x 18" x 13".

Some applications for hydraulic shakers:

- fatigue testing of heavy structures and members
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- vibrating heavy mass loads directly-supported on the shaker
- simulating transportation specifications
- applying static and dynamic loads simultaneously
- pulse testing and combined tests in environmental chambers
- simulating vibratory loading transmitted through more than one support



Principle of operation—input signals are fed to electronic servo amplifier, where they are combined with feedback signals from hydraulic shaker. After amplification, this signal is supplied to the electro-hydraulic servo valve which converts electrical variations into fluid flow variations which in turn are reproduced by the hydraulic power stage of the valve. Actuator velocity is proportional to oil flow and varies according to electric input signal.

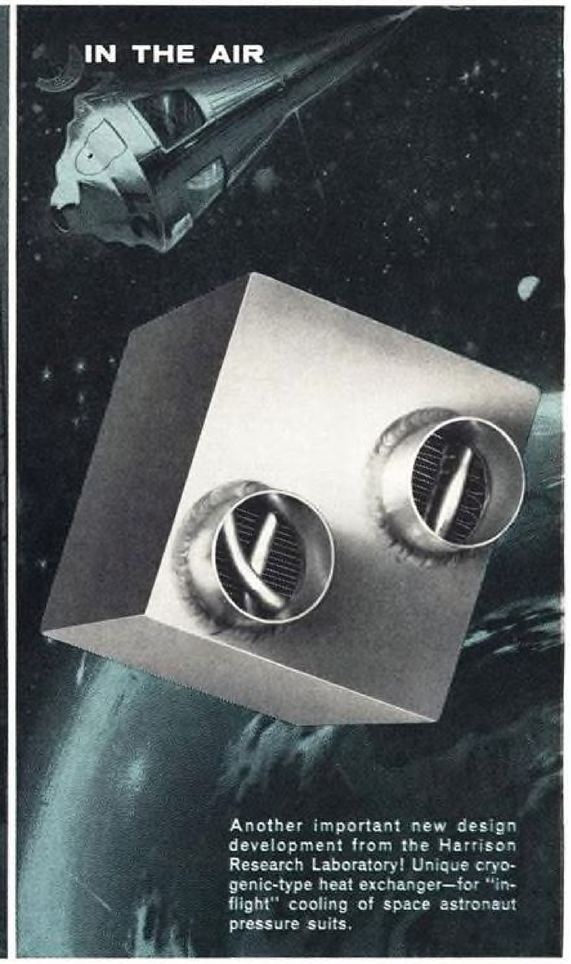
An MB hydraulic shaker system can add extensively to your testing capabilities; available in 27 standard models with forces of 1,000 to 100,000 lbs. and strokes to 18". These shaker systems can also be custom designed to meet your specific requirements.

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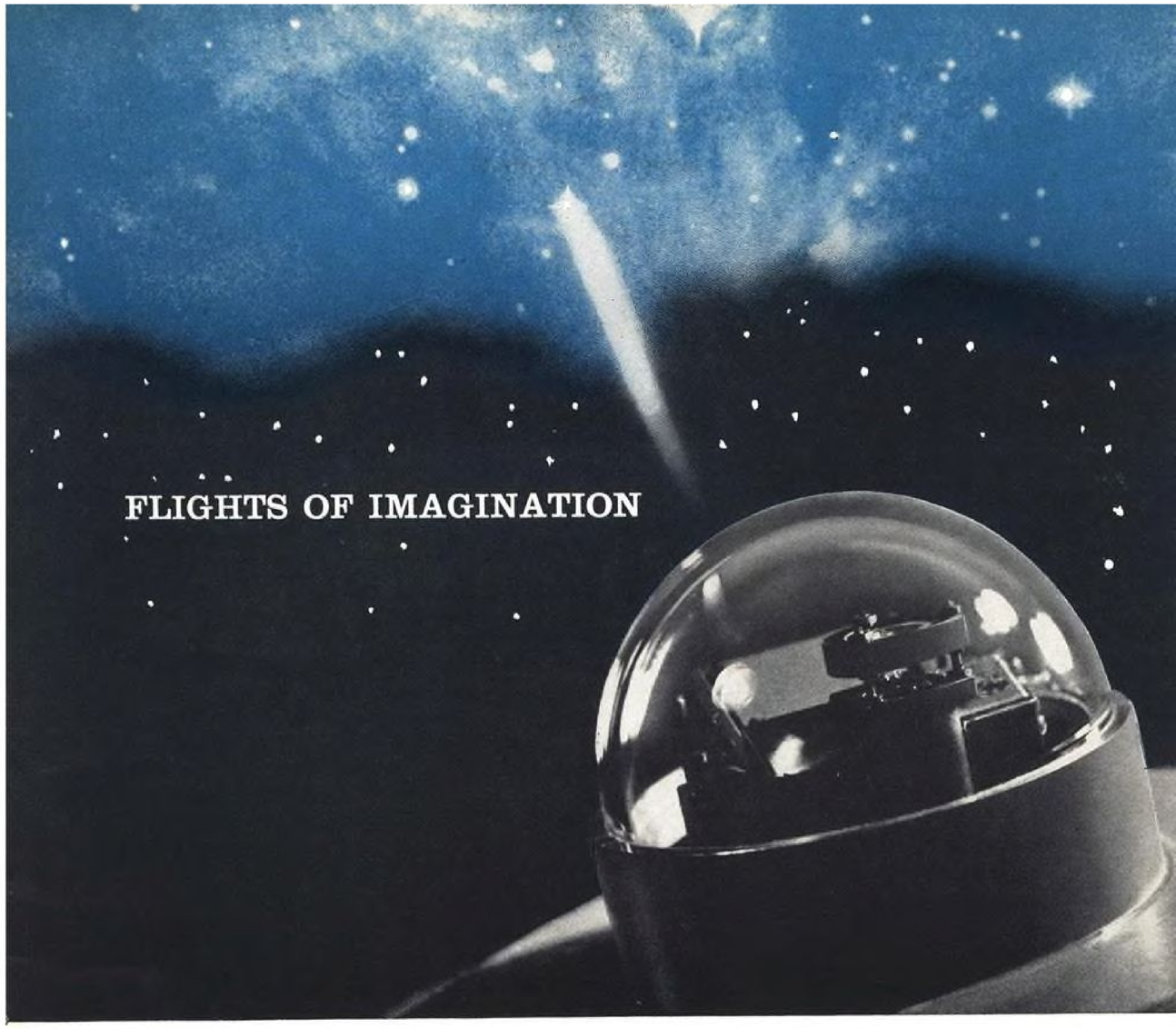
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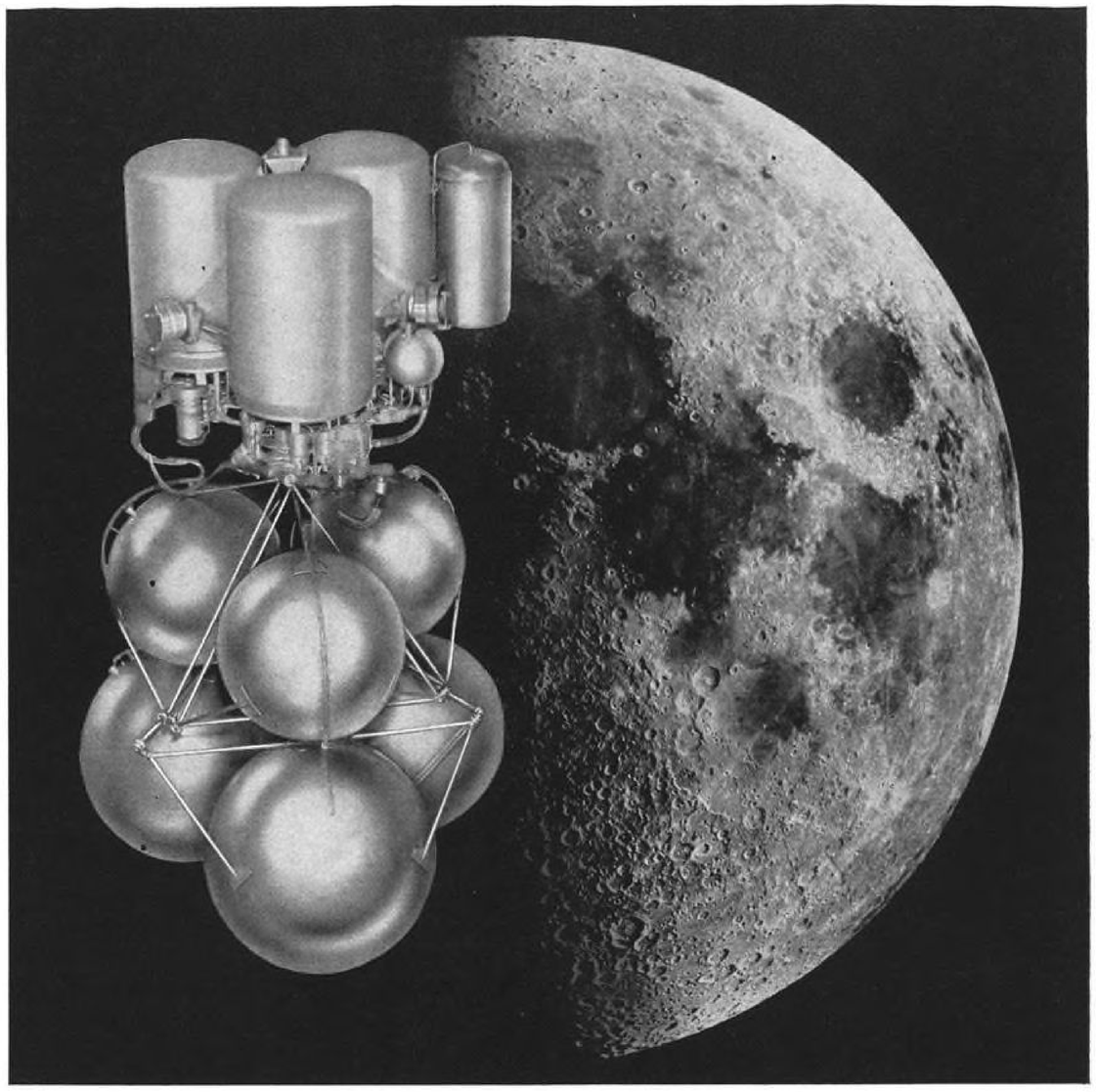


CELESTIAL NAVIGATION Space vehicles will hasten their own evolution as information gained from each orbiting study spurs the creative imagination of design engineers. Anticipating rapid advances in satellite range and controllability, Kollsman is pacing its refinement of astro tracking systems accordingly. At the same time, it is making significant progress in horizon scanners and sun sensors. □ Since 1946, Kollsman has been both the research and production leader in space-age celestial navigation systems. Aggregate output: more than 10 times that of all other free world producers combined. No other source has equal ability to meet specific requirements, whether for manned aircraft, missiles or space vehicles.

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A fuel cell for Apollo

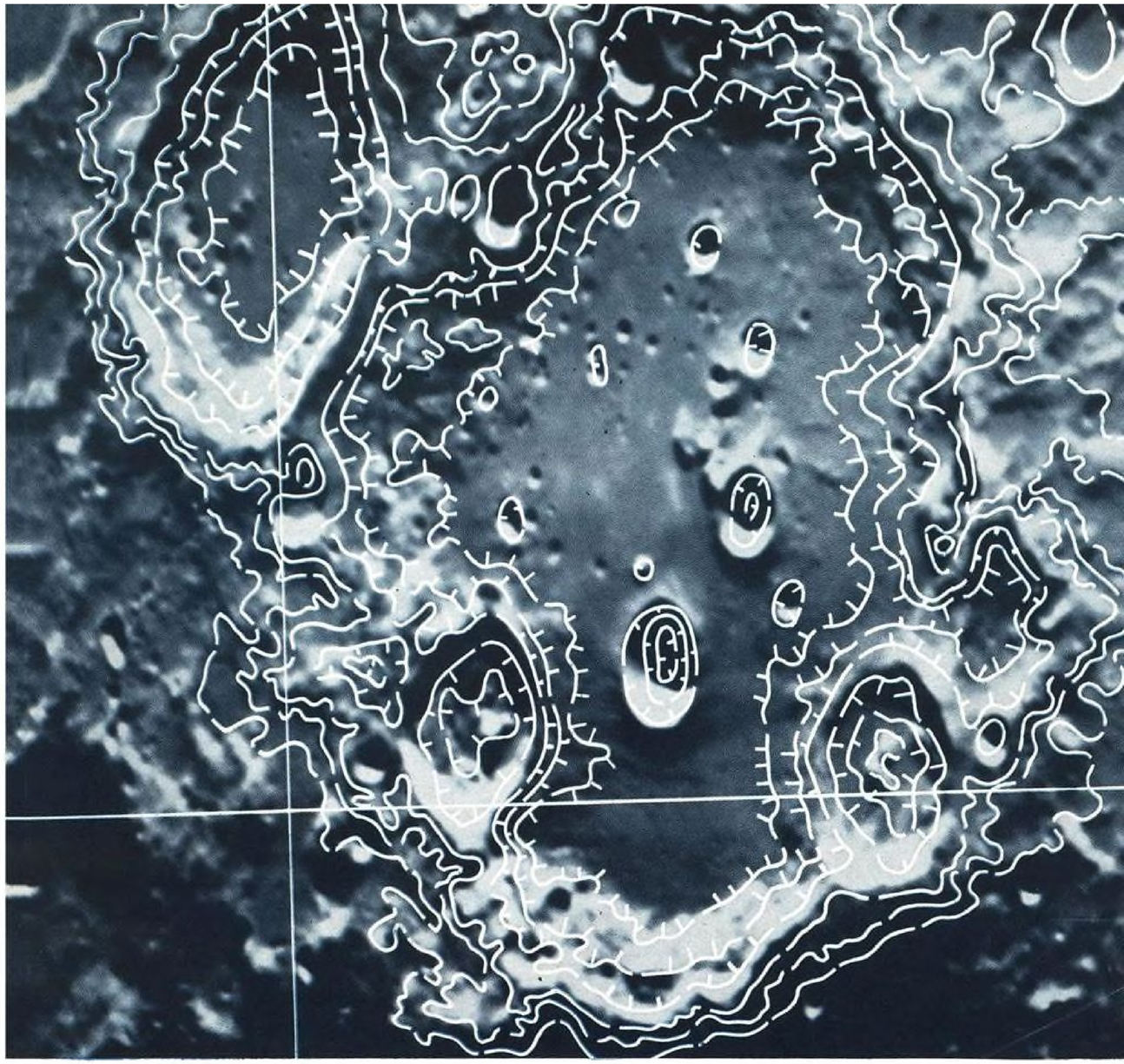
This is a model of a fuel cell designed by Pratt & Whitney Aircraft—the company chosen to develop a fuel cell system for Apollo, America's first manned lunar craft. The Apollo spacecraft will be built for NASA by North American Aviation.

The hydrogen-oxygen cell will supply power for environmental conditioning, communication, instrumentation, and scientific equipment. In addition to generating electricity, the fuel cell will provide water for Apollo's three-man crew.

Pratt & Whitney Aircraft's fuel cell is far more efficient than conventional power systems. During tests, cells have demonstrated efficiencies of 70 to 80 per cent.

The fuel cell has a significant role in space. Moreover, it promises to be a significant power source on earth. Pratt & Whitney Aircraft is currently studying fuel cell power systems for such applications as remote-site power, vehicle propulsion, commercial power generation, and other industrial tasks.

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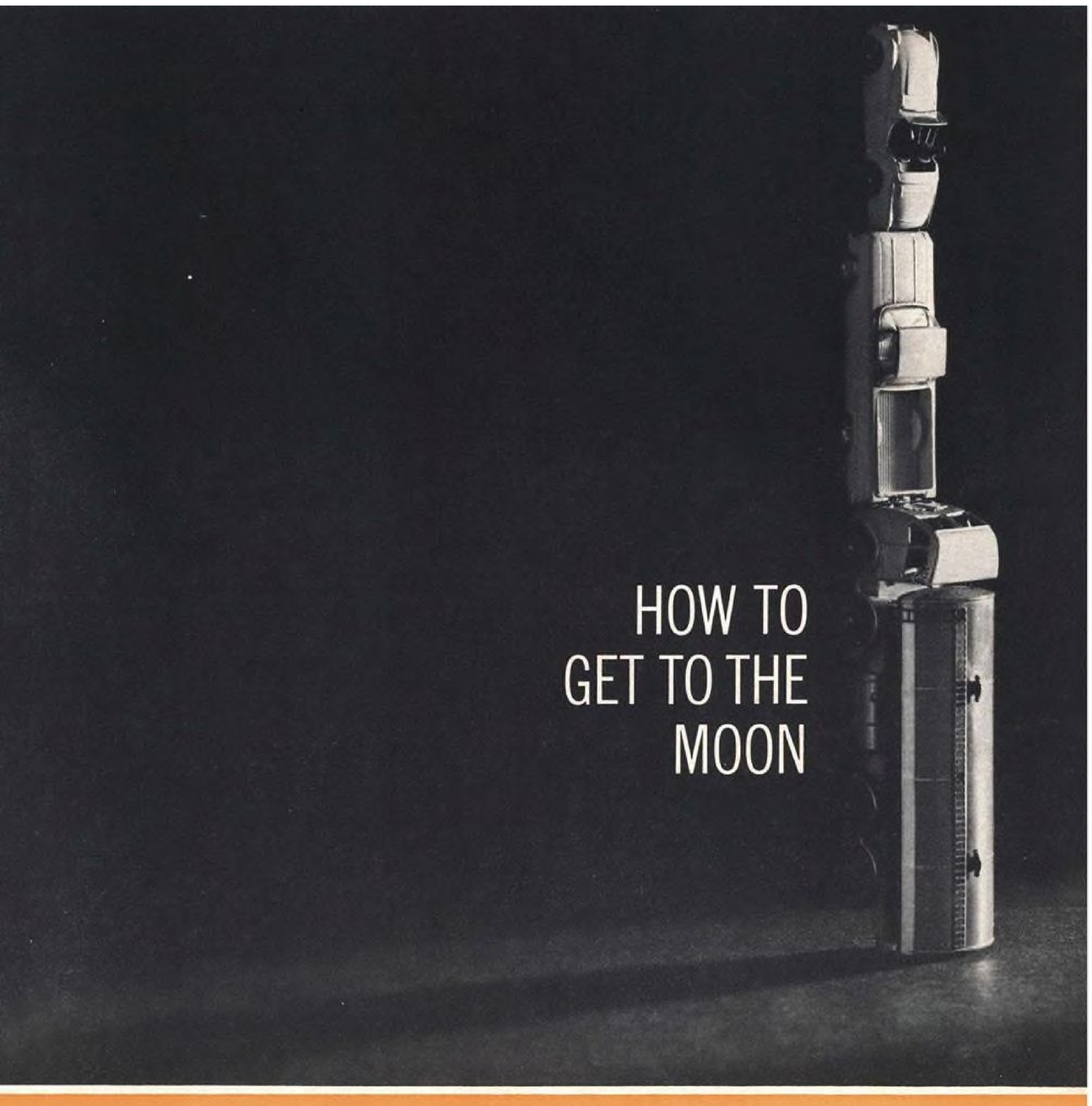
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PICTURE CREDITS

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EDITORIAL

A Tragic Paradox

Six years ago this summer, we stood in the garden of the Red Army Club in Moscow listening to Nikita Khrushchev twit Gen. Nathan F. Twining, then USAF chief of staff, on the relative merits of the Soviet socialist system vs. the American capitalistic system. The Soviet boss was still relatively new in his position at the top of the Red totem pole and had just begun to experiment with the technique of the vodka-inspired phrase as a major instrument of international diplomacy. But even then he had already run afoul of the enormous, creaking official Russian bureaucracy spawned by the Communist doctrine of state control for everything. He had already tabbed this bureaucracy as one of the major roadblocks lying squarely across the path of Russian economic progress.

"Your country is moving more in the direction of socialism," Khrushchev told Gen. Twining with a quick side-glance to make certain that Western reporters present were getting the translation of his remarks. "But we in Russia are moving more in the direction of capitalism. In 10 years it will be hard to tell the difference between your system and ours."

Soviet Incentive Failure

These remarks were deleted by Soviet censors in the Moscow cable office when Western correspondents tried to file them that evening. It is still official Soviet heresy to admit that the incentive of the Communist system has failed miserably to stir the Russian people into anything near the kind of effort really needed to develop their country economically. However, there has been ample evidence since Khrushchev made these remarks in the summer of 1956 that he has personally made a tremendous effort to bend the official system to establish some sort of effective individual incentives in the Russian economy. He has also conducted vigorous warfare against the centralized state planners and regional bureaucrats who are more concerned with following totally unrealistic plans blindly, even to the point of faking successful statistical results, than in operating a growing economy.

Recently, Soviet newspapers have been spotted with detailed case histories of the failures of bumbling bureaucrats who executed their portion of the state plan to the letter, even though it meant disaster for the over-all economy. Soviet courts have also recently resumed handing out death sentences to managerial types who have run their particular enterprises into the ground, although the official verdict never quite puts it that bluntly.

One of the most remarkable insights into the failures of the centralized Soviet state planning bureaucrats came from the distinguished Russian aircraft designer Oleg K. Antonov. His criticism was initially published in the Moscow daily newspaper Izvestia and was reprinted in AVIATION WEEK & SPACE TECHNOLOGY (July 23, p. 74). Designer Antonov's article was remarkable for several reasons, perhaps the most important being the fact that top Soviet leadership felt it necessary to have a Russian of Antonov's technical stature publicly attack the official Soviet system in one of its most important government-controlled publications. This is also a fair gage of just how serious this situation has become.

Bureaucratic Bumbling

It is also noteworthy that Antonov not only attacked the bumblings of the bureaucracy as it fumbled with the production system but that he also attacked failures of the educational system induced by blind adherence to centralized conformity. Even to Antonov, the response from the Russian citizenry was remarkable. He based a subsequent article on specific case histories of bureaucratic bumbling written to him by Izvestia's readers.

Western readers of the Antonov analysis will also be interested in his conclusion that the lack of supply and demand relationships and the lack of competitive aspects of the marketplace are major flaws in the Soviet economic system. These features, so typical of Western economies, are a favorite target of Communist doctrinaries, who dismiss them as "wasteful."

Since 1956, Nikita Khrushchev has taken a variety of steps to provide increased incentives for Soviet citizens that are more significant than the cheap, enamelled "hero" badges that seem to be a major production item of Soviet factories. Mr. Khrushchev's actions since 1956 have validated that portion of his prediction that the Soviet system would be moving more in the direction of capitalistic techniques. Unfortunately, the national leadership of this country has provided considerable evidence that his analysis of our drift toward the centralized planning and dulling of human incentives that characterize the socialist system may also prove to be correct.

In no other facet of American life has this growth of a highly centralized planning dictatorship been more pronounced than in the technology and industry embraced by the national defense effort. The full blame for this trend cannot be laid on the power-hungry government bureaucrats who have been the architects of this system. They never could have erected such a mighty bureaucratic superstructure without the acquiescence of key segments of American industry and the indifference of a majority of the American people.

It is a rather tragic paradox that in this critical stage of the power struggle between the Communist system and the Western concepts of social and economic organization, the Communists are now adopting the basic elements that gave the Western system its vitality and growth, while the great Western nations are stupidly picking up those very elements of the socialist system that have been discarded as unworkable by the socialists themselves.

—Robert Hotz

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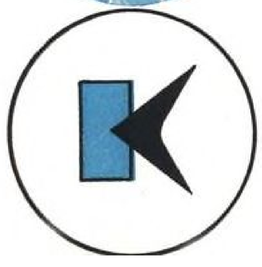
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WHO'S WHERE

In the Front Office

John A. Dundas, a vice president, General Dynamics Corp., New York, N.Y., to coordinate and expand the company's international activities. Mr. Dundas has been executive vice president and a director of Douglas Aircraft (AW Mar. 19, p. 101).

The Boeing Co., Seattle, Wash., has appointed **Vice President George C. Martin** as general manager of the F-111A program (AW Aug. 6, p. 25).

Marvin B. Ruffin, president, chief executive office and a director of Bogart Manufacturing Corp., Brooklyn, N.Y. Formerly, Mr. Ruffin was president of Chicago Aerial Industries.

Emiel T. Nielsen, a vice president, FMC Corp., San Jose, Calif. Mr. Nielsen continues as manager of the company's Ordnance Division.

Robert T. Campion and **John J. Burke,** senior vice presidents, Lear Siegler, Inc., Santa Monica, Calif. Also: **David Gerstein,** executive vice president of LSI's newly formed Data & Controls Division, New York, N.Y.

Gerald E. Donovan, a director, Marshall Industries, San Marino, Calif. (AW Apr. 16, p. 23).

Robert S. Rosenast, vice president-manufacturing and a director, Swedlow, Inc., Los Angeles, Calif.

H. Buckingham and **Dr. E. S. Moult,** directors of Bristol Siddeley Engines, Ltd., London, England.

George J. Renne, vice president-finance, Beckman Instruments, Inc., Fullerton, Calif.

Collins Radio Co. has announced the appointment of the following vice presidents: Dallas Division—**F. C. Dyer** for Alpha Systems, and **R. C. Mullaley** for construction; Cedar Rapids—**J. C. McElroy** for engineering, and **J. D. Nyquist** for manufacturing.

Ivan M. Ponedel, vice president-customer relations, Electro-Optical Systems, Inc., Pasadena, Calif.

Wendell R. Stevens, a vice president, Air Express International, New York, N.Y.

Republic Aviation Corp., Farmingdale, N.Y., has appointed **Vice President Lowery L. Brabham** program manager for F-105D production.

National Aircraft Noise Abatement Council, Washington, D.C., has appointed the following as directors: **Charles H. Ruby,** newly elected president of the Air Line Pilots Assn., replacing **Clarence N. Sayen; George F. Hannaum,** acting president of the Aerospace Industries Assn., replacing **August C. Esenwein.**

Col. John L. Martin, Jr., director, Office of Space Systems, USAF headquarters, succeeding **Brig. Gen. Richard D. Curtin** (AW June 18, p. 35).

S. Vaughan Andrews, assistant vice president-administration, Aerospace Corp., Los Angeles, Calif., and director of administration for San Bernardino (Calif.) Operations.

Carson E. Boone, president and general manager, Security Valve Co., South Pasadena, Calif., a division of Menasco Manufacturing Co., and a vice president of Menasco.

(Continued on page 121)

INDUSTRY OBSERVER

► First mission for the space flight simulator-trainer to be installed at Edwards AFB, Calif., will be to check out pilots on simulated Boeing X-20 (Dyna-Soar) flights. More than 50 aerospace companies attended USAF Aeronautical Systems Division briefing on the simulator-trainer held at Edwards recently (AW Aug. 6, p. 35). Design and development proposals are due Sept. 4.

► **Results of Advanced Research Projects Agency-sponsored program to measure the radiation characteristics of different re-entry bodies—an effort to find a distinctive signature which would enable an anti-ICBM defense system to discriminate between warheads and decoys—indicate that the optical and infrared portion of the spectrum is the most promising.**

► Planned cancellation of the English Electric Blue Water tactical ballistic missile (AW Aug. 6, p. 31) probably will not be announced until the British Parliament reconvenes in October. Cancellation charges will cost the government about $10 million. Staunchest supporter of Blue Water continuation is War Secretary John Profumo, who canceled a planned inspection trip to West Germany to argue the missile's case before the cabinet last week.

► **Navy will test a mission-stretching technique with the Lockheed P3V-1 Orion anti-submarine warfare patrol aircraft involving use of only two of the four Allison T56 turboprop engines to remain on station. High-speed approach to the area of a submarine contact would be made with four engines operating, then two engines would shut down. Feasibility of the technique already has been demonstrated on the prototype aircraft. Lockheed will deliver the first production model of the P3V-1 at the Naval Air Test Center, Patuxent River, Md., today.**

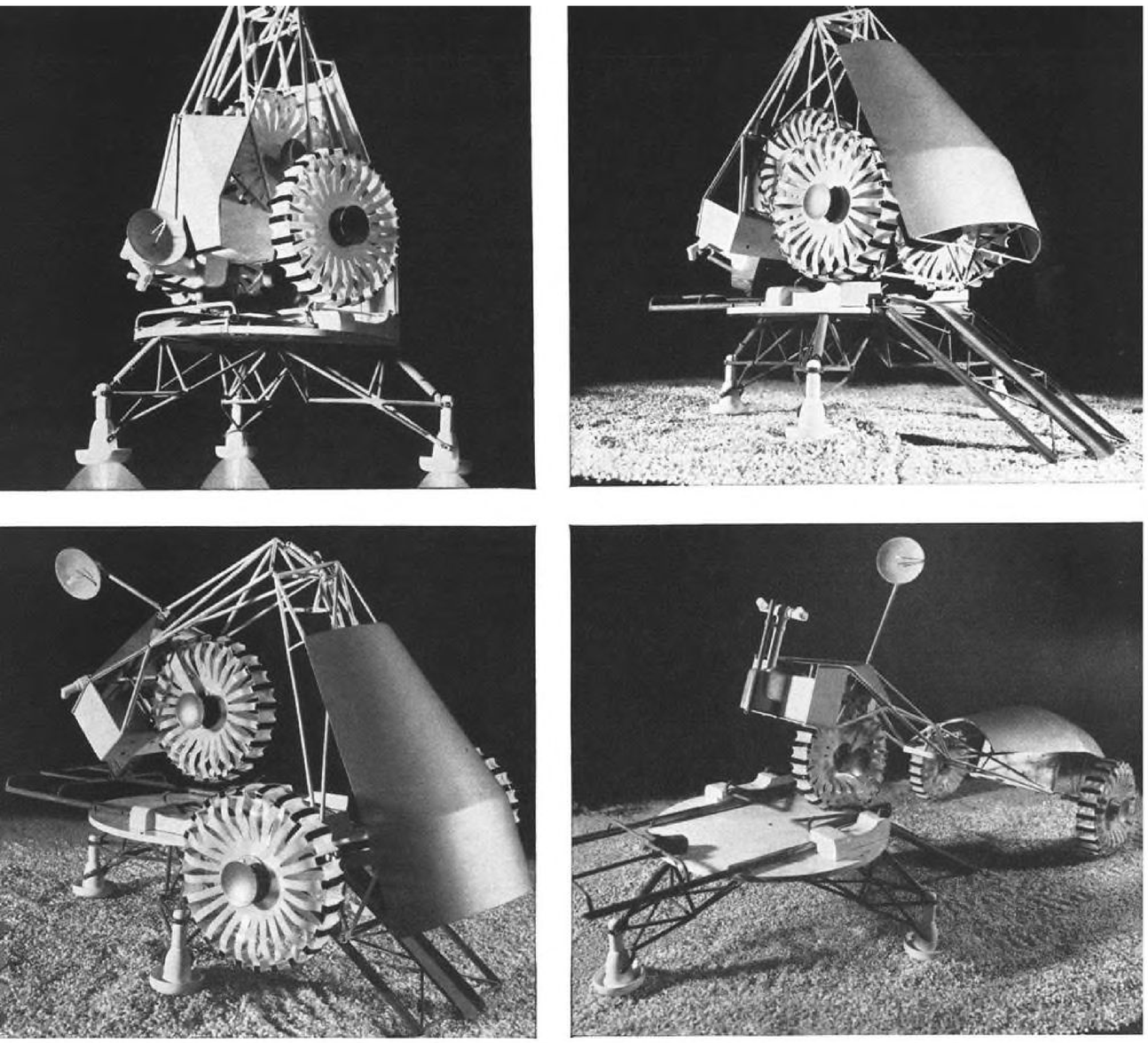
► Air Force's Systems Command's Aeronautical Systems Division is evaluating industry proposals submitted late last month for a study of environmental-resistance requirements of operational equipment likely to be installed in aerospace vehicles, such as Aerospace Plane. The Aerospace Plane has been the subject of Air Force feasibility studies and limited component development.

► **Allegany Ballistic Laboratories, a Navy-owned, Hercules Powder Co.-operated facility, has developed and static-fired experimental motor No. 36 (EM-36) which had a mass fraction of 0.95, attained through a combination of a Spiralloy glass filament-wound case, a minimum of internal insulation, a new loading technique and core geometry. Developed under joint sponsorship of Navy and NASA, EM-36 is longer than ABL's 6-ft.-long Altair motor, has about the same diameter (18 in.), but is heavier and uses a higher energy propellent.**

► Poland has started quantity production of hydrofoil boats at Gdansk (Danzig) and also is developing a ground-effect vehicle for over-water use. The Polish hydrofoil craft is described as a "younger brother" of the 188-passenger Russian Comet hydrofoil boat. It has a 1,000-hp. engine and a maximum speed of 75 kilometers per hour (46.5 mph.). First regular route for the Polish hydrofoil boat will be on the Oder River between Szczecin (Stettin) and Wroclaw (Breslau).

► **Aerojet-General Corp. and Dainippon Celluloid Co. of Japan (DaiCel) are discussing licensing of an Aerojet solid rocket fuel formula and technical assistance for construction of a plant to manufacture the propellant in Japan. If an agreement is reached between the companies, then both the U.S. and Japanese governments must approve the arrangement.**

► NASA may request money to build a combination Agena B and Centaur launch complex at the Atlantic Missile Range to the south of Centaur Launch Complex 36B. A mushrooming schedule, which will worsen the already crowded launch plan in the mid-1960s, is the reason for the contemplated request.



A model of a roving lunar vehicle is shown (upper left) in its folded position on the landing system during the final stages of descent to the lunar surface. (upper right) The landing shock triggers the release of an unloading ramp and initiates the debarking process. The vehicle, hinged in the middle and actuated by compressed gas, starts to unfold. (lower left) During the initial phase of debarkation the vehicle wheels, which were retracted during the flight from Earth, are extended outward and the communication antenna is erected to permit radio contact with Earth. (lower right) Near the end of the debarking process, the vehicle is fully extended and is locked into its operation position.

LUNAR RECONNAISSANCE is a Bendix program involving the design of roving vehicles systems, both manned and unmanned. It is one of several Bendix programs in the deep space sciences. If you are an engineer or scientist in the space technologies, and would like to join this team for greater personal recognition and opportunity, please contact our Personnel Director, Bendix Systems Division, Ann Arbor, Michigan—an equal opportunity employer.

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WHERE IDEAS UNLOCK THE FUTURE

Washington Roundup

Pentagon Investigations

Deputy Secretary of Defense Roswell Gilpatric has ordered all top Pentagon civilians to report to him twice a month on any conversations they have with businessmen or business press representatives. Ostensible reason is that Defense wants to keep closer track of relations between the department and industry. Some Pentagon observers, however, see a connection between the order and the recent intensive investigation in the Pentagon of information leaks. These investigations have centered chiefly around specific daily newspaper reports, have involved the Federal Bureau of Investigation, and have covered most civilian secretaries and assistant secretaries and three- and four-star generals.

Mercury-Atlas 8 flight date has been changed from Sept. 18 to Sept. 25 but the one-week delay has nothing to do with concern over the possible conflict between the flight and Russian high altitude nuclear tests (AW Aug. 6, p. 35). Major concern is that Russia might conduct a test as the countdown for the flight is under way, necessitating a delay in the flight. There is no fear that an explosion would take place while astronaut Walter M. Schirra is in orbit. Both NASA and the State Department believe Russia would not risk so arousing world opinion. Russia detonated a 30-megaton device near Novaya Zemlya on Aug. 5 and a smaller one in central Siberia Aug. 7. The U.S. Atomic Energy Commission also said there were indications that Russia actually resumed tests in Siberia a few days before the 30-megaton blast.

Targeting Staff Move

Army and Navy are supporting a Defense Department suggestion that the Joint Strategic Target Planning Staff, now located at Strategic Air Command headquarters in Omaha, Neb., be shifted to Washington. The targeting staff is headed by USAF Gen. Thomas S. Power, who is also SAC chief, and reports directly to the Joint Chiefs of Staff. It is manned by Navy and Army officers and by SAC officers who do the same job for both their command and the target staff.

Air Force bitterly opposes any move. Some Navy officers have mixed feelings because they look on the move as a possible first step toward a unified Strategic Command (AW Oct. 16, p. 34). Behind the proposed move is the idea among some defense civilian leaders that strategic operational war gaming should be done in an atmosphere free from the influence of any particular service.

Centralized industry public relations office for companies working on manned space flight contracts has been proposed for Cape Canaveral, Fla., to take some of the workload off NASA public information officers there. The office would be located near NASA's news center for each shot.

Another Advent Probe

Congress will take another look at the management of the Advent military communication satellite program (see p. 28). The forum will be a House space subcommittee headed by Rep. Joseph Karth, who does not believe Advent would have been ready to fly even if the Atlas-Centaur launch vehicle had remained on schedule. Rep. Karth will demand to know why Advent had so much old-fashioned equipment in it (AW June 18, p. 32). He also will probe whether the reoriented Advent program will duplicate National Aeronautics and Space Administration's Relay and Syncom satellite programs. Hearings have not been scheduled but probably will be held next week.

Dr. Harold Brown, defense director of research and engineering, recently told another congressional committee that Advent's principal difficulty once the management setup had been arranged "was an attempt to rush into an experiment without having a payload which had any high assurance of working and in a circumstance where the booster that would finally put it into orbit was slipping." He said it would have cost $300 to $500 million for two satellite systems.

'Saigon Laboratory'

Much of what is being learned by U.S. military advisers in the fighting in South Vietnam will be considered in conjunction with recommendations of the Howze board on what form future Army vehicles, weapons and tactics should take (see p. 27). Because of extensive use of U.S. aircraft, helicopters and small arms, South Vietnam is providing a testing ground for both techniques and hardware, and is being referred to as "the Saigon laboratory." Comparisons are being drawn with German and Russian testing of weapons in the Spanish civil war in the 1930s. Defense Department is monitoring Vietnam operations through its Advanced Research Projects Agency. This annoys the military services, which would prefer to make their own evaluations and conclusions.

Air Force Systems Command's new Research and Technology Division, which is headed by Maj. Gen. Marvin C. Demler (AW July 30, p. 16), will have an eminent civilian scientist as its executive director and should give contractors "not necessarily a more responsive ear but perhaps a more effective ear with respect to getting on with certain things that seem to be wise to get on with," AFSC Commander Gen. Bernard A. Schriever told Congress.

—Washington Staff

Defense Yields Bioscience Effort to NASA

Move is part of plan for national bioastronautics program; extensive flights with animals are planned.

By Edward H. Kolcum

Washington—Responsibility for all U.S. space biosciences programs, including animal flights, has been given to the National Aeronautics and Space Administration as the result of an informal agreement between the Defense Department and NASA. This is the first major decision to result from attempts now being made by the two agencies to form a national bioastronautics program.

Biosciences is a subdivision of bioastronautics, and NASA uses the word to describe research into the effects of the space environment on human organisms and the search for life in space. NASA's biosciences work now emphasizes laboratory animal research, and the agency is developing plans for an intensive flight program that gives major roles to military and other non-NASA researchers.

U.S. animal space flight program has been inactive since Nov. 29, 1961, when the chimpanzee Enos was flown in the Mercury Atlas-5 capsule to qualify the Mercury environmental system for manned flight. NASA has a balloon program under way using monkeys and small animals to study the effect of heavy cosmic primary radiation, but these flights are made at altitudes of less than 30 mi. (AW Aug. 6, p. 30).

The balloon experiments are considered the pilot program for developing life support systems and instrumentation for bioscience satellite payloads.

Air Force has proposed a large number of research animal flights but none of the plans has survived the Pentagon. The most ambitious was part of the Discoverer series, and General Electric Co. constructed several long-term chimp capsules for this program. They were never flown.

Decision to give NASA responsibility for animal flights came during discussions of a joint program. Defense Secretary Robert S. McNamara was understood to have suggested that NASA take over the biosciences phases. NASA Administrator James E. Webb agreed.

NASA split its bioastronautics program into mission-oriented projects last November, which resulted in formation of a biosciences directorate in the Office of Space Sciences. Biotechnology program is in the Office of Advanced Research, and the Office of Manned Space Flight manages the aerospace medicine program (see box, left).

It is not known how the McNamara-Webb decision on biosciences will affect the other national bioastronautics programs, but there is a possibility that some project tradeoffs will be made. Both NASA and Air Force maintain that former differences between the two agencies regarding life sciences have been resolved, and that both are ready to implement the biosciences flight program as quickly as it becomes firm.

Life sciences had been a major battleground between NASA and USAF, but early this year, after congressional insistence, the two agencies finally began to make progress toward a formal combined program.

NASA looks on the biosciences flight program as one of the most urgent research areas because of the critical information it will provide for extended manned flight. Because of this urgency, the agency expects to make a decision on an animal flight spacecraft in 4-6 weeks. Fundamental objective of the program—to understand the detailed workings of the biological system—dictates a relatively long-lived satellite with the capability of being recovered.

NASA expects to rely on existing hardware. If it does so, choice of a spacecraft narrows to three vehicles:

- **Mercury**, which has a several-day life support system for primate and is being uprated for an 18-orbit manned mission. The number of manned Mercury flights remaining has not been decided, but when the program ends there could be as many as eight capsules which have not flown. It is likely that capsules will be flown more than once in an animal program.
- **Discoverer** capsules launched by Thor Agena.
- **Samos-type** capsules launched by Atlas Agena.

Discoverer and Samos systems have the capability of ejecting recoverable reentry vehicles.

One NASA official said the agency might use a combination of systems, but because NASA will obtain launch vehicles, animals and experiments from USAF, the program "is not going anywhere without the Air Force."

The biosciences program, he said, "is under terrific study and analysis by NASA, Defense Department and the scientific community," and several of the experiments have been defined.

Although the decision may be to use existing spacecraft hardware, NASA is looking at new systems which could be more reliable and economical than those in use. Among them are passive recovery devices based on magnetic, gravity and solar pressure stabilization to provide angular orientation.

Life Sciences Chief

Washington—Administration has urged the National Aeronautics and Space Administration to appoint a high-ranking manager to coordinate the agency's life sciences programs, which are becoming more diverse as NASA expands.

When the agency reorganized last November, the Office of Life Sciences was abolished and program offices were established for aerospace medicine, Office of Manned Space Flight; biotechnology, Office of Advanced Research and Technology, and biosciences, Office of Space Sciences. Since November, human factors branches have been formed in several manned space flight directorates.

Concern apparently is that there is no single manager for all the programs and projects with a medical or biological background. Suggestion was that a deputy for bioastronautics be named, and that he report directly to Dr. Robert C. Seamans, Jr., associate administrator.

White House panel which considered the over-all bioastronautics effort last year (AW Aug. 21, 1961, p. 26) suggested in the Beeson Report that a list of 10 top candidates be developed and that one of them be selected to pull the programs together.

Long-Range Space Study

Washington—Top space agency officials are studying long-range space program recommendations submitted by about 50 top U.S. scientists at the conclusion of the first Summer Study Group at the State University of Iowa.

The eight-week session was conducted by the National Academy of Sciences for the National Aeronautics and Space Administration to provide "a completely independent, unbiased view of our program," according to John P. Nicolaides, director of program review and resources in the NASA Office of Space Sciences.

The project was originated by Dr. Homer E. Newell, director of NASA Space Sciences, and participants were briefed on all NASA, USAF, Navy, Army and Atomic Energy Commission space-related projects.

Soviets Hint at More Manned Flights

Moscow—First anniversary of the flight of Vostok 2, in which USSR air force Maj. Gherman S. Titov flew 17¼ orbits last year, occasioned hints last week in the Soviet press that more manned space flights might occur shortly.

Titov, in an interview with Tass, the Soviet news agency, said that "our pilot cosmonauts—numbers three, four, five and others—are dreaming of new flights."

The newspaper Pravda quoted Titov as saying that future flights would be measured in millions, rather than hundreds of thousands kilometers. In that same story, Maj. Yuri Gagarin, first Soviet space pilot, said that other pilots were "training stubbornly and persistently" for long-distance flights. Neither gave any precise indication when these future flights might happen.

Titov, who—during his recent visit to the U.S.—made light of the nausea he experienced during his flight (AW May 7, p. 35), now says that Soviet scientists are not convinced that the effect of weightlessness on the human organism has been fully "elucidated."

The second Soviet space pilot said that further research was needed on the adaptability of the cardiovascular system to a space environment.

"Of great significance also," Titov added, "is the study of the functions of the central nervous system, particularly the cortex of the hemispheres of the brain."

U.S. bioastronautics experts believe that Titov had reference to the cerebral cortex, the gray matter surrounding the brain. To study this segment of the brain would require an electroencephalograph (EEG) imbedded in the skull and Titov's comment has been interpreted to mean that the USSR might be planning to so instrument the next several pilots in an attempt to determine their alertness, fatigue and consciousness patterns. Some U.S. bioastronautics observers believe that Titov may have been instrumented with an EEG.

Titov also commented on the requirement of protection against radiation during prolonged flights and said that Soviet scientists were of the opinion that the natural defenses of the body (against radiation) could be increased by the application of "special curing and prophylactic preparations."

This would seem to imply drugs, an area in which the Soviets have indicated interest (AW Mar. 19, p. 103).

Army Board to Urge Development Of Variety of Airborne Vehicles

By Larry Booda

Washington—Army's Tactical Mobility Requirements Board next week will recommend initiation of a five-year program of applied research and development of a wide variety of airborne vehicles. The program would cost $300 million in the current fiscal year and expand to include production of proved items during the five-year period.

The board will recommend development of a relatively low-speed, close-support attack aircraft similar to aircraft which Air Force and the Navy, acting for the Marine Corps have written specific operational requirements.

Combine Requirements

One Army official said it is possible that the three services will combine their requirements for this aircraft. This voluntary amalgamation would be a departure from the past, when service efforts on major weapon systems were combined only after orders from Defense Secretary Robert S. McNamara.

The board, headed by Lt. Gen. Hamilton H. Howze, was ordered last April by McNamara to study how best to fulfill Army's tactical aircraft requirements (AW June 25, p. 26). The board was overwhelmed by industry's response to a request for ideas. More than 200 ideas were received from 90 companies, embodying every type of concept of air transport and airborne limited war weapons.

Expand Groups

So many proposals were received that Gen. Howze had to expand the six working groups by bringing in officers from all over the U.S. to Ft. Bragg, N. C., where the studies were conducted, in order to be sure that each company's ideas would be reviewed and considered.

It will cost $35,000 just to catalog the submissions. This catalog will be made available to Army planning, research, development and procurement offices.

The Howze board began its work late in May after McNamara approved a general outline of how the studies would be made. The complete report is being printed and will be submitted to McNamara on Aug. 24, one week before the deadline of Sept. 1. Gen. Howze last week briefed Army Secretary Cyrus R. Vance and the chief, vice chief and deputy chiefs of staff on the report and its recommendations.

Needs of the Army for the period from 1963 to 1975 were considered. The letter sent to industry on May 25 asked for submissions by June 18. Companies were asked to indicate the time frame of their suggestions and when the system or piece of hardware would be available.

Study areas were divided into the long-range group, strategic area group, inter-theater and communications zone logistical operations group, operations research group, field tests group and the programing and budget group.

In ordering the studies, McNamara emphasized that traditional concepts were to be ignored and unconventional approaches emphasized. He based his reasoning on a concept that it has been proved that air transport in combat zones is cheaper than ground transport when costs of road-building, transportation pools, warehousing and related items are considered.

Stage Demonstration

Climax of the board's work came when it was asked on short notice to stage an air mobility demonstration at Ft. Bragg last July 25 for McNamara. Gen. Howze decided to make the conditions as realistic as possible, and was aided in this by the weather.

There was a 400-ft. ceiling when McNamara and his guest, Air Force Secretary Eugene M. Zuckert, arrived. Scene of the demonstration was a rugged gulch area.

A stream separated McNamara's party from the action area.

Attack aircraft and helicopters fired a variety of weapons to reduce ground resistance. Because of zero wind conditions, the smoke from these weapons lay close to the ground, reducing visibility for paratroop drops and cargo aircraft and helicopter landings. One de Havilland AC-1 Caribou made a relatively high-speed approach over the trees. In killing his excess speed, the pilot stalled the aircraft about 20 ft. in the air. A wing dropped and the aircraft crashed. Although it was demolished, the crew escaped without injury and there was no fire.

During a mass helicopter landing, the landing skid of one Bell HU-1A touched the rotor of another HU-1A but both landed safely (AW Aug. 6, p. 25).

One Army official who attended the demonstration said it resembled actual combat more closely than any he had ever seen. There has been no indication of what effect the demonstration had on the attitudes of McNamara or other top defense officials toward Army's air mobility problems.

Compromise May End Comsat Stalemate

By Katherine Johnsen

Washington—Hope developed last week that the Senate would start moving soon toward passage of compromise communications satellite legislation as supporters and opponents discussed possible amendments to the bill establishing a privately owned corporation to operate the U. S. segment of a worldwide system.

Floor debate on the measure will be resumed this week, following a 10-day suspension for a review by the Senate Foreign Relations Committee. A Senate vote has been blocked for almost two months by a determined talkathon by advocates of government ownership (AW Aug. 6, p. 37).

In their testimony to the Foreign Relations Committee, State Secretary Dean Rusk and Defense Secretary Robert S. McNamara stressed the urgency of quick action so the U. S. will have an entity to take the lead in making business arrangements for a world-wide communications satellite system. This was the first appearance on Capitol Hill of the top Administration spokesmen on foreign and defense policy in support of the legislation.

Amendments being considered by the Democratic leadership to soften the opposition, but which would not resolve the fundamental issue of government versus private ownership, would:

• **Increase the number** of corporation directors appointed by the President, and authorize the President to designate the chairman of the board of directors. As the legislation now stands, there would be 15 directors who would elect a chairman. Six directors would be elected by holders of publicly subscribed stock, six elected by holders of stock earmarked for communications common carriers, and three appointed by the President.

• **Strengthen and specify** the role of the State Department in negotiations with foreign countries. Under the present legislation, the corporation is required to notify the State Department when it enters into international negotiations concerning facilities, operations, or services. The opposition has protested that this means that the narrow economic interests of the corporation will prevail over the broad U. S. cold war interests in decisions on what type of communications services are to be offered and to where. Particularly, the opposition has argued that a private, profit-making corporation would have no incentive to extend services to the three areas of major conflict with the Communist bloc —Africa, Latin American, and Southeast Asia.

• **Require the corporation** to give the U. S. government reduced or "at cost" rates. This was strongly urged by Edward R. Murrow, director of U. S. Information Agency, who estimated that a minimal program of 1½ hr. a day of television to seven areas of the world would cost USIA over $900 million a year—or almost nine times the agency's present annual budget.

Meanwhile, Sen. Wayne Morse (D.-Ore.), one of the opposition leaders, pushed for a variation of government ownership under which the communications satellite system would be managed and operated, under lease, by a private concern. This concern, in turn, would lease channels to communications carriers.

Under the original plan, proposed by Sen. Estes Kefauver (D.-Tenn.) and supported by Morse, a communications satellite authority, composed of nine directors appointed by the President, would manage and operate the system, and lease channels to communications carriers.

Morse argued that his new plan "would be private enterprise in the true spirit. Radio Corp. of America, Hughes Aircraft Co., or any qualified company, could get in on the bidding to operate the system, and the government, with a lease subject to cancellation or non-renewal, would not be permanently stuck with a monopoly."

During the Foreign Relations Committee hearings, Rusk said he was still hopeful there would be a single worldwide satellite communications system, but that the situation might deteriorate into the establishment of a system by the Western bloc nations and the Communist bloc, with the two systems in competition in the uncommitted areas.

Murrow discounted any possibility that the Russian government, which would control the ground receiving stations, would beam U. S. television over its domestic network.

Rusk said he expected the international situation to begin crystalizing at the end of this year when the views of member nations on the technical aspects, as well as frequency allocations for space communication, are due for submission to the International Telecommunications Union. ITU has set a meeting for October, 1963, to decide on space frequencies. Only frequencies set aside so far by ITU for space are for experimental satellites.

McNamara told the committee that Defense Department, which now spends about $20 million a year for intercontinental communications over commercial facilities, would be a heavy user of the satellite system. He also anticipated that development of the commercial satellite system would contribute to development of Defense Department's own system for unique military requirements.

He said Defense is considering moving forward with a medium altitude—10,000 mi. system in lieu of the 22,000-mi. altitude Advent system that had been under development for several years (AW June 18, p. 32). After the approach of the re-oriented communications satellite program is decided upon, McNamara said it would be funded at a level of $100 million a year.

McNamara noted the Telstar program of American Telephone & Telegraph Co. is directed toward an operational system of medium altitude satellites in a range of 6,000 mi. to 12,000 mi. altitude. The first experimental Telstar is in a low altitude elliptical orbit of 600 mi. to 3,000 mi. (AW July 16, p. 26). A medium altitude system would require only 20 or more satellites for world coverage, compared with 40 or more for a low altitude system.

The USSR is behind the U. S. in development of a synchronous 22,000-mi. altitude satellite, McNamara told the subcommittee. He assured members that there is little likelihood that Russia will leap ahead of the U. S. by successfully launching three synchronous satellites giving global communications coverage.

NASA Studies Interplanetary Probes

Los Angeles—National Aeronautics and Space Administration is continuing studies of several space probes which might make interplanetary measurements during the Year of the Quiet Sun—starting in 1965—when there will be a minimum of sun spot activity.

Two interplanetary probes are getting serious attention, although only the first is currently an approved program. They are called IMP (Interplanetary Monitoring Probe) and a follow-on, known as PIQSY (Probe for International Quiet Solar Year).

IMP is a Goddard Space Flight Center in-house effort designed to monitor fields and particles and study effects of the sun on interplanetary environment. IMP represents a composite of at least two earlier spacecraft, including Explorer 10, and is intended to be placed into a highly elliptical earth orbit, not exclusively during the quiet sun period.

PIQSY, under study at both Goddard and Ames Research Center, would use a spacecraft of the Pioneer 5 type equipped with instruments for measuring magnetic fields, meteoroid population in space and energetic particles in the thousand to million electron volt range.

PIQSY would be sent out of the earth's geomagnetic field and might travel between 0.8 and 1.2 Astronomical Units (AU) from the sun, or roughly ±18 million mi. from the earth.

NASA also is investigating solar probe concepts which involve sending a spacecraft to within .3 AU, or roughly 28 million mi. from the sun.

Thus, the examination of the sun and its effects would be approached in three basically different types of space probes. These are:

• Orbiting Solar Observatory (OSO), a solar observatory in a close earth orbit.
• IMP, an interplanetary probe for monitoring the sun's effects.
• True solar probes which might move closer to the sun into the solar corona or the plasma cloud.

Profits Rise for Three Aerospace Companies

General Dynamics Corp. last week reported a $12,108,221 profit for the first half of 1962, but forecast lower sales volume in the second half because of the phase-out of the B-58 Hustler bomber and the Atlas intercontinental ballistic missile base activation program.

Lockheed Aircraft Corp. and United Aircraft Corp. reported increased earnings for the period, but Boeing Co. reported a decline from $16,175,000 in 1961 to $15,480,000.

The figures for each company:

• **Boeing**—Sales of $833,726,000 compared with $823,629,000 in 1961. Per share earnings dropped from $2.03 to $1.94. Backlog as of June 30 was $1,658 million compared with $1,755 million as of Mar. 31.

• **General Dynamics**—Sales of $1,057,395,704 compared with $1,010,887,737 a year ago and earnings of $22,844,417 or $2.29 a share compared with a net loss of $55,674,379 or $5.57 a share last year. The 1961 figure includes adjustments to allow for income tax carryback credit. New orders during the period totaled $653 million, a 26% increase over the $519 million figure for the first half of 1961.

• **Lockheed**—Earnings increased to $16,491,000 or $2.12 a share from $9,223,000 or $1.24 a share last year. Sales also rose, from $679,163,000 in the 1961 period to $848,120,000. Backlog on July 1 was $1,590,886,000 as against $1,315,654,000 a year ago.

• **United Aircraft**—Earnings were $9,273,356 or $1.34 a share on sales of $585,290,654 for the first half this year compared with $5,001,879 or 67 cents a share on sales of $568,360,039 last year. Cost of company-funded development programs were $23 million during the period compared with $21 million a year ago. Backlog at June 30 was $1,075 million compared with $1,050 million on the same 1961 date.

Boeing's second-quarter sales of $367 million marked a decline from the $466 million first quarter figure. The reduction was attributed to transition of parts of the Minuteman ICBM program from cost plus to fixed-price incentive contracts. With this change the company's accounting system changes from billing on a percentage of completion basis in cost plus contracts to billing on delivery. On the latter basis, sales and earnings on the program are, in effect, largely delayed and in this case will not really be shown in financial reports until 1963.

First Polaris A3 Test Is Partly Successful

Cape Canaveral—Polaris A3 test missile was launched on a partially successful first flight down the Atlantic Missile Range from here Aug. 7.

First stage of the 2,500-naut. mi. version of the submarine-launched ballistic missile burned successfully.

The second stage separated from the first and ignited, but did not burn as long as programed. The shot thus fell short of its 1,700 mi. range goal.

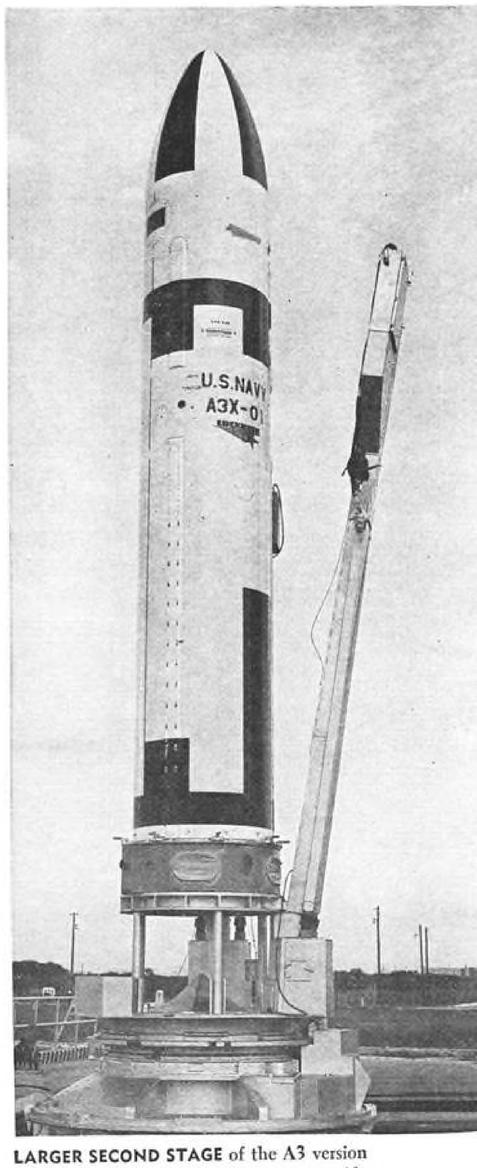
The flight was controlled by a self-contained programmer and an autopilot in place of the operational all-inertial guidance system, in the interests of economy, since the guidance system costs are much higher. Accuracy in hitting an impact point was not an objective of this flight.

The guidance system for the A3 Polaris missile is one-third the size and weight of the systems installed in the 1,200-naut.-mi. A1, now operational, and the 1,500-naut.-mi. A2 missile, due to be operational soon. The guidance system was designed by the Massachusetts Institute of Technology and produced by the General Electric Co. and the Hughes Aircraft Co.

Glass filament wound casings for both stages in the A3 replace steel casings of the earlier models for weight saving.

The A3 carries a greater amount of a more powerful solid propellant. Jetavators, which are used for first flight control in the A1 and A2, have been replaced by rotatable nozzles capable of altering the thrust line to change the direction of flight or to impart a spinning motion around the thrust axis. The second stage flight control involves the injection of an unidentified fluid into the nozzle, eliminating large moving parts for the control system.

Polaris A3 will not necessarily be programed for hitting targets 2,500 naut. mi. away. Larger warheads could be carried over shorter ranges.



LARGER SECOND STAGE of the A3 version of the Navy-Lockheed Polaris can provide for increased range from 1,500 mi. for the A2 to 1,700 mi. or possibly for a larger warhead. The increased size gives the latest version of the submarine-launched ballistic missile a bullet-shaped configuration. Guidance system for the new version is lighter, and the glass filament wound casings also save weight and are used in both stages. Second stage malfunction on the first launch last week prevented a full-range flight.

NASA Issues 52 Bid Invitations For Lunar Supply Vehicle Studies

Washington—Large segment of the aerospace industry has been asked to compete for three-month engineering study contracts for lunar supply payloads and the spacecraft bus to carry them in the National Aeronautics and Space Administration's lunar logistic system project (AW July 16, p. 32).

The hardware phase of the system is not an approved project, and NASA looks on the system as one which will enhance the Apollo mission, but not required for its success.

NASA issued 28 invitations for the payload study and 24 for the bus study. Twenty-one firms were invited to bid on both. Proposals are due Aug. 20, and the agency expects to award two payload study contracts and a single contract for the bus study by Sept. 1. Bidders briefing was held at NASA Headquarters Aug. 8.

Basic Purpose

Douglas R. Lord, assistant director for systems studies and mission planning in the NASA Systems Office, told AVIATION WEEK the basic purpose of the payload study is to determine what should be landed on the surface, how it should be packaged and how it should be made available to the crew. Studies will be made of seven separate payloads to provide:

Extended time stay on the moon by the crew, either emergency or planned; crew shelter; crew maneuverability with a roving vehicle; bulldozer-type equipment or other devices to level the lunar surface, and chemicals capable of settling the lunar dust; power station; communication; and a combination of payloads.

Companies are asked to study the payload in relation to a modified Saturn C-1B, able to carry a 1,500-lb. useful load to the moon, and to the Saturn C-5, which has a 20,000-lb. capability. The C-1B phase limits payloads to a single type, and combinations will be specified for the C-5.

The bus study calls for conceptual design of a spacecraft which will take the payload from the point of lunar injection to landing. NASA is asking for a vehicle which can be adapted to both the C-1B and C-5, using as many common components as possible.

The lunar logistics systems will call for three new stages which are not under contract—a third stage for the Saturn C-1B, and landing stages for the bus in both C-1B and C-5 applications. NASA in-house studies will be conducted on the C-1B third-stage, managed by Marshall Space Flight Center, which also will compute trajectory analyses for the mission.

Configuration of the C-1B logistics launch vehicle will be an S-1 first stage powered by eight Rocketdyne H-1 engines; a Douglas S-4B second stage powered by a Rocketdyne J-2 engine, and the undesignated third stage. Two-stage configuration will be used to qualify the Apollo spacecraft system in earth orbit.

Project Manager

NASA project manager for the studies is William B. Taylor of Lord's office.

Companies invited to bid on both payload and spacecraft are Avco, Bendix, Boeing, Douglas, Ford Acronutronics, General Dynamics, General Electric, General Precision, Grumman, Hughes, Lockheed, Librascope, Litton, Martin, McDonnell, North American, Northrop, Radio Corp. of America, Raytheon, Space Technology Laboratories, and Electro-Mechanical Research.

Others invited to bid on the payload study are Goodyear, Melpar, Pratt & Whitney, Republic, American Machine and Foundry, General Motors and Westinghouse.

Invited to bid on the spacecraft study only are Atlantic Research Corp., Chance Vought and United Aircraft.

Bolkow-Nord Team

Munich—Germany's Bolkow Entwicklungen and France's Nord Aviation will collaborate on future developments of ground-to-air and surface-to-surface missile systems under a recently signed agreement sponsored by the French and German governments as a cost-cutting move.

The agreement will not affect the two companies' current series of anti-tank missile projects, according to a spokesman here, but all work on systems beyond Bolkow's Cobra and Nord's Entac missiles will be developed on a joint basis.

Although more limited in scope, the agreement follows the same general lines of a guided-weapons collaboration pact between Nord and the British Aircraft Corp. (AW Aug. 6, p. 31).

Both the BAC and Bolkow agreements look primarily toward the next round of weapon systems rather than existing operational equipment. As a result, the two Nord pacts are expected to evolve into a loose tri-partite working and planning arrangement, at least in the ground-to-air and surface-to-surface fields, even though there is no formal agreement between BAC and Bolkow.

System Protection

First phase of a study to examine methods of protecting future Air Force command and control systems is being conducted in-house at USAF's Electronic Systems Division. Subsequent portions of the study may be offered to industry on a competitive basis late this year.

The planning study, No. 7990-27, is the seventh in a series proposed for ESD (AW July 9, p. 45; July 30, p. 16).

One of the studies in the series, identified as Command and Control of Defensive Forces—No. 7990-25—which was to have explored the survivability of command and control in the post-1970 period, was dropped and will be reworked into USAF's Space Command and Control System.

Another proposed study, No. 7990-26, Space Activities Data Collection, has not been approved.

Cost Accuracy Bill's Passage Seen Likely

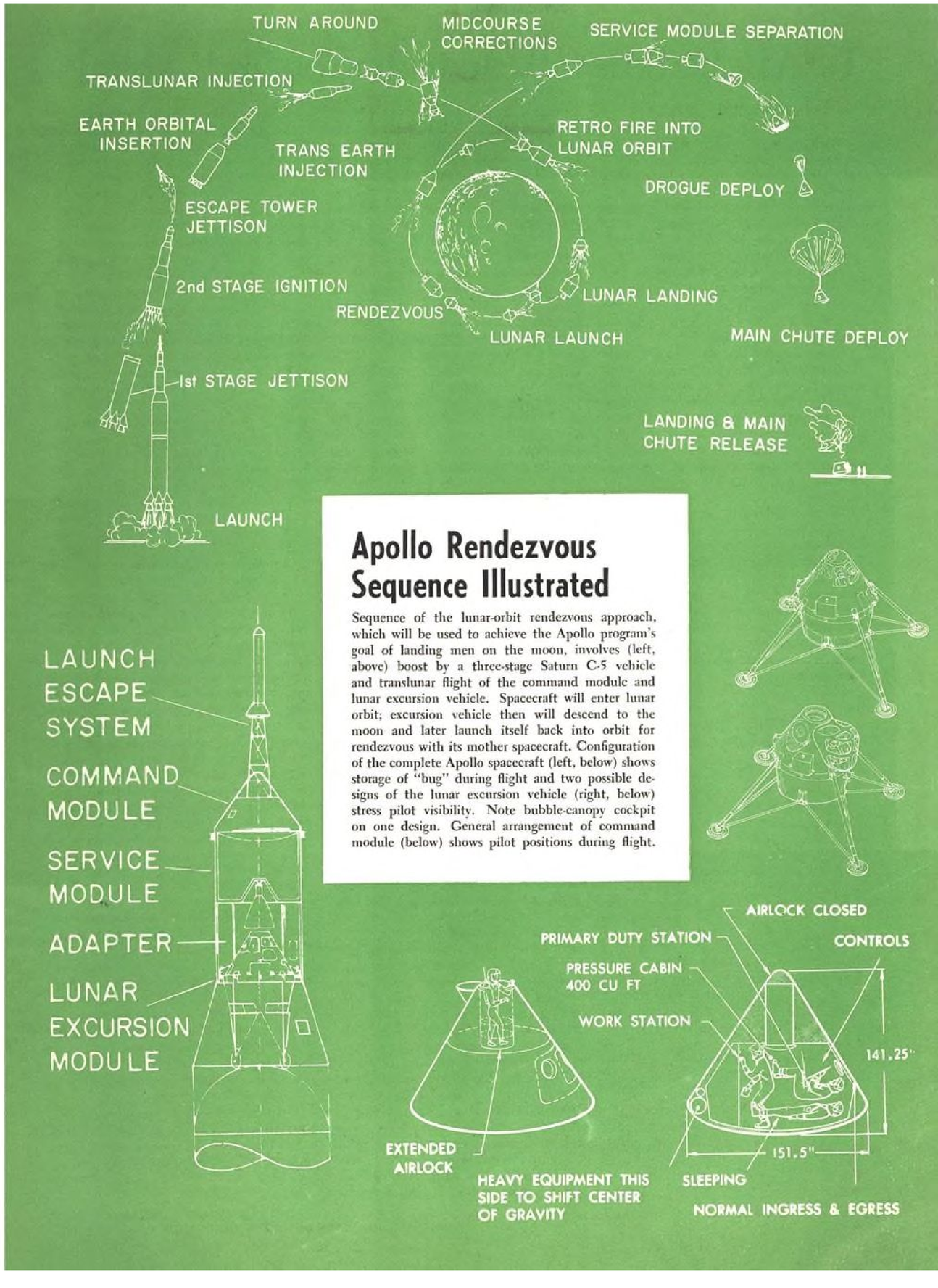
Washington—Congressional approval of new military procurement legislation requiring defense contractors to certify the accuracy of their cost figures now appears likely this session.

Senate Armed Services Committee is scheduled to make its recommendations to the Senate this week. The measure passed by the House requires the certification on incentive type contracts only. The Senate committee is expected to extend the certification requirement to all negotiated procurements.

Committee members have particularly urged this to discourage the practice of intentional under-bidding by contractors—in the belief that once obtained, the contract will not be taken away. After it is under way, cancellation means loss of time as well as money to Defense Department. Defense estimates cost over-runs on research and development contracts now average 40%.

Sentiment in the Senate, which has blocked legislation requiring certification of costs by contractors in the past, has changed. The main reason is a recent survey by General Accounting Office which GAO said showed that Defense has not followed through on its promise to obtain certification by regulations.

Although Defense did issue a regulation requiring certification of the cost accuracy on negotiated procurements in October, 1959, GAO said its study showed that 121 out of a total 364 contracts negotiated since that time failed to include the certification. The omissions were all on the part of Army and Navy. Certifications were obtained in all of the 88 Air Force procurements reviewed, GAO said.



Apollo Rendezvous Sequence Illustrated

Sequence of the lunar-orbit rendezvous approach, which will be used to achieve the Apollo program's goal of landing men on the moon, involves (left, above) boost by a three-stage Saturn C-5 vehicle and translunar flight of the command module and lunar excursion vehicle. Spacecraft will enter lunar orbit; excursion vehicle then will descend to the moon and later launch itself back into orbit for rendezvous with its mother spacecraft. Configuration of the complete Apollo spacecraft (left, below) shows storage of "bug" during flight and two possible designs of the lunar excursion vehicle (right, below) stress pilot visibility. Note bubble-canopy cockpit on one design. General arrangement of command module (below) shows pilot positions during flight.

USAF-Defense Research Conflict Aired

By George C. Wilson

Washington—Conflict between Air Force and Pentagon civilian leaders is being outlined as a House Government Operations subcommittee explores the controversial question of how military research dollars should be spent.

The hearings are of special significance to the aerospace industry since they supply the latest thinking of Defense policy makers on such questions as the adequacy of the national space program and ways to improve military-contractor relationships.

Gen. Bernard A. Schriever, commander of the Air Force Systems Command, has shown that he is chafing at the degree of emphasis civilian leaders are putting on defining military programs before embarking on them, while Dr. Harold Brown, defense director of research and engineering, has indicated that this preliminary analysis will be intensified.

The fact that the debate is being publicly aired is in itself significant. For the first time since the first Sputnik was launched, military leaders feel they have time to reappraise their research and development programs rather than proceed on a crash basis. Herbert Roback, staff administrator of the Military Operations Subcommittee conducting the hearings, calls this relative lull "a plateau in urgency."

The reappraisal is also prompted by the recent Budget Bureau report on government R&D contracting and by the general realization that the gigantic cost of modern weapons demands the most careful selectivity since there is only so much money available.

Military and civilian leaders in the Pentagon agree the Defense Department must be selective. Their differences are ones of degree. As Gen. Schriever told the subcommittee: "The secret of success is finding that delicate balance point between taking a big enough step to be a little radical and yet not so big as to rip our britches."

Regarding the military space program, Gen. Schriever obviously believes the steps being taken are too small while Dr. Brown feels going any faster would be too radical. This testimony given on different days, portrays their varying viewpoints:

• **Gen Schriever:** "We have certainly identified systems that have operational potential for the military even though they are in the research and development stage today. And I name the areas of reconnaissance, surveillance or warning, communications, the Navy's navigation system, weather satellites . . . I think this is only the beginning. There are many things that have to be done in the way of applied research and technology. Who can say that we will not need a defensive system in space at some stage of the game? Who can say today that there might not be use for space offensive systems? It is true enough that our national policy is space for peaceful purposes, and this is a sound policy. But we also have had the policy of freedom of the seas, but nevertheless we have had the largest and most effective Navy that the world has seen over the past 100 years or more to keep the seas free. We may have to do the same thing in space.

"I can't today visualize an offensive system, for example, that on a cost effectiveness basis is competitive with other systems for strategic purposes, for example. That doesn't mean that this will continue to be the case. I can visualize the development of recoverable boosters. The Aerospace Plane concept is one that I'm sure will come. I don't know just when. When I say the Aerospace Plane concept, I am talking about boosters that can either be one stage or two stages, get into orbit and you recover and you reuse the same boosters.

"These are things that technology certainly will provide us in the future. We have to move in that direction . . . If you try to think about operational systems imposed upon today's environment you always come out sort of sterile. I don't think we have exercised enough imagination . . . I don't think we have advanced technology to the point in space where I would recommend going forward on a system development other than in certain areas where the potential is fairly close—communications and so forth, in the passive area. An acceleration or expansion of applied research and advanced technology in developing techniques is the important thing. . . ."

• **Dr. Brown:** "I think that it is quite notable that people have been thinking about what military purposes of space are for a fairly long time—four years, three years—and there was some thought of it quite early during that period. I think that they are correct. I mean they [military space uses] do exist. We are working fairly hard on them. But not very many, if any, new ones have been thought of in recent years which have been as convincing [as earlier ones]. And our estimates of what is important about military activities in space have not really changed in the past two or three years. . . .

"I don't think it is possible to look back and say: 'Here is a military space activity that we should have been working on very much harder, and if only we had, we would have this magnificent weapons system which can do so and so.' That just isn't so in the space program."

Ivan A. Getting, president of the nonprofit Aerospace Corp. which works almost exclusively for the Air Force, reflected Gen. Schriever's viewpoint in testimony before the subcommittee last week. Getting said "there are clearly advantages to the military exploitation of space that we can do today. This includes communication, reconnaissance, surveillance. It includes weather . . . We have somehow as a national policy espoused space for peaceful purposes with the implication that the earth should be reserved for warlike purposes. I would much rather reverse that and save the earth for peaceful purposes and do all our warfare in space."

Another difference in degree between Gen. Schriever and Brown concerns the amount of time that should be spent defining a program before proceeding to its development and whether the development should be done on a concurrent basis. Here again the testimony is indicative of their thinking:

• **Gen. Schriever:** "This matter of defining programs is not anything particularly new . . . You have to always weigh the importance of a program to the national security and the technical feasibility of the program based on the best judgments of the scientists as to the degree of calculated risk that you want to take . . . There is one danger in this definition business. In research and development or in development of systems, there always is going to be some uncertainty. If there isn't some uncertainty, then you are very like to come out with an obsolete system when you get it into the inventory because you haven't taken a big enough step forward. So these things have to be weighed and the only thing that can answer a question of this kind is judgment.

"And so I for one think what the Defense Department is doing with respect to better definition, a more realistic cost estimating, is very definitely essential in the over-all management of systems . . . From where I sit I think that we could move faster on certain of our programs. We have not really initiated a new system program for some time . . . It has been over a year. We have several under consideration now in the so-called definition phase."

Gen. Schriever said the main reason for the delay between concept and going out to contract with industry is that Defense is "defining programs to a higher degree than we have defined programs in the past . . . It is a matter of judgment on how far you can go on paper before you proceed with a program contracted . . ."

"I still think in the over-all technological race that we have got to move forward certainly in the applied research and advanced technology area, and we have got to move into new systems as soon as they are technically feasible when they provide us with increased capability for the national security. And this should still be done on a concurrency basis because I think you save money by doing it that way in the long run. . . . When you relate concurrency only to urgency, this is the wrong connotation to place on concurrency. We developed with the ballistic missile program a philosophy of packaged programing. Instead of thinking only about the research and development test program, we at the same time in our planning and programing took into account the production requirements, the logistic support requirements, the training requirements, the matter of creating an operational base. . . . When I talk concurrency, I am talking about planning and programing a complex weapon system with all of those elements in it and this should be done on a concurrent basis. . . I am talking about doing those things in such a way that they all come out at a point in time where you have got a complete system operational. . . If we had waited until we had proved a missile out, that it would fly and would perform before we started our base construction, we would have stretched the program out another three or four years. . .

• **Brown:** He said the greater emphasis Defense is placing on the definition phase did not stem from any relative lull in the weapons race. "I think that the main reason for being more careful in estimating costs and times and knowing what you are doing before you go ahead is that this is the only way you can make sensible decisions. It does not insure sensible decisions, but it makes them far more likely." He cited 624A—Titan 3—as one program undergoing intensive review. "Decisions as to whether to go ahead and develop it or not must rest on a fairly detailed analysis of how much it will cost, how long it will take and what it will do. . . The Secretary of Defense can make the decision based on the knowledge generated from that program definition phase."

Getting said the decision on Titan 3 could have been made a year ago because "certainly no new technology is involved which was not available a year ago." Getting urged Defense to develop Titan 3, declaring it is vitally needed and that its transtage would be the only new upper stage funded in the last two years.

Brown said "concurrency" does not save time when the concurrency involves developing something after it has been produced, as has occasionally happened in some programs. "If you go ahead with the big program and say, 'Well, we will develop it during the test program, chances are that it will take you as much time or perhaps even more than if you had done the first thing first'," he said.

He said a "certain amount of concurrency" was justified "where something is very important and you know all the components and you know you can do all the components and everybody agrees you ought to do it. . . I see very few such programs coming along today. . . Unless one can show that a project is vital, that without it the U. S. stands in a very serious danger of failure of deterrent, say, or of an enormous loss of military power, I do not think concurrency is justified.

"I think that you should develop something to show that it is feasible and it will work before you go ahead and produce it," Brown said. "If you take the opposite attitude, you are sure it will cost you more money. By and large you are not sure it will save time, although it can save time to do concurrency.

"And when you are all finished, it is not clear that you will have anything good."

These and other differences of opinion are bound to deepen as the Defense Department moves along in its campaign to hold down costs and improve contractor performance. Brown concedes there is no easy answer to the problem of cutting down on research and development costs. But he is pondering some novel contracting approaches, including:

• **Showing preference** to contractors with proven reputations rather than using new firms. "When it comes to a big engineering job, particularly a big engineering job which is a refinement of one that has been done before," Brown said, "I think that the criterion of how well a company will do is largely what experience it has and not how many people it is able to recruit who have very great scientific reputations." He said the manpower drain would be less if Defense made it "a little harder for new companies to start. . . ."

• **Rating the performance** of companies by divisions, not as a whole. "Quite often," Brown said, "where a company does very well in one place and very poorly in another, you find that it is different people, a different place, a different plant, different managers. And if you identify the people who the company agrees to put on the contract if they get it, then you can weigh them accordingly. . . . I think we are quite far from being in a position to do the evaluation and selection as much on the basis of experience and performance as I would like. I think we are closer in the arrangements for incentive fee contracts."

USAF Solids Program Cut

Washington—Air Force this week will submit a development program for large solid rocket motors that has been cut down considerably on orders of the office of the Director of Defense Research and Engineering.

Gen. Bernard A. Schriever, commander of the Air Force Systems Command, told a special House subcommittee last week that the purpose of the new program will be to prove the feasibility of such large solids as the 156-in. and 260-in. motors. The more modest program was ordered last June and will be submitted to higher officials as soon as it reaches his desk this week, Gen. Schriever said.

The original program submitted by the Air Force in April was considered by DDRE to be too ambitious, especially since National Aeronautics and Space Administration is no longer considering large solids for backup boosters for its lunar program, Gen. Schriever said. The reduced program will be conducted at existing facilities. The original program would have required extensive new facilities and equipment.

Gen. Schriever said he had no criticism of DDRE's decision but he personally was convinced of the need for large solids and still would like to go into a development program. He said DDRE's objective was "to prove beyond the shadow of a doubt" the feasibility of large solids before a broader program was undertaken.

Renewal of NASA Role in ANNA Urged

Washington—House Science and Astronautics Committee last week recommended that the National Aeronautics and Space Administration "should again actively participate" in the ANNA geodetic satellite program now managed by the Defense Department (AW May 21, p. 27).

The committee adopted its Space Sciences Subcommittee report which said "in view of its responsibilities in the field of space sciences, and for international cooperation on matters involving space exploration NASA should prepare a detailed proposal for a follow-on geodetic satellite program designed to meet the needs of all interested parties, scientific and military. There is no apparent reason for postponing this step until after the first successful launch of the ANNA satellite.

Single-Gas Lasers Developed by Bell Labs

By Philip J. Klass

New York—Five new gaseous optical masers, which employ a new principle of operation that requires only a single gas instead of a mixture of gases as in previous gas lasers, is expected to result in a family of lasers with output radiation distributed over a wide portion of the optical spectrum.

Bell Telephone Laboratories reported last week that its scientists have successfully operated the new noble (pure) gas lasers using helium, neon, argon, krypton and xenon to generate continuous beams of coherent radiation at a total of 14 different wavelengths in the infrared band ranging from 1.690 to 2.189 microns.

The new technique for energy transfer used in the noble gas lasers does not presently appear usable for high power outputs, however.

Gas Laser

Bell Telephone Laboratories also revealed additional details on another recently developed gas laser, using helium and neon, which generates visible coherent radiation, the first to operate in this portion of the optical spectrum. The new gas laser radiates in the red portion of the visible spectrum at a wavelength of 6,328 Angstroms. The ability to examine the output of a laser directly with the human eye is expected to be extremely useful in analyzing its performance.

Also reported was a traveling-wave pulsed ruby laser, constructed by BTL, which directly amplifies light. The device has demonstrated an amplification of 20:1, corresponding to a gain of 13 db.

Bell Laboratories scientists were the first to successfully operate a gas maser in February, 1961, using a mixture of helium and neon. In this first gas laser, the helium electrons were excited by an external radio frequency source and these in turn collided with the neon atoms, raising them to a higher energy level to produce laser action. This technique, however, is usable only for two gases which have similar metastable energy levels and there are few such gases.

In June of this year, BTL announced that it had developed a new type of gas laser, based on a fundamentally different technique for energy transfer. The technique had been applied to a laser using both a mixture of neon and oxygen and a mixture of argon and oxygen. Radiation produced was at a wavelength of 8,446 Angstroms in the near infrared region.

In the technique announced in June, the gas mixture consists predominantly of neon or argon with only a small amount of molecular oxygen. The neon atoms are first excited and these collide with the molecular oxygen. The collision dissociates the oxygen into two atoms, one of which is excited in the process to a higher energy level where it produces laser action.

The extra oxygen atom absorbs any residual energy, eliminating the need to match the energy levels of the two gases as in the case of the earlier helium-neon laser. This was considered an important advance because it permitted the use of a wider variety of gas mixtures. However, radiation was produced only at a single wavelength, determined by the use of oxygen as the laser material.

The most recent advance, the development of the single-gas laser, further expands the number of different gases which can be used. But in addition, the new technique opens the way to producing radiation at a wide variety of wavelengths corresponding to the various gases employed. Another interesting feature of the single-gas laser is that the excitation is provided by a direct current voltage across two electrodes.



VISIBLE RADIATION from a helium-neon gas laser, one of several recent advances in laser technology reported by Bell Telephone Laboratories, is watched by technician.

Arc Discharge

In the single-gas laser, energetic free electrons are produced by a continuous arc discharge through the gas between the two electrodes. These free electrons in turn directly excite the atoms of the gas to raise them to the higher energy level, from which they fall to the lower level and emit coherent radiation in the process.

Previously, it was thought that the arc discharge might fill up the lower levels as well as the upper energy levels, preventing the building up of a greater number of atoms at the higher level which is a requirement for laser action. However, this proved not to be the case.

The single-gas laser using helium operates in a slightly different manner because this gas has a different electron configuration from the other four gases. The process is believed to be a two-stage energy transfer in which the helium atoms are raised to the higher level directly through collision with other helium atoms.

The optimum pressure used in the new type lasers varies with the type of gas, ranging from about eight millimeters of mercury for helium to about 0.02 mm. Hg. for xenon. The efficiency of the single-gas lasers is relatively low, ranging from about 3 to 10% per meter of length of the quartz discharge in which the gas is contained.

The new traveling-wave pulsed ruby laser has a bandwidth of 100,000 mc., as large as the entire range of frequencies currently used for all types of radio, television and radar services.

The device consists of two laser amplifiers separated by a flint-glass (lead oxide) isolator, a material which is transparent to light over most of the optical range. The experiments were conducted under a contract with the Army Signal Research and Development Laboratory.

Sarnoff Proposes One Communication Firm

Creation of a single, privately-owned American international communications common carrier to take over the operations of 10 companies now operating in the field of telegraphy plus the international telephony services of American Telephone & Telegraph Co. has been proposed by David Sarnoff, chairman of the Radio Corp. of America.

The proposed communications satellite corporation (see p. 28 for story) might be the logical chosen-instrument for American international communications under the plan that was proposed by Sarnoff.

Sarnoff said the Kennedy Administration "deserves commendation for its foresight and initiative in advancing the communications satellite project," and that his recommendations "are not intended, in any way, to suggest that we halt or delay our plans for establishing a satellite communications service at the earliest possible date."

Pointing out that radical changes in communications technology, such as the communication satellite, have outmoded current U.S. policies in this field, Sarnoff said the U.S. needs to develop and adopt a new unified national communications policy in order to resolve questions raised by fast-moving technology.

For example, in the international field, AT&T has a monopoly on voice communications while 10 companies compete in the telegraphy field. But with the advent of pulse code modulation techniques for transmitting voice, the old distinction between voice and record-type messages has become "completely blurred," Sarnoff said. Both can now be sent and received over the same circuit.

But an American international telegraph company is not allowed to use existing international voice circuits for its purposes, nor can it interconnect with established domestic telephone service, Sarnoff said. The proposed communications satellite corporation presumably will be able to grant authorized communications companies the right to transmit both voice and record messages through its facilities, he noted. But unless carriers other than AT&T are allowed to interconnect into the latter's domestic circuits, they will suffer an unwarranted handicap in competing with AT&T, Sarnoff said.

Sarnoff's remarks were made before the Law and Layman Conference of the American Bar Association in San Francisco. They were delivered by Robert W. Sarnoff, chairman of the National Broadcasting Co. because the RCA board chairman was recovering from surgery.

Officer Shifts

Trans World Airlines, Douglas Aircraft Corp. and Ling-Temco-Vought have completed what amounts in some respects to an exchange of financial officers with the recently announced appointment of Bernard L. Brown, former Douglas treasurer, to a similar post at Ling-Temco-Vought.

Brown replaces Lee D. Webster, who will become executive vice president of Electro-Science Investors, a small business investment company founded by James Ling.

Brown left Douglas following the appointment of A. V. Leslie, former TWA senior vice president, as vice president-finance for Douglas. That post had been vacant since the resignation of Gerald E. Donovan last spring.

Leslie, in turn, was replaced by James J. Kerley, who was formerly the vice president and controller of Ling-Temco-Vought.

X-15 Flight Measures Skin Heat Transfer

Los Angeles—Air Force Maj. Robert A. Rushworth flew the No. 2 X-15 last week in the first of a series of tests designed to measure skin heat transfer rates at moderate speeds, altitudes and angles of attack.

Rushworth throttled the X-15's 57,000-lb.-thrust engine to 40% and used the aircraft's speed brakes to maintain airspeed at 2,989 mph. (Mach 4.39) at 71,000 ft.

After launch, the research craft climbed to 90,000 ft. to achieve the desired conditions. Rushworth rolled into an 80-deg. bank 48 sec. after launch, making a 45-deg. turn to the right.

The maneuver achieved an angle of attack of 20 deg. at the proper airspeed and altitude. Maximum skin temperature was 900F, not high by X-15 standards.

Future flights are planned at airspeeds of 2,700, 3,500 and 3,800 mph., and at angles of attack of 2 deg., 10 deg., and 20 deg. to obtain necessary aerodynamic data on different sets of flow conditions.

Radioisotope Powerplant

Martin Co.'s Nuclear Division, Baltimore, has received a contract to investigate the feasibility of a radioisotope-fueled powerplant from the Atomic Energy Commission. Contract calls for development of a conceptual design for a 500-watt power system using decay heat from radioactive material and a thermionic conversion system.

News Digest

Hughes Aircraft Co. proposal for the Navy TFX guided missile system has been accepted by the Navy, which said the contract involves a refinement and definition of system characteristics, but not final development.

Four hamsters carried aloft to a maximum altitude of 130,500 ft. by the second of four NASA high altitude balloons died shortly after the capsule, in which they were carried, landed. Death was not believed caused by cosmic radiation, effects of which are being studied during the flights. Two rhesus monkeys survived the flight.

Kuwait Airways, state-owned carrier, last week ordered the first two de Havilland Trident three-turbojet transports to be sold outside the United Kingdom (AW July 30, p. 34). The airline also purchased a de Havilland Comet 4C and took an option on a third Trident. In addition, the airline ordered three British Aircraft Corp. BAC 111 twin-turbojets with an option on a fourth for 1965 delivery. The Tridents will be delivered in 1965 and the Comet in 1963. Sale price of the Tridents is $16 million. Cost of the BAC 111s is $9 million.

Northrop T-38 has been given the USAF designation F-5A. This is the first change under the new designation system (AW July 30, p. 26).

Nominations of Army Gen. Maxwell D. Taylor as chairman of the Joint Chiefs of Staff and Gen. Earle G. Wheeler as chief of staff of the Army were approved last week by the Senate Armed Services Committee (AW July 30, p. 23).

Royal Netherlands Navy has placed an order for eight Agusta Bell 204 turbine-powered helicopters, the Italian-built version of the Bell HU-1B Iroquois.

Swedish Committee for Space Research fired the first of a series of U.S. Nike-Cajun rockets from Kronogard Aug. 7 to sample the high, fast moving noctilucent clouds that appear over that country at this time of year.

Pacific Airmotive Corp. has acquired Curtiss-Wright Corp.'s aircraft engine overhaul operations at North Hollywood, Calif., and is moving the work to PAC's Burbank, Calif. plant. Major portion of the new business gained by PAC will be overhaul of engines for Lockheed Constellation and Douglas DC-7 aircraft.

Eastern Resumes Shuttle Despite Strike

Airline speeds flight engineer training of pilots; Goldberg ends mediation efforts, criticizes all parties.

By L. L. Doty

Washington—Eastern Air Lines resumed hourly Washington-New York-Boston Air-Shuttle service last week despite a seven-week-old flight engineers' strike that showed no sign of ending (AW July 30, p. 29).

Another attempt to negotiate differences between the Flight Engineers International Assn. and Eastern collapsed when a new offer was rejected by the union. FEIA officials claimed that the Eastern proposal was completely unacceptable since it would, within two years, end the flight engineer profession as it now exists.

The first of 64 daily shuttle flights from La Guardia Airport in New York departed with 15 passengers for Boston and 24 were aboard the initial Washington schedule. Loads aboard the 95-seat Constellations were averaging about 35 persons through the first day, although one Washington flight, with a group of Italian architects aboard, carried 90 persons.

Revenue traffic was low on Eastern's resumption of jet flights to Miami, but in San Juan service restored last week both DC-8s were sold out on their first departures.

Capt. Paul Quigley, assistant operations manager in charge of shuttle service, said Eastern Air Lines began getting its 23 shuttle Constellations ready on Monday, Aug. 6 for resumption of service.

The three-man shuttle crews fly two round-trips a day between New York and either Boston or Washington. All engineers aboard are regular engineers, not pilot-engineer trainees, Quigley said.

The airline, said, however, that its training program of jet pilot-engineers had been expanded by 60 trainees, bringing the total to 140. Six engineers at La Guardia formed a picket line.

Meanwhile, Eastern continued to train copilots as flight engineers. This was the situation late last week:

• **FEIA said that Eastern's** latest offer included a 3% wage increase with no provision for retroactive pay. It proposed that copilots be trained as flight engineers for jet operations and that FEIA members take over piston-engine operations without a guarantee of job priority, the union said. Priority over engineer-trained pilots and continued representation by FEIA are principal issues in the negotiations. FEIA also wants a 10.8% retroactive wage increase back to May, 1960, a 3% pay increase this year and another 3% increase next year. Weekly flight hour limits and certain fringe benefits are included in FEIA's bargaining position.

• **Union said Eastern** has refused its offer to arbitrate on retroactivity and some other issues. Eastern claims that FEIA, by continuing the strike, rejected the company's offer to grant priority on the pilot-engineer jobs to "all flight engineers then employed who were willing to accept the required pilot training at company expense."

• **Federal Aviation Agency** last week set new guidelines for the training of pilots for the flight engineer seat. FAA's program calls for a minimum of 60 hr. training, while Eastern has proposed 24 hr. Flight engineers without pilot training currently take 120 hr. training. FAA Administrator N. E. Halaby told Eastern President Malcolm A. MacIntyre in a letter that Eastern's plan for qualifying pilots as engineers, which was adopted on July 10, did not provide sufficient training time.

• **Air Line Pilots Assn.,** following a series of direct collective bargaining meetings with Eastern in Miami and New York, agreed to operate with a three-man crew. The agreement makes no reference to job priority.

Meanwhile, Labor Secretary Arthur J. Goldberg ended his efforts to settle the dispute. Although MacIntyre termed a meeting with Goldberg last week as "amicable," Goldberg later made it clear that he disagreed with the course of action taken by Eastern and the Eastern council of ALPA.

In effect, Goldberg, while agreeing that the shutdown of Eastern was originally caused by the FEIA strike, lifted the blame for its continuance from the shoulders of FEIA. He said that two weeks ago the engineers were ready to accept a government-recommended settlement and that the shutdown should have ended then. He added:

"At that point, however, the company and Eastern pilots refused to accept the proposed crew complement terms, and so the shutdown has continued."

Meanwhile, Eastern began its Air-Shuttle service with 30 of the carrier's 615 flight engineers who voluntarily agreed to return to duty. Of the 30, 22 are supervisors, and eight are union members, indicating strong support of FEIA leadership in this case.

A total of 80 Eastern copilots are now undergoing flight engineer training, which will permit the carrier to increase the two round trip jet flights daily between New York and Miami which it has been operating for several weeks. MacIntyre said load factors on these flights have been low.

Scheduled late last week, in addition to the New York-Miami flights, were single daily round trips between New York and Mexico City, New York-San Juan, and Miami-San Juan. The restored flights are expected to result in the call-back of a very small percentage of the 17,000 employes furloughed as a result of the strike.

MacIntyre said that the company would operate with a skeleton headquarters staff, and that because the shuttle operation needs no ticketing or reservations personnel, ground crews needed for the flights will be small.

Meanwhile, FEIA President R. A. Brown charged Eastern pilots with working in collusion with management in attempts to "break" the FEIA and "its lawful strike against Eastern." In a letter to AFL-CIO President George Meany, Brown charged that the ALPA members were training as "strike breakers, crossing picket lines and in other ways acting to break the strike."

He told Meany that ALPA has been raiding FEIA jurisdiction and requested that the AFL-CIO entertain a motion at its next regular session to suspend ALPA for 30 days. He further recommended that if ALPA continues these practices, it be permanently suspended, its charter revoked and a new organization be established to enlist pilots "who wish to be represented by a trade union and not a collection of strike-breaking management tools."

Meanwhile, it became evident that MacIntyre was ready to operate the airline permanently with pilot-trained engineers if the company was unable to come to terms with the engineers' union. Prior to last week's meeting with FEIA, MacIntyre suggested that this meeting would be the last once operations were resumed.

Baker to Play Key Role at Riddle Airlines

Washington—G. T. Baker, board chairman of National Airlines, is expected to play a major part in the management of Riddle Airlines once he withdraws from active participation in National Airlines affairs (AW July 16, p. 38).

Under a Riddle reorganization plan, Baker was named to serve the company as a financial adviser and consultant. Plans call for him to take over a leading Riddle management position shortly, but in the interim, he will work with top officials on financial matters.

James B. Franklin, former vice president of Capital Airlines and until recently a United Air Lines jet captain, was elected to the Riddle board of directors and named executive vice president. Also elected to the board were J. H. Carmichael, former president of Capital, who will serve as a consultant to Riddle, and A. J. Rome, former Riddle vice president in Washington and now vice president-sales for the airline.

Robert M. Hewitt remains president and W. R. Price, director, was elected chairman of the board. Price and Hewitt are principal stockholders in the company. After leaving Capital, Carmichael was named president of Fairchild Stratos Corp., and, more recently, has conducted a private consulting business.

Three Competitors File Protests Over Continental Coach Fare Cuts

By James R. Ashlock

New York—Three major competitors of Continental Air Lines are opposing the 20% reduction in coach fares that Continental plans to begin offering between Chicago and Los Angeles on an experimental basis on Aug. 24 (AW July 30, p. 28).

Trans World Airlines and American Airlines have both filed protests with the Civil Aeronautics Board, terming the fares economically impractical. United said its protest would be filed shortly. At the same time, all three carriers asked for CAB approval of "defensive" fares matching those proposed by Continental.

United plans the service and seating configuration most similar to that Continental is proposing with the fares. Using Boeing 720 jets, United would provide a 77-seat economy class, with fares 20% below present coach fares, and a 47-seat economy-first class section with fares 14% less than current first class.

Meals would not be served in the six-abreast economy sections, and seat spacing would be tighter than on present coach class. Economy-first class passengers, seated five abreast, would receive meals of a quality similar to those now in coach sections.

TWA, to compete with Continental, is considering converting one of its Boeing 720-120 jets to an all-economy configuration with 160 seats, flying one daily round-trip between Chicago and Los Angeles.

Both TWA's and United's arrangements differ from that proposed by Continental, which would convert three jets into three passenger classes. In the rear would be the 62-seat, six-abreast economy section, and in the middle would be the new category—business class—with 50 seats arranged five abreast. The forward area would retain 20 first class seats set four abreast.

On Continental, the business class fares would be 12-15% below present first class rates, while the economy coach would be 20% under present coach fares. First class fares would retain present levels.

All three carriers would offer one-way economy coach fares between Chicago and Los Angeles for $85. Other lowered economy fares, as proposed by United, would be Chicago-Denver, $44, and Denver-Los Angeles, $46. For economy-first class passengers on United, the fares would be Chicago-Los Angeles, $116; Chicago-Denver, $61, and Denver-Los Angeles, $63.

TWA also requested CAB approval for a $22 economy coach fare on a daily round-trip flight between Chicago and Kansas City, $5.10 less than present coach fares. The airline would also reduce from $72.70 to $69 the night-coach fare on a daily jet between Kansas City and Los Angeles.

American has not yet determined the aircraft configuration it would use.

In its protest, American termed the planned fares "a long step toward disaster for the industry." It said the airlines, in their present financial condition, "simply cannot afford to gamble with uneconomic fare cutting on a large scale, even as an experiment."

American said the only real savings the proposed fares would provide would be in food and liquor, which it estimates would amount to about $2 per passenger, while the fare reduction would total $20.45 between Chicago-Los Angeles.

The only way such reductions could be justified, American feels, would be for passengers to voluntarily shift from economy to the new business class—a possibility American views as unlikely—or if new traffic were generated. American said the chances of additional traffic are slim, as recent surveys show a hesitancy of auto travelers to shift to air transportation (AW July 16, p. 41).

Reduced fare experiments cannot be conducted on a major transcontinental artery such as Chicago-Los Angeles, American said, without affecting through-fares and other services.

"The economy proposal would undercut by more than $16 most jet coach fares between Los Angeles and such points as New York, Boston, Cleveland and Detroit," the airline continued. "This would be a strong incentive for the use of connecting flights via Chicago."

American emphasized that its coach traffic between Chicago and Los Angeles represents more than $10 million in annual revenue, much of which would be diverted to the lower-cost service. Also exposed to diversion would be the $55 million in American's coach traffic between Los Angeles and the triangle between Chicago, Washington and Boston, the carrier maintains.

TWA and United supported American's views in their protests. United said it "firmly believes that the reduced coach fares would be uneconomic and otherwise in violation of the Civil Aeronautics Act."

United also said it would ask the CAB to make an investigation of the proposed fares and suspend their institution until the investigation is completed.

Breech Stock Sale

Ernest R. Breech, chairman of the board of Trans World Airlines, has sold the 1,000 shares of common stock and $16,700 worth of 6½% debentures that represented his entire investment interest in TWA.

Executives of various airlines have in the past sold all or part of their holdings for any one of several reasons. TWA's stock is currently at a low of $9, well below what Breech paid for it. The debenture values have likewise decreased.

Juan T. Trippe, president of Pan American World Airways, sold 23,300 shares of stock in Pan American in November and December, 1961, when the open market price ranged from $20-23 a share, and bought back 20,000 shares late last June when the market price was in the $16-16.75 range. The Securities and Exchange Commission report of the purchase indicated it was not through option.

CAB-FAA Crash Probe School Proposed

By David H. Hoffman

Washington—Joint training center for Civil Aeronautics Board and Federal Aviation Agency accident investigators is being proposed to clarify the often-misunderstood role each should play following the crash of a U. S. aircraft.

In concept, the center has been endorsed by both CAB Chairman Alan S. Boyd and FAA Administrator N. E. Halaby. Testifying on FAA's Fiscal 1963 budget before a Senate appropriations subcommittee last week, Halaby disclosed that the center would be headed by a CAB official appointed by Boyd. However, FAA aircraft would be used to rush the specially trained investigators of both agencies to the scene of an accident.

By law, each of the two agencies must take action when a U. S. aircraft is destroyed or suffers major damage.

CAB's duty is to determine the accident's probable cause and to submit long-range safety recommendations to FAA. Because this process usually is time-consuming—it took the Board almost 18 months to decide what caused the 1960 midair collision over New York City—FAA is to immediately identify and remove hazards that may have contributed to the accident.

The new accident school, if it is established, would work to end friction that repeatedly has cropped up between CAB and FAA investigators in the field. According to Halaby, it would capitalize on the resources of both agencies and the employes of both would be eligible to attend it. But CAB students would receive more thorough training than those assigned by FAA, he said.

No date has been set for the school's opening by Boyd and Halaby. However, there is agreement that amendment of the Federal Aviation Act need not precede its creation.

Agency Reorganization

While the training center is being planned, Director George C. Prill of FAA's Flight Standards Service is undertaking a reorganization that would place about 90 to 100 agency investigators under a single accident branch. Its head probably will be Philip N. Goldstein, a veteran investigator now assigned to Flight Standard's Control Systems Division.

Ultimately, Prill believes, the reorganization will reduce rather than expand FAA's role in accident investigation. It will also lead to minor cutbacks in the number of FAA personnel who are now assigned this duty, he said.

Although airline pilots had taken no formal stand on the training center plan late last week, they probably will react with open skepticism to more intimate collaboration between FAA and CAB. Some said the joint training center probably would duplicate courses now offered by the University of Southern California's flight safety curriculum.

The direction FAA is moving in the field of accident investigation came out in testimony before the Senate appropriations subcommittee, which was urged by the agency to restore virtually all of the $71,175,000 cut from its Fiscal 1963 budget by the House (AW Aug. 6, p. 45). FAA requested $810.8 million, but the House approved $739,-625,000.

Funds Asked

Halaby asked the Senate to return $70,733,000 of the sum pared, including all $15 million taken from FAA's civil supersonic development program.

In asking for the full $25 million in his original budget, Halaby said that with substantially less "we cannot achieve our 1963 objectives." In essence, this is to determine whether the U. S. should pay the approximately $600 million in research and development costs associated with a Mach 3 civil supersonic transport.

But Sen. A. S. Mike Monroney (D.-Okla.) placed less urgency on the program. If the Senate restores the House cut, it should be prepared to defend spending the whole $600 million, said Sen. Monroney, who is chairman of the Senate aviation subcommittee and a member of its appropriations subcommittee.

Casting doubt on whether $25 million should be spent on studies this year, Sen. Monroney suggested the U. S. should slow the pace of its supersonic transport research program until the technology had been advanced by RS-70 development. He speculated that passengers may prefer a more leisurely transcontinental flight via subsonic jet, and said that it might be wise for FAA to study the supersonic transport's economic potential in greater depth. Its passenger revenue yield in domestic service probably would be less than FAA estimates, he indicated.

Halaby's counter-argument was based on these points:

- **Technological improvements** and breakthroughs that flow from the RS-70 and F-111 programs will be applied to the supersonic transport program as it evolves.
- **Largest single cost item** in the supersonic transport program—fabrication of its steel skin and structures—would refine techniques USAF could use in building its own supersonic transport, when one was required.
- **Under Sen. Monroney's** logic, National Aeronautics and Space Administration would not have begun spending on the Gemini and Apollo programs until Mercury flights were over and analyzed, thus jeopardizing U. S. chances of landing a man on the moon before the Russians.
- **First flight of a Soviet** supersonic transport—probably an adaptation of the Bounder bomber—could be expected as early as 1965. But the Russians are also building a civil supersonic transport designed as such from the beginning (AW July 31, 1961, p. 36).
- **Market for at least 150 civil** supersonic transports, each selling for between $10 million and $30 million, will exist during the 1970-75 period. Of these, Halaby estimated, about two-thirds would be used on domestic transcontinental routes.

Although Republican leaders have accused the Kennedy Administration of going too slow on supersonic transport development (AW Aug. 6, p. 32), that party's senators on the subcommittee were not vocal in defending Halaby's request for $25 million.

At least 18 long range radars, 49 VORs, 13 airport towers and five air surveillance radars now completed or being built cannot be operated this year if the Senate fails to restore the bulk of the $29.1 million cut from its operations budget by the House, Halaby said. Implementation of new services, such as broader use of radar handoffs and area positive control, would also be deferred, he said.

Halaby asked restoration of the full $15 million eliminated from his research and development budget by the House. His argument was interrupted by Sen. Allen J. Ellender (D.-La.), who warned FAA to curb the growing practice of indirectly subsidizing universities through study grants. Describing some such contracts as "cancerous," Sen. Ellender said that several colleges are totally dependent on them and that others secure more than their share through influential friends.

Such contracts, he said, should not be used to shirk executive decisions. However, FAA was not more guilty than other government agencies in resorting to them, he said.

Halaby said he did not consider it wrong "to pay for brainpower" when comparable talents could not be found within the agency. However, FAA's management philosophy was to do everything in-house if it could be done with agency resources and personnel.

Halaby or other ranking agency officials also:

- **Promised to insert** for the record at a later date answers to a long list of written questions posed by Sen. Warren G. Magnuson (D.-Wash.). Many were aimed at past FAA management of its research and development effort, which Halaby described as "not system oriented, poorly organized and badly managed."
- **Disclosed that a representative** of private industry, probably an airline executive, is being sought to boost the utilization and centralize the management of FAA's fleet of aircraft. In all, the agency operates 108 aircraft costing about $30 million. Annual average utilization in Fiscal 1962 was about 790 hr. per aircraft.
- **Defended installation** of a non-directional homing beacon at Johnson City, Tex. (population 600), on the ground that Vice President Johnson, who lives nearby, and his state visitors deserve adequate navigation aids. Halaby offered to compare the cost of the Johnson City beacon with the portable VOR once installed on the Gettysburg farm of former President Eisenhower.
- **Disclosed that on Sept. 1,** FAA would start flight-checking military navaids in Alaska as the first step toward flight-checking all such U. S. installations.
- **Warned that the RS-70** was totally unacceptable as a supersonic transport framework because its powerplants used afterburning on takeoff, its specific fuel consumption was so low that midair refueling would be required, and its transition to supersonic speeds would come at such low altitudes the sonic boom would be intolerable to those living beneath it.
- **Predicted that by reducing** the number of Air Route Traffic Control Centers in the U. S. from 29 to 21 within the next two years, an estimated $100 million will be saved during the next 16 years. Since pilots will deal with few centers, the possibility of controller error and the resulting threat to safety also would be lessened.

National Jet Ban

Washington—Federal Aviation Agency Administrator N. E. Halaby has strongly hinted that all turbojet transports will be banned from Washington National Airport at least until the Boeing 727 enters airline service during the mid-1960s.

From his earlier remarks, many officials concluded that smaller jets such as the Sud Caravelle and the Boeing 720 might be admitted to Washington National after Dulles International Airport's scheduled opening in October. But Halaby, who admitted last week that his jet ban at National would be "difficult to hold to," said that he preferred to confine such operations to the new international terminal.



Fujita, DETA Receive Fokker F-27s

Fokker Friendship Series 200 transports, equipped with Rolls-Royce Dart 7 Mark 528 turboprop engines, are shown in the markings of Fujita Air Lines of Japan (top) and DETA airlines of Mozambique. Fujita will use its aircraft to link Tokyo with major holiday resorts and will take delivery of another Friendship 200 transport in the near future. DETA will place its aircraft in service after a period of crew training.



Mexican Government Buys Guest Airways

Mexican government's recent takeover of Guest Aerovias de Mexico leaves Compania Mexicana de Aviacion (Mexicana), a Pan American World Airways affiliate, last privately owned carrier involved in a proposed consortium of three Mexican flag carriers (AW May 28, p. 39).

Sale of Mexicana as part of the proposed consortium is considered inevitable, the only stumbling block being the price the Mexican government is willing to pay for its portion of the ownership. Mexicana has dropped its price to about 200 million pesos or about $16 million, Mexican sources say.

The Mexican government has a powerful weapon to bring Mexicana to terms—taking away key cities on its routes. Mexico did not renew Mexicana's rights to Tiajuana, an important gateway city for the airline.

Mexican government's purchase of 80% of the capital stock of Guest Airways from Mexican financier Carlos Trouyet leaves the composition of the proposed consortium unknown at present. Original basis for the consortium of Aeronaves de Mexico, Guest and Mexicana was to have been 50% ownership by a government holding company to be called Aero Mexico, S. A.

Trouyet turned over Guest's stock to the government on Aug. 1. He had bought Guest from Scandinavian Airlines System last September and put up $1.6 million to operate the airline.

The Guest route system included Miami, Guatemala, Panama, Caracas, Curacao, Bogota, Paris and Madrid.



FLAP AREA of 320B is designed for quicker liftoff and low speed stability. Fillet flaps, located where wing trailing edge joins fuselage, is new innovation, and leading edge flaps now extend most of length of forward wing area.

320B Provides Range, Payload Flexibility

First two months experience with the Boeing 320B in service with Pan American World Airways indicates the airplane can consistently fly nonstop westbound on such long stages as London to Los Angeles or Honolulu-Tokyo.

Pan Am, whose aircraft are designated 321B, used the 320B to inaugurate the first nonstop westbound jet service between London and the U.S. West Coast, flying the polar route in 13½ hr. Eliminating the fuel stop at Winnipeg shaves an hour off the schedule time.

Reliability has been good, with only one aircraft substitution necessary since service began June 1. Two unscheduled engine changes have been performed, both precautionary changes resulting from malfunctions found while the aircraft was on the ground.

In meeting schedule times, the 320B is near but not equalling Pan Am's earlier 707-series jets, which, in completing globe-circling flights, were arriving at Idlewild within an hour of schedule 89% of the time. Pan Am attributes the lag to the breaking in of the new aircraft.

Pratt & Whitney JT3D-3 turbofan powerplants on the 320B, producing 18,000-lb. thrust each, are the first fan engines used by Pan Am. No major problems have been encountered, although more maintenance time is required because of the JT3D's greater complexity and compactness than standard turbojets. Problems encountered earlier by other carriers using JT3D series engines—excessive oil consumption or high temperature because of tight cowling of the forward fan ducts—have not arisen with Pan Am's later versions. No burner, turbine section or bearing failures have occurred.

The malfunctions that caused the two unscheduled engine changes have not been diagnosed. Both powerplants are undergoing overhaul and examination at Pratt & Whitney. Two other JT3D-3 engines completed their operation time and are in overhaul at Pan Am's maintenance facility at New York.

Ingestion of unknown objects occurred on two occasions, causing minor damage to the forward compressor blades in one instance and to the turbine blades in the other. Neither incident necessitated engine shutdown.

Overhaul Times

Time-between-overhaul (TBO) of the engines was 800 hr. when service began, but it has already been advanced to 1,000 hr. and will go to 1,200 hr. shortly, Pan Am said.

The long aircraft substitution occurred at San Francisco, where one of the two premature engine changes was made. A standard Boeing 707-320 was used for the switch.

Daily utilization is averaging 13.3 hr. for each 320B, giving Pan Am a 66½-hr. daily use factor with all five planes. The five 320Bs completes Pan Am's order for this series, its option for five more having expired. No additional orders are planned at present.

The 320B is proving an economical airplane to schedule, enabling Pan Am to reduce costs on its longer segments. For example, with standard 320 jets, a backup aircraft and a lengthy schedule break were required at Hong Kong. Since the 320B came on, the backup airplane has been eliminated, and the break has been shortened to standard in-route station stop time.

The 320B also flies nonstop consistently westbound from Honolulu to Tokyo. Wake Island was a frequent fuel stop on this segment for earlier jets facing headwinds or foul weather at destination, increasing fuel reserve requirements. The 320B overflies Wake, covering the 3,853-mi. run in 8 hr.— 1 hr. 35 min. less than the stop at Wake Island.

G. F. Maxwell, Pan Am's division operations manager, said that fuel consumption in the JT3D-3 engines has been "right on the curve," referring to the manufacturer's performance graph.

Boeing economic studies indicate that for a trip from London to Los Angeles and return, total direct operating cost of the aircraft is $17,735. This cost figure is based on the 1960 ATA method and includes insurance, depreciation, spares, non-revenue flying of 3%, 3,000 hr./yr. utilization, fuel at 11 cents per gal. plus other standard considerations.

Using the 53.4% load factor average of international carriers last year (AW May 7, p. 62), fares for the same trip would yield $63,440, leaving $45,705 to apply to overhead, etc. Passenger configuration on Pan Am's 320B varies, but 37 first class and 88 economy is the most commonly used ratio.

Maxwell said the 320B is being flown at Mach .79-.80 on the westbound polar segment, about two points below the average cruise speed of the earlier 320 series. Reason is, he said, that the 320B is flown at long-rang cruise speed for maximum fuel economy. In the interest of time, earlier jets were flown at Mach .82 to make up for the refueling time loss. Optimum cruise altitude remains 35,000 ft.

Top speed for the 320B is 597 mph. at 23,000 ft., or about Mach .86. However, Pan Am's experience has lent accuracy to the manufacturer's specification that Mach .80 provides the most economical operating speed.

One advantage of the 320B is that with its lesser rate of fuel consumption, desired ground speed can be maintained in the face of strong headwinds by adding more power. However, Maxwell said Pan Am usually takes the ground speed loss in such instances, since it adds an average of only 10 min. to flying time. Ten minutes doesn't justify the extra fuel and wear of faster engine operation, he said.

Ideal Aircraft

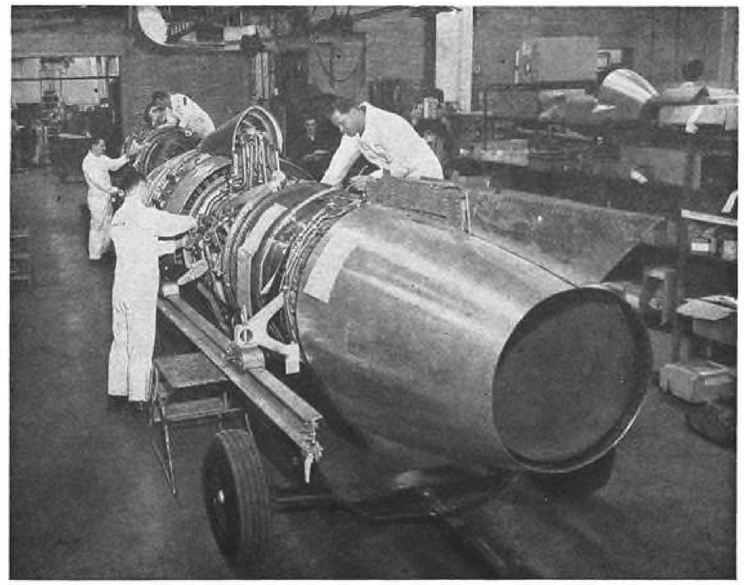
The 320B is an ideal aircraft for Pan Am's routes, Maxwell said, and was readily adaptable to the carrier's jet fleet. Because of its similarity to Pan Am's other Boeings, no flight training was necessary in the transition of cockpit crews for operation of the turbofan aircraft. "We were able to give all the training on the ground, which provided substantial savings in training expense," Maxwell said.

Another advantage of the 320B is that many of its parts and components are interchangeable with those of the standard 321. Maxwell said no problems have arisen with either the airframe or control system.

"By putting all the 320Bs in one schedule pattern, we are learning a lot, and learning it quickly, about how to operate the aircraft most efficiently," Maxwell said.

The decision to put all five in a single round-the-world cycle was prompted mainly by the ready availability of backup aircraft which formerly flew the 320B's present segments. A significant feature of this pattern is that one of the 320Bs is always at Idlewild overnight, where Pan Am can concentrate maintenance attention on it.

Pan Am placed no extensive sales effort on the 320B when it entered service. Consequently, the carrier makes no claims that it generated new business through added passenger appeal. It is a corporate policy in Pan Am not to emphasize one aircraft over another, since such action is viewed as downgrading other equipment flown by the airline.



JT3D-3 turbofan engines for the 320B, Pan Am's first fan powerplants, are now being overhauled at the carrier's Idlewild maintenance facility.

Trans World Airlines will be the next to receive the 320B, with five on order for leasing. Air France has four on order, Lufthansa two and Northwest Orient three.

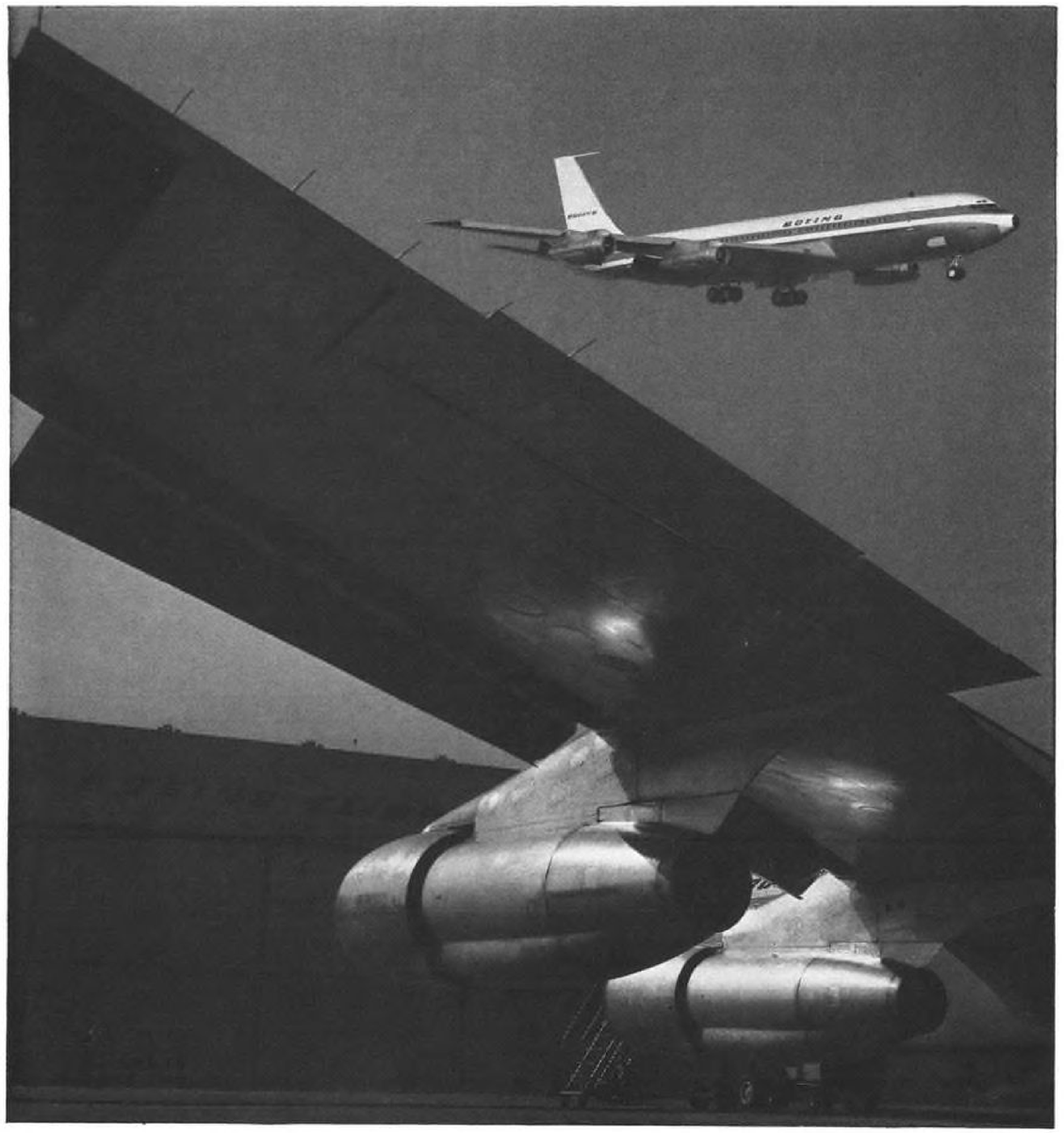
Air France is particularly interested in the 320B's range and accompanying high payload factor. The French carrier has been using its present 320s for nonstop service between Paris and Anchorage, but it has been able to do so only by sacrificing payload for modifications that increased the 320's fuel capacity.

Air France will receive its four 320Bs between December, 1962, and February, 1963. It has an option to buy five more, but spokesmen for the airline say it is too early to determine whether the option will be picked up.

The JT3D-3 engines will also be Air France's first fan powerplants. Maintenance on them will be done by

IDLEWILD AIRPORT is termination point for Pan Am's 320Bs on round-the-world schedules, including London-Los Angeles nonstop segments. Top speed for the jet transport is 597 mph. at 23,000 ft., or about Mach .86.





World's longest-range jetliner – the Boeing 707-320B

The new Boeing turbofan Intercontinental is now in service. It is the longest-range jetliner available today.

The -320B can carry a full passenger payload from Seattle to Tokyo, or Europe to the U.S. West Coast, nonstop, against normal headwinds, with normal fuel reserves.

The U.S. Federal Aviation Agency certificated the -320B at 328,000 pounds. During FAA flights, the new Boeing jet made landings at weights more than 100,000 pounds above certificated landing weight, demonstrating the wide margins of safety and growth-potential of this new Boeing jet.

Cruise speed, at route altitude, is 575 mph, true air speed. Passenger capacity is from 100 all first class, to 183 all economy class.

A further development of the famous 707-320, the -320B incorporates new wing leading-edge and trailing-edge flaps, low-drag wing tips and other aerodynamic refinements. It brings a new dimension of range and speed to the world's very long-range routes. Already in service with Pan American, the 707-320B has been ordered also by Air France, Lufthansa, Northwest and Trans World airlines.

BOEING 707 Intercontinental

Snecma, the French engine manufacturer.

TWA plans to use the 320B on West Coast-Europe service during the summer, but also views the plane as an improved performer on transatlantic schedules from New York. Since TWA's planes will be delivered this winter, first service will be performed on the North Atlantic.

Lufthansa's 320Bs will also provide polar service, while Northwest Orient's will fly Pacific patterns similar in length to those of Pan Am's.

BOAC has also expressed interest in the 320B, although no orders have been placed. The British carrier wants a jet that can operate nonstop on polar routes to Los Angeles, which the 320B has proven it can do on routes between 5,000 and 6,000 mi. Vickers has assured BOAC that the Super VC.10, which BOAC has ordered, can be modified to meet long-range requirements. However, a BOAC spokesman said a final decision on any 320B orders would probably be made this fall.

Polar Routes

The polar routes, which someday promise to open even a Europe-Tokyo nonstop service over Russia, feature wind conditions that require an especially versatile aircraft for consistent schedule reliability. In winter, for example, the jetstreams move southward and to lower altitudes, hampering westbound flights. Airlines able to counteract these headwinds with a plane like the 320B will have a substantial advantage over carriers with equipment that must make fuel stops en route.

Competitive nonstop routes on which the 320B promises to be particularly effective include: Los Angeles-London, 5,443 mi.; Los Angeles-Paris, 5,663 mi.; Seattle-Tokyo, 4,793 mi.; Chicago-Frankfurt, 4,332 mi.; New York-Buenos Aires, 5,303 mi.; New York-Honolulu, 4,975 mi.; New York-Moscow, 4,660 mi.; Honolulu-Sydney, 5,076 mi.; Madrid-Rio de Janeiro, 5,062 mi.; and London-Tokyo (across Russia), 5,959 mi.

One factor limiting the 320B on polar flights—and one over which it has little control—is noise abatement. For instance, it must depart London during the times which permit use of the longest runway under noise regulations. A lighter fuel load, necessitated by using a shorter runway, will require a fuel stop at Winnipeg.

The 320B, which costs about $6,360,000, is a big-airport plane. Standard day, no-wind takeoffs from sea level fields require a field length of 10,400 ft. at a maximum gross weight of 327,000 lb. Landing field length at maximum landing weight of 207,000 lb. is 6,500 ft., with an approach speed of 133 kt.

Sabena Congo Ban

Brussels—Political strife within the Congo is again disrupting scheduled services of Sabena Belgian World Airlines.

Latest operation to be affected is the four round-trip-a-week Sabena service between Brussels and Elisabethville, capital of the secessionist Katanga Province, following a ban on all flights into the area except those under the direct supervision of the United Nations.

The ban was imposed by the Congolese central government and is being enforced by UN personnel as a first step in a planned economic campaign designed to force Katanga to accept the authority of the central government in Leopoldville.

Under terms of an arrangement with the government of Northern Rhodesia, Sabena is now flying four weekly Douglas DC-7C flights into Ndola, about 140 mi. from Elisabethville. Passengers are then transferred to surface transport for the remainder of the trip.

If the 320B took off with a maximum payload of 52,593 lb., unlikely in an all-passenger configuration, 110,000 lb. of fuel would have to be expended before the plane was down to landing weight. This indicates that the 320B is not designed to carry large payloads over short distances.

Main differences between the 320B and its predecessor 320, aside from the turbofan engines, are in the new trailing edge flap arrangement and cambered wing tips. The flaps now extend into the wing trailing edge fillet and have large end plates between the flaps and the fuselage. The end plates are readily apparent when the flaps are extended.

The new cambered wing tips are designed to decrease drag due to wing tip vortices, but are not readily discerned when looking at the aircraft. Other refinements, such as improved air conditioning unit air inlets and wing heater pump vents have been incorporated as a result of service experience.

Another version of the 320B is the 320C, now being built by Boeing. Orders for the 320C stand at two for Pan Am, two for World Airways, an independent airline with an all-piston fleet, and one VC-137C (military designation) for use as a presidential transport.

The 320C is a convertible passenger-cargo transport which can be rapidly shifted from an all-passenger configuration accommodating 188 economy class passengers to an all-cargo version of 80,000 lb. payload. Convertibility allows the aircraft to fly all-cargo one way and all-passenger on the return trip, or it can handle a combination of passengers and cargo varied to suit the demand.

The 320C retains all the major systems and components of the 320B, permitting interchangeability of ground-handling equipment, spare parts and training. In addition, the aircraft is equipped with a 7 x 11 ft. forward cargo door and a mechanized cargo-handling system which allows a complete cycle of loading and unloading of an 80,000 lb. palletized load in less than 1 hr. A strengthened cabin floor uses integral floor tracks which accommodate seats, cargo tiedowns and bulkhead separators. The cargo-handling equipment can be disassembled and stowed in one of the lower cargo compartments.

Gross weight of the 320C will be 327,000 lb. maximum flight weight, but landing weight will be about 228,000 lb. because of the increase in maximum payload from 52,000 lb. to 80,000 lb. Range with maximum cargo will be 3,500 mi.

Presidential VC-137C will not have the convertibility features of the 320C but has been equipped with a special interior and extensive communications gear. Aircraft is distinguished by the words "United States of America" painted on the fuselage rather than the "United States Air Force" as are the other three VC-137s (versions of the 707-120) in the presidential fleet.

Further Reductions

Further reductions in approach speed are predicted for the 320C over the 320B because of incorporation of a contoured and slotted leading edge flap. What the performance improvement will be has not been determined because flight tests were only begun after first flight of the 320B, No. 6, which has been temporarily fitted with the new flap.

Tests with the No. 6 aircraft are also aimed at improving the performance of the 320B itself, particularly in takeoff distance and anti-skid braking.

The 320B, under conditions of high load and hot temperatures, often runs right up to the prescribed runway limits before lifting off. There is still room on the wing leading edge for more flaps that could correct this situation, and tests will be conducted with extra flaps to see if takeoff can be accomplished quicker.

The anti-skid improvement, designed to shorten landing roll, is expected to come through the Hytrol Mark 2 computer-type sensing device linked to the braking system.

It senses the amount of brake pressure required under any runway condition and regulates it.

Problems arose because of the varying load on each of the gear truck's four wheels as the aircraft rolled on the runway. Shifting the dual sensors from a tandem to a lateral position on the truck is being tried in an effort to compensate for the load variances.

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AIRLINE OBSERVER

►Watch for Federal Aviation Agency to scrap its practice of clearing IFR inbound traffic first to an approach/feeder fix, then to a destination airport. Instead, the agency plans to issue radar-controlled inbound aircraft a single clearance that would enable them to fly to an ILS localizer course serving a major terminal and execute approaches without intermediate holding. Under such a procedure, which would be predicated on radar handoffs, the United DC-8 that collided with a TWA Constellation on Dec. 16, 1960, probably would have been cleared to New York International Airport instead of to the Preston Intersection. Probable cause of the accident, according to CAB, was the jet's overshooting of the Preston feeder fix (AW June 25, p.39).

►Plan to modify the approximately 800 U.S. VORs (very high frequency omni ranges) so that pilots could recognize an out-of-tolerance signal sent by a particular station is being studied by FAA. In current cockpit installations, a very small warning flag appears when either ground or airborne equipment malfunctions. FAA's proposed modification would cause a malfunctioning VOR to emit a distinct, audible tone that would warn pilots not to rely on that station's signal.

►Russia's Aeroflot has rebuked over-enthusiastic traffic promotion personnel who give inaccurate information to the public. It especially criticized Aeroflot advertising writers in the Caucasus who issued an information booklet early in 1962 stating that twin-jet Tu-124 and twin-turboprop An-24 service had begun. Actually, regular Tu-124 and An-24 service still had not started by mid-summer. Aeroflot did not mention that the carrier's top officials had first promised that the service would begin in 1961 and that several subsequent dates for putting the aircraft into service were not met.

►Proposal to merge El Al Israel Airlines with the Israel domestic airline, Arkia, is under consideration; will soon be brought before the Israeli National Aviation Council.

►Top officials of FAA and the six-nation Eurocontrol Assn. met last week in Washington to exchange views on air traffic control research and development. Eurocontrol is an agency established to exercise air traffic control at high altitudes over Great Britain, France, Germany, Belgium, The Netherlands and Luxembourg.

►Civil Aeronautics Board last week set temporary subsidy rates for the six months ending Dec. 31, 1962 for the three subsidized U.S. helicopter airlines. For the period, New York Airways will be granted $827,437, Los Angeles Airways $773,720 and Chicago Helicopter Airways $556,416. CAB said the six-month period, rather than one year, was chosen to guard against overpayment. During that period, it added, New York and Los Angeles will gain experience with its new equipment and Chicago's traffic situation will be clearer.

►Air Force and FAA last week agreed that three Sage direction centers in Great Falls, Mont., and Minot and Grand Forks, N. D., would be used jointly for ATC and air defense operations (AW Nov. 6, p. 39). About one year will be spent preparing the three centers, which will employ 150 to 180 FAA controllers. Concurrently, FAA's ATC center at Great Falls will be phased out and its operations shifted to the nearby Sage center at Malmstrom AFB.

►British Overseas Airways Corp. is adding two more passenger seats to its de Havilland Comets. Modification involves replacement of crews' fixed bench seat in the cabin with tip-up seats hinged on reinforced bulkhead and installing two new seats in the positions. BOAC calculates revenue gain will be $1 million annually.

►TWA order to reduce administrative overhead is bringing transfer of some management personnel from company headquarters to regional and district levels. Cutback of administrative staffs reportedly will run as high as 10-12%. Strict cost control measures also are being introduced.

SHORTLINES

►**Aeroflot** has adopted a capitalist public relations touch for passengers flying its turboprop Il-18s from Moscow to Jakarta, Indonesia. The Soviet carrier is handing out special Neptune badges stating that the recipient has crossed the equator with Aeroflot.

►**Air Transport Assn.** said interline business conducted by U.S. certificated air carriers in June totaled $91,233,000, an 8.5% increase over June, 1961.

►**Bonanza Air Lines,** with Civil Aeronautics Board approval, plans to begin discounted round-trip fares for groups as small as five persons on Sept. 1. Depending on the group's size, fare discounts will range from 30 to 38% under first class charges. The groups do not necessarily have to be composed of members of any organization.

►**Delta Air Lines** said it flew a record 274,139,000 revenue passenger miles during July, a 13.5% increase over June, and had a 66.83% passenger load factor. Delta also accepted delivery of four Convair 880s during July, bringing its jet fleet to 25 aircraft.

►**Federal Aviation Agency** announced formation of two new divisions within its Systems Research and Development Service. Frequency Management Division will formulate FAA radio frequency spectrum requirements and obtain radio channels for FAA use from Telecommunications Management of the Federal Communications Commission. Applications Engineering Division will oversee all design, prototype development, and specifications for air traffic control and navigation equipment used by FAA.

►**Irish International Airlines** said its profit for the fiscal year ended Mar. 31 was $718,771. During the same period, its transatlantic passenger total of 55,077 represented a 57% increase over the previous year.

►**Japan Air Lines** is negotiating with Douglas to acquire a turbofan DC-8, through a lease-purchase agreement, for delivery in July, 1963. JAL recently purchased its sixth DC-8, also a turbofan, for delivery in February. JAL's five other DC-8s utilize standard turbojets.

►**West Coast Air Services, Ltd.'s** request for a temporary foreign air carrier permit to conduct charter operations between Vancouver, British Columbia, and all points in the United States except Alaska has been approved by a CAB examiner.



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COLLINS

AUA Plans to Revise Order for Caravelles

By Edith Walford

Vienna—AUA Austrian Airlines, accelerating its planned entry into the jet market after a major management reorganization, now hopes to obtain jet transports in time for the 1963 summer schedule by placing a firm order soon for two 6R versions of the Sud Caravelle.

The company also hopes to sign a profit-sharing agreement with Scandinavian Airlines System effective this fall covering the joint operation of an SAS Caravelle on flights from Vienna to the Near East.

Under earlier programing, the carrier had planned to introduce its first jet service in 1964 (AW Dec. 18, p. 51).

Decision for accelerated action followed the first general assembly here of AUA's new top management officials. Management changes and revision of the company's capital structure followed the lines of recent parliamentary legislation governing the final reconstruction and recapitalization of the state-owned carrier.

Appointments to the airline's top three positions reflect a parliamentary mandate that high-level personnel be "qualified persons with previous airline economic and technical experience who also represent a balance of power between the two national political parties."

New President

New president is former Secretary of State Franz Grubhofer, a member of the People's Party, whose career has been largely confined to the field of politics, although he is now serving as president of the Austrian Aero Club. Grubhofer replaces Dr. Joseph Koller, who has left the company.

Managerial tasks held by Felix Schalk, former managing director and a member of neither political party, will be divided among two new officials —Helmut Lerider as commercial director and Dr. Lambert Konschegg as technical director in charge of operations.

Schalk joined the company in January, 1960, as commercial director and was named managing director pro tem six months later upon the resignation of Technical Director Ferdinand Brandner. At the time, Schalk assumed technical direction of the airline, although Brandner's post as such remained vacant until Konschegg's appointment.

A member of the Austrian People's Party, Konschegg has served as a Swissair pilot since 1952. Lerider, an Austrian Socialist Party member, has been regional manager for Eastern Europe for SAS since 1956. Prior to that, he had served as SAS district manager in Austria.

The reshuffle is regarded as a final step in the reorganization of Austrian Airlines, which resumed post-war operations in March, 1958. Since that time, top management officials have been employed on a flat two-year contract basis. New appointments are permanent.

In a related move, the government has written off $1.92 million of Austrian Airline's initial operating capital of $2.4 million spent on equipment purchases and has helped the company recapitalize. Most of the $6 million recapitalization will be provided by a new share issue of $5.52 million, one third owned by the government, one third by local governments and one third by private enterprise, primarily banks and industry.

Delivery of the first of the two Caravelles, powered by two Rolls-Royce Avon 533R turbojet engines of 12,600-lb.-thrust each and with a 75-passenger configuration, is scheduled for next February, the second for April.

Caravelles will cost about $3.5 million each, and the necessary spares 7% of the purchase price, or an additional $250,000 per aircraft. AUA will be required to pay a 10% deposit when the order is placed, 10% on delivery, and the balance to Sud in 10 semi-annual installments. The carrier says it hopes to finance the Caravelles from its own reserves and over-all revenue plus some bank credits but without the need for government loans or additional subsidy.

When the Caravelles become operational next spring, they will be used initially to replace Vickers Viscounts on some turboprop services to West European centers, particularly Vienna-London, Vienna-Paris, Vienna-Rome and Vienna-Frankfurt.

In addition, they will be introduced on direct flights over a number of the airline's longest medium-range routes such as Vienna-Moscow and Vienna-Beirut.

The airline's fleet of five 56-passenger Viscount 837s and two 44-passenger Viscount 745s will continue to operate to points in Western Europe and the Balkan countries.

No Extension

AUA Austrian Airlines is not planning any extension of its present route network, according to a company spokesman. For the time being, effort will be concentrated on generally improving and increasing the frequencies of existing services.

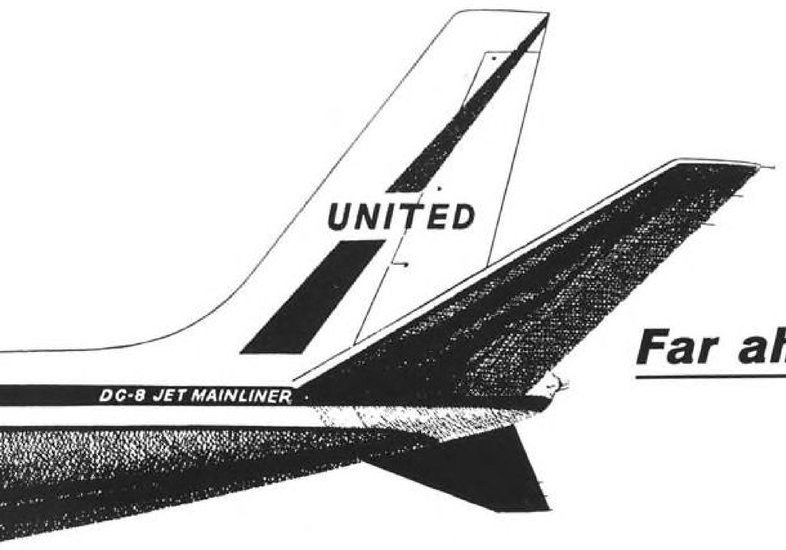
At the moment, the new management also is completing negotiations for a traffic and profit-sharing agreement with SAS, a 15% shareholder of the Austrian carrier, concerning the joint use of an SAS Caravelle on flights from Vienna to the Near East.

The agreement would permit the Austrian carrier to trim its original Caravelle order from three to the pres-

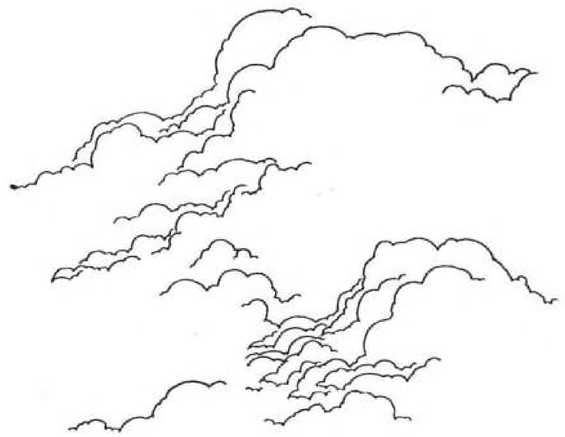


Pittsburgh Uses Floating Heliport

Privately owned floating heliport moored in the Monongahela River in downtown Pittsburgh provides terminal for helicopter service to two airports in Allegheny County. Heliport, 160 ft. in length with a landing area of 54 x 90 ft., is owned by Copter Skyways, Inc., and Pittsburgh Airways, Inc. (AW May 21, p. 113). Helicopter is a Sikorsky S-55.



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AUA Traffic Gains

Vienna—AUA Austrian Airlines reports that it registered gains of 43% in passengers carried, 62% in freight/tons and 30% in mail/tons during the first quarter of 1962 over the same period of last year.

Passengers carried totaled 23,309 as compared with 16,299 during the first quarter of 1961; freight amounted to 209 U.S. tons and mail to 76.5 U.S. tons during the first quarter of this year as compared with 128.5 and 58.7 tons, respectively, for the 1961 period.

ently planned two. It also will enable the carrier to gain experience in jet operation well in advance of delivery of its own jet transports early next year and bolster a route now being served by Vickers Viscount 745 turboprop transports.

Under the projected terms of the agreement with SAS, the two airlines will operate a Vienna-Istanbul-Beirut service, and possibly as a second step a Vienna-Athens service, on a joint basis. SAS will supply the pilots, the Austrian company the cabin crews.

The Austrian carrier has reached an agreement with Swissair and SAS for the latter two airlines to carry out major overhauls on the SAS Caravelle. AUA, however, will be responsible for intermediate servicing in Vienna.

This procedure, which Austrian Airlines hopes to extend to its own new Caravelles next year, coupled with an appreciable reduction in operating costs as a result of the joint AUA-SAS operated Vienna-Beirut flights, will save AUA an estimated $360,000 annually.

Training of future Caravelle flight personnel is currently being split between Swissair and SAS. Technicians are receiving instruction at Sud Aviation's Toulouse plant.

Lerider told AVIATION WEEK that his company wishes to maintain a completely independent policy. It does not plan to use the present close cooperation with the Swiss and Scandinavian carriers as a first step toward sharing in the existing pool agreement between the two airlines. Nor, Lerider says, has AUA any desire to become a member of Air Union.

A top priority project, in the new management's view, is reorganization and gradual expansion of Austria's domestic air services which, except for a number of charter services, have been virtually non-existent. Accordingly, a three-member study group was formed to examine the questions involved. One now being investigated is whether to establish a domestic route network as part of AUA's scheduled operations. Another is whether to acquire a majority interest in a new charter company on the lines of Balair of Basle, 40% of which is Swissair-owned.

If AUA's plans are realized, first step will be the establishment of regular flights to connect the main Austrian centers of Vienna-Salzburg-Innsbruck as well as Vienna-Graz-Klagenfurt, providing domestic connections with AUA's international services. The company is considering operation of both these routes on a twice daily—early morning and afternoon—round-trip basis with one Douglas DC-3. A second DC-3 may be purchased later to bolster the schedule.

Introduction of a twice daily Innsbruck-Bregenz service to the Vorarlberg region may follow, possibly with a six-passenger Dornier Do.28 aircraft capable of landing on unprepared grass strips. Vorarlberg has no airport facilities thus far.

Second step in the reorganization of internal services under consideration is acquisition of a 51% interest in a new charter flight company scheduled to be formed out of the joint assets of the two private companies, Aero-Transport and Austria Flugdienst GmbH.

Aero-Transport's fleet of one de Havilland Dove, one Lockheed Constellation and two Vickers Viking aircraft operate non-scheduled tourist, sight-seeing, air taxi and cargo flights. Austria Flugdienst GmbH., with a single Douglas DC-3, offers passenger and cargo transport services.

Should AUA Austrian Airlines decide to become a majority shareholder of the new company, it plans to extend available services to include international charter flights with the initial purchase of one Douglas DC-6B and later, probably, a second of this type.

Six-Month Profit Is Recorded by Western

Western Air Lines last week reported net earnings of $2,560,000—or $1.79 per share on 1,430,730 shares outstanding—for the first six months of 1962, compared with a loss of $549,000 in the same period last year.

The first six months profit include $338,000 from the sale of property. Operating revenues for the period were $41.4 million—a record figure for Western—compared with $25.7 million in the same period of 1961. Last year's operating revenues were depressed by a labor strike early in the year.

Operating expenses for the period were $35.8 million to give the airline an operating income of $5.6 million. Interest expense for the 1962 first half rose to $979,000, compared with $699,000 in the corresponding period of 1961. Net profit for the month of June was $675,000 against a net gain of $162,000 in June of last year.



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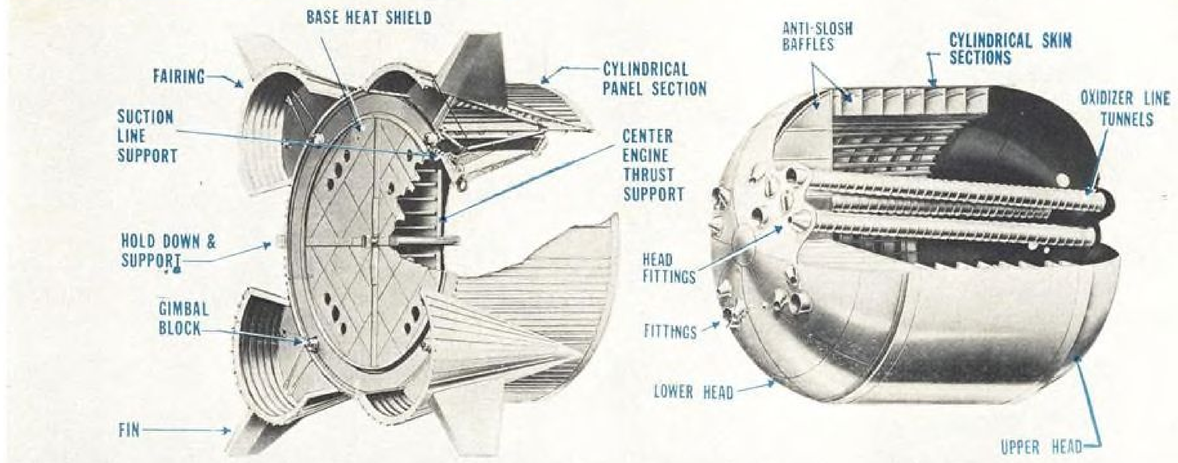
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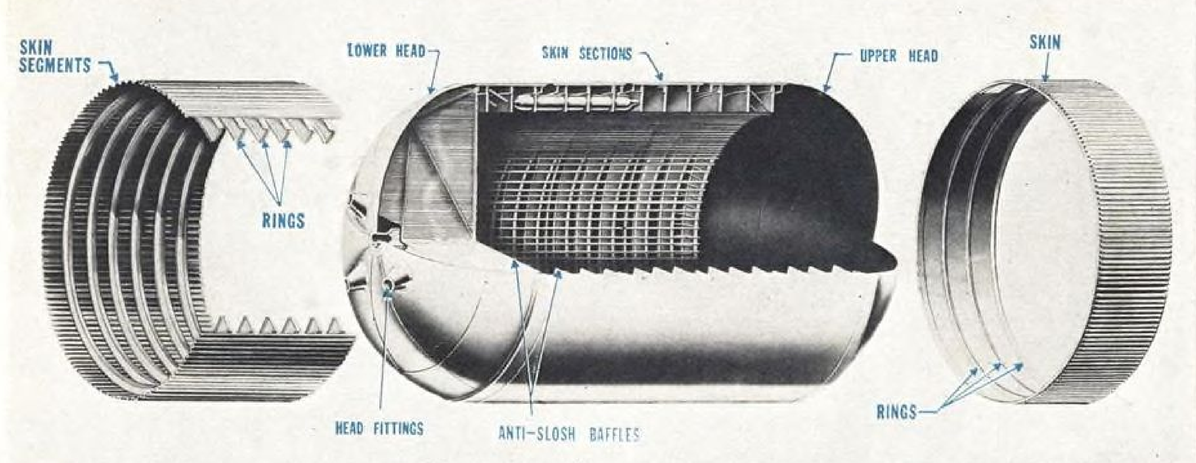
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MAJOR ASSEMBLIES of the Saturn S-1C booster consist of (l. to r.) tail, fuel tank, inter-tank structure, oxidant tank and skirt.



S1-C, to be built by Boeing for the Marshall Space Flight Center, will be the booster of the three-stage Saturn C-5 launch vehicle.

Boeing Faces Unique Fabrication Challeng in Developing NASA's Saturn S-1C Booster

By George Alexander

Huntsville, Ala.—Development of the S-1C first stage of the advanced Saturn C-5 launch vehicle will fall within the present state-of-the-art in booster technology, but its size will pose some unique challenges in the design, manufacture and testing of the unit.

The Boeing Co. will build 24 flyable S-1Cs and one dynamic test model for the National Aeronautics and Space Administration's Marshall Space Flight Center under the terms of a five-year contract for approximately $300 million.

Boeing's role in development of the S-1C will be considerably larger than that played by Chrysler Corp. in building the S-1 booster for the early-model Saturn C-1 and reflects the recent trend in Marshall's management philosophy of granting more and more responsibility to contractors.

Since signing an initial contract with the company last February, Marshall has included a significant number of Boeing engineers in establishing the design criteria of the S-1C over the last six months. This effort, carried out on an elbow-to-elbow basis here at the Marshall center, has been to the mutual advantage of each; the center, with its many programs, can no longer afford to assign the great amount of manpower required to design a vehicle of the magnitude and complexity of the S-1C and Boeing has had the opportunity to help shape the unit before it begins to build it.

Chrysler, although it conducted a number of S-1 studies for Marshall on a task basis, is manufacturing the C-1 booster from a design developed largely by NASA engineers long before the production contract was awarded (AW Nov. 27, p. 22).

As of late last month, Boeing had about 490 engineers working alongside Marshall personnel and, in some instances, under direct NASA supervision as the preliminary design of the S-1C approached completion. Indicative of Marshall's swing from its old do-it-yourself philosophy is the present arrangement between the center and the contractor for the S-1C. As a major assembly or component of the stage reaches the point where a hardware design would be the next logical step, responsibility for that step is delegated—subject to NASA's review and approval—to Boeing. Boeing personnel now are working out the manufacturing blueprints of most major parts of the S-1C.

Management Trend

Other examples of this management trend that might be cited include the S-2 stage, being designed and manufactured by North American Aviation's Space and Information Division, and the S-4 and S-4B stages, being designed and built by Douglas Aircraft Co. One Marshall spokesman said that is reasonable that this trend will continue in the development of Nova stages.

S-1C, as the booster of the three-stage Saturn that will fly the manned Apollo spacecraft to the moon, will be a conventional liquid-oxygen and RP-1 kerosene design. Power is to be provided by five Rocketdyne F-1 engines, each developing 1.5 million lb. of thrust.

In its present design configuration, the S-1C will stand 138.04 ft. tall and have a diameter of 33 ft. Span across the tail fins will be 63 ft. Dry weight now is estimated to be 270,500 lb. and will be distributed this way; airframe structure—151,350 lb.; propulsion system, including engines and accessories—107,050 lb.; engineering systems, including test instrumentation, destruct packages, etc.—9,900 lb.; and guidance subsystems, telemetry units and range instrumentation—2,200 lb.

Saturn S-1C Assemblies

S-1C will consist of five major assemblies: tail section, fuel tank, inter-tank structure, oxidant tank and forward skirt.

Tail section will include the thrust bearing structure, upon which the five Rocketdyne 1.5-million-lb.-thrust engines are mounted, base heat shield, four semi-conical fairings over the outboard engines, four fixed stabilizing fins and four hold-down support clamps.

Four of the five F-1 engines that power the S-1C are to be located 90 deg. apart around the circumference of the 33-ft.-dia. thrust section. These outboard engines will be gimbal-mounted and used in unison to provide pitch, roll and yaw control. Each engine will be driven by two hydraulic actuators mounted 90 deg. apart around the combustion chamber. Stop-to-stop gimbal capability of each engine will be ±7 deg. with normal operating limit of ±3 deg. Fifth engine will be located dead center on the thrust frame and is rigidly fixed. All five engines have zero cant.

Thrust of each outboard engine is to be applied through the gimbal block to a forged 7075 aluminum alloy beam approximately 14 ft. long and 2 ft. square. Each beam will be joined to the airframe at a point just below the juncture of the lower dome of the fuel tank and the airframe. Thrust of the center engine will be transmitted through a horizontal four-legged spider frame to the four vertical beams.

Thrust loads also are to be distributed from the beams through the corrugated aluminum (also grade-7075) skin surrounding the tail section. In comparison, engines of the S-1 booster are canted inward at a slight angle and their thrust vectors meet at a point inside the booster's tankage.

Heat Shield

Like the S-1, the S-1C will have a heat shield in the tail section to protect engine pumps, plumbing, lines and the base of the fuel tank from the intense heat of the F-1 powerplants. Various materials are still being evaluated, but Marshall and Boeing have decided that the shield is to be a fixed unit mounted just above the engine gimbal points with cutouts to accommodate the thrust chambers. Shield will be built as a series of removable panels and will also serve as an access platform to plumbing for maintenance personnel.

Four semi-conical aluminum fairings will be fitted to the side of the tail section over the four outboard engines; they will smooth the air-flow over the engines and add to the launch vehicle's stability. Four fixed fins, each about 75 ft. in area, will be mounted toward the base of the fairings for stability.

Hold-down and support clamps will be positioned 90 deg. apart around the thrust structure, between the engine fairings.

Fuel Tank Details

Fuel tank of the S-1C will be a cylinder capped at each end with a dome; over-all length will be approximately 517 in. Cylindrical portion of the fuel tank will be formed of two hoops; each hoop, in turn, will be formed from four segments, each segment measuring approximately 310 in. long by 121 in. wide. Segments will be milled from 2-in. thick 2219 aluminum alloy stock and will vary in thickness from 2 in. at the longerons to .250 in. at the skin between longerons.

T-shaped longerons, running the length of the tank to provide longitudinal stiffness, will be spaced 6 in. apart around the circumference of the tank.

Doughnut-shaped stringers, 32 in. wide, will be spaced every 35 in. up the length of the tank to maintain structural circularity and—because they extend into the tank's volume—to act as anti-slosh baffles.

These stringer-baffles will be perforated and about 20% of their total surface removed. Two semi-circular plates will be positioned vertically at right angles to each other in the bottom of the tank to damp out frequencies in the RP-1 fuel during powered flight.

Total capacity of the RP-1 tank will be about 1.45 million lb.; actual flight usable capacity will be about 1.33 million lb.

Five liquid-oxygen lines, each 20 in. in dia., will run through the fuel tank to the five engines. Each line will supply only one engine, will be contained within a 22 in. dia. tunnel to prevent RP-1 freezing and will angle out from the center of the top dome in the fuel tank to its outlet at the bottom dome—almost directly over its engine.

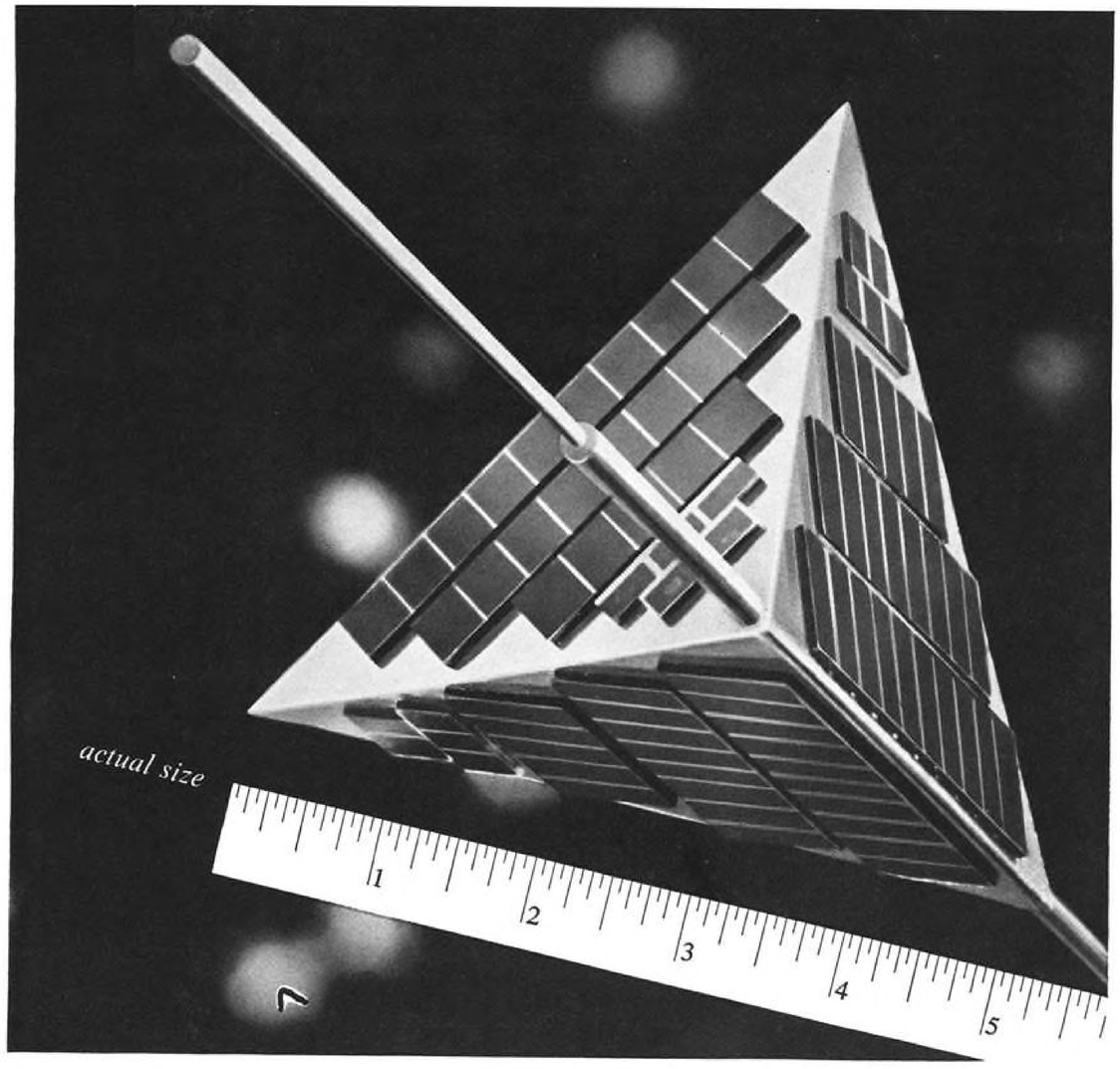
Also in the bottom dome of the fuel tank will be 10 outlets—two per F-1 engine—for RP-1 section lines. Turbopumps on the F-1s are designed for one liquid-oxygen and two fuel inlets. Average mixture ratio of oxidant to fuel will be 2.28-1.

Fuel tank will be pressurized by gaseous helium, which will be carried in a liquid state under high pressure in four tanks.

Tanks, which are to be about 15 in. in dia. and about 25 ft. long, will be mounted 90 deg. apart in the lower half of the liquid-oxygen tank. Liquid helium will be passed through a heat exchanger in the engine compartment before being introduced into the upper dome of the fuel tank.

Oxidant Tank

Oxidant tank also is to be a cylinder capped at each end by a dome. The liquid-oxygen tank, approximately 769 in. long, will be made up of four hoops from segments of the same aluminum stock and size as the fuel tank. Skin of the oxygen tank, however, will be milled to .180 in. thickness and the longerons will be spaced 10 in. apart. Stringers will be 32 in. wide, as in the fuel tank, but will be spaced 40 in. apart. The stringers, plus a cruciform structure at the bottom of the tank, will



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reduce sloshing of the liquid oxygen.

Volumetric capacity of the oxidant tank will be about 3.34 million lb.; approximately 3.06 million lb. will be loaded aboard for flight. Tank is pressured by gaseous oxygen which will be generated by liquid oxygen drawn from the tank, passed through a heat exchanger and then ducted back to the upper dome.

Inter-tank structure, which will connect the fuel and oxidant tanks, will be 268 in. long and made of corrugated 7075 aluminum alloy skin around 10-in. wide stringers. Upper dome of the fuel tank and lower dome of the oxidant tank will extend into the inter-tank structure; separation between the two will be approximately 30 in. An access door will allow the installation of some subsystems in the cavity between stages –such as power units, telemetry and guidance components–and permit maintenance personnel to service these units.

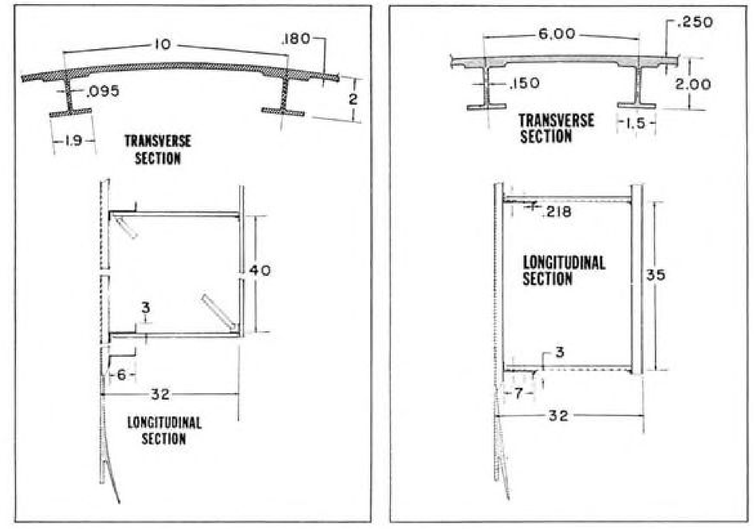
Forward skirt structure, also made of 7075 aluminum alloy, will be approximately 10 ft. long and will encircle the upper dome of the liquid oxygen tank. Inter-stage structure to support the S-2 stage will be joined to the S-1C at this skirt.

Boeing and Chrysler will build their boosters at the NASA-owned plant in Michoud, La., near New Orleans. Constructed during World War 2, the plant –now an operating division of the Marshall center–has about 2 million sq. ft. of manufacturing floor space under one roof and about 180,000 sq. ft. of office in a separate, but connecting, building. Manufacturing area will be divided about 60-40% between Boeing and Chrysler, with the larger area going to the former.

At present, a number of construction firms are active in the renovation of the cavernous manufacturing building. The overhead is being cleared of air-conditioning ducts and supporting truss-work to restore the original 40-ft. clearance of the plant and the floor is being reinforced by pilings in some locations to take the weight of the heavy tooling that soon will be installed. The floor has been determined to be strong enough to sustain the heavy weights that will be moved across it.

As the architect-engineer contractor, Vector Corp., defines packages of renovation or construction for the plant. Marshall seeks competitive bids from firms to do the work under fixed-price contracts. Mason-Rust Co. provides general housekeeping services in the plant.

Those renovation jobs that are plant-wide in nature–such as air conditioning, electric power, gas, etc.–are the responsibility of Marshall which has a resident staff of about 85 persons at the plant. Those modifications to the existent structure that are dictated by fabrication of a booster–such as the re-inforcement



TRANSVERSE AND LONGITUDINAL CROSS-SECTIONS of the S-1C's oxidant (l.) and fuel (r.) tanks shows the heavier construction of the latter. T-shapes in the transverse sections are longerons. Shaded segments at bottom of longitudinal sections are Y-rings which join tank domes to cylindrical sides.

of a floor to accept a heavy jig–are the responsibility of the individual stage contractor.

Because neither Marshall nor Boeing believe that the structural circularity of the S-1C can be maintained in a horizontal position during the exacting assembly phase, the booster will be put together in a vertical position. To accommodate the nearly 140 ft. height of the S-1C, Boeing and Marshall are planning to add a 200 ft. tall, 195 x 215 ft. high-bay structure off one end of the manufacturing plant.

In this new building will be five positions: one hydrostatic test and cleaning bay; one complete stage assembly bay; and three tank assembly bays.

Boeing's Wichita, Kan., plant will fabricate the aluminum segments, gores and corrugated skins that will be used to build up different sections of S-1C.

Manufacturing sequence to be employed by Boeing will call for delivery of structural sub-assemblies to the low-bay (40 ft. ceiling) area in the Michoud plant in a ready-for-welding condition.

Assembly of gores and segments into domes and cylinders, respectively, will take place in Boeing's part of the low-bay manufacturing plant. There, eight gores–with pre-cut cutouts, will be welded together to form a dome; four 310-in. x 121-in. aluminum segments will be joined to form a cylindrical hoop; and rings with Y-shaped cross section, which will be used to connect domes to hoops, will be cut from 5-in. aluminum alloy stock in quarter-rings and welded together.

Tail section will be built in the low-bay area by an assembly jig that either will be clam-shelled or split into two rail-mounted halves. Reason for this is that the boat-tail stands about 24 ft. tall and to use a conventional jig would demand a clear height overhead of at least 48 to 50 ft. so that the section could be raised clear of the machinery after fabrication. Present 40-ft. height of the ceiling prevents this.

After components have been assembled into sub-assemblies, they will be moved into one of the three tank assembly positions in the high-bay building. Building from the bottom up, Boeing will lay down a dome first, add a Y-ring, then a hoop, a second hoop, another Y-ring and finally an upper dome to assemble a fuel tank. Same procedure will be followed in putting together an oxidant tank, except that four cylindrical hoops (of different skin thickness) will be used and the helium pressure containers will be inserted as the tankage is built up. All hoops will be staggered so that weld seams will not be aligned.

In the stage assembly position, a tail section will be laid down first and, then consecutively, a fuel tank, an inter-tank structure, an oxidant tank and a forward skirt will be moved by overhead crane to the stand and mated to form an airframe.

After assembly, the S-1C airframe will be lowered onto a horizontal dolly and returned to the low-bay area where the engines and their accessories and other equipment will be installed. Lying horizontally on its transporter, the S-1C will reach a height of 39.5 ft.–leaving only a 6-in. clearance to move in the low-bay area.

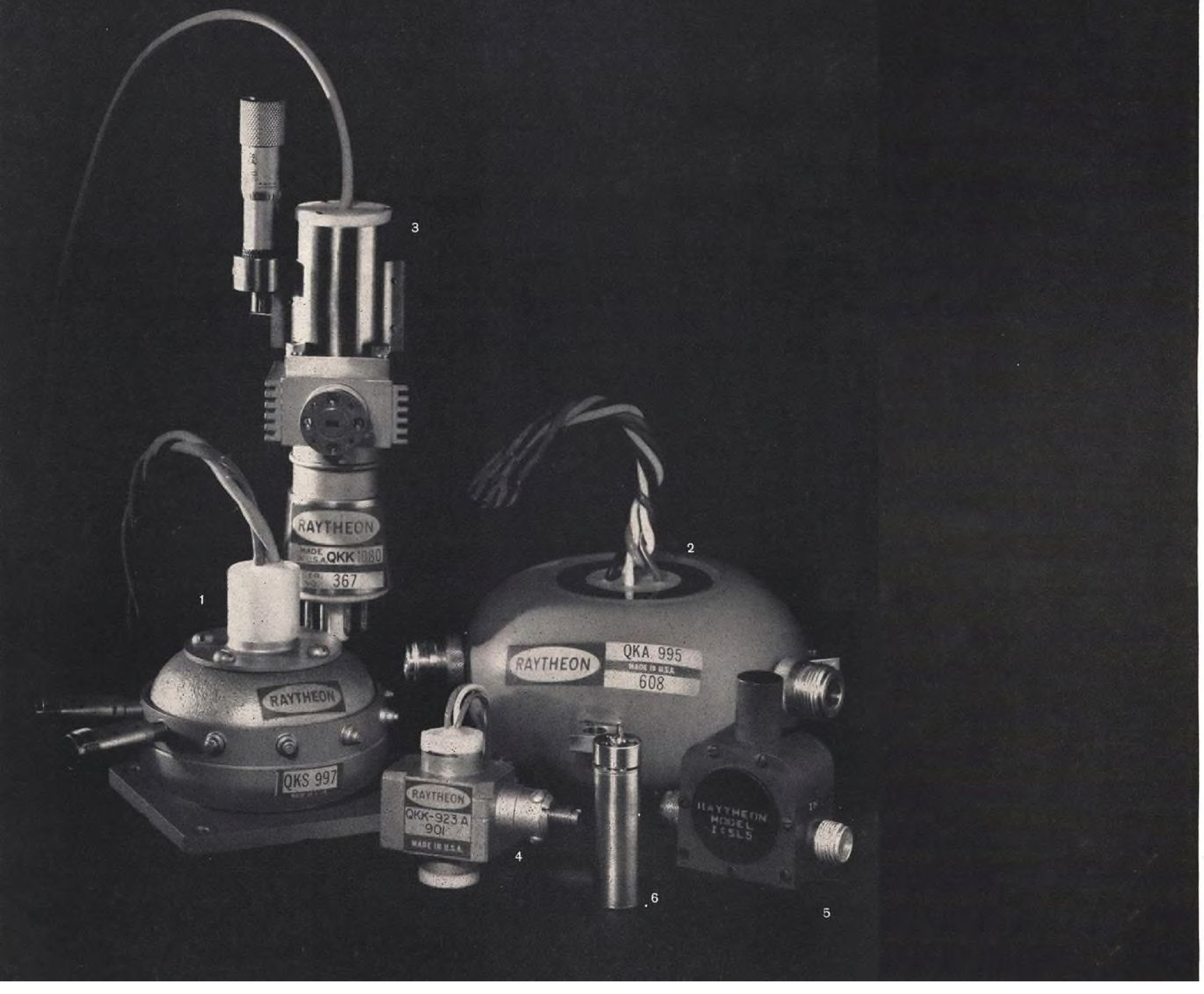
The S-1C then will be moved into

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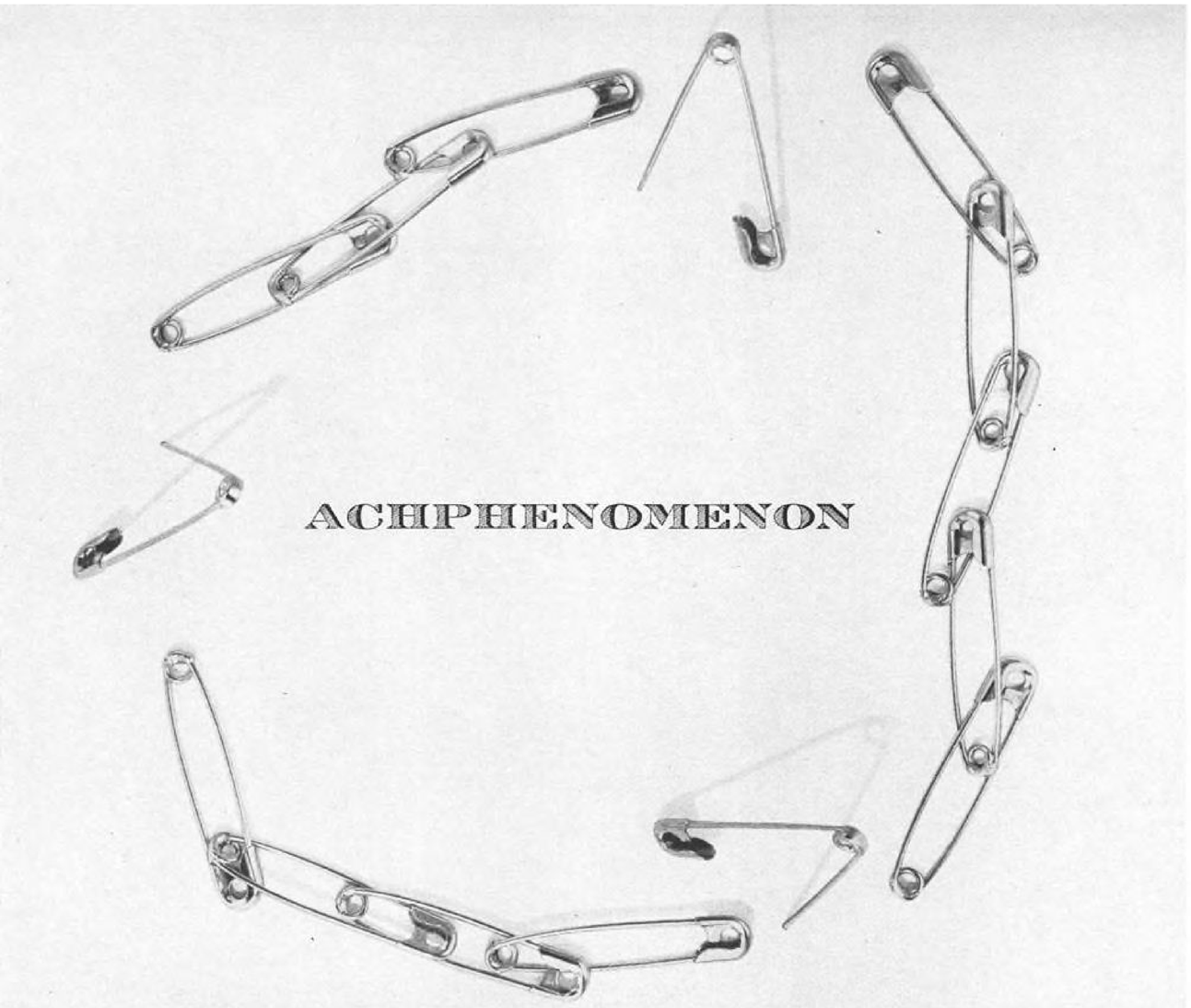
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A cursory analysis leads some to say that five breaks and rejoins are required to make a fifteen-link chain out of five chains of 1, 2, 3, 4, and 5 links. If you say four, you show imagination and perception. The optimal solution, three, requires the ingenuity, acumen—Achphenomenon, if you will—that is welcome at Litton Systems.

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the test area where it will be checked out. Test area will comprise four test cells, two on either side of a triple-tiered test structure and, eventually, will be highly automated. Boeing now estimates that there will be 650 to 700 test points on each booster and that an average time of 10 weeks will be spent by a booster in a cell. After checkout, the S-1C will pass through weight, balance and center of gravity checks, be painted (for tracking purposes) and then barged either to the Mississippi Test Facility or to Huntsville for static test firings.

Static Firings

Upon successful completion of these static firings, the S-1C will be returned to Michoud for refurbishing and then finally barged to the Launch Operations Center at the Atlantic Missile Range.

Ten to fifteen automatic welding mechanics will be employed by Boeing in building the S-1C and multi-pass welds—from a minimum of two to a maximum of about 30—will be standard. Generally, weld heads will be fixed in the high-bay building and the unit-to-be-welded will rotate; in the low-bay area, the hoops and domes will be held rigid and the weld heads will travel. After each weld pass, the head will be shut down and the seam examined by both X-ray and sonic equipment. Boeing presently estimates that there will be approximately 33,000 in. of welding on every S-1C. The company says it will inspect every inch.

Boeing personnel says they are not unduly concerned about the six miles of welding on the S-1C as they have had considerable experience dealing with 2219 aluminum in past aircraft and missile programs. A more serious problem, these company engineers say, will be maintaining alignments of components during welding and assembly operations. It is planned to use optical systems to align sections.

Using tooling, equipments and subassemblies provided by Boeing's Wichita plant, Marshall will build three ground test models of the S-1C and a number of major structural components. Those models are:

• **S-1C-T,** to be started in the first quarter of 1963, will be a static test firing model similar to the SA-T static test version of the S-1. The T-model will resemble closely a flyable S-1C but will lack such items as fins, guidance, range instrumentation, etc., as these are unnecessary in a ground vehicle and would only add to construction time. The T-model is expected to begin test firings in mid-1964 and will be shipped to the Mississippi Test Facility in early 1965 to check out the S-1C test stand to be built there.

• **S-1C-S,** to be started in mid-1963, will be a structural test model of the booster. It will lack engines and plumbing and basically be just an airframe for full-load tests, which are expected to begin in mid-1964.

• **S-1C-F,** to be started in late 1963, will be a facilities test model of the stage and will lack engines, guidance and instrumentation. Expected to be finished by late 1964, it will be shipped to the Launch Operations Center at the Atlantic Missile Range early in 1965 for checkout of the launch complexes being built there for the Saturn C-5 (AW July 2, p. 135).

Boeing Production

Equipment provided Marshall by Boeing-Wichita to build these test models will be shipped to Michoud as the NASA center finishes with it. At Michoud, the equipment will be added to tooling installed there by Boeing so that several S-1Cs may be under construction at the same time.

First Boeing-made booster also will be a ground test model and will be designated the S-1C-D. A dynamic test model, the D-model is expected to enter fabrication in mid-1963 and be rolled off the production line in the spring of 1964. It will carry only one engine, with weights simulating the other four F-1s, and will be shipped to Marshall in the middle of that year to be mated with an S-2 and S-4B stage in a dynamic test facility now under design. Most severe bending moment in flight is expected to be 400 million in.-lb. at station 1200—a point about mid-way up the oxidant tank.

First flyable booster to be built by Boeing will be designated 501 and will enter the production line sometime in 1964, rolling off the end early in 1965. Present Boeing manufacturing time-estimates figure 7 to 9 months to fabricate and assemble tanks—the longest lead-time item—and approximately 14 months for assembly of a complete S-1C, from the time the first two dome gores are welded together to the time the stage enters a test cell.

First flight test of the S-1C, carrying dummy S-2 and S-4B stages, now is tentatively scheduled for 1965. Second flight test will be made with live S-1C and S-2 stages and the S-4B inert. From the third flight on, all Saturn C-5 vehicles will carry three live stages.

Since each mission flown by a Saturn-Apollo vehicle will be different from the preceding one, each S-1C also will be slightly different.

To accommodate mission changes and the modifications that will come from the first 10 development flights, Boeing intends to maintain a fluid manufacturing process by:

• **Flexible tooling.**

• **Small inventories** of only essential long lead-time items, such as Y-rings and thrust frames.

• **Scheduling** built-in allowances in the manufacturing time-cycle so that these changes can be incorporated into a vehicle already on the line.

S-1C Management

To build the S-1C, Boeing has established the Saturn Booster Branch within its Aero-Space Division. The branch, under George H. Stoner, includes elements at Huntsville, Michoud, Seattle and Wichita. It is Stoner's responsibility to tie together the efforts of these diverse organizations so that Boeing fulfills the terms of its contract with NASA. Michoud will be the headquarters of the branch.

The Seattle element, under Scott Hinckley, provides engineering development and research support—such as wind tunnel studies—to designers at Huntsville and Michoud. Seattle might also fabricate some special items, such

Computer Center

Michoud, La.—Central computer facility will be established at Slidell, La., 23 mi. from the NASA plant at Michoud, to process and evaluate data gathered during the manufacture of the S-1C and S-1 boosters.

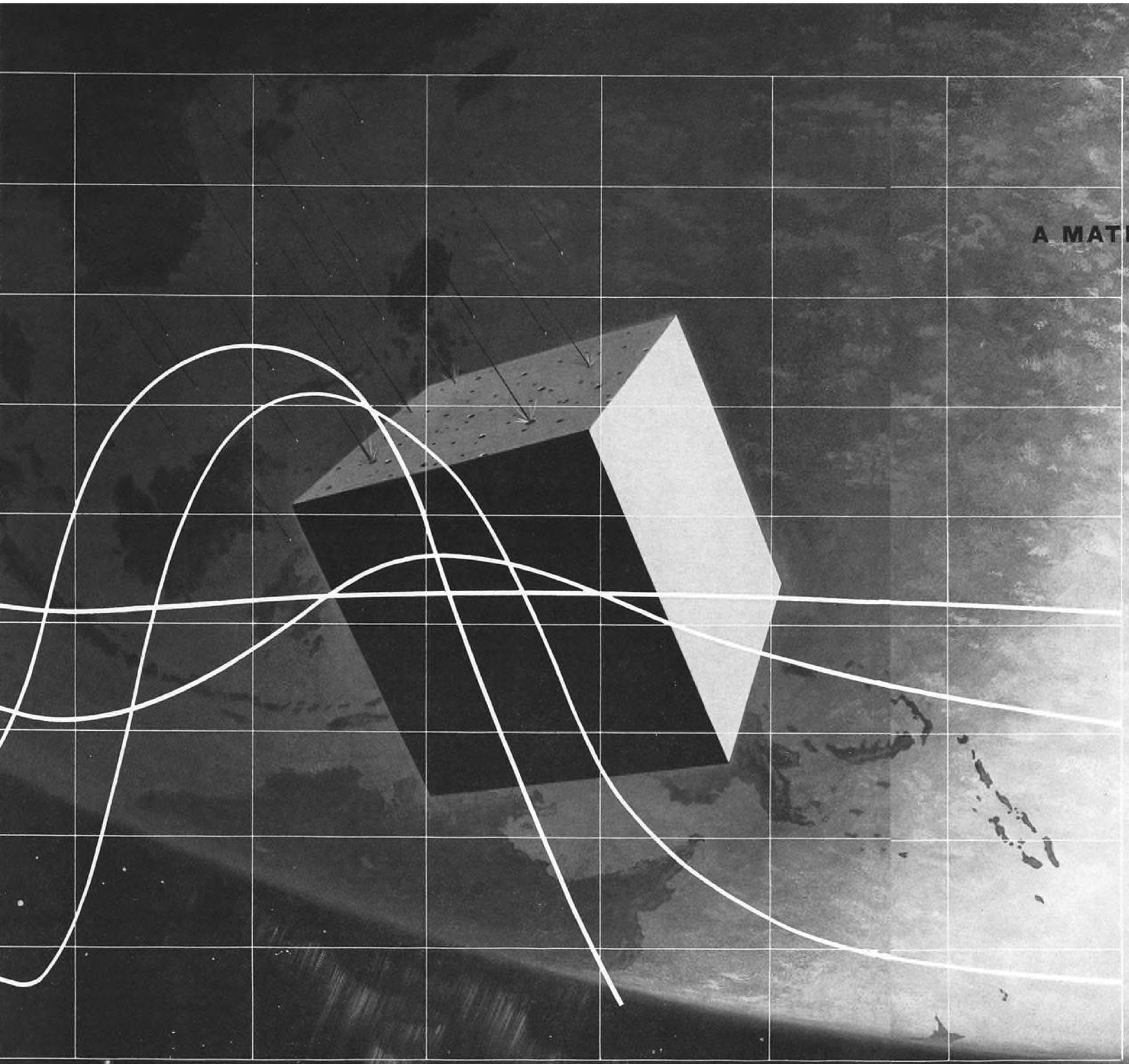
Engineering data will be run off International Business Machine (IBM) 7090 and 1401 computers and a General Electric 225 unit. Management data will be handled by a Minneapolis-Honeywell 800 and two Honeywell 400 computers.

Marshall Space Flight Center is expected to select a contractor this month to operate the facility. The facility, which is housed in a three-story building turned over to the civilian space agency by the Federal Aviation Agency, is expected to become operational by October of this year and will be managed by Marshall as part of the Michoud plant.

Saturn C-5 Test Facilities

Huntsville, Ala.—Dynamic test tower, 360-ft. tall, and a 405-ft. tall static test stand will be built here at the Marshall Space Flight Center to test both the S-1C booster and the assembled three stages of the Advanced Saturn-C-5 launch vehicle.

Static test tower, with a 160-ft. square base, will be used for captive firings of the S-1C stage. Dynamic test tower, now under design by Maurice H. Connell and Assoc., Inc., will test bending modes of the approximately 350-ft. tall Saturn-Apollo vehicle.



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A comprehensive understanding of the reaction of materials to outer space is an important key to this country's space program. In their study of materials, scientists at Lockheed Missiles & Space Company found the problem could be most graphically depicted by showing the various environmental factors impinging on a simple cube-shaped vehicle. A cube, placed in a noon polar circular orbit, would allow unusual isolation of the effects of space on materials; make their measurement simpler and more accurate; and offer a built-in control of the results.

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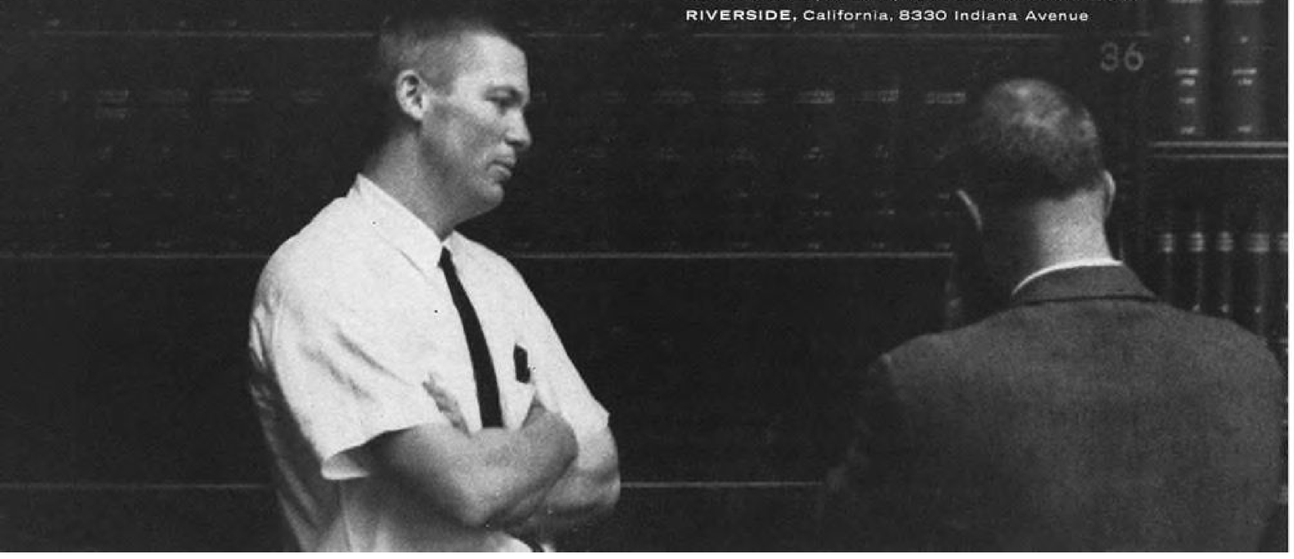
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as the helium tanks, although this is not yet firm.

Wichita, under Sylvester Stein, has two major functions: providing the heavy tooling required at the Michoud manufacturing plant and fabricating the subassemblies from which the tankage and thrust frame will be built. Huntsville, under Joseph F. Peters, presently is heavily involved in the final hardware design of the S-1C and, after the program emphasis shifts to manufacturing at Michoud, will continue to work with the Marshall center in a liaison role, working out the C-5 integration problems, evaluating proposed modifications, etc.

Michoud, under Richard H. Nelson as general manager, will be the focal point of the branch's total effort. To accomplish the task of building the S-1C, Nelson has four operating sections: Operations, under Francis "Bud" Coenen; Quality and Reliability Assurance, under Clarence Riley; Engineering, under Clint Wilkinson, and Booster Test, under Robert Dunigan. The Test section has field offices at Cape Canaveral, Fla., Mississippi Test Facility and Huntsville.

Boeing Force

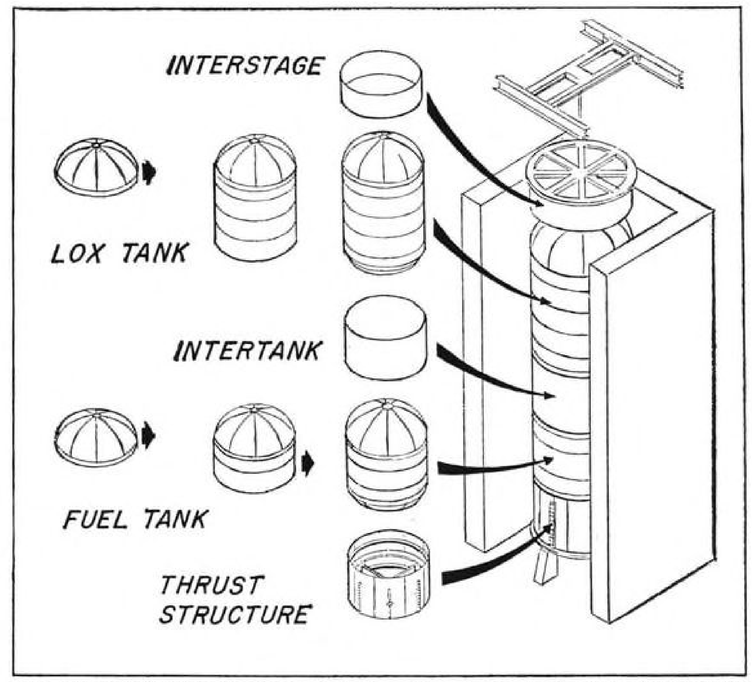
Boeing presently has about 1,100 personnel stationed in Huntsville, including the 490 who are working at the Marshall center, and approximately 600 of these are engineers and technicians. There are approximately 450 Boeing employes now at Michoud, of which a little less than 200 are classed as "technical."

Each man who is physically remote from the renovated cotton warehouse that serves as the company's Huntsville office, is identified with some line supervisor in Nelson's organization. He also is organized into a team at his remote site and each week the team captain sends a summary report on the group's activities back to the Huntsville supervisor.

Meetings, conducted every week, both with Marshall engineers and within the company, are standard for Boeing personnel.

Working Relationships

Working relationships between Boeing and Marshall usually reflect similar levels of responsibilities. Thus, Stoner and Nelson normally deal with such Marshall program officials as Matthew Urlaub, S-1C stage director; J. B. Bramlet, Saturn C-5 program director; Oswald Lange or Konrad Dannenberg; director and deputy director respectively of the Saturn Systems Project Office; or Dr. George N. Constan, Michoud resident manager. Coenen, Riley, Wilkinson and Dunigan and others at this level deal with the directors of Marshall's nine support divisions



TANK MANUFACTURE SEQUENCE starts when the upper dome of a tank is inserted into a tank assembly position. Dome then is raised by overhead crane and a hoop placed beneath it. After welding, dome and hoop are raised and another hoop inserted in the position. Assembly of a complete S-1C booster is done from the bottom up.

(AW July 2, p. 100), where almost all of the center's in-house work on the S-1C is being carried on.

Boeing recently received a supplemental $15.9 million, 3-month contract for continued design work on the S-1C. By the time this contract expires Oct. 31, it is expected that a final contract will be negotiated for the construction of the 24 flyable boosters, the dynamic test model and test assemblies.

Initial contract awarded to Boeing this past February was for approximately $9 million.

Air Force to Study Reflex Deterioration

An 18-month experiment to improve astronauts' tolerance to re-entry stresses after prolonged space flight where lack of activity deteriorates certain reflexes is under way at the School of Aerospace Medicine, USAF Aerospace Medical Division, San Antonio, Tex.

It is expected that the study will result in new techniques to be incorporated in future astronaut training schedules, and indications are that some of the techniques may be used during flights to keep personnel in trim for re-entry phases.

Study with human subjects will emphasize maintenance of certain cardiovascular reflexes that deteriorate with lack of use, compromising man's ability to perform tasks. Also, it is known that certain conditioned body reflexes tend to deteriorate when not used and need to be retrained.

Project is divided into three phases. In Phase One, subjects will undergo physical exercises and a variety of tilt-table runs.

The 28-day tilt-table training periods will include tilting the subject from an upright to head-down position 30, 45, 60 or 90 times daily, with one group of subjects doing 30 continuous 360-deg. rotations daily.

Phase Two will include metabolic studies to determine bodily changes occurring that contribute to cardiovascular deficiencies.

The baseline information is obtained in two week periods of bed-rest, then the subjects undergo four weeks of tilt-table and other training followed by two weeks of bed rest, with special in-bed exercises undertaken during the second bed-rest session.

Phase Three will utilize those training procedures found most effective in the earlier work, with the objective being to see how long the training is effective and what types of refresher procedures are useful.

Scientists conducting the project include Dr. Lawrence Lamb, Maj. Perry Miller, Dr. Bryce Hartman, Dr. Richard Jenson and Dr. Fred Katz.

See Cannon at Wescon Booth 2054-56



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NASA Contracts

National Aeronautics and Space Administration recently awarded the following contracts:

Compudyne Corp., Hatboro, Pa.—$359,000 for service and materials to design, fabricate and install electro-hydraulic model positioning systems for Mach 10 and Mach 20 helium bowdown jets of the hypersonic aerothermal dynamics facility.

Remsco Associates, Matawan, N. J.—$212,000 to design, fabricate and install high pressure helium heater at Building 1247-B. This contract is being performed jointly by Remsco Associates and Heat Transfer Engineers, Inc.

Army Ordnance Missile Command, Redstone Arsenal, Ala.—$924,000 for XM-33-E5 rocket motors.

Navy Bureau of Weapons, Washington, D. C.—$1,004,000 for X-259-A2 rocket motors.

GODDARD SPACE FLIGHT CENTER, GREENBELT, MD.:

Cable & Wireless Ltd., London, England—$359,000 for maintenance and operation of communications equipment at Kano, Nigeria, and Zanzibar, East Africa.

Aerolab Development Co., Inc., Pasadena, Calif.—$200,000 for Argo D-8 rocket vehicles.

Voorhees, Walker, Smith, Smith & Haines, New York, N. Y.—$114,000 for architect-engineering services for applied sciences laboratory and tracking and telemetry laboratory.

Space Technology Laboratories, Inc., Los Angeles, Calif.—$367,000 for study and experimentation to investigate effects of high-energy proton bombardment on spacecraft materials and components.

Atlantic Research Corp., El Monte, Calif.—$109,000 for Nike-Cajun missile hardware sets.

Miller Research Laboratories, Baltimore, Md.—$70,000 for design, construction, installation and testing of a moment of inertia facility.

Ampex Instruments Products Co., Washington, D. C.—$139,000 for magnetic tape recorder/reproducers and spare parts kit.

Collins Radio Co., Dallas, Tex.—$240,000 for microwave communications systems in Bermuda in support of Project Mercury program.

International Telephone & Telegraph Co., Nutley, N. J.—$95,000 for ground station services at Nutley, N. J., for Project Relay.

Texas Instruments, Inc., Dallas, Tex.—$80,000 for development of metastable helium magnetometer.

Packard Bell Computer Corp., Washington, D. C.—$82,000 for PB250 Packard Bell computer and peripheral gear.

Spectrolab Inc., N. Hollywood, Calif.—$100,000 for design, development and fabrication of solar paddles for S-3A satellite.

Ampex Instrumentation Products Co., Washington, D. C.—$66,000 for high performance magnetic tape recorder/reproducers.

Electronic Engineering Co., Santa Ana, Calif.—$80,000 for computer format control buffers with dual time decoder and insert record mark option.

Yardney Electric Corp., New York, N. Y.—$50,000 for design, development, fabrication and test of silver cadmium batteries.

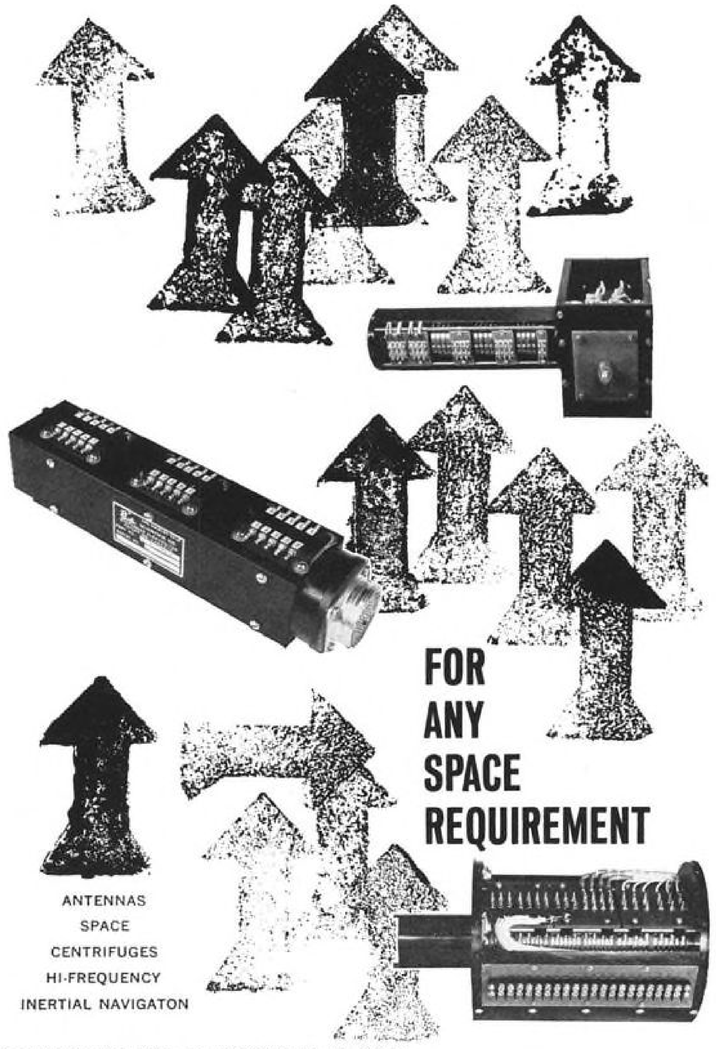
Tracerlab Inc., Waltham, Mass.—$66,000 for research and development of a radiochemical exchange system for measurement of atomic oxygen, atomic hydrogen and atomic nitrogen.

Vector Manufacturing Co., Inc., Southampton, Pa.—$82,000 for oscillators and amplifiers.

Technical Appliance Corp., Sherburne, N. Y.—$76,000 for telemetric antenna array, cables and cable reel.

University of California, Berkeley, Calif.—$70,000 for instrumentation and support for experiment in solar cosmic ray for EGO (S-49) satellite.

International Telephone & Telegraph Co., Fort Wayne, Ind.—$70,000 for photoelectric cameras, supporting documentation and field support for OGO experiment.



See Pacific Scientific at WESCON Booth 2168

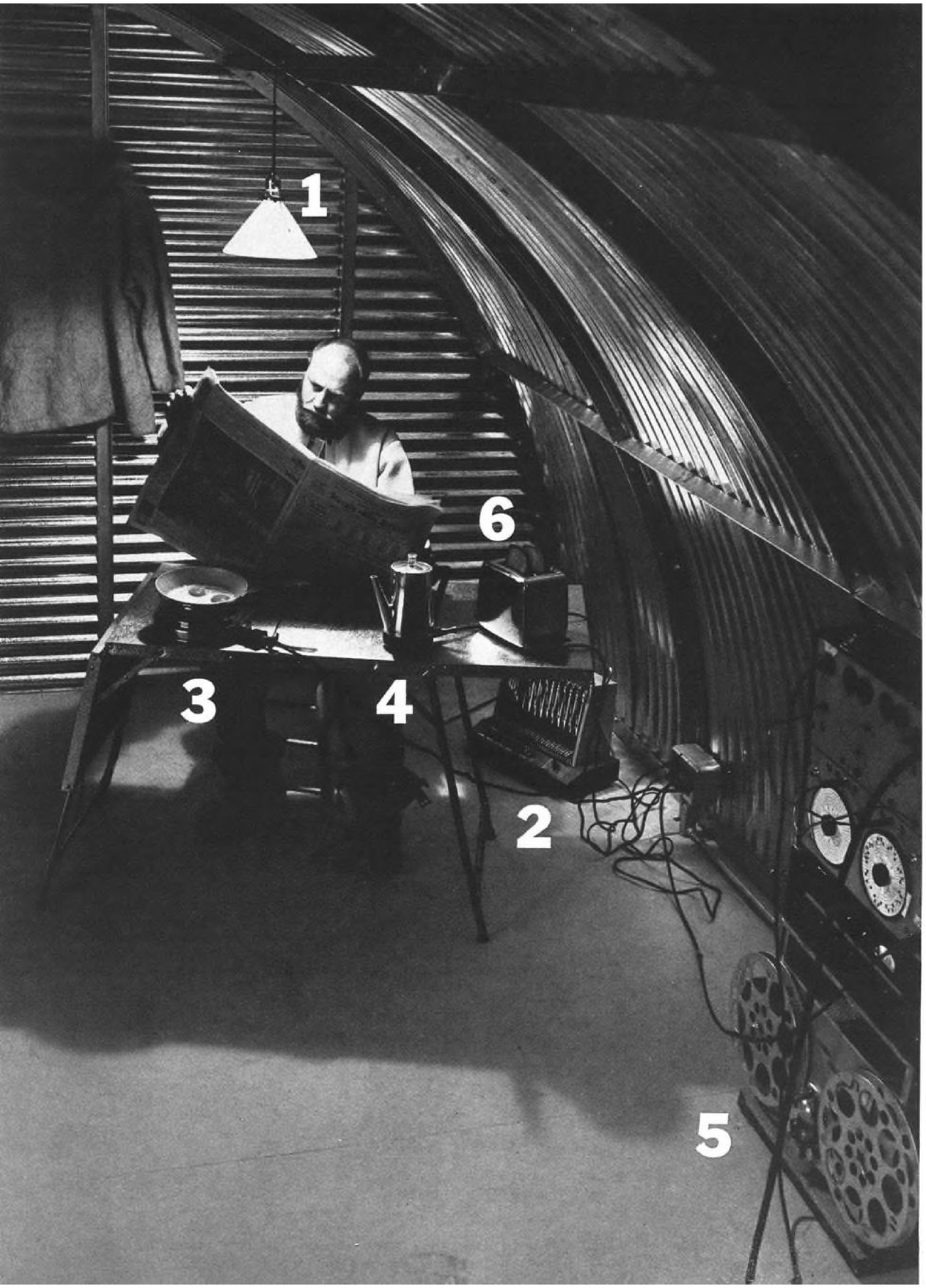
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Antarctica's first nuclear power plant is now operating. It supplies all the electricity for the 1000 men stationed at the Navy's McMurdo Sound Research Base.

The heart of the plant is an extraordinary metal cylinder that helps turn nuclear energy into electricity. The cylinder is only 3 feet high and 2 feet in diameter, yet it does the job of millions of gallons of ordinary fuel oil. It delivers 1500 kilowatts and has to be replaced only once every 2-3 years.

Because nuclear energy packs great power in little space, it's extremely useful when you need electricity in remote spots. It's portable and gives you power that lasts for years.

Take outer space. Right now a tiny nuclear generator is spinning around the earth aboard the Navy Transit Satellite System. It runs many of the instruments, can keep them running for at least 10 years.

Near both poles of the earth, small atomic generators are being used to power unmanned weather stations.

In Sundance, Wyoming, a nuclear reactor powers a new Air Force radar station. On the Atlantic Coast, the Coast Guard now has its first atomic buoy. On the floor of the Atlantic, a sound beacon for navigation will be atomically powered. Soon a floating nuclear power plant will enable the Army to bring electricity to distressed coastal areas.

Each of these installations was designed and built by the nuclear division of Martin Marietta. Each utilizes portable nuclear power, a form of power that is becoming recognized as one of the most practical known. Portable nuclear power units can carry us to outer space. And some day they may be used for simpler things like frying your eggs.

MARTIN MARIETTA

Mariner 2 Will Probe Venus Environment

By Philip J. Klass

Cape Canaveral—Mariner 2, scheduled for launch soon in a second attempt to make a Venus fly-by, will carry microwave and infrared radiometers to make measurements which may resolve long-standing questions on the planet's atmosphere and temperature.

If successful, scientists hope to learn whether Venus has an environment which is hospitable to life as well as other information about the earth's closest planetary neighbor which is continuously shrouded by a dense blanket of clouds.

The 446-lb. spacecraft, designed and built by the Jet Propulsion Laboratory, National Aeronautics and Space Administration, also is designed to carry four other scientific experiments for use en route and in the vicinity of Venus. These include:

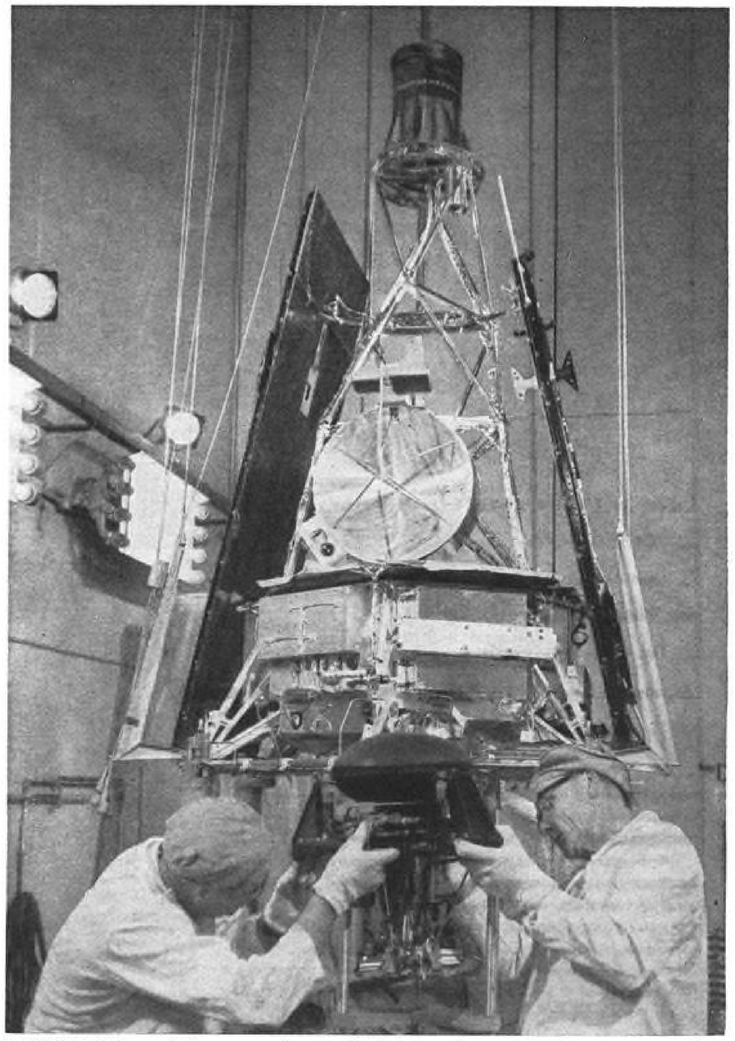
- **Magnetometer,** to measure the strength and direction of interplanetary and Venusian magnetic fields.
- **Ionization chamber** and three Geiger-Mueller tubes, to measure number and intensity of energetic particle radiation in interplanetary space and near Venus.
- **Solar plasma detector,** to determine the particle energy and density of charged particles that are emitted from the sun.
- **Cosmic dust detector,** to measure density and momentum of tiny particles found in space.

The sensors for the six experiments weigh approximately 40 lb., representing less than 10% of the total spacecraft weight.

Original design work on a Venus space probe was based on the use of an Atlas-Centaur booster, which would have permitted a total spacecraft-payload weight of about 1,000 lb., according to Jack James, JPL's Mariner project manager. When serious delays developed in the Centaur program, the Mariner was re-oriented for an Atlas-Agena booster, which meant that the spacecraft weight had to be slashed by more than half. This was approximately 11 months ago.

This forced NASA to abandon the ultraviolet spectrometer experiment originally planned, which would have provided considerably more information on the constituents of the Venusian atmosphere by measuring absorption bands of its clouds. Also dropped was on-board data storage which would have permitted finer-grained measurements.

With payload limitations imposed by the Atlas-Agena, weight became even more critical than usual in the design of the spacecraft and its scientific experiments. At one time, JPL considered substituting a 100-mi. high parking orbit for the presently planned 115-mi. parking orbit, which would have enabled the spacecraft to carry an additional 15 lb. of payload, but this would have reduced the probability of a successful trajectory. Every additional three pounds of spacecraft weight reduces the nominal 50-day "window" for launch by one day, James said.



MARINER 2 Venus fly-by spacecraft, scheduled for launch soon, should answer many long-standing questions about earth's nearest planetary neightbor. If launched by Sept. 10, Mariner should arrive in vicinity of Venus by early December to probe planet's atmosphere. Technicians are installing rocket motor used for mid-course trajectory corrections. Mariner 1, above, identical to Mariner 2, was destroyed during unsuccessful launch July 22.

Mariner 1 and 2 spacecraft were designed and built on a "crash program basis" and delivered here in less than nine months. A few of the designs and components used on the Ranger [lunar] spacecraft and planned for the original Mariner were used, but in most instances new designs were required to meet the stringent weight limitations," James indicated.

Temperature measurements of Venus, made from the earth, have yielded widely conflicting figures. Based on measurements in the microwave portion of the spectrum, the near surface temperature of the planet appears to be about 615F, while those based on infrared radiation indicate a temperature of −38F. But because of the tremendous distances over which these measurements were made, scientists are unsure about the results.

Mariner microwave radiometer is designed to detect radiation from the planet at two wavelengths, 13½ and 19 mm. The 13½ mm. band is absorbed by moisture, so that the absence of radiation at this wavelength will indicate water vapor in the Venusian atmosphere. The 19 mm. wavelength is not attenuated by moisture and its intensity will indicate the temperature at the surface of the planet.

The 19 mm. wavelength measurement also is expected to test two of the theories about the atmosphere of Venus by determining whether the apparent high planet temperature exists at its surface or is due to a dense ionosphere. If the former, the temperature sensed by the radiometer as it scans the planet should remain constant over its entire surface. If planet temperature rises sharply near its rim, this will indicate a dense ionosphere.

A 20-in. diameter parabolic antenna mounted at the base of the Mariner spacecraft provides the sensors for the microwave radiometer. Approximately 10 hr. before the Venus encounter, the radiometer will be turned on and the antenna will begin to scan at the rate of one degree per second until it has located the planet. The scan rate will then change automatically to 0.1 deg./sec.

Control System

When the antenna finds the edge of the planet's disk, a control system automatically reverses the direction of scan. The antenna will scan only along one axis, at right angles to the spacecraft direction of motion. The entire surface of the planet will be scanned as the Mariner passes by.

During the initial portion of the fly-by, the antenna will see the dark side of the planet, while the sunlit side will come in view subsequently.

To provide a reference signal for calibrating the intensity of the received signal, two small reference horns are located on top of the antenna, but directed 60 deg. away from its aiming point, so they always look at empty space. Signals from the antenna and the reference horns are chopped electronically and alternately fed to a crystal video-type receiver located behind the antenna dish.

This microwave radiometer, weighing 22 lb., requires 3.5 watts of power when operating and 8.9 watts during calibration sequences initiated periodically during the mission.

Experimenters on the microwave radiometer include Dr. A. H. Barrett, Massachusetts Institute of Technology; Dr. J. Copeland, Army Ordnance Missoil Command; D. E. Jones, Jet Propulsion Laboratory; and Dr. A. E. Lilley, Harvard College Observatory.

Infrared radiometer is rigidly attached to the microwave antenna so both scan the same portion of the planet simultaneously. The radiometer is designed to measure infrared energy in two spectral bands: 8-9 microns and 10-10.8 microns. The former band has good transmission through atmosphere, except in the presence of clouds, while the latter band will experience attenuation if there is carbon dioxide present in the Venusian atmosphere.

Astronomers have observed occasional changes in the markings on Venusian clouds, suggesting that these markings may be breaks in the cloud formation. If Mariner measures the same pattern of radiation at both infrared wavelengths, it will indicate that the cloud cover is continuous. If there is substantial difference between the two wavelengths, it will indicate breaks in the clouds. Through a cloud break, the 8-9 micron radiometer would be able to penetrate to a much lower point in the atmosphere.

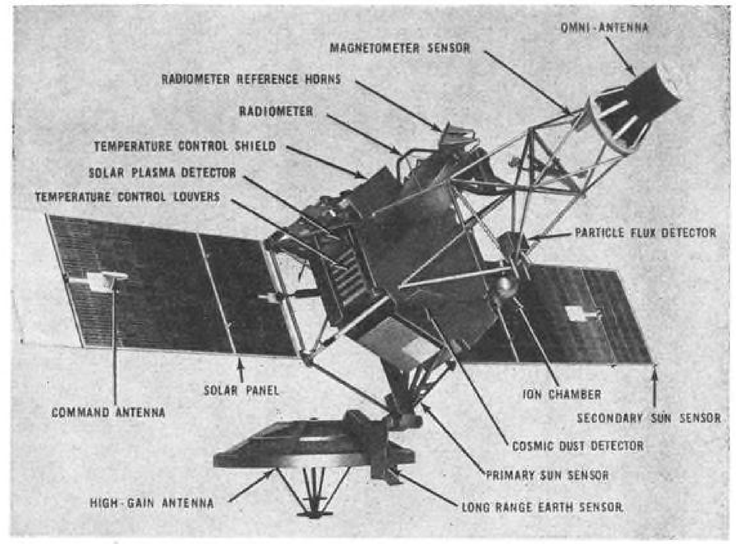
This modest infrared data plus measurements from the microwave region should enable scientists to make important deductions about the atmosphere of Venus.

The infrared radiometer weighs 2.7 lb. and consumes 2 watts power. It contains two optical sensors, one of which is designed to scan the planet while the other looks away 45 deg. to obtain a reference signal from space.

Experimenters on the infrared radiometer include the following: Dr. L. D. Kaplan and Dr. G. Neugebauer of Jet Propulsion Laboratory; Dr. C. Sagan of the University of California at Berkeley.

Three-axis magnetometer to be carried by Mariner 2 will be used periodically during the en route flight to measure the magnitude and direction of interplanetary magnetic fields. Present magnetohydrodynamics theories suggest that plasma emitted by the sun may drag away with it the sun's magnetic field. The upcoming Venus probe offers an opportunity to check this theory outside the influence of the earth's own magnetic field.

As the spacecraft approaches Venus, its measurements of planetary magnetic fields will enable scientists to deduce some tentative conclusions about the interior of the planet, whether it also has Van Allen radiation belts, magnetic storms and aurorae.



MARINER SPACECRAFT, shown in model form, will carry six scientific experiments. These include microwave and infrared radiometers to measure Venus temperature and atmosphere constituents, plus magnetometer to measure interplanetary and Venusian magnetic fields, energetic particle sensors, a solar plasma detector and a cosmic dust detector.

Metal Cylinder

The sensors of the fluxgate type magnetometer are housed in a metal cylinder measuring six inches long and three inches in diameter which is located just under the omnidirectional antenna in the spacecraft nose. This location places the sensors as far away as possible from payload equipment which might generate spurious magnetic fields.

Each of the three sensors is aligned mutually perpendicular to the other two to provide data on the direction of the magnetic field. Instrument sensitivity is ½ gamma, or about 1/100,000th the strength of the earth's magnetic field. The magnetometer weighs 4.7 lb. and consumes 6 watts power.

Experimenters for the magnetometer include the following: P. J. Coleman and Dr. C. P. Sonnet, National Aeronautics and Space Administration; Dr.

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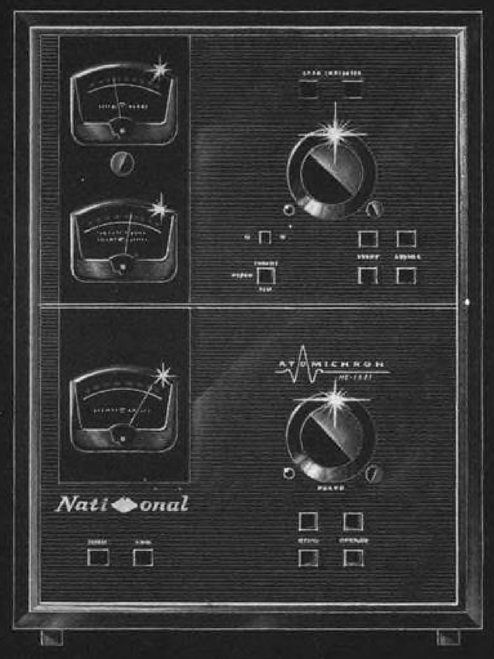
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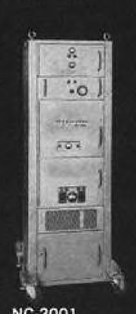
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Earth's magnetic field and atmosphere make it difficult even in an earth satellite to measure the natural density and intensity of cosmic rays. By measuring the amount of radiation at the earth, near Venus, and in interplanetary space, and comparing these figures with the intensity of magnetic fields in the same locations, scientists hope to learn more about the complex nature of the radiation from its reaction with magnetic fields.

Mariner 2 ionization chamber, a Neher type, is designed so that only protons with an energy greater than 10 million electron volts (MEV), electrons with an energy greater than ½ MEV and alpha particles with an energy more than 40 MEV will be able to penetrate and register. When enough particles with sufficient ionization energy to trigger the chamber have penetrated the sensor, a pulse is transmitted back to earth and the chamber is reset to its original condition. The number of pulses per interval of time gives a measure of the average ionization rate of the cosmic rays being tested.

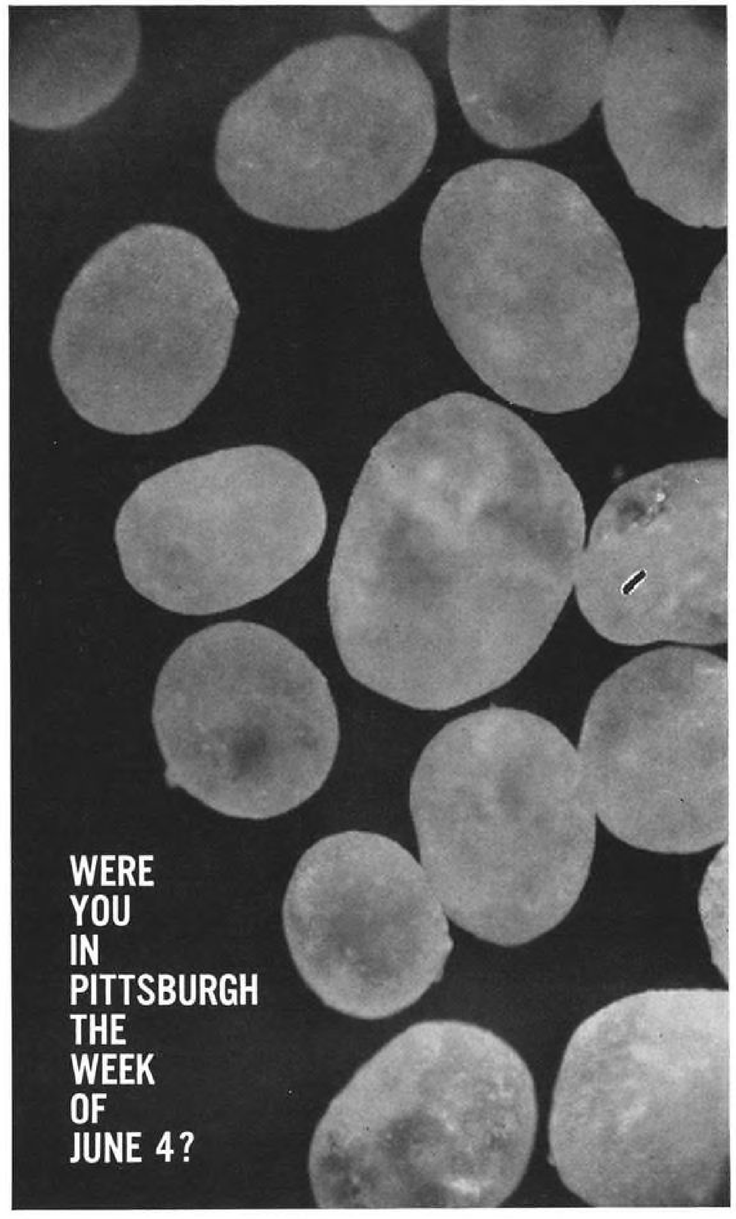
Associated with the ionization chamber are two Geiger-Mueller tubes which provide a count of the number of particles that penetrate their shells. Each uses a different shielding material to provide different sensitivities from which scientists can infer the ratio of electrons present to other types of energetic particles.

A third Geiger-Mueller sensor of the end-window type measures the flux of lower-energy particles which are not capable of penetrating the other detectors. It admits protons with energies greater than 1 MEV and electrons over 40,000 electron-volts.

The Geiger-Mueller detectors are mounted on the superstructure of the spacecraft to separate them from large masses which might produce secondary particles when hit by cosmic rays. The total weight of the combined experiment is 2.8 lb., power consumption is 0.4 watt.

Experimenters include the following: Dr. H. R. Anderson of JPL, Dr. H. V. Neher of California Institute of Technology and Dr. James Van Allen, State University of Iowa.

Solar plasma, sometimes called "solar wind," consists of low-energy particles which continuously stream outward from the sun. There are many conflicting theories on the nature of solar plasma. Because the particles themselves are charged, they not only are affected by magnetic fields but produce their own field. If the external field is strong enough, it may control and divert the solar plasma; if the reverse is true, the interplanetary magnetic field may



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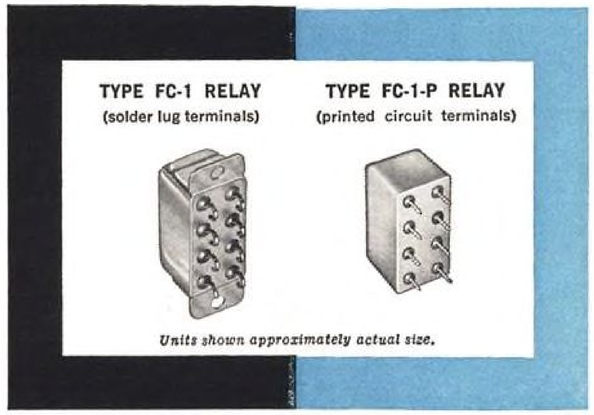
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be trapped in the solar plasma and move with it through space.

Where the other Mariner 2 energetic particle sensors are sealed to keep out low-energy radiation, the solar plasma sensor is left open to space, pointed along the roll axis of the spacecraft so that it will be oriented toward the sun for most of the mission.

The sensor essentially is an electrostatic tunnel which will pass particles whose energies are in the desired range of values. Periodically, the voltage on the sensor plates is automatically changed to pass particles of a different energy level, over a 10-increment band from 240 to 8,400 electron volts.

Solar plasma detector weighs 4.8 lb. and consumes 1 watt power. Experimenters are Dr. C. W. Snyder and M. Neugebauer of JPL.

Although scientists have attempted to study cosmic dust in scientific earth satellites and sounding rockets, Mariner 2 offers the first opportunity to obtain data on its distribution in interplanetary space.

There are several theories which seek to explain the source of this cosmic dust. One holds that it is the debris left over when the solar system was formed. Another suggests that the dust comes from gallactic space and becomes trapped in the solar system by magnetic fields.

The cosmic dust sensor is located on top of the hexagonal-shaped payload area. It consists of a rectangular-shaped magnesium sounding board, measuring 5 x 10 in., with a tiny crystal microphone located at its center to measure the impact of dust particles on the board.

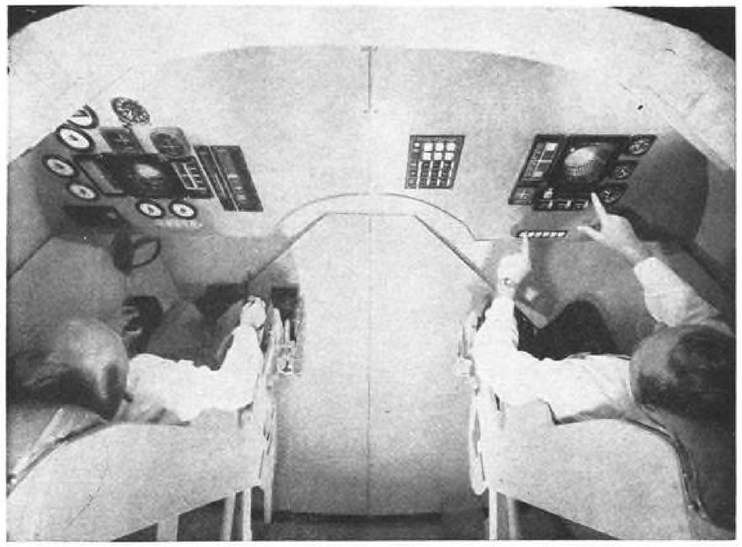
Number of particle hits is recorded on one of two electronic counters, depending upon the particle momentum (product of its mass and velocity). During cruise portion of the mission, the dust hit count will be telemetered back every 37 sec., while during the Venus encounter the data will be sent back once each 20 sec.

Cosmic dust detector weighs 1.85 lb. and consumes 0.08 milliwatts of power. It was designed by NASA's Goddard Space Flight Center under direction of W. M. Alexander.

In addition to measurements made by the six scientific experiments, Mariner 2 is instrumented to report 60 different engineering parameters which indicate the status of the spacecraft and payload.

Because of on-board power limitations, it is not possible to transmit all of the data simultaneously. A small electronic clock controls the selection and sequence of data telemetered back.

During en route cruise, measurements from each of the scientific experiments is transmitted once during a 20 sec. interval, followed by transmission of engineering data for nearly 17 sec. after which the cycle repeats. When spacecraft approaches within 10 hr. of its Venus encounter, transmission of engineering data will be halted to provide full time reporting of the scientific experiment measurements.



System Checks Performed in Apollo Mockup

Mockup of the Apollo three-man space capsule has been built by Minneapolis-Honeywell to check out breadboard models of manual control and display systems which the company is developing under contract from North American Aviation, Apollo prime contractor. Mockup instruments are controlled by a bank of analog computers which simulate electronically conditions expected to occur during an Apollo mission.

• NEW •



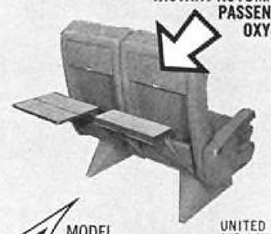
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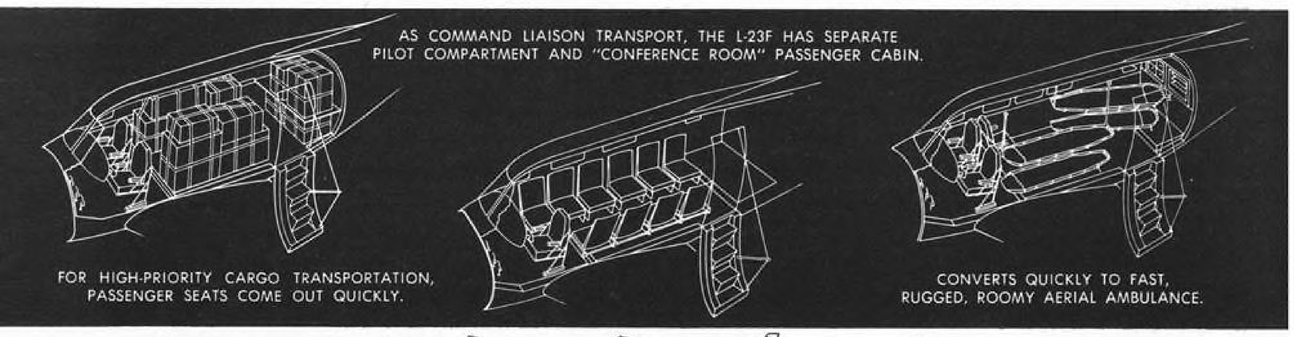
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USAF to Integrate Range Instrumentation

By Barry Miller

Los Angeles—Series of parallel one-year studies intended to yield a concept for an integrated global range instrumentation complex to satisfy the national missile and space systems testing programs in the period from 1965 to 1970 will be launched early this fall by the Air Force's Electronic Systems Division.

One objective of the studies will be to specify areas of applied research and advanced development necessary to further test instrumentation technology. As such, the companies picked for the studies may have an excellent opportunity to shape and direct future range instrumentation requirements.

Studies are to be conducted under Air Force planning study number 7990-23, the range instrumentation planning study (RIPS). Planning studies are the successor to the old Air Force study requirement as the vehicle for joint Air Force-aerospace industry studies of future Air Force requirements and weapon systems (AW July 30, p. 16).

Contractors Limited

Unlike study requirements, which often tapped the talents of many aerospace companies in an overabundance of largely unfunded or underfunded studies that frequently had no realistic future, the planning studies as a rule are limited to three or fewer contractors, funded at more than a token level. Both Air Force Systems Command, and to a greater degree the Department of Defense, which must approve the larger prospective planning studies, are far more selective of these advanced studies, funding only a handful to date. This has evoked hope in industry that studies finally pursued by USAF will evolve into meaningful, funded requirements.

Two contractors are expected to be picked from among an imposing list of aerospace companies (see box) for cost-plus-fixed-fee RIPS contracts by Oct. 1, and they will be expected to submit completed reports by September, 1963. Each study will require at least 15 to 20 engineering man-years of effort. If earlier planning studies at ESD (AW July 9, p. 45) serve as adequate criteria, the RIPS studies may be funded for about $250,000 each.

An integrated global range instrumentation plan to be derived from the studies is intended to permit timely development and installation of test instrumentation and to insure technical compatibility of equipment to be used in global testing of future aerospace vehicles. With such a plan, Air Force hopes to avoid unnecessary duplication of range instrumentation.

Air Force believes the concept of an integrated test environment and an orderly plan to implement the concept are necessary for two reasons:

- **Deficiencies in current method** of provisioning new equipments for the nation's ranges (AW Mar. 26, p. 68).
- **Anticipated spread** in quantity and complexity of test environment requirements beyond geographic spans of existing U. S. ranges and onto a global scale.

In the past, the primary concern of the nation's test ranges were aircraft and missiles which had finite range capabilities and whose testing could be confined within geographical limits. Now that orbital and superorbital vehicles and deep space probes with unlimited range and duration are emerging, the test environment becomes global and the duration of test operations swells to days and weeks.

Instrumentation on the national and services ranges (and these include Atlantic Missile Range, Pacific Missile Range and White Sands Missile Range, administered respectively by Air Force, Navy and Army, as well as Air Force Flight Test Center, Air Proving Ground Center, Missile Development Center and Satellite Control Facility) evolved principally for missile system testing and only recently has undergone updating to enable it to perform orbit insertion measurements and monitoring of suborbital, orbital and superorbital scientific experiments. But this instrumentation was not intended for integrated testing of space systems and cannot effectively test them on a global scale.

For some satellite systems, for which continuing control through communications tracking and command is necessary during extended in-orbit lifetime, separate global test facilities were established. These include the Satellite Control Center (Discoverer program) and the Project Mercury global net.

Test plans for missile and space programs of the near future show, according to the Air Force, that instrumentation needed to support single programs will extend across the geographic span of several ranges and introduce problems in technical and operational compatability.

While ranges tried in the past to minimize the incompatability through effective coordination, the problem will worsen as future programs simultaneously will use several ranges and require extension of range instrumentation and geographic capabilities.

Major Systems

During the 1965 to 1970 period, a number of major military and civilian space systems requiring long-term control and communications will be sent into space with growing regularity. These would include Surveyor lunar spacecraft, planetary spacecraft like Mariner and possibly Voyager, Apollo, the Dyna-Soar (X-20) boost glider and manned space stations.

It is apparent that the Air Force is anxious to look ahead, anticipate its future needs, plan for an orderly transition and cut down on duplication, in-

Range Instrumentation Planning Bidders

Companies which submitted proposals late last month in a competition to select contractors for two concurrent studies in USAF Electronic Systems Division's Range Instrumentation Planning Study (RIPS) include:

- General Dynamics/Astronautics with International Business Machines.
- North American Aviation with Hughes Aircraft.
- Sperry Rand with Lockheed Missiles & Space Co. and Page Communications.
- Philco with Aeronutronic Division of Ford.
- International Electric Corp. with Northrop Space Labs, Raytheon and Cubic Corp.
- Boeing with Reeves Instrument and Cook Electric.
- Radio Corp. of America with Radiation, Inc.
- Daniel, Mann, Johnson and Mendenhall & Assoc. with Burroughs Corp., Douglas Aircraft, Raytheon and ITT Kellogg.
- Martin-Marietta with Collins Radio and Raytheon.

Also, Control Data Corp., Sylvania Electric, General Electric, Lear Siegler, Bendix and Space Technology Laboratories.

The RIPS planning study, designated 7990-23, is one in a continuing series of Electronic Systems Division studies (AW July 9, p. 45) intended to explore future Air Force avionic needs and likely to shape subsequent requirements.



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compatibility and likely stumbling blocks.

Companies chosen for RIPS studies will have to have experience in data processing, communications and display, sensor development and studies or planning for large scale military and commercial systems development. The complete integrated testing environment recommended by the study contractors will have to perform functions of tracking, communications, data processing, telemetry, timing, calibration and range safety.

RIPS study contractors will be expected to:

- **Describe test criteria** including test plan-procedures, flight profiles, schedules, types and accuracies of range measurements and data link capabilities for test of both military and civilian space systems during the 1965 to 1970 time period.
- **Outline physical** and performance characteristics of major instrumentation equipments and installations.
- **Pinpoint general geographic** locations of major instrumentation equipment and installations.
- **Outline netting of major equipment** and installations.
- **Estimate time and cost** of associated development, implementation and logistic programs.
- **Identify areas** of applied research and advanced development necessary to realize required test environment.

Air Force expects prospective contractors to consider an entire spectrum of current and advanced techniques in electromagnetic energy propagation, sensing and detection, as well as processing, display, storage and reduction of data. The magnitude and breadth of the global range undertaking accounts partially for the teaming of a number of large companies which otherwise might be expected to tackle alone a $200,000 study program.

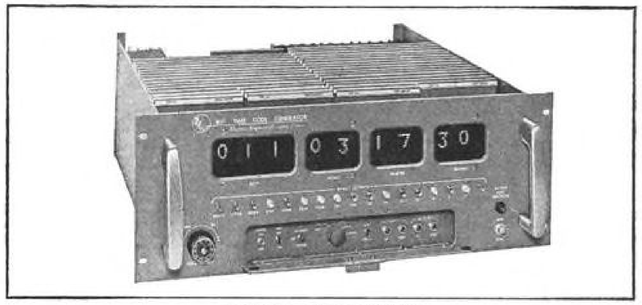
Techniques and systems selected by contractors must provide for simultaneous real time control of many test vehicles over global, cislunar and interplanetary orbits and trajectories in addition to supplying metric and performance data. USAF has instructed bidders that payload, booster instrumentation and on-board control system design is relevant to the study only to the extent needed to make trade-off analyses.

The RIPS studies are expected to identify necessary instrumentation to meet test requirements without concern of organizations which will ultimately operate them. Facilities now in existence and those planned by government agencies are to be considered in the study.

In addition, the contractors will find a basis for relating the measurements and controlling functions of geographi-

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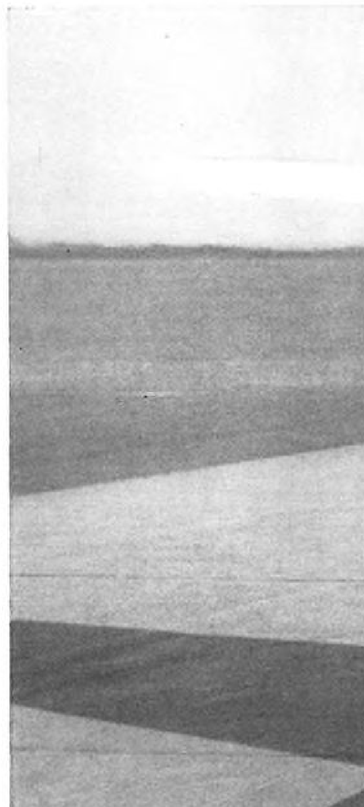
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Code Frame Length	0.1 second	1 second	1 minute	1 hour
Code Scan Rates	1000 pps	100 pps	2 pps	1 ppm
Code Carrier Frequency	10 kc	1 kc	1 kc or 100 cps (switch selection)	1 kc or 100 cps (switch selection)

An all solid state, card construction, precision "metronome" for the most demanding range or laboratory instrumentation. Supplies all four serial IRIG time-code formats with an accuracy of better than 1 second a month. Frequency stability is 1 x 10^{-8} per day at laboratory temperatures; 3 x 10^{-8} per day throughout entire operating range of −20°C to +55°C. Parallel code output. 10 pps and 1 pps synchronizing pulses. Synchronizing pulse for controlling external control element scanner. Both digital and resolver time shift for fast, accurate synchronization with WWV or other time standard. Operates on 115v ac ±10%, 50-400 cps, 1 amp, with power supply on same chassis.

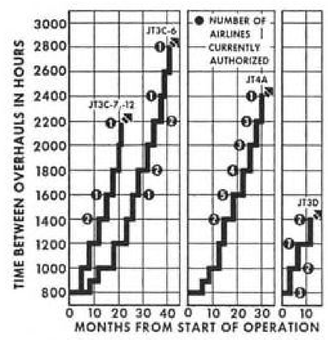
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We've taught jet facts to thousands of students everywhere, from 40,000 feet over Stockholm to ground level at our Connecticut headquarters.

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Finally, we pay attention to the details—spare parts, manuals, drawings, catalogs—that are an integral part of Pratt & Whitney Aircraft service.

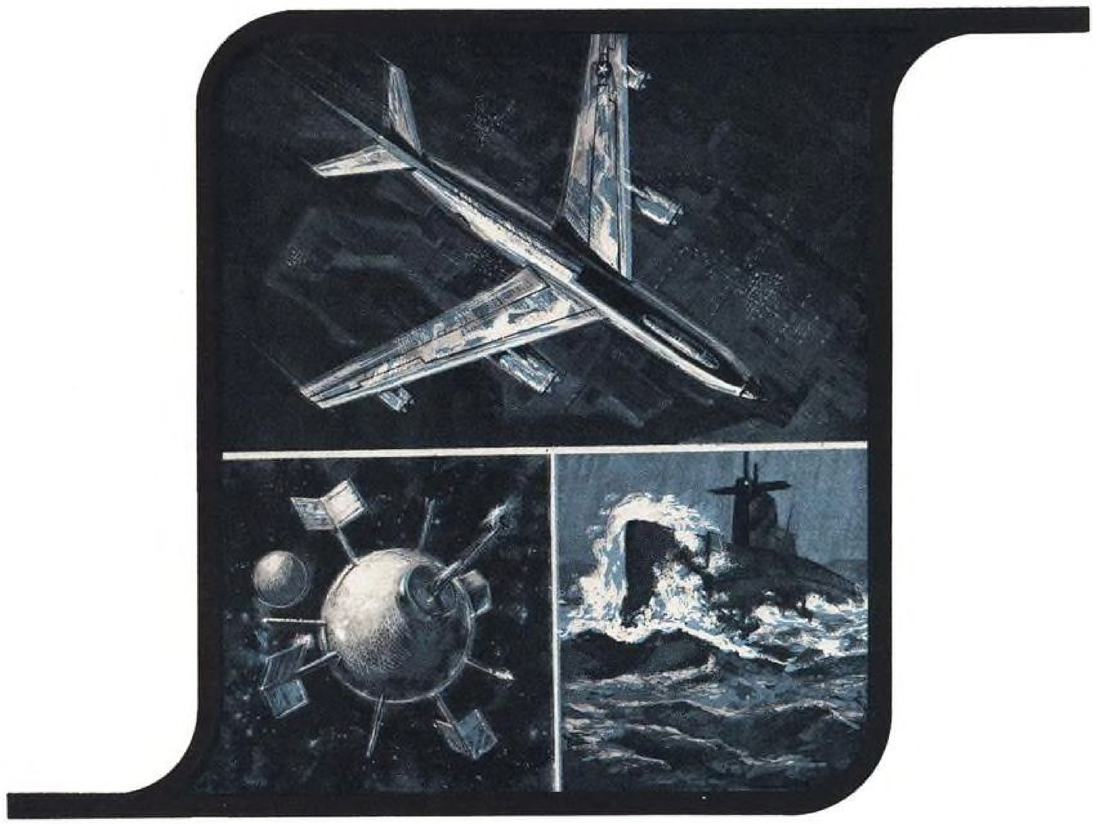
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"More tape in the same space" tells the story of "SCOTCH" BRAND Thin Coat Heavy Duty Instrumentation Tapes! For recorders used in airborne, shipboard, and other data acquisition applications where space is at a premium, these super-thin tapes offer 25% more playing time than tapes of standard heavy duty coating thickness; or make possible the use of smaller recorders. Yet there is improved resolution with no sacrifice of backing strength.

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A choice of seven Thin Coat Heavy Duty Tapes is available, all with .18 mil oxide thickness, and polyester backing. "*400*" series features long wear, excellent high and low frequency resolution. Backing: No. 490 is .65 mil, No. 491 is 1.0 mil, No. 492 is 1.5 mil. "*500*" series assures sharp resolution of extremely high frequencies, with long life, smooth travel. Backing: No. 591 is 1.0 mil, No. 592 is 1.5 mil. "*900*" series provides ultra-smooth recording surfaces for extremely short wavelength requirements. Backing: No. 991 is 1.0 mil, No. 992 is 1.5 mil. "*900*" series is specifically recommended for predetection recording.

Consult your nearby 3M representative for helpful technical details. Or write: Magnetic Products Division, Dept. MCJ-82, 3M Co., St. Paul 19, Minn.



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Magnetic Products Division 3M COMPANY

cally separated, instrumented sites through calibration of instrument accuracies, control timing and determination of instrument site location errors.

Since government supported development or procurement of systems identified in this study will be based partially on cost estimates, contractors will be expected, as a basis for selecting particular systems, to estimate costs for development of new or improved systems or subsystems and operating costs over the life of such systems. They also must provide estimates of the cost of the over-all test environment configuration for each year through 1970.

Compatibility Requirements

To insure compatibility of equipments the complex is to be designed as an entity with instrumentation compatibility to be assured by determining data format, data rates, transmission delays, instrumentation response and dynamic range.

Equipment compatibility will be necessary to assure satisfactory functioning of the complex and to permit speedy phase in and out of specific items of instrumentation.

Development of evaluation and operational instrumentation for future test environment will be directed toward an optimum solution to the problem, rather than patching up existing, inadequate and outmoded systems incapable of meeting aerospace test evaluation requirements. Yet to achieve economy, the standardized equipment is desired where possible for global operations. Whenever possible new instrumentation should be developed providing functional support for many projects using common hardware.

Major aspect of the concept design will be the selection of sites for instrumentation systems or complexes to test space systems in cislunar and interplanetary space. Choice of a fixed or mobile site will depend on factors such as space vehicle orbit and trajectory characteristics, instrumentation systems performance characteristics, test control and data requirements, available real estate, frequency of use and logistics requirements. Political and geological factors, crew or support personnel facilities and manpower requirements will get cursory attention.

The possible use of communication satellites to assist in relaying surface to surface communications from outlying sites, in effect replacing high frequency links subject to blackouts, especially in periods of solar storms expected later in this decade, may be considered by RIPS contractors. When they are, the contractors are expected to identify prospective boosters and launch sites.

Defining the degree of communications coverage with particular test vehicles will be an important aspect of the program. For superorbital missions, continuous line of sight coverage will be possible with NASA's Deep Space Instrumentation Facility starting at about 8,000 mi. above earth. A critical period for the vehicles, however, will occur during mid-course injection, which may correspond to the period of maximum data traffic flow for the entire mission. This requirement may restrict launch times which will have to be balanced against other approaches requiring remote sites and ship stations with attendant difficulties of communications and logistics, position determination and station keeping.

Contractors will be expected to devote attention to the location, amount and time of data processing required for each space program since a prime function of the test environment is to gather and present data in usable form. Quantity, quality, methods and types of data presentation and security of data will all get attention.

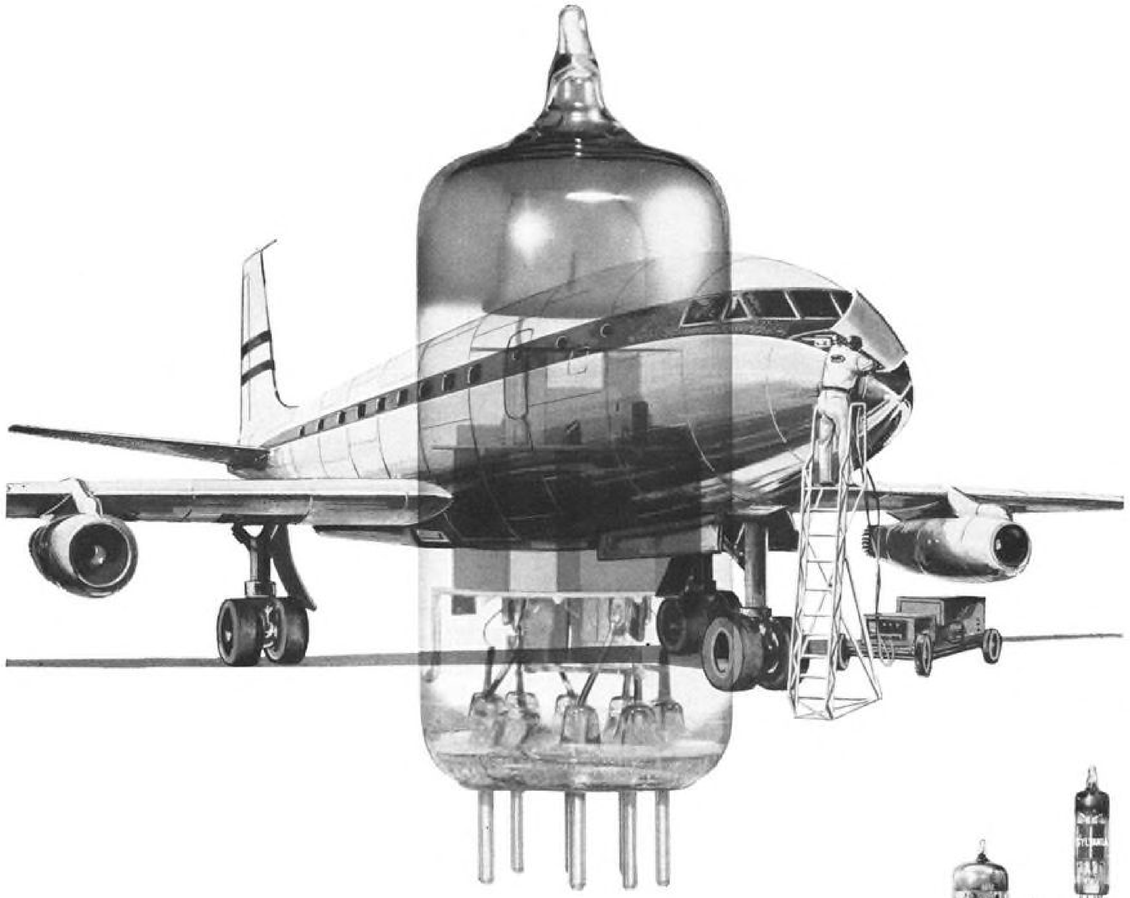
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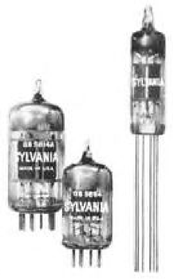
▶ **Superpower Competition Won**—Industry competition conducted by Rome Air Development Center to select a contractor to develop an X-band linear beam tube (klystron), capable of delivering a megawatt of average power at about 8.5 kmc. (AW Feb. 12, p. 73), has been won by Eitel-McCullough. Program is one of several megawatt microwave tube development efforts being conducted by DOD, Air Force and Army in hope of obtaining superpower microwave tubes needed for ballistic missile and satellite defense systems.

▶ **New High in Laser Peak Power**—Hughes Aircraft Co. has achieved a new high level in peak power output from an optical maser—100 megawatts—scientists from Aerospace Corp. reported at a recent American Rocket Society meeting in Los Angeles. Device employed in the experiments was a Kerr-cell shuttered ruby optical maser. Because many scientists and engineers working on optical masers have strong reservations about adequacy and accuracy of output power measurements, the spiraling peak power figures of optical masers reported in recent months are now being regarded as qualitative indications of the potentially high powers available, not necessarily as precise quantitative measurements.

▶ **Speeding Naval Aircraft Navigation Alignment**—Technique for speeding the alignment of an inertial navigation system in a combat-ready aircraft on an aircraft carrier's catapult station is being developed for the Navy by the Guidance







How to enhance reliability of critical avionics equipment!

A good equipment design, proven under laboratory conditions, may sometimes perform erratically during field life. Why? Consider the type of components used. Are they field proven? Do they offer documented reliability?

Take the case for electronic vacuum tubes. Tests by ARINC Research Corp.* illustrate the dramatic improvements in tube reliability since 1954. The results of tests conducted aboard naval vessels, for example, show a combined tube removal rate of 15% per 1000 hours in 1954. By 1960 this figure dropped to 1.2% for miniature tubes and a remarkable 0.19% for subminiature tubes. All the controlled subminiature types in this test were Sylvania tubes.**

Electronic tubes are virtually unaffected by extremes in environment. Example: Sylvania GB Gold Brand Tubes, specifically designed for business-commercial aviation, maintain rated performance even after shocks of 500g, fatigue tests of 2.5g for 96 hours, bulb temperatures of 165°C. They are unrivaled in electrical stability, uniformity and ease of interchangeability.

If avionics equipment reliability concerns you, be specific about the components you use. Make certain they are superior-quality electronic tubes—look for the Sylvania GB Gold Brand markings on the tubes. A complete list of GB Gold Brand types, and prototypes, is yours for the writing. Electronic Tubes Division, Sylvania Electric Products Inc., 1100 Main St., Buffalo 9, N. Y.

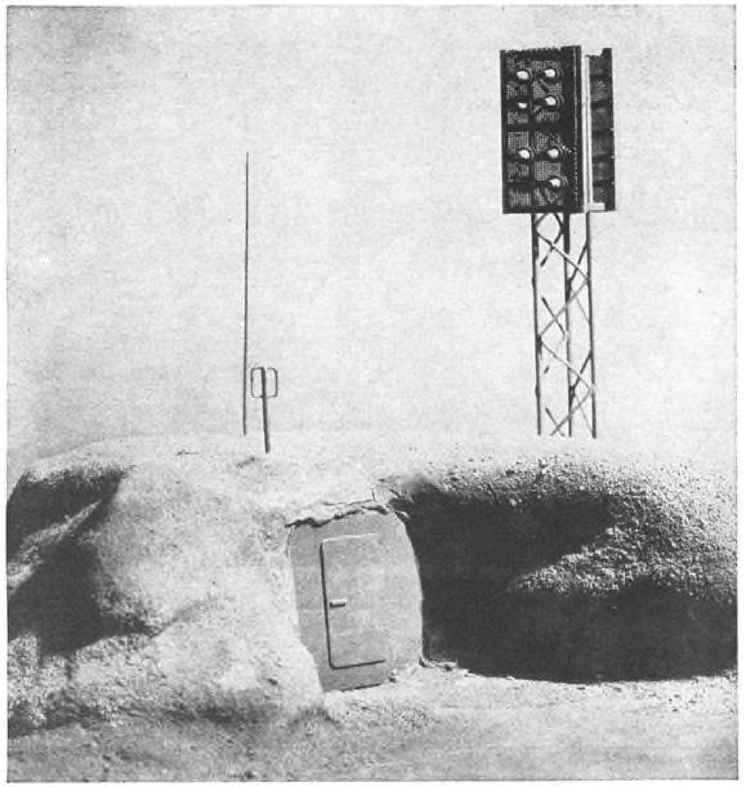
*Courtesy ARINC Research Corp., as published in publication #101-28-166, #101-26-160.

**Tubes were use-tested in eight SRR-13A receivers. Contributing factors to improved reliability included: applied receiver line voltage reduced to 92% of its nominal value; continuous operation of receivers. Sylvania subminiature types included—5636, 5644, 5647, 5718, 5719, 5840, 5899, 5902.

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Nudets Sensor Site Model

USAF Electronic Systems Division model shows one proposed configuration for an unmanned sensor site for the Nudets (nuclear detection system) project. Over-all system is designed to provide defense agencies with information on nuclear explosions within U. S. Sites containing automatic equipment to detect and report nuclear detonations will be constructed throughout the nation.

and Control Systems Division of Litton Systems. The technique involves transferring navigation information from the carrier's reference system to that of the plane via a lightweight gyro platform and a 5-lb. alignment mount that can be quickly attached and then detached from the aircraft. Process may take only 30 sec.

► **Recent Optical Maser Contracts**—Among research and development contracts in optical masers awarded recently by government agencies are the following:

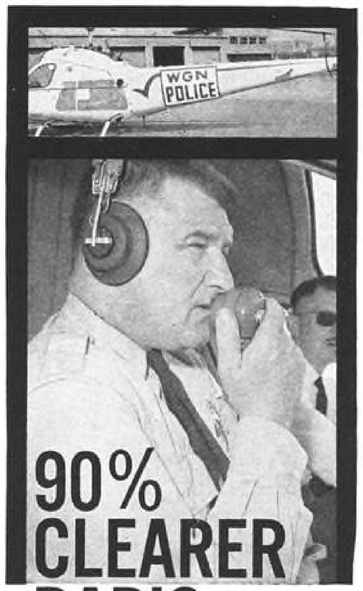
• **General Telephone & Electronics Corp.**, Bayside, N. Y., will investigate infrared optical maser using a semiconductor under contract from the Army at Ft. Belvoir.

• **Electro-Optical Systems**, Pasadena, Calif., will study infrared optical masers in a companion study to the above, also from Ft. Belvoir.

• **Technical Research Group**, Syosset, N. Y. will develop a high-power optical maser for the Army's Signal Corps.

► **Improving Western World Mapping**—Air Force's Aeronautical Systems Division is going ahead with the development of an airborne data collection and ground data processing subsystem, designated USQ-28, to increase the productivity of aerial photo mapping missions. System, to be carried in a Boeing KC-135, will use an S-band version of RCA's Hiran (pulsed radar), called Shiran, being manufactured by Cubic Corp., as an airborne ranging system for line crossing. Procurement of many system parts, including ground support equipment for checkout, ground equipment for processing collected data, cameras and airborne profile recorders is expected on basis of competition completed late last month.

► **RTCA Reorganizes**—Radio Technical Commission for Aeronautics (RTCA) will name a full-time chairman and expand its technical staff as part of a reorganization move intended to strengthen its role as a joint government-industry medium for resolving mutual avionics problems and developing basic technical performance specifications.



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Model 488T

Shure SonoBar noise-cancelling microphone. Only $72.50



Literature:
Shure Brothers, Inc.,
222 Hartrey Ave.,
Evanston, Illinois



FAIRCHILD C-123H has two General Electric J85 turbojets suspended from each wing. Butterfly-type dust excluder in each jet intake closes automatically during propeller reversing. Weight of each J85 installation, including pod, nylon, engine and accessories, is 690 lb.

USAF Speeds Tests of Fairchild C-123H

By David H. Hoffman

Hagerstown, Md.—Air Force, which lacks a large STOL transport for close support of Army troops in primitive areas, will speed testing of its twin-turbojet, twin-piston-engine C-123H in a program that reflects the national emphasis on preparation for limited war.

Not until the 1964-66 period, when Vought-Hiller-Ryan's XC-142 and de Havilland's Caribou 2 should become operational (AW July 23, p. 26), will assault aircraft of similar size be available under current procurement schedules. Meanwhile, Army must rely on the AC-1 Caribou, an STOL transport that can lift less than 8,000 lb.

The Fairchild C-123H was equipped with two General Electric J85 turbojets and a drag-parachute braking system in less than 90 days by the manufacturer. A tight flight test program, which began one week ahead of schedule on July 30, is to end on Sept. 1, when Air Force will evaluate the aircraft for Defense Department. During the middle of this month, the aircraft is to be flown from Fairchild's factory here to Eglin AFB, Fla., where Air Force Systems Command and Tactical Air Command will conduct a joint evaluation.

Fairchild hopes that performance of the C-123H will convince Air Force that all or some of its 250 C-123s should be modified in similar fashion.

Effective airlift of Army weapon systems, such as the 105-mm. howitzer and three-quarter ton truck, is limited within a tactical theater by the landing distance and runway stress requirements of Lockheed C-130s and Douglas C-124s, mainstay transports in the Air Force fleet. Carrying typical fuel and payloads, both require runways in the 3,000 ft. category.

This usually means their cargo either must be air-dropped or travel via helicopter, truck or relatively light aircraft to its front line destination.

Fairchild's case for the C-123 as an interim STOL assault transport rests to a large extent on modifications that would permit the aircraft to fly medium-distance routes, then land on unimproved, 1,000-ft. airstrips. Thus the C-123 might do the work of two aircraft types, doubling as an intra-theater tactical transport and a STOL vehicle that could deploy and re-supply Army units in the field.

Whether the C-123 actually can fulfill this role is the question Air Force intends to answer during its evaluation of the C-123H with hybrid powerplants.

Engineering work on the modification began here May 7 under a $900,000 Air Force contract. The project stresses speed rather than sophistication, and, according to Fairchild, the test aircraft "must be considered a preproduction prototype which will require further refinement once the concept has been proven feasible."

Tests for the C-123H are aimed at proving the aircraft able to:

- **Take off from a prepared** runway with a 20,000-lb. payload, fly 500 naut. mi. and land within 1,000 ft. over a 50-ft. obstacle on an unprepared field.
- **Take off from the unprepared** field in 1,000 ft. over a 50-ft. obstacle with 20,000 lb. of payload and return 500 naut. mi. to the point of origin.

The last 100 mi. inbound to and outbound from the midpoint airstrip would be flown at tree-top altitude to avoid enemy detection.

When built by Fairchild, the C-123H was equipped with wide track gear in a successful attempt to remedy what pilots consider a serious operational problem: the standard aircraft's tendency to capsize when taxied in strong crosswinds. Wide track gear also improved the C-123H's STOL capability by lessening the friction between tire and ground on takeoff.

Standard C-123Bs in the Air Force inventory—about 300 were accepted between July 30, 1954, and July 30, 1958—roll on 16-ply tires with a 12.6 ft. tread. By comparison, the C-123H has a 22-ply tire with a 17.6 ft. tread. Footprint area is 338 sq. in. on the 123B and 478 sq. in. on the 123H.

Expressed in Unit Construction Index numbers, which measure the ability of an aircraft to make repeated landings and takeoffs without inflicting breakdown loads on a given runway, these dimensions give the 123H a UCI of 18.1 and the 123B a UCI of 20.5. Unprepared bare soil can withstand UCIs as high as 20. Perforated steel landing mats boost this figure to 25.

If the 123 were equipped with tandem, wide track main gear, Fairchild believes it could operate from almost any level surface. Such an aircraft could land and taxi over sand and mud so soft that larger trucks would have difficulty unloading the airplane without bogging down.

Each of the two J85 (civil CJ610) turbojet installations, including engine, accessories, pod and pylon, adds 690 lb. to the basic weight of the C-123H. Developing 2,850 lb. thrust, the jets are hung outboard of the C-123's Pratt & Whitney R2800 piston engines. The extra structural strength needed was gained by adding ribs, doublers and sections of heavier skin to each wing.

Standard 115/145 octane aviation gas is consumed by both jet and piston engines on the C-123H. By electing this arrangement, Fairchild spared itself the necessity of designing and installing a separate fuel system to contain jet fuels or kerosene, which the R2800s could not use.

To guard against ingestion of rocks and dirt kicked up during propeller reversing, Fairchild-designed butterfly valves seal off the two jet intake automatically when the piston-engine throttles are lifted into the reverse pitch position. After reversing is complete, these valves may be opened by throwing a switch in the cockpit.

In an actual STOL landing pattern, the modified C-123H is established on final approach at 80 to 90 kt. IAS, and full flaps are lowered. With the first of a row of toggle switches on his overhead switch panel, the pilot opens a parachute door housed high on the underside of the 123's upswept aft fuselage.

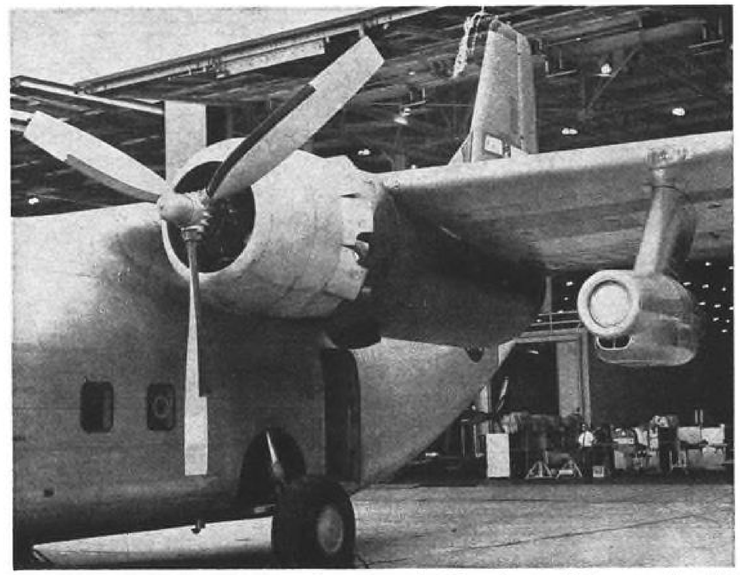
The drag-chute system then is armed. When a switch labeled "Approach Deploy" is thrown, a slug propelled by a powder charge ejects a small pilot chute from its canister. This, in turn, tugs out an approach chute, which is designed to increase the angle at which the aircraft can descend without increasing its rate of descent.

After touchdown, the approach chute itself deploys a cluster of three, 28-ft.-dia. drag chutes to shorten the C-123's rollout distance. In the process, the approach chute automatically is jettisoned.

At any time while on final, should a go-around be unavoidable, an abort switch enables the pilot to disconnect the approach chute. Another switch jettisons the drag chute cluster when the aircraft has been slowed.

Optimum size of the approach chute will be determined during flight tests by reefing a standard parachute to vary its diameter.

If the project was less urgent, Fairchild probably would have elected to substitute double slotted wing flaps for the rather cumbersome parachute braking system in order to get STOL performance. But the pressures of time ruled out such a major modification for test purposes. Serious technical questions, nevertheless, are posed by the use of parachutes.



FOOTPRINT AREA of the C-123H wide track gear is 478 sq. in., or 41% greater than that of the standard C-123B now in USAF inventory. Modified aircraft's first flight on July 30 was one week ahead of schedule set by Air Force, which will test C-123H at Eglin AFB.

For example, will propeller reversing tend to suck air from the drag chute canopies, thus spoiling their effectiveness during the critical landing rollout? How will the drag chutes be deployed if, during an earlier go-around, the approach chute was jettisoned? At what precise point on the fuselage should the chutes be attached so that they deploy properly in the aircraft's wake?

Almost certainly, the C-123H as modified can land safely on a 1,000-ft. strip, probably within 800 ft. But it will require more than 1,000 ft. to take off again at either 67,000 lb., design gross weight of the modified aircraft, or at 60,000 lb., standard C-123 weight.

To illustrate what the standard aircraft can do, in recent tests involving five landings a C-123B weighing 53,000 lb. used an average 1,400 ft. to clear a 50-ft obstacle on a sod field. On takeoff, a C-123B weighing 42,000 lb. normally is airborne within 1,700 ft.

According to Fairchild, these distance figures could be reduced substantially by a number of relatively simple improvements that are not found on the test aircraft. A C-123 retrofitted with four GE T64 turboprops, each developing about 2,800 shp., would have more power for prop reversing after touchdown plus better acceleration on takeoff. One with double-slotted flaps would have a lower stalling speed, hence lower landing and takeoff speeds. With tandem wheels on each main gear, the aircraft's flotation would be improved.

Pressurizing the entire C-123 cargo compartment is not a feasible modification. However, the crew compartment of the aircraft could be pressurized for

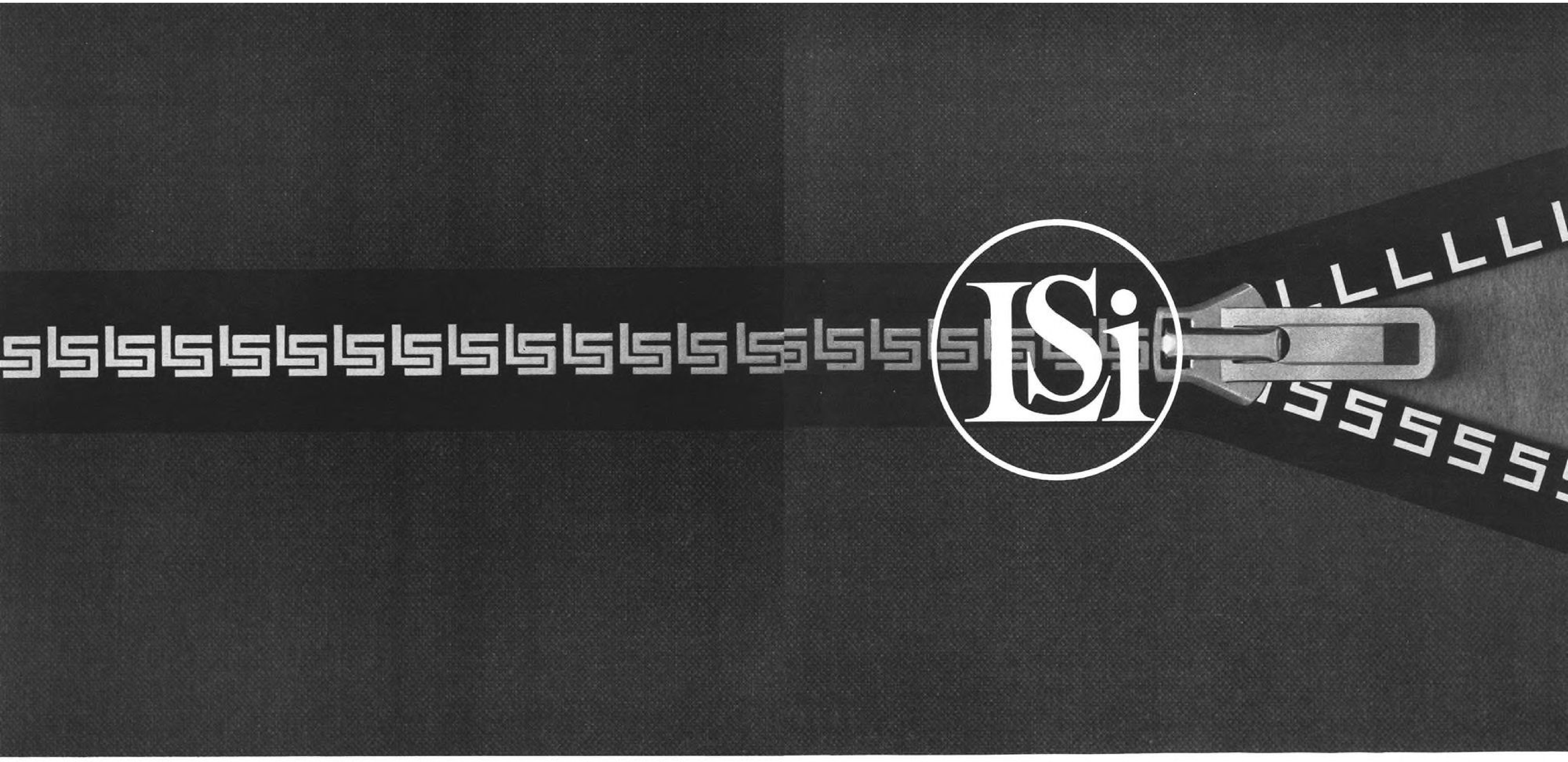
Improved C-130B STOL Capability Sought

Lockheed has modified a four-turboprop C-130B to improve its STOL performance and estimates indicate the aircraft will take off within 1,650 ft., clear a 50-ft. obstacle and then fly the 500-naut.-mi. mission Air Force may assign to an interim assault transport (see story).

To gain more thrust in reverse, the C-130B's propeller-gear ratio has been lowered from 13.54 to 12.5 and a governing device adjusted in its throttle linkage. Maximum flap extension on the Hercules also has been increased, and the aircraft has been fitted with a drag parachute.

In the Air Force STOL assault mission, the C-130B would take off at 108,000 lb. and land over a 50-ft. obstacle within 1,520 ft. at its destination. Ground roll for second takeoff over a 50-ft. obstacle would be 1,220 ft., the company stated.

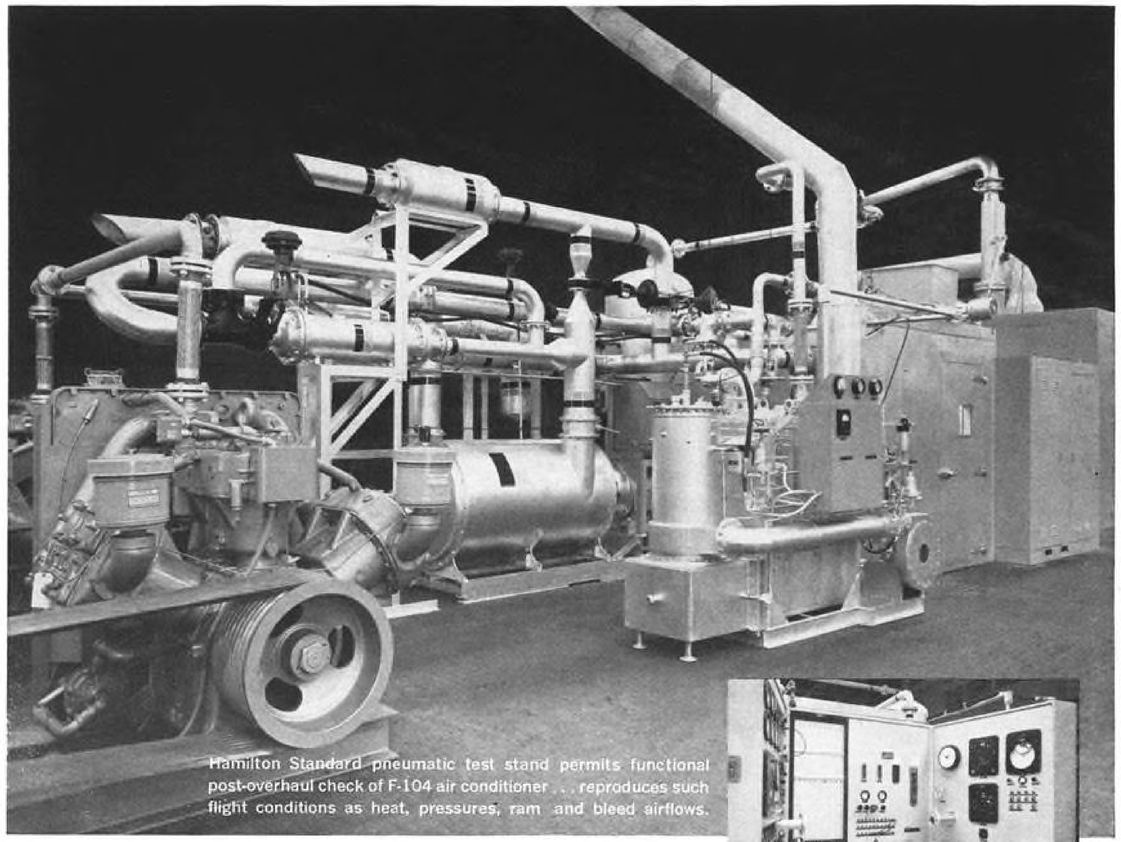
The unmodified C-130B at the same gross weight could take off in 1,885 ft., land in 1,900 ft. and take off in 1,315 ft. on the STOL mission. It is understood that recent short field tests of three C-130s—one with Lockheed's boundary layer control system, a standard C-130B and the STOL-modified aircraft—were inconclusive.



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Hamilton Standard pneumatic test stand permits functional post-overhaul check of F-104 air conditioner . . . reproduces such flight conditions as heat, pressures, ram and bleed airflows.



Flight lab for the F-104 air-conditioning system

The Lockheed F-104 Starfighter's air-conditioning and pressurization system "flies" within this pneumatic test stand, designed and built by Hamilton Standard.

Two electrically driven 150-hp reciprocating compressors in the test stand simulate engine bleed air. This air, routed through aftercooler-water separator, surge tank, and furnace, is then supplied to the turbine fan and the test chamber. A 150-hp turbine compressor simulates ram air. Capacity: bleed air, 55 lbs/min at 200 psig, 480°F; ram air, 130 lbs/min at 6 psig, 400°F; pressure, up to 1 lb/min at 550 psig.

Building test stands of this type demands a high degree of technical competence in systems engineering, electrical circuitry, pneumatics, hydraulics, electronics, and packaging. At Hamilton Standard, these capabilities are integrated with quality manufacturing.

Hamilton Standard has produced test stands for environment conditioning equipment, jet engine fuel controls, propellers, and a broad range of related aerospace systems and components. For the solution to your aircraft and missile test equipment problems, write: Sales Manager, Ground Support Equipment, Hamilton Standard Division of United Aircraft Corporation, Windsor Locks, Connecticut.

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CL-41R Electronics Trainer Makes First Flight

Canadair CL-41R jet trainer (AW July 9, p. 21), equipped with full range of electronics system designed for the Lockheed F-104 jet fighter used by Canada and other North Atlantic Treaty Organization nations, made its first flight recently. CL-41R is a development of the CL-41A pilot trainer now in production for the Royal Canadian Air Force.

sustained flight at high altitude where turbine powerplants are more efficient.

Within Air Force, there is general agreement that a 10-ton, STOL transport should be procured without delay. There is some disagreement, however, on how this should be done. One Air Force group feels that STOL performance should be built into the four-turboprop C-130 Hercules. Another believes that even the lighter C-130A, with a gross weight of 105,000 lb., is too large to operate on short strips in primitive areas.

Should the C-130 be excluded, it is probable that Air Force will be limited to modifying some of its C-123s, holding a new competition or foregoing its requirement for the large STOL assault transport.

According to Fairchild, the C-123 with four T64 turboprops—which lost out to the Caribou 2 in Army's recent competition for a 5-ton-payload, STOL transport—could be produced for $1.3 million. This figure assumes a run of 200, but includes the $560,000 cost of the four T64s.

Equipped with tandem main gear, double slotted flaps, a short-span aileron and spoiler system and two smaller fins on the tips of its horizontal stabilizer, the T64-powered C-123 is designed to carry a 33,000-lb. payload more than 500 mi. Its cargo compartment measures 110 in. x 98 in. x 37 ft. Any of the larger pieces of equipment that accompany an Army airborne division, including the Pershing missile system, could be fitted into this envelope. Design gross weight of the modification would be 68,000 lb., with an overload takeoff weight of 80,000 lb.

In the Army competition, Fairchild teamed with Republic Aviation Corp. and offered to produce four of these modified C-123s for $22 million. Included in this sum, the second lowest quoted, was $9 million the two companies agreed to spend privately in the hope of getting follow-on orders. Thus, Army's cost was $13 million.

Rogallo Design Studied For Dropping Troops

San Diego—Use of the Rogallo design is being explored by Ryan Aeronautical Co., working under an Army contract to develop a flexible wing which would enable airborne troops to glide from drop planes to the ground.

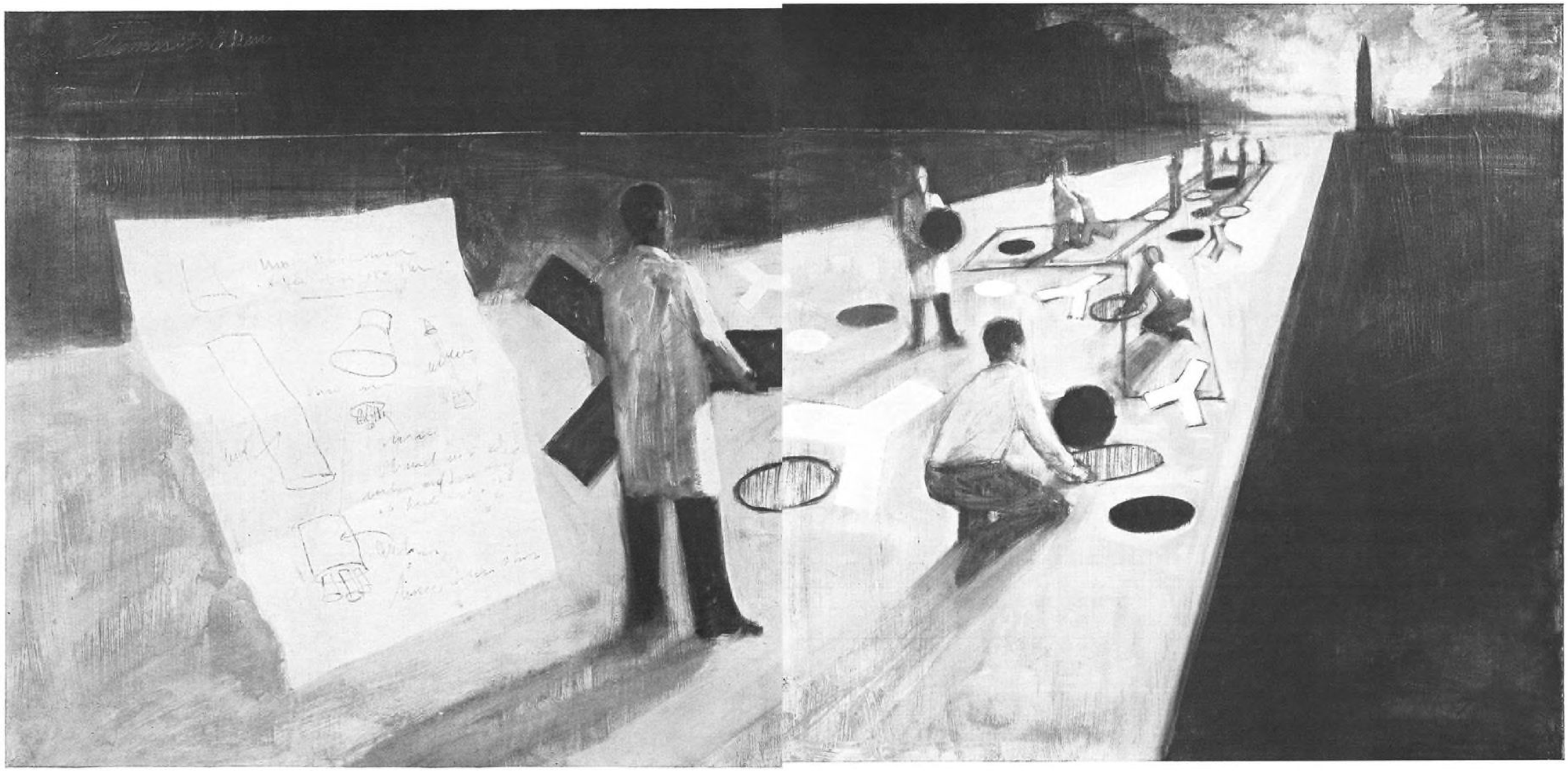
Contract calls for the design, construction and testing of six collapsible wings, which can be folded into parachute-size packs. Testing, jointly sponsored by the Transportation and Quartermaster Corps, is scheduled late this summer at the Army's Yuma, Ariz., test station.

Collapsible airtight tubes will form the keel and leading edges of the wing, which will be covered with a flexible membrane. When the wearer jumps from an aircraft, gas cartridges will inflate the tubes and deploy the wing. Fully deployed, the wing will form a V-shaped kite with a keel length of 22 ft. and a wing area of about 30 sq. ft.

The soldier, suspended beneath the wing in a harness, will control his direction and rate of descent by manipulating parachute-type suspension lines.

Instrumented full-scale dummies will be used in the Yuma tests to record drop and ground impact forces. Descent rates and landings will be controlled by radio command from the ground.

One advantage of the wing over the conventional parachute will be a reduction of troop assembly times, since the soldiers can all glide to one area after jumping. Soldiers jumping from 500 ft. may be able to glide as far as four miles, enabling transport planes to stay away from the troop landing zones.



THE PRACTICAL MEN

An idea is born.

It could lead to a great scientific accomplishment. It could even create a new technology.

But first it must achieve reality. To do this it must leave the theorist and go to another kind of man, a man with a more practical bent of mind.

This is the challenge for creative engineers and modern management: to turn ideas into realities. And today this work is more difficult than ever before.

For now the aerospace industry is called upon to engineer space ships that will travel thousands of miles from earth and return. It is called upon to develop rocket engines with the power of a million automobiles. It is called upon to produce electronic equipment that will last thousands of hours... to design antenna systems that can listen to stars billions of miles away...to produce electricity by nuclear power with increasing efficiency.

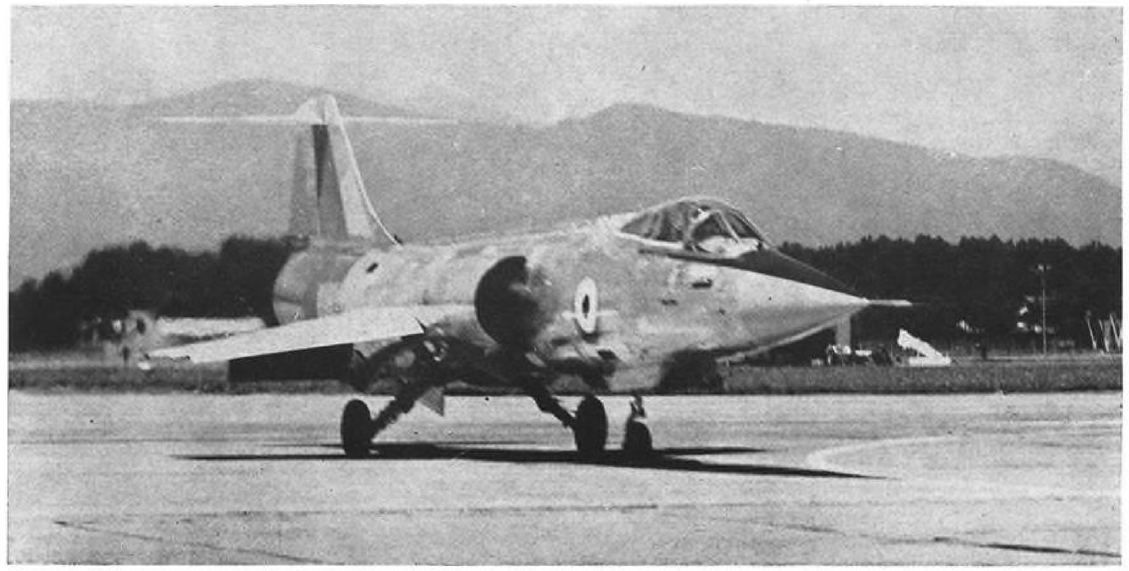
Even while you are reading this, the engineers of the aerospace industry are working toward these objectives. They are creating functional ideas from broad theories. They are searching out the exact materials, equipment, systems, and components to suit their needs. Often in this search they must create their own answers.

Steadily, piece by piece, part by part, the finished whole begins to emerge. The prototypes are examined. Tests run. And finally the new system is complete—tested, proved, ready to use.

This is the work of men who turn ideas into reality. This is the work of men who are creating the products of tomorrow and the industries of the future.

This is the work of the practical men.

North American Aviation is at work in the fields of the future through these six divisions: Atomics International, Autonetics, Columbus, Los Angeles, Rocketdyne, Space & Information Systems.



FIRST F-104G PRODUCED by the Italian group headed by Fiat, last group to enter the consortium, recently rolled out. Aircraft currently is undergoing flight acceptance trials prior to customer delivery.

European F-104 Program–Part 2

Costs Balloon in Drive to Meet Schedule

By Cecil Brownlow

Geneva—U. S. companies in the European F-104G program are finding that unforeseen costs in keeping the program on schedule and protecting U. S. technological prestige are biting deeply into their return from the overseas licenses they granted.

Not only are U. S. companies under pressure from their own government, but they also recognize that their own interests are at stake. How well program goals are met—to produce a weapon system with all weather capability in three modes of interceptor, strike fighter and reconnaissance aircraft —will influence future U. S. aerospace sales in Europe. More important perhaps, it may also influence future USAF programs.

If the program is adjudged a success when the last of 949 aircraft for European use rolls off the line in 1965, the entire U. S. aerospace industry is likely to benefit.

"U. S. companies will always sell over here as long as they can keep the state of the art a jump ahead of Europe," one observer says, "but it will be a lot rougher if the F-104 program falls on its face. There have been critics all along saying that it should have been an European aircraft (e.g., the Dassault Mirage 3) and not an American one. They jump back in everytime there's a slip, and the denunciations start all over again.

"On top of that, some people like to see the Americans in trouble. They're on our side . . . but it's nice to see the top dog slip sometimes."

General consensus now is that the program will not fall on its face, at least not on the production side. The European lines are approaching schedule, and it is estimated that they will be on the mark sometime next year.

Although there is still concern over the project, North American Aviation says the -41 version of its NASARR fire-control system, the most critical and controversial component of the weapon system package, is approaching required performance specifications. In this regard, details of the final contracts with the European licensees for NASARR were recently settled after lengthy negotiation.

Nevertheless, the F-104G program has been in trouble, often serious trouble, and there promises to be more. Complexity of "buying" as much technology at one time was underestimated on both sides of the Atlantic.

The European governments, with little or no precedent to guide them, did not sufficiently anticipate the scheduling needs of long lead time items. They overlooked to a large degree the necessity of adequate spares and looked suspiciously at suggestions for the contracting of field service engineers from the major U. S. companies involved.

"We told them two years ago what they would need in these areas," one contractor contends, "and they thought we were trying to take advantage of them."

The recommendations on spares and long lead time items are only now beginning to be heeded, and as a consequence the Europeans have found they are having to spend roughly twice the projected amount for direct purchases from the U. S. in order to keep the program moving without serious delay—a factor that benefits the U. S. gold flow policy but one that is scarcely popular over here.

West Germany, in particular, is beginning to move in this area, however slowly. Its first spares depot is being established, although at a time when Germany already has an operational wing in being. The other three consortium nations—The Netherlands, Belgium and Italy are farther behind.

"As a whole, the governments are still operating under letters of intent [for spares] in too many instances," according to one spokesman, "and some of these can't be firmed into contracts before the end of the year.

"The problems of support aren't going to be so great for the first squadron or the last squadron, but some of those activated in the middle of the program aren't going to be supported very well because of late orders."

Keeping the flow of spares and long lead time items moving and provisioning for future needs are areas in which the U. S. companies are now devoting major effort. A large proportion of the cost is coming from company funds and there is little hope of reimbursement. Alluding to this factor, one contractor says:

"We're going to lose our shirts on this program by the time it's over, but we've been told from the top to make it go, one way or the other. That's what we are trying to do. But it gets to be a question of how much money your image in Europe and to the Air Force at home is worth."

Lockheed, for example, has been turning out additional, largely-unprogramed spares and long lead time items at its Burbank, Calif., facilities for the past several months and having them flown to Europe by charter aircraft. The European firms pay for the hardware, but Lockheed has had to carry the charter cost.

Sources outside Lockheed estimate that the company is spending $3 million a year on the airlift and the extra support personnel it has found necessary to station in Europe. With luck, it will finish the project with a profit, but only a fraction of that originally estimated.

Without the air charter, however, the program easily could have foundered. U. S. officials connected with the project in Washington and Europe give a large degree of credit for the successes attained thus far to A. M. Folden, now Lockheed vice president in charge of the F-104G program, who initiated the air freight system.

North American, for its part, has opened a new facility in Turin, Italy, with its own funds, staffed by 40 U. S. engineers who will be augmented by 160 Italian technicians. Incorporated as an Italian firm with the name of North American Aviation S. p. a., the facility was formally commissioned on July 4.

Outlays include about $1.5 million in test equipment and $2 million in spares for fast shipment to critical areas. Sole reason for the facility is test, modification and spares support for the Euro-



F-104G's, most of them destined for the West German air force, line the ramp at Lockheed's Palmdale, Calif., flight test facility. More than 70 of the 96 aircraft to be built by Lockheed have been delivered to the West Germans.

U.S. Companies Warned to Produce

Major pressure from the U. S. government on U. S. firms to push the European F-104G program stems from an Air Force Special Projects Office meeting at Dayton, Ohio, about a year ago, just before the first European-assembled aircraft was due off the assembly line.

Until that time, the Air Force generally had followed a hands-off attitude so far as the European program was concerned, except for a contract to handle a portion of the flight test work. The meeting was called to discuss this aspect as well as to consider possible standardization of the G model and the F-104s to go to Mutual Aid Plan countries outside the consortium, primarily Greece, Turkey, Norway and Denmark.

"The Air Force had expected a nice quiet session," one observer recalls. "Instead, the Europeans walked in like hornets, saying the F-104 was no good, that it had been jammed down their throats by the [U. S.] Air Force and that the Air Force had then walked off without taking any further interest in it. . . . They yelled about the R&D costs, lack of contractor cooperation, the performance of the airplane as a whole . . . in short, they said we had sold them a bill of goods."

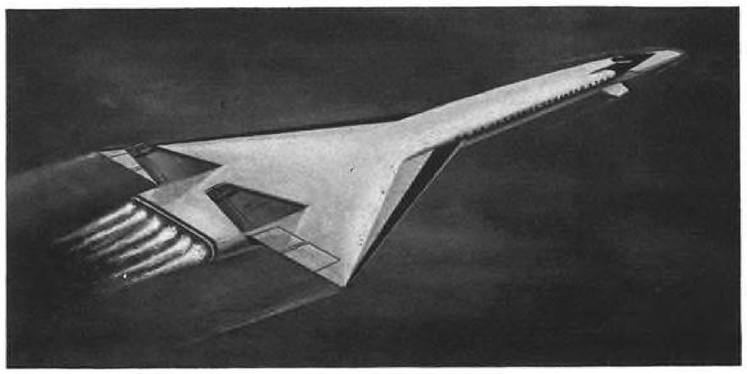
Most USAF officials deny that the Air Force played an active role in the sale of the F-104. Others, however, agree with the Europeans that it did play a major, though unofficial, part in the transaction.

At any rate, reverberations of the Dayton meeting quickly reached into top echelons of the Pentagon, and a resultant warning—produce or else—was just as quickly spread to the U. S. contractors.

"Or else," as the companies interpreted it, meant that any company that failed to produce would find itself in an unfavorable position in future USAF competitions. Corporate headquarters issued edicts in line with the Pentagon warning—identify the problems and rectify them no matter what the cost.

Flight Propulsion NEWS

A report about progress in research and products from the Flight Propulsion Division of the General Electric Company



Artist's concept of supersonic transport (SST) for which General Electric's Flight Propulsion Division is currently investigating possible propulsion system designs.

G.E. STARTS MAJOR SST ENGINE STUDIES

CINCINNATI, Ohio—Major research on jet engine designs for America's supersonic airliner was recently launched under FAA contract at G.E.'s Flight Propulsion Division here.

The FAA announced the contracts in a program calling for broad advances in the state-of-the-art of jet propulsion to meet the nation's objective of an economically feasible supersonic transport (SST) by the 1970's.

Contracts for $1,519,000 have been granted to General Electric for engine component research and other SST powerplant studies, with anticipation of total awards of $3.2 million.

General Electric's efforts will be aimed at building a broad base of knowledge which can be used in the eventual choice of an optimum economic powerplant.

The studies will include applied research in such critical areas as compressor aerodynamics; high turbine and combustor temperatures; advancements in lightweight component design; improved reliability in controls and other engine components; advanced exhaust augmentation systems; and determination of operating environmental conditions imposed on fuels, lubricants, seals, and bearings.

General Electric will also conduct studies to determine optimum operating cycles for the SST engines at both sub- and supersonic speeds, plus studies to determine optimum designs of inlet, engine, and exhaust systems, including a thrust reverser.

G.E. will continue its own company-funded SST research program in addition to work done under the FAA's initial and anticipated contracts.

Other current G.E.-funded and joint G.E.-Air Force programs in various areas of propulsion technology will also contribute to SST research.

For example, advanced compressor development and lightweight engine component design studies and hardware development are being supported by G-E funds and Air Force-funded contracts.

The Air Force and General Electric are contributing to research cost in several areas—advanced high pressure ratio compressor development; fuel injector work; turbine bucket and nozzle diaphragm cooling techniques for high-temperature turbines; advanced exhaust system design; materials and advanced fabrication technology to raise temperature capability and lower manufacturing costs.

The FAA research contract was negotiated through the Air Force's Aeronautical Systems Division, which provides administration and technical support of SST development projects for FAA. The FAA has over-all responsibility for the supersonic transport program as a national undertaking. Basic research and technical support are contributed by the National Aeronautics and Space Administration.

G-E CJ610's to Boost USAF Fairchild C-123 In "JATO" Application

LYNN, Mass.—Two General Electric CJ610 turbojets will be used to boost an Air Force Fairchild C-123 in an effort to increase the transport's STOL capabilities for application in limited wars or police actions.

Use of the lightweight turbojets is expected to provide a significant increase in the C-123's rate of climb, program officials said.

Under Air Force contract to Fairchild, the CJ610's will be installed below the wings, outboard of the piston engines. Flight tests of the modified aircraft are scheduled to get under way late this summer.

Chief use of the CJ610's is expected to be during take-off, but the jets may also be used for quick get-away in an emergency and would probably be at idle on landing.

Top speed of the conventional piston-powered C-123 is 245 mph. Cruising speed is 190 mph. Range with maximum cargo and minimum cruising speed at 15,000 feet is 1470 miles.

In service with the Air Force since 1955, the C-123 has been used mainly as a troop and cargo carrier. The aircraft can carry 60 troops, fully equipped, or one howitzer and one heavy truck.

The G-E CJ610's chosen to augment the C-123's take-off power produce more thrust for their size and weight than any other aircraft power plant available today. The CJ610 has also been selected to power several executive, utility, and trainer aircraft throughout the world.

Lockheed C-141 To Use G-E Power System

LYNN, Mass.—An all-General Electric power generating system, including 6000-rpm constant speed drives from the Aircraft Accessory Turbine Department here, has been selected for Lockheed Aircraft's forthcoming C-141 jet cargo transport.

The C-141 electrical system, similar to that already operational aboard Convair 880 and 990 commercial jet airliners, will also utilize generators and controls mounted on each of its four main engines, plus generator and controls for the aircraft's auxiliary power unit.

Lockheed-Georgia Company, a division of Lockheed Aircraft, is developer and producer of the C-141 for the Military Air Transport Service. Intended specifically for cargo and troop transport duty, the C-141 is designed to take off from short runways. It will be the first jet cargo transport to meet both military and civil requirements.

General Electric's constant speed drive for the C-141 is of the in-line type, rated at 40-kva. Most of its parts are identical to those in the drive's commercial twin aboard 880's and 990's. Drive modifications necessary for the C-141's front-fan engine installation were tested and demonstrated for Air Force, Federal Aviation Agency, and Lockheed personnel prior to the contract award.

Among the features of General Electric's hydraulic constant speed drives is its unique ball-piston transmission which uses precision steel balls instead of conventional pistons. Weight of the drive unit designated for the C-141 is only 76 pounds.

T58-Powered 'Copters Begin Service for NYA In New York City Area

NEW YORK, N. Y.—New twin-turbine Boeing-Vertol helicopters were placed in passenger service here on July 1 by New York Airways.

Powered by G-E CT58-110 engines, the new turbocopters make flights every half-hour linking New York's three metropolitan airports with Manhattan and the Greater New York area.

For New York Airways service the CT58 has been approved for 1000 hours operation between overhauls. The G-E engine was the first FAA-certificated U.S. helicopter gas turbine.

The 25-passenger 107's cruise at 155 mph, greatly reducing travel time. Flying time from Newark to Idlewild is 11 minutes, and the LaGuardia-to-Wall Street run takes only 5 minutes. From Idlewild to Wall Street the G-E powered 107 takes 7 minutes. Rates on many routes are below taxi fares.

The twin installations of the 1250-shp, 300-pound CT58 engines produce 1000 more horsepower than a helicopter reciprocating engine, yet together total less than half its weight.

In addition to New York Airways, major helicopter airlines in Los Angeles and San Francisco-Oakland are now operating CT58-powered turbocopters. A military version of the CT58-110—designated the T58-8—powers helicopters selected by all the U.S. military services.



Boeing-Vertol 107 moves swiftly through the skies over New York, high above busy expressways. The G.E.-powered turbocopters were placed in service July 1 by New York Airways.



Northrop Corporation's promising new Laminar Flow Control (LFC), designed to reduce aerodynamic friction drag, will be flight-tested early next year on two modified Air Force WB-66D's. Northrop officials expect use of the principle, developed under sponsorship of the USAF Systems Command, can eventually result in a 50 percent increase in large aircraft range, payload, or endurance. The LFC "breathing" wing on the aircraft uses underwing compressors to inhale turbulent boundary air through paper-thin wing slots. Two G-E XJ79-13's, non-afterburning versions of the J79-3A, are mounted on the aft fuselage to broaden the range of experimentation on the Laminar Flow Control wings and to minimize weight and noise effects.

VERTOL 107 PICKED FOR AIR FORCE DUTY

WASHINGTON, D.C.—The Boeing Vertol 107 has been selected by the Air Force for long-range logistics support.

Powered by twin General Electric T58-8 turboshafts, the 107 is slated for Air Force utility tasks such as re-supply of Texas Towers, recovery of target drones, and rescue missions.

Current versions of the aircraft, already in production at Vertol's Morton, Pennsylvania plant, will receive only slight modifications to satisfy Air Force specifications for a long-range helicopter. The 107 must be able to carry 25 troops or 15 litter patients and two attendants.

During Air Force evaluation tests, the 107 made repeated flights to Texas Towers off the Atlantic coast, demonstrating its ability to carry 5000-pound payloads 200 nautical miles or 2400-pound payloads 700 nautical miles. Top speed of the aircraft is 168 mph; cruising speed, 155 mph.

The 107 has a watertight hull to permit water landing. Two fuel-tank sponsons jutting from the lower part of the fuselage provide stability to prevent capsizing while on the water. They are airfoil-shaped to provide lift during forward flight.

The General Electric T58 turbine engines produce 1250 shp each. To date this engine has accumulated well over 100,000 hours in military and commercial service.

The civil version of the 107, powered by CT58 engines, is in service with New York Airways, and has been ordered by Kawasaki Aircraft Company of Japan. Military versions of the helicopter, powered by T58 engines, have been ordered by the United States Marine Corps, and the Royal Canadian Air Force.

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For free bulletins on the G-E engines and propulsion systems discussed above, just check below and send coupon to General Electric, Section A206-50, Schenectady, N. Y.

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- ☐ SAE-120A "T58 Engine"
- ☐ GED-4114 "J79-Powered Record Holders"
- ☐ GED-4516.2 "G-E J79-8 Power for F4H and A3J"
- ☐ GEA-7542 "G-E Constant Speed Drive"

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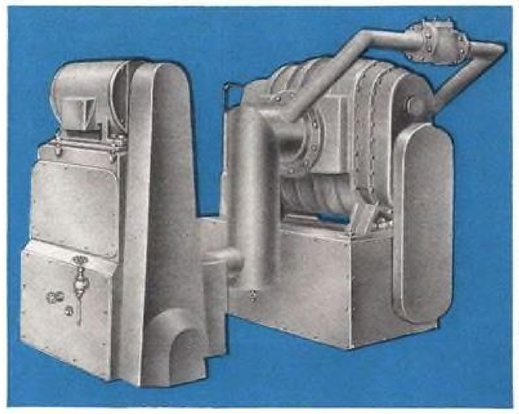
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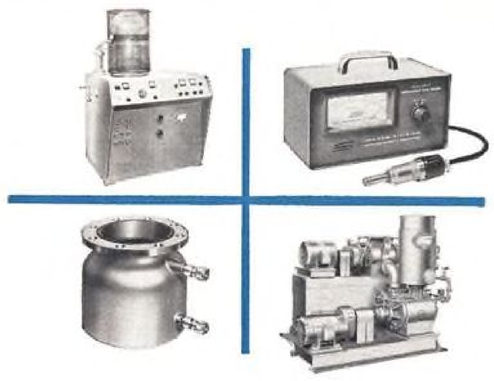




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This 5000 cfm system combines a lobe-type booster pump with a new and original triplex pump in a vibrationless compact package operating automatically from atmospheric pressure to a blank-off of 2×10^{-4} torr. A patented by-pass roughing line reduces the time required to reach the booster pump cut-in pressure. Chief assets are high pumping capacity over a wide pressure range, freedom from oil vapor backstreaming, and long dependable service under the severest applications.



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pean NASARR contractors until they can take over all aspects of the program and their output meets demand in an estimated two years time.

Because of the Turin costs and those for company-funded research and development, unanticipated home production and the additional field personnel it has supplied, North American probably will lose money on the program.

Cost of the European production lines also has risen beyond expectation. Again, a prime factor here has been the accelerated technology which the licensee contractors have had to absorb. Messerschmitt, for example, was still cutting its post-war teeth on the licensed production of France's Fouga Magister jet trainer when it was called upon to begin tooling for the F-104.

A difficult step in any event, it was further complicated by the fact that the company had never before used the linear system. All previous projects had been on the metric scale, and, as some U. S. firms have learned in the past, a switch from one to another can be difficult.

European View

From the European point of view, the long lead time item and spares purchases, the production problems here and a largely unanticipated financial drain for research and development work on the over-all weapon system have served to double estimated costs in some areas. The Europeans contend they were not sufficiently warned of the R&D yet to be done when initial contracts were signed in 1959, and, whether they were or not, the problem of financing had become an embarrassing one, creating additional headaches for the U. S. companies and explaining to some degree the lag between letter of intent and firm contract for a number of items involved.

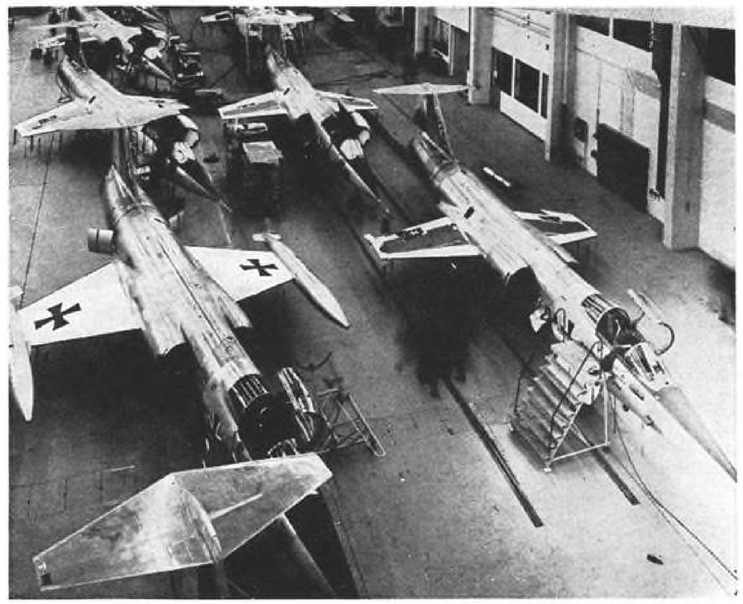
Some U. S. officials in the Pentagon and elsewhere tend to agree with European charges that, in their initial sales efforts at least, some U. S. firms "oversold" their products, played down the development work still needed on the system as a whole, failed to mention that certain components could not be built outside the U. S., or that over-all performance would have to be sacrificed to some extent in order to fit the aircraft to its three-mission mode.

In consequence, there have been recommendations for a coordinated government-industry policy of contracting for any major license programs of the future.

"Everything has been confused," one U. S. official observes. "Each contractor was—and still is—running around on its own, and so is the Air Force . . . . everybody has been doing a lot of end running, making separate agreements on his own.



F-104G PRODUCTION LINE at the Messerschmitt factory at Manching is where aircraft produced by team of Dornier, Heinkel, Siebel and Messerschmitt are assembled.



F-104G AIRCRAFT currently are being delivered from this twin production line at the Manching factory to West German and other NATO air forces.

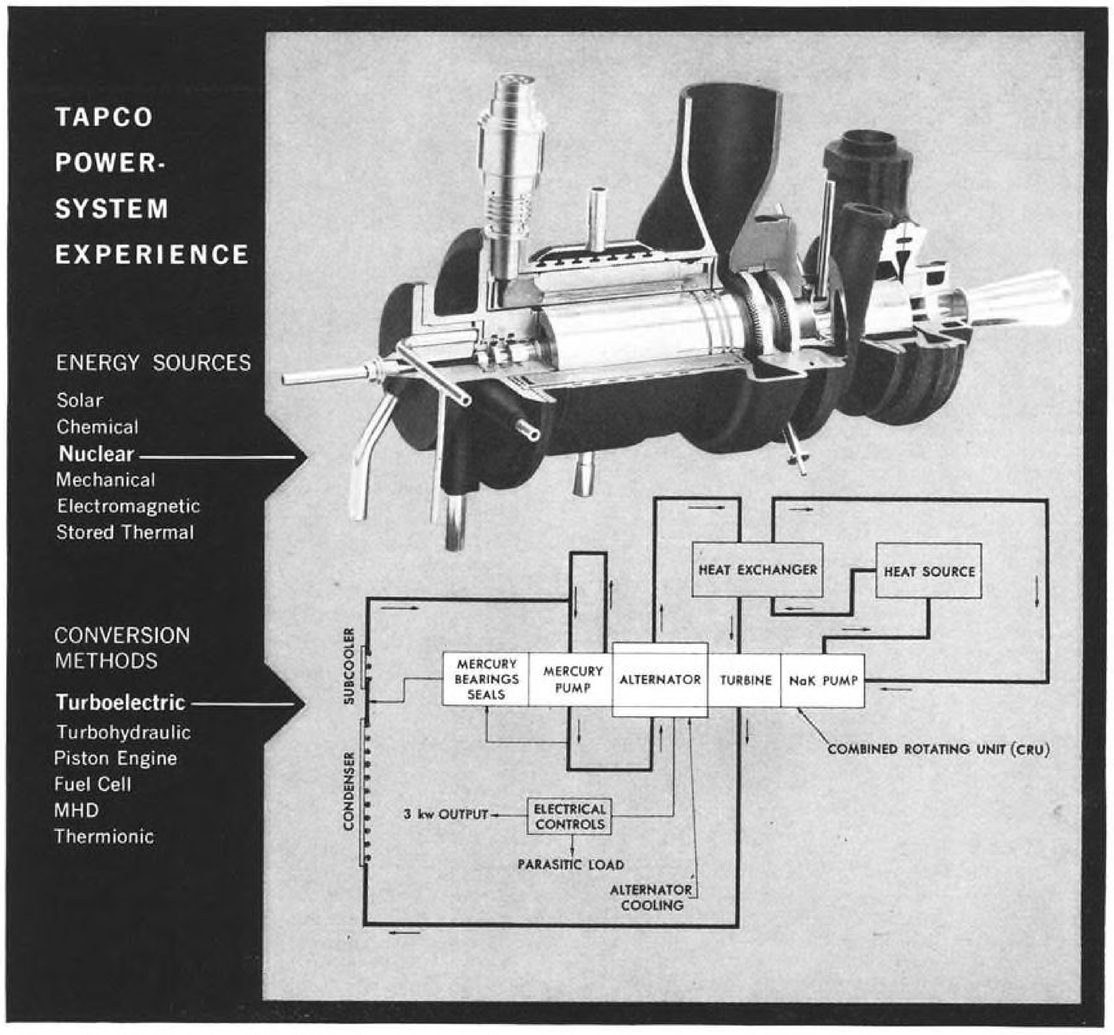
"Even after the program was set up, other [U. S.] companies kept moving in, still trying to sell, saying, 'This system's no good, use ours instead.' This confused things even more.

"On matters like this, we need a united government-industry approach. The U. K. and France come in on a sales program with a common front. We never do, but we've got to start. . . . The government sits back until there's trouble, and then everybody gets into the act—Dayton, Edwards, the Pentagon—one saying the program is all right, another that it's no good. . . ."

To avoid any future potential overselling, others are urging that U. S. companies be compelled to go down the list with the customer on an item-by-item basis, pointing out in advance the status of each unit, its reliability and state of development and stating definitely whether it can be produced aboard or whether it must be built in

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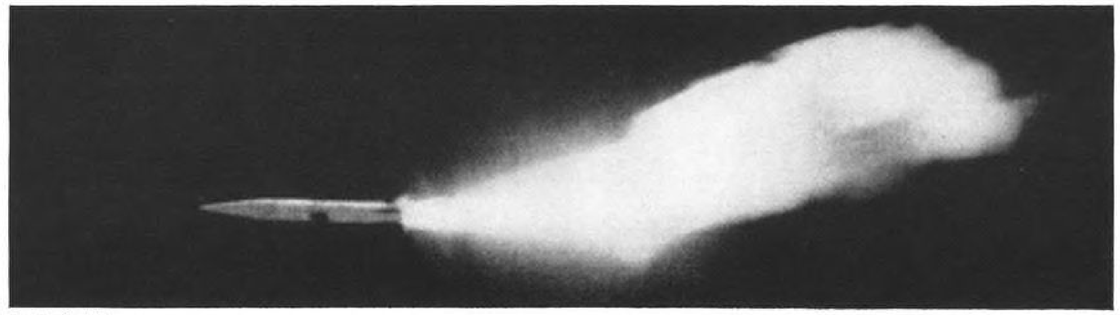
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Douglas Skybolt



North American A3J

DAYSTROM TRANSICOIL'S ROSTER OF MODERN MISSILES AND AIRCRAFT ...AND OUR SERVO ASSEMBLIES ABOARD THEM



Height Indicator



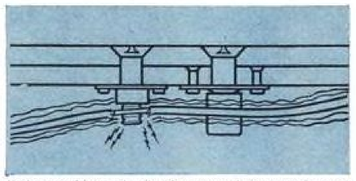
Guidance Controls

As on a multitude of other weapons systems, Transicoil subsystems are aboard both Skybolt and the A3J. ■ For Skybolt, Transicoil supplies the guidance control packages shown at left. These consist of gimbal-mounted synchro resolver transmitters; azimuth, roll and pitch repeater assemblies; and synchro computing resolvers. ■ For the A3J, Transicoil supplies the radar height indicator shown at left. This precision airborne instrument, which utilizes synchro data from the altimeter, consists of control transformer, motor generator, transistorized servo amplifier, anti-backlash gear train, and the meter indicator itself. ■ All rotating components are size 8 in both applications, and are manufactured by Transicoil. This is design excellence and reliability. This is Daystrom Transicoil. Write for booklet, "Cases in Servo Control".

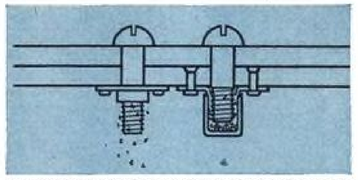
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BOOTS CAPPED LOCKNUTS

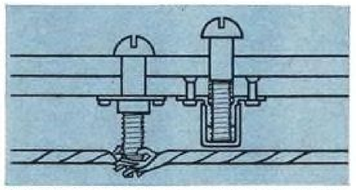
Protect Vital Assemblies, Assure Safe, Trouble-Free Operation



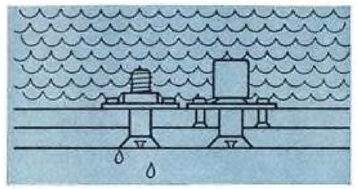
Under conditions of vibration, capped locknuts increase assembly reliability by preventing the abrasive removal of insulation from wires near protruding bolt threads.



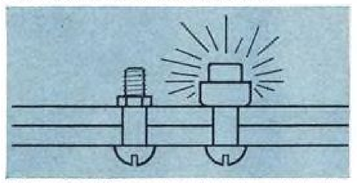
Increased reliability and protection for delicate exposed circuits—cap effectively traps metallic flakes or other fallout resulting from assembly of screw and nut.



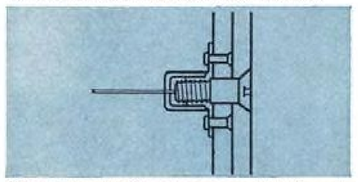
Automatic quality control—capped locknut prevents damage to internal and hidden assembly from screw that is too long. Important wire bundle circuits are safe.



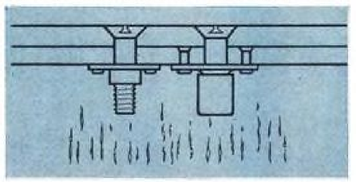
Used in conjunction with liquid sealing "gunk," capped locknuts provide one of the lightest weight integral seals possible for fastening integral tanks or other liquid reservoirs.



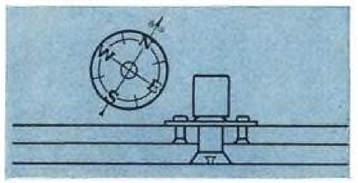
Neat, workmanlike appearance is always a product plus—capped locknuts show extra care in design and manufacturing—experienced buyers look for these extras.



For maximum reliability, caps can be provided with a probe hole so inspectors can check penetration of screw in nut locking element.

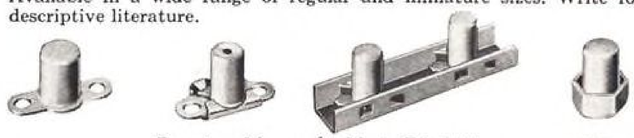


Protection from galling of screw threads in high temperature and corrosive atmospheres. Capped nut protects threads and permits easy subsequent removal of screw—fast replacement of sub-assemblies.



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the U.S. because of industry or government requirements.

Defense ministers of the four consortium nations have been hesitant to approach their respective parliaments for additional funding because of criticism over the F-100G decision or its subsequent problems.

"They don't want to do it," one spokesman says, "but it is something they can't avoid, and they're going to have to do it."

Increased Costs

Nevertheless, speculation as to the increased cost of the program has touched off reports of cutbacks in the over-all total of 100-200 aircraft. Here, the cost problem has been joined by charges that the aircraft will be obsolete by the time it actually becomes fully operational.

Officials close to the program doubt that there will, or can be, any cutbacks. More than half of the funds needed for the program as a whole already have been committed for production, tooling, new facilities, materials on order, etc. Much of this inevitably would be lost in any substantial cutback.

Estimated price is predicated upon the full 949-aircraft program. A cutback by one country not only would raise the unit price of its own aircraft but also those of the other three involved. Under terms of existing agreements, the responsible nation would be liable to pay the other partners the difference in cost.

There is still another restriction so far as Italy, Belgium and Holland are concerned. Together, they are to receive 345 F-104Gs, of which 100 could be financed by the U. S. Mutual Aid Program, if certain conditions are met.

MAP Conditions

One is that the three countries stand by their own initial purchase orders. Therefore, any reduction in quantity could endanger their respective shares under the MAP program.

Another condition could mean that the three countries may at the same time find themselves absorbing some of the costs on the 100 MAP aircraft in view of the general price spiral. The agreements, as one spokesman explains, provide that the U. S. will contribute a total of $140 million toward the aircraft, including spares and ground equipment. This represents production money only, and no funds for research and development are included.

"We said, 'If the cost is less than $140 million, it's your good luck. If it's more, it's your bad luck, but, if there are any changes in the numbers bought, we'll have to come back and renegotiate'."

European governments are falling behind on their progress payment schedules, sometimes drastically. One U. S. company, which hesitated to cut off the hardware supply for fear of upsetting the program and having to accept the resultant blame, recently found that its customers were $11 million behind in payments. More money must be found, and the only answer appears to lie in new approaches to the parliaments concerned.

Ultimate capability of the aircraft in its three all-weather roles is largely dependent upon the -41 version of the NASARR fire-control system. NASARR has come in for its share of criticism, and these complaints probably will continue because, by concept, the unit must meet conflicting requirements.

In the air-to-air mode, for example, evaluation pilots at Palmdale and Edwards AFB, Calif., have complained of ground clutter interference on the scope. The same system, however, also must be used for air-to-ground work, where ground reference is the basic ingredient. Just how clutter could be blanked out in one mode and then restored for another without an unacceptable loss in over-all performance or unit price increase appears to be beyond present capabilities.

Other NASARR Criticisms

Aside from clutter—the most persistent item and one that has U. S. Air Force monitors seriously concerned—complaints have risen about the system's ability to lock onto and hold its targets and distortion in the general presentation.

By late March, after a series of evaluations at Edwards, a total of 278 pilot complaints had been registered on the -41. North American feels that a breakdown of these justifies its position that the system will become a "good piece of equipment" once the growing pains are over.

Of the total, only 1% required actual modifications to rectify, while 53% were taken care of by cockpit adjustments to the control settings.

The problems that had to be faced in development of the unit can be seen from its mission requirements:

- **Air-to-air:** airborne target detection, target tracking, aircraft steering data.
- **Terrain avoidance:** provide data necessary for low-level all-weather flight.
- **Ground mapping:** locate and define ground targets for navigational and bombing purposes.
- **Air-to-ground:** provide range data to the bomb computer.

The -41, developed especially for the F-104G, is essentially a modification of the basic NASARR-31MC air-to-ground system used in the Republic F-105 fighter bomber. "When you start cranking in an air-to-air capability," one official concedes, "you're going to run into problems. You are never going to get



United States Patent No. 2931532. Qualifies under NAS Specification 1400 and meets Standard Pages NAS 1398 and 1399. For technical data on the Cherrylock "2000" Series rivets, write Townsend Company, Cherry Rivet Division, Box 2157-N, Santa Ana, California.

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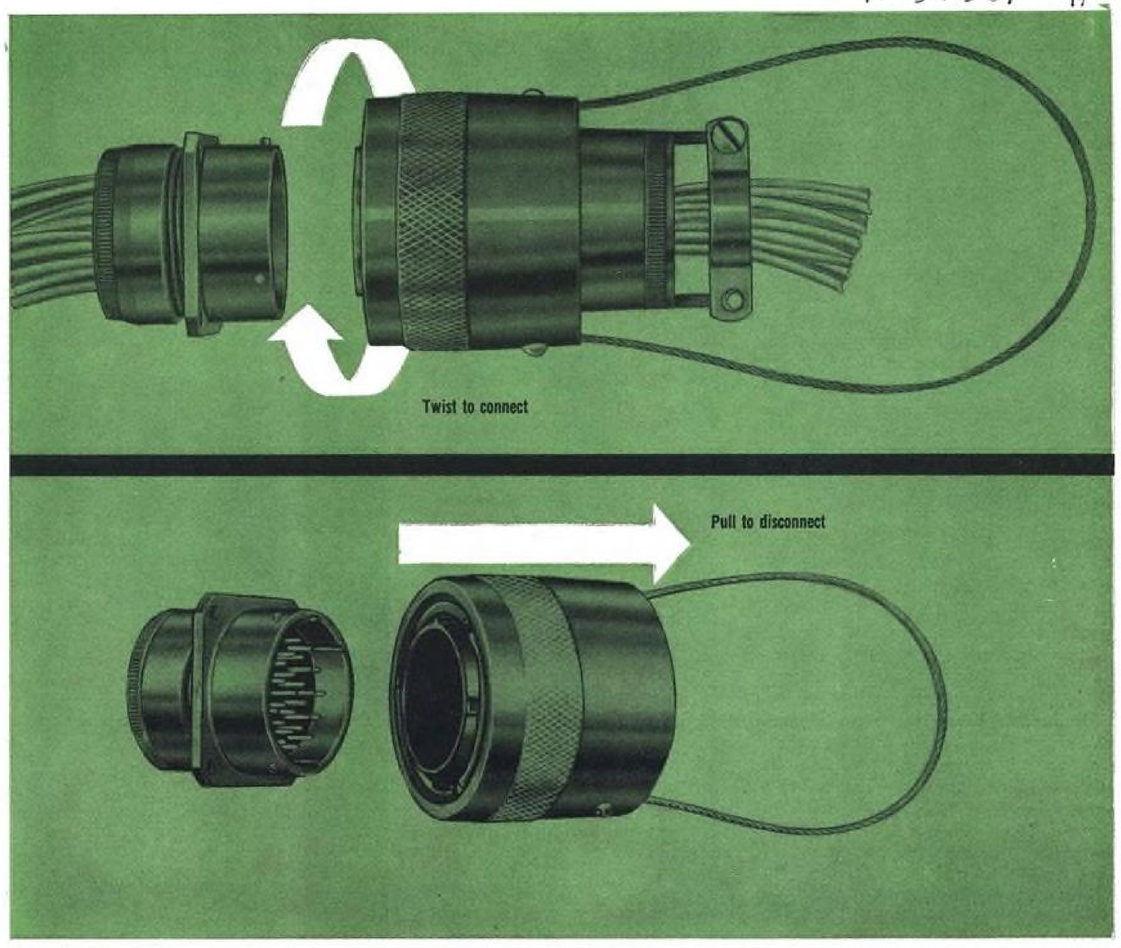
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it perfect in both modes." He adds, however:

"I think a lot of the criticisms will take care of themselves once people get accustomed to using the system. . . . I believe this is about 90% of our problem."

North American can expect another round of complaints when the pilots of operational and training units become accustomed to flying the aircraft and begin paying more attention to its all-weather systems.

Troubles Anticipated

"We know there are going to be malfunctions," one spokesman says. "They're going to turn on the black boxes for the first time, and sometimes they just aren't going to work."

European failure to accept recommendations for the employment of field service engineers complicated the fire-control situation. The Americans, for their part, were slow to recognize that the scope, complexity and magnitude of the F-104G project removed it from the realm of the relatively-simple licensing programs of the past and would require special attention.

North American, for instance, did not actually participate in the sale of the 40 aircraft now in operational service with the West German air force or in some of the later shipments to Europe. Equipment, -31MC units that still had to be modified to the -41 version, was sold directly to Lockheed, and no final adjustments were made by North American before the aircraft were delivered to Germany. The company has not yet had the opportunity to make detailed inspections of the equipment.

Had North American taken an earlier interest in the program as a whole, some observers contend, its present headaches would be less severe. In turn, North American maintains that it handled the initial orders in the normal way.

Lockheed, as the systems manager within the U. S., placed the order and North American delivered, rendering the services requested by the systems manager.

System Sales

Of the 1,472 NASARR systems presently scheduled for the over-all F-104G program, including Canadian production, 218 complete sets were sold directly to Lockheed by North American.

Lockheed also underestimated the size of the task involved. In its original contracts, the company stipulated that one Lockheed technician would be based at each of the licensee contractor plants. This, essentially, was to represent the company's contribution within Europe, except for recommended field service personnel, check pilots, etc. The system had worked well in earlier Lockheed licensing programs, and the company felt it would be sufficient in this instance. It wasn't.

At the moment, the American firm has 125 of its own employes in Europe working exclusively on the F-104G program. Of these, 38 are being carried entirely by Lockheed with no cost or salary reimbursement from the European side.

North American also is funneling in field personnel in addition to the Turin-based staff in an effort to compensate for the slack caused by European reluctance to employ them on their own. Two years ago North American proposed that a minimum of 57 NASARR technicians be placed in the field. The Europeans thus far have employed three.

North American is establishing at its expense a six-man team at Germany's Norvenich air base, home of the first G wing and of general F-104 training activities, that will serve as a flying squad to respond to and rectify, if possible, complaints from the field. This group, working under the aegis of North American S. p. A. in Turin, will handle problems met as the NASARR units begin to phase into day-to-day operations.

European failure to employ U. S. technicians on the required scale also has been influenced by pride. Recent employment at U. S. insistence of 19 Lockheed technicians within the technical divisions of the European F-104G management agency in Koblenz, Germany—the NATO Starfighter Management Office (NASMO)—to speed development pace was strongly resisted in some quarters despite the fact that the American government is subsidizing most of the cost by means of a technical assistance contract.

A major goal is to buy technology, and the thought of having to use U. S. technicians on a broad scale rankles. American insistence on this seems to some as a slur against the technician skills of their own people.

Europeans Irked

"It goes against their grain," one observer says. "They don't consider that, if it had been the other way round, the U. S. would have needed a large number of European technicians in the States to get things moving." Another adds:

"We should have had 30-40 Lockheed people at NASMO a year ago. Finally, we have 19, and they only arrived this spring."

The European management program itself has come in for its share of criticism, particularly over its structure: a board of directors composed of representatives of each of the four nations in-

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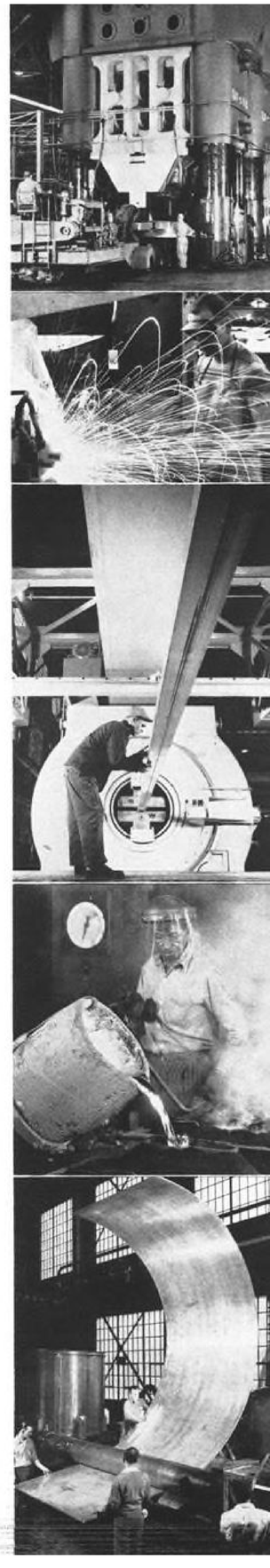
This is another example of what Alcoa total capability can do and is doing every day in the production of scores of defense items for all services.

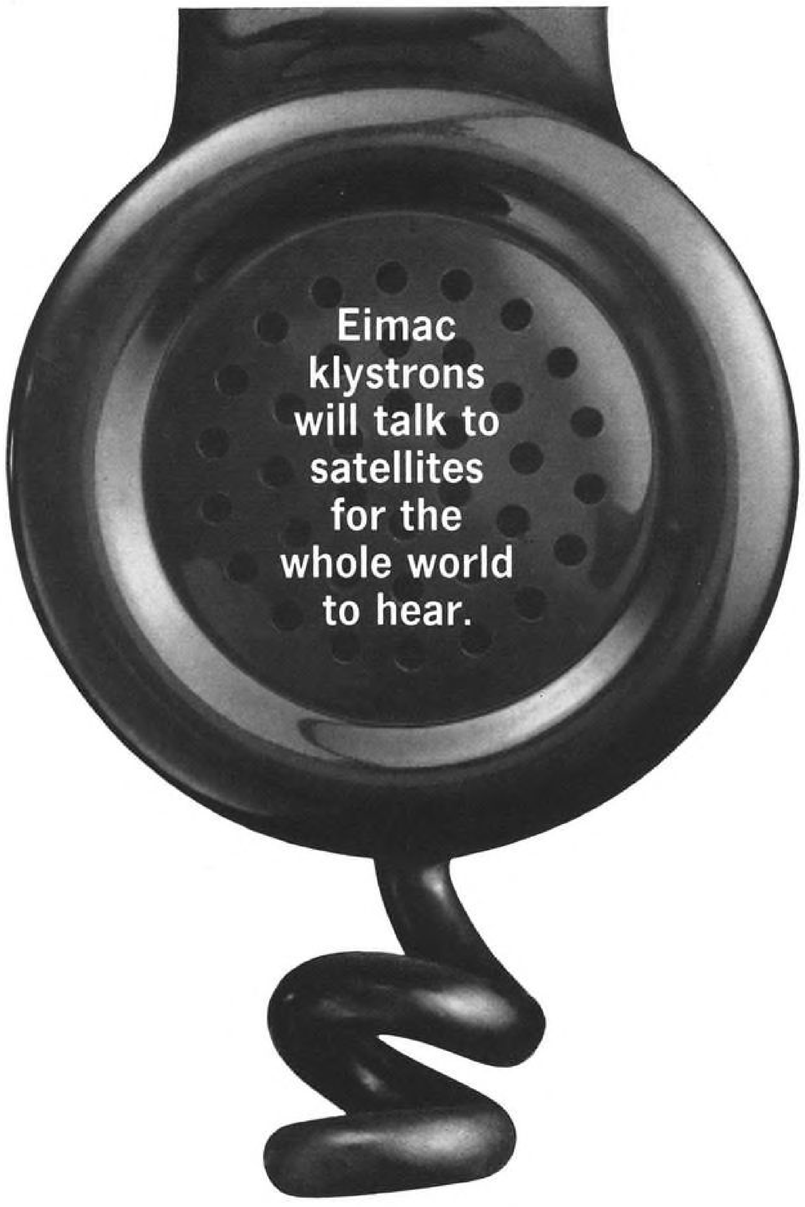
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volved. As now revised, a U. S. representative also sits on the NASMO board, but his responsibilities and authority are limited.

Although the NASMO system has its defenders, others contend that the multi-national board is directly responsible for a number of the program's present and past ills.

"One big reason these countries are having to spend more than they planned in the U. S. is that the board can't agree on anything," one observer complains.

"Everything has to be unanimous . . . and the management office isn't capable of managing the program . . . They probably have lost the equivalent of one full year of production over here because of this." Another adds:

"The board has haggled for days and literally months over such questions as whether the number of people in a division should be 27 or 22 and how the jobs should be split up among the different nationalities or how many safes there should be in the headquarters office."

Most agree, however, that the board's and NASMO's effectiveness are improving as the four nations gain trust and respect for one another.

On the acceptance timetable, the F-104G passed its Category 2 customer acceptance tests in May at Edwards, AFB, Calif. after more than 1,000 hr. had been flown by U. S., German, Canadian, Belgian, Dutch and Italian pilots on five aircraft involved.

Category 3 squadron acceptance tests are scheduled to begin at Norvenich later this year, a regimen that will evaluate the G model's capability in each of its three specialties, including live bomb drops, air-to-air intercepts and reconnaissance strikes. Final acceptance here will be a major milestone, and the combat-condition compromises the aircraft must sacrifice in order to attain its multi-mission capability will be better known and understood.

Before the conclusion of the Category 3 trials, the -41 versions of NASARR should be in Europe in fair quantity, and the already-delivered -31MC units should have been modified to the three-mission mode.

Approximately 70 of the -31 units already are in Europe, and the modifications to convert them to the -41 configuration will be carried out at both Turin and Palmdale on a roughly 50-50 basis. Final modification is scheduled before the end of the year.

Under present planning, Turin will accept 10 units a month for modification, with each set remaining there for about five weeks from the time it is received until it has passed through final inspection.

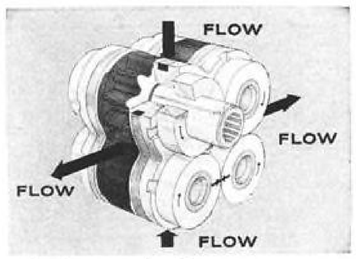
Major emphasis on the step from the -31 to the -41 has been placed on component reliability, and North American says the results are promising. Guaranteed over-all mean time between failures on the -41 is 50 hr. Present figure is approximately 40 hr.

Design of the -41 system is virtually completed, and future modifications are expected to be minor enough to handle in the field.

One anticipated compatability modification will have to be made when the European consortium decides upon a radar-guided air-to-air missile to supplement the infrared Sidewinder. Leading contender at the moment appears to be the Hughes HM55, a high-explosive warhead version of the nuclear-tipped GAR 11.

The European licensees for the -41 system, now tooling for test and repair work, are scheduled to build a total of 689 units. They are now letting subcontracts in Europe and issuing purchase orders for certain components within the U. S., normally with North American Aviation vendors.

North American's Turin facility will handle the majority of the modification, overhauls and repair work until the European licensees can take over. Turin is keeping a close watch on the licensee programs through its own quality control experts at each plant.



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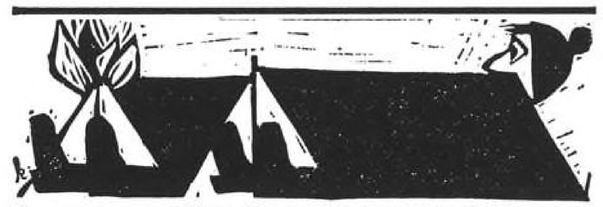
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PROBLEMATICAL RECREATIONS 131



Two campers, Penrod and Sigmond, have pitched their tents not far from a river. Smelling smoke, Penrod looks out of his tent only to notice that Sigmond's tent is on fire. Penrod grabs a bucket and is about to make a dash for the river to fill the bucket followed by a quick return to Sigmond's tent. The chances of quenching the fire are good if he wastes no time. Can you advise Penrod what point of the river he should head for? — *Contributed*

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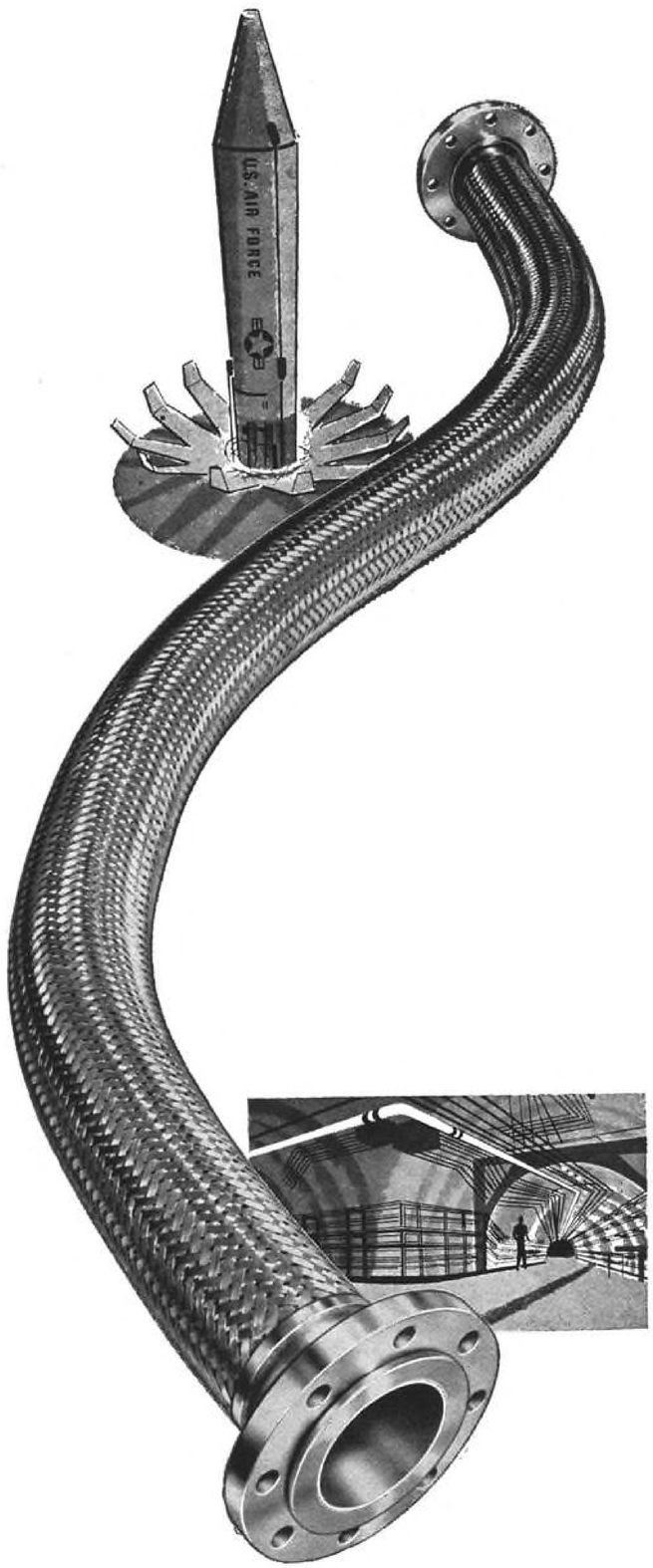
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General Electric Co.'s Ordnance Department, Pittsfield, Mass., will build fire control systems for Polaris missiles under a $17,170,000 Navy contract. Hughes Aircraft Co. has received a $20-million contract to build the same systems, under Navy's dual source supply plan. Hughes also has received a $2.5-million contract from GE, to assemble and test five of their systems.

Thiokol Chemical Corp.'s Reaction Motors Division, Denville, N. J., will continue company-sponsored research on the use of oxygen difluoride (OF_2) as a high-energy, space storable oxidizer for use in space vehicles.

American Machine & Foundry Co.'s Atomic Division, Greenwich, Conn., will design and build remote handling systems for ground testing the nuclear Nerva (nuclear engine for rocket vehicle applications) engine, under an $850,000 contract from Aerojet-General Corp.

Northrop Corp.'s Ventura Division has received a $1,365,783 Army Signal Corps contract for 150 SD-1 surveillance drones.

Avco Corp.'s Everett Research Laboratory, Everett, Mass., will expand its re-entry monitoring activities to include the study of wake measurements as a means of discriminating between missiles and decoys for the Nike Zeus system. Work will be done under a $682,832 contract from the Army Ordnance Missile Command.

Rocket Power, Inc., Mesa, Ariz., has received a $21,849 contract from Air Force's Electronic Systems Division to develop and flight test 15 JUDI Dart rockets to boost balloons aloft for high-altitude meteorological research.

Talley Industries, Mesa, Ariz., will build mechanisms for opening Minuteman silo lids and withdrawing umbilical cables from the missile guidance systems under a Boeing Co. contract approximating $1.4 million. The mechanisms are for Minuteman underground launching systems in Montana and South Dakota.



SIMULATION

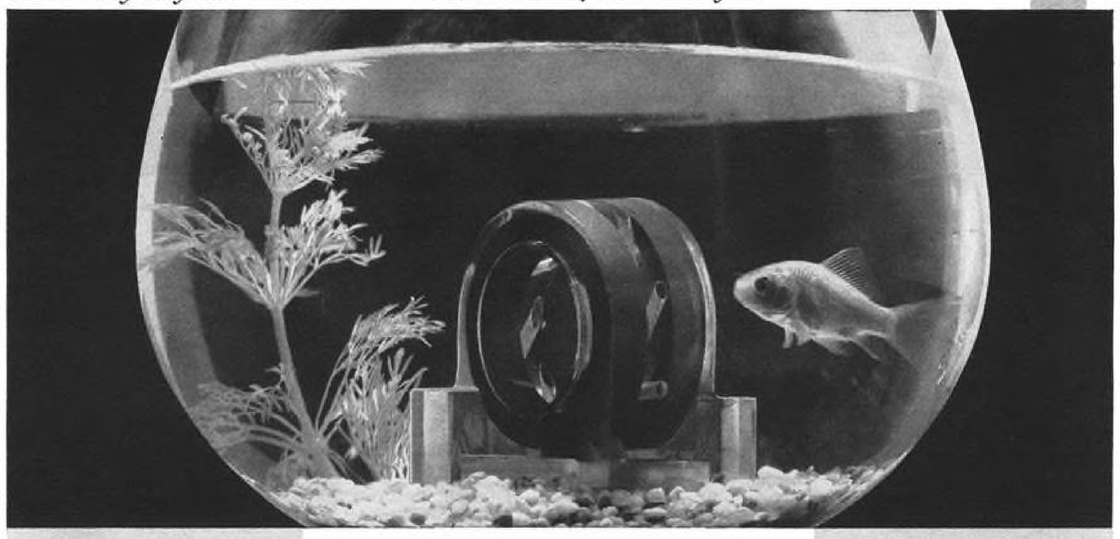


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Aerial Refueling Simulator Utilizes Three-Dimensional KC-135 Model

New York—Ground training device which will enable Strategic Air Command bomber pilots to simulate aerial closures and hook-ups with KC-135 jet tankers is being developed by Link Division of General Precision, Inc., at Binghamton, N. Y.

Link's equipment, the outgrowth of a contract received more than a year ago from USAF Aeronautical Systems Division, is designed to serve initially as an attachment to the Boeing B-52G flight simulator produced for the Air Force by Curtiss-Wright Corp.'s Electronics Division.

Link engineers maintain, however, that the refueling simulator will be easily adaptable to other types of combat aircraft simulators to augment pilot and copilot training in air refueling and low-level attack procedures. The refueling simulator is scheduled for delivery to the Air Force early next year.

Display Unit

The attachment is a visual display unit incorporating a color Orthicon camera focused on a three-dimensional, 1:50 scale model of the KC-135. The camera is mounted on a servo assembly which permits 6 deg. of freedom for vertical, lateral and back-and-forth movement of the camera in relation to the model.

The tanker's image will be projected on a 12 ft. x 16 ft. screen positioned in front of the flight simulator cockpit. The light-valve projector used in the Link unit will cover a field angle of 50 deg. A minute hemispherical lens developed by Link will provide a much larger and brighter color projection than possible with similar closed-circuit television techniques, a company engineer says.

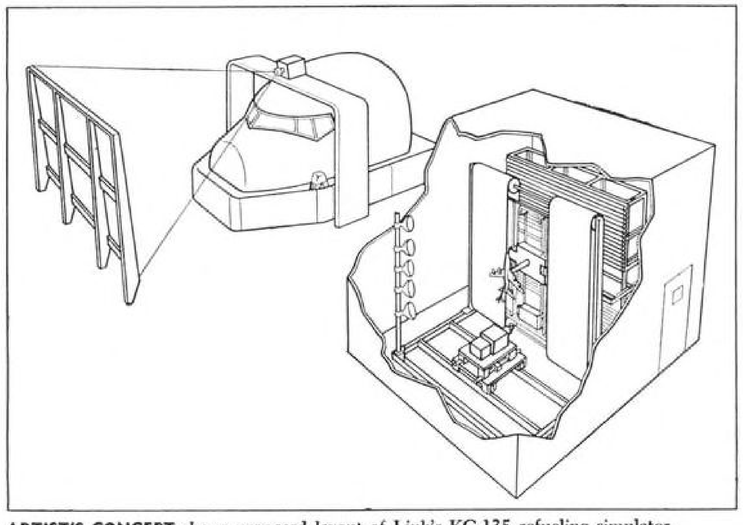
The KC-135 model, fastened to a continuous belt assembly, is to be marked with the same underbody color trim used on SAC tankers. The model also will have facsimiles of rendezvous beacon and navigation lights, boom marker and boom nozzle lights used on the KC-135 to assist the bomber pilot in positioning his aircraft for contact with the refueling boom.

Simulate Refueling

Pitch, roll and yaw servos within the model, gimbaling devices and other servos controlling movement of the boom will be used to simulate refueling operation as closely as possible.

In operation, the Link unit will simulate closure on the tanker from a separation of 500 ft. and extend through simulated hook-up, when the boom nozzle will appear to be inserted into the bomber's fuel intake just aft of the cockpit. Fuel flow and break-away of the two aircraft after completion of the refueling also will be simulated.

An instructor boom operator with extensive KC-135 experience will control the tanker's movements and vertical, horizontal and telescoping movements of the boom on the model. Boom actuating servos will move the refueling device in three motion degrees—up-



ARTIST'S CONCEPT shows proposed layout of Link's KC-135 refueling simulator.

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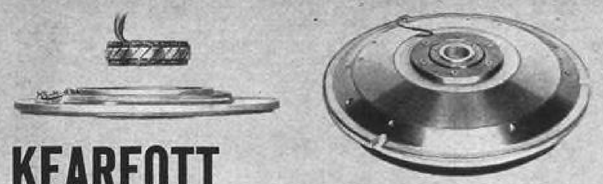
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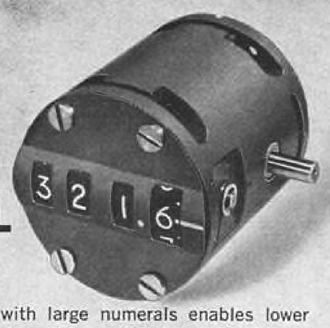
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SPECIFICATIONS

Typical Part Numbers	Function	Excitation	Accuracy
3Z6390-001	Resolver Transmitter	20v 900 cps	3 min.
CZ06360-002	Resolver Transmitter	115v 800 cps	20 sec.
5Z6360-009	Resolver	115v 800 cps	3 or 5 min.
3Z6210-006	Synchro	As req'd	2 min.
1/3Z6360-006	Resolver	115v 800 cps	20 sec.

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CHARACTERISTICS

Part Number	Maximum Count	Counts Per Rev.	Maximum Speed RPM	Break-Away Torque IN. OZ.
C160432-( )	179° 59′	20′	1200	.75
C160431-( )	179° 59.9′	2′	1200	1.0
C160435-( )	179.9°	2°	1200	.75
C160433-( )	99.9	2.0°	1200	.75
C160434-( )	999.9	2.0°	1200	.75
MK 3 MOD 1	359.	2.0°	1800	.35
C160407004	359.9	2.0°	1800	.35

For complete data write Kearfott Division, General Precision, Inc., Little Falls, New Jersey.

GENERAL PRECISION

down, swing-right and swing-left, and telescoping, the latter referring to extension or retraction of the nozzle for contact and break-away with the bomber receiver.

Switching Mechanism

A switching mechanism releases the servos when contact has been made with the bomber in the simulated refueling.

If contact is broken for any reason, the servos will be automatically re-energized. Limit switches are to be included in the tanker model controls to break contact automatically if receiving aircraft movements exceed boom range.

This simulates the same procedure which is followed in an actual refueling hookup.

Downwash effect of the KC-135 on the bomber will be simulated for the flight simulator pilot. An analog function generator will be used to trigger the movements of the bomber simulator in the same manner as downwash would buffet a bomber in flight when the airplane comes within close proximity to the KC-135. Much of the success or failure of the simulated refueling will depend on the pilot's ability to compensate for this effect of artificial turbulence.

Other Uses

Link is considering other possible uses for the techniques employed in the refueling simulator. The key to adaptation of the unit to simulated fuel transfers involving other types of aircraft is the mere substitution of another model for the KC-135 replica.

Model targets could be filmed by the camera and projected in front of a cockpit to provide ground training in low-level bombing or strafing tactics.

Homing Chute Keyed To Ground Signal

New York—Parachute designed to guide itself to within 50 yd. of a ground transmitter signaling to it, has been developed to aid recovery of instrument packages dropped from high altitudes.

The homing parachute is the development of Sandia Corp., an Albuquerque, N. M., subsidiary of Western Electric. Sandia Corp. operates under a non-profit, no-fee contract with Atomic Energy Commission to develop equipment prototypes connected with nonnuclear aspects of the atomic bomb program.

Basically, the homing parachute consists of a standard circular parachute with one panel removed. Air rushing into the canopy escapes through the missing panel exerting a force which pushes the parachute in the opposite direction to that of the air current.

By keeping the missing panel turned away from the ground transmitter controlling the descent, the parachute can be guided toward it.

To keep the opening turned away from the transmitter, a small transistorized control unit consisting of two antennas, a receiver and a small electric motor is used. Through the two antennas, the receiver senses the position of the opening relative to the transmitter.

If correction is needed, the receiver signals the motor, which is connected to the shroud lines on either side of the opening.

Canopy Rotation

A pull on one shroud or the other, triggered on signal to the motor, deflects the air stream rushing through the opening, causing the canopy to rotate until it is in the desired position relative to the transmitter. When proper position is achieved, the motor releases the shroud, allowing the parachute to glide toward the transmitter until further correction is needed.

Glide distance is limited by the capabilities of the parachute. Standard parachutes with a glide ratio of less than 1:1 have permitted landings within 5 to 50 yd. of the transmitter when dropped within a mile of it.

Possible applications for the homing parachute, according to Sandia, include nose cone recovery and air drops of supplies and equipment, particularly when visibility is low.



Protective Suit

Plastic suit covered with 24-kt. gold is designed to protect personnel working with exotic fuels. The manufacturer, Snyder Mfg. Co., of New Philadelphia, Ohio, says the suit can protect the wearer from flash temperatures up to 3,000F. Suit weighs 15 lb. and contains air supply and built-in two-way radio. Gloves, boots are acid resistant.

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Of simplified construction, using Beryllium in major structural elements, this gyro contains only 33 parts, (only four in the motor). This makes possible a readily producible, highly reliable gyro with repeatable performance.

Day-to-day performance of 0.1°/hr without summing over a 12 month period has been obtained. The King gyro has been subjected to temperature of —80°F without damage. In tests, warm up has averaged 5-10 minutes from this temperature. In addition, mass unbalance was found to vary a total of 0.25°/hr/g to 0.75°/hr/g over the temperature range of 75° to 180°.

CHARACTERISTICS

	C70 2519 001 C70 2523 001 C70 2527 001
Angular Momentum (gm cm²/sec)	5.1 X 10^5
Drift, Vertical (short term) (°/hr.)	0.003
Drift, Azimuth (short term) (°/hr.)	0.015
Mass Unbalance (max. each axis) (°/hr.)	0.2
Fixed Torque (max.) (°/hr.)	0.2
Mass Unbalance Shift (max. spread) (°/hr.)	0.2
Fixed Torque Shift (max. spread) (°/hr.)	0.2
Torquing Rate (max.) (°/hr.)	22,000
Torquer Linarity (% to 165°/hr.)	0.02%

FEATURES

C70 2519 001—Incorporates heaters and temperature sensors. It is trunnion mounted.

C70 2523 001—identical to the C70 2519 001 except flange mounted at gyro CG rather than trunnion mounted.

C70 2527 001—Basically the C70 2519 001 without integral stand-by heaters and temperature sensors.

For complete data write Kearfott Division, General Precision, Inc., Little Falls, New Jersey.

GENERAL PRECISION

INTERNATIONAL AIR TRANSPORTATION ISSUE SEPTEMBER 10, 1962

The impact and challenge of recent trends and developments in international air transportation will be the subject of AVIATION WEEK & SPACE TECHNOLOGY's *International Air Transportation Issue*, September 10, 1962.

This major editorial effort will analyze the direction and problems associated with the growth and expansion of air transportation in all major world markets including Atlantic, Europe, South America, Africa and Asia.

Subjects slated for special emphasis are: Development of a new U.S. international air policy; Worldwide impact of common market and African consortiums; New flag carriers of emerging nations; New trends in supersonic transport research; Communist bloc penetration in world air markets; 1962 traffic trends; and future international tariff and merger problems.

Copies of this issue will be airlifted to delegates at the opening session of the International Air Transportation Association (IATA) Conference in Dublin, Ireland. Here will be gathered the international leaders of air transportation whose attention and discussions will be focused on these and other major issues.

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Marquardt Sales May Reach $60 Million

By Ward Wright

New York—Marquardt Corp. is predicting $60 million in sales for 1963 despite the probability of complete phaseout of its ramjet engine for the Boeing Bomarc ground-to-air missile that now accounts for 30% of sales.

Total sales predicted for this year were $54 million—about 13% above last year's figures.

Roy E. Marquardt told the New York Society of Security Analysts that his company expects about $1.4 million in profits this year and "has a fighting chance" to match that figure in 1963. One factor affecting profits is independent research which will cost the company $1.7 million this year and about the same in 1963.

Marquardt said he expects increases in the company's electronics and rocket activities—now constituting about 20% of total sales each—plus air-breathing propulsion programs, which comprise another 30%, to more than cover the loss of Bomarc work.

At its peak in 1958, Bomarc subcontracts accounted for about 70% of the company's sales with a dollar peak reached in 1959 when Bomarc engine sales totaled $46 million. This year Bomarc engine sales will bring in $16 million.

Marquardt said diversification—beginning in 1958 with acquisition of Cooper Development Co., a small sounding rocket manufacturer, and an electronics division of American Machine and Foundry Co.—has enabled non-Bomarc work this year to increase 45% over last year.

The acquisitions were not without their problems, Marquardt said. "No sooner had Marquardt acquired Cooper," he said, "than the sounding rocket business fell out of bed." After that, Cooper's operations, which were to have supported small rocket research, had to be supported with Marquardt money.

Marquardt said he is negotiating with two "good prospects" for acquisitions which would allow further diversification, but he declined to name them. By 1963, diversification should have reached the point where no one program will account for more than 20% of sales.

Right now, the company's largest single rocketry program is manufacture of reaction control engines for Project Apollo. Marquardt is under a subcontract from North American Aviation Space and Information Systems Division which may total more than $10 million. Right now initial funding increment is $2 million (AW May 21, p. 39).

Marquardt's reaction control engines will be mounted in the unmanned service module of the vehicle to provide attitude stabilization during the en route and return portions of the flight. Reaction engines in the command capsule will control attitude during reentry.

Engines will be in the 100-lb. thrust category and employ a hypergolic propellant consisting of hydrazine blends and nitrogen tetroxide.

Other rocket activities consist of the manufacture of sounding rockets, Polaris A3 nozzles and miscellaneous rocket components, Marquardt said.

In electronics manufacturing, Marquardt said he anticipated further diversification and indicated his firm would become more involved in mapping and geodesy.

Marquardt named several areas concerning air-breathing propulsion—which total about 30% of expected sales this year—in which he expects new earnings to offset loss of Bomarc:

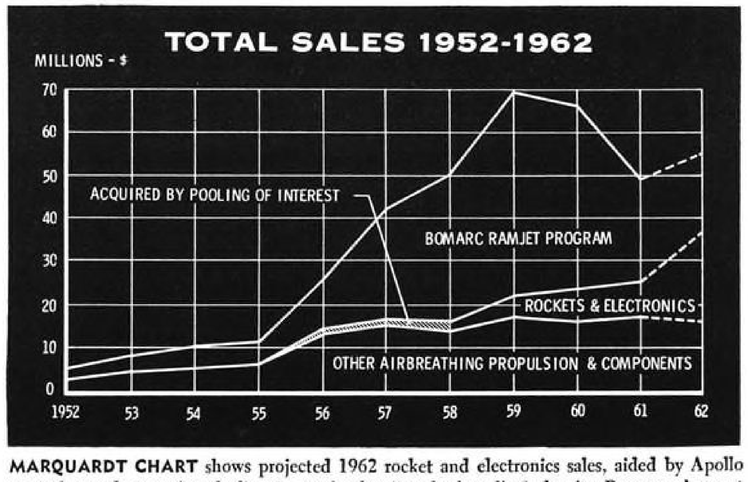
• **Air breathing** boosters for space vehicles. Marquardt said he felt chemical rocket systems had about "reached the end of their potential" for booster purposes. Citing a programed two-fold increase in government expenditure for 1963 aerospace propulsion research, Marquardt said his firm was at work on large air-breathing boosters that would offer greater operational flexibility, lower costs and smaller size than comparable chemical rocket boosters. The project is the company's largest single research program. The company's other principal air-breathing booster programs are LACE (Liquid Air Cycle Engine) (AW Nov. 6, p. 59) and a nuclear version called NULACE.

• **Nuclear ramjet research.** Second largest research program at Marquardt is nuclear ramjet research (Project Pluto). Marquardt said funding for the program is three times what it was in Fiscal 1962, but as yet, he did not know what the breakdown on expenditure would be or whether the authorized amount would be spent entirely. Marquardt is working with the University of California and Ling-Temco-Vought on the project.

• **Variable geometry** intake ducts for jet aircraft. Marquardt said these are "bread and butter" items at present but have a limited future. Marquardt is currently building variable intake ducting for McDonnell F4H and F-110 aircraft, Hound Dog missiles, and has a contract to build intake ducting for the North American B-70. Short-range prospects for these items are very good, Marquardt said.

Marquardt said the firm had about $2 million in contracts, mostly research and development, for miscellaneous air-breathing engine projects. Principal value of these, he said, is that they allow research in this field without involving company funds.

Marquardt reported earnings of $947,997 on sales of $26.7 million for the first 28 weeks of 1962. Earnings for the same period last year were $150,787 on sales of $24.2 million.



MARQUARDT CHART shows projected 1962 rocket and electronics sales, aided by Apollo control award, reversing decline in total sales (top broken line) despite Bomarc phaseout (narrowing gap between top and middle broken lines).



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In May of this year, a company-wide program was instituted by General Electric to sharpen every employee's awareness of the extra values that should be built into every G-E product — whether it's a clock-radio or a continent-spanning command and control system.

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Forward your resume in strict confidence to Mr. P. W. Christos, Div. 64-WG, Defense Systems Dept., General Electric, Northern Lights Office Bldg., Syracuse, N. Y.

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Aerospace Firms File Management Salaries

Following is a list of aerospace industry officers and directors with 1961 salaries above $30,000, and the stockholdings of these officers as reported to the Securities and Exchange Commission.

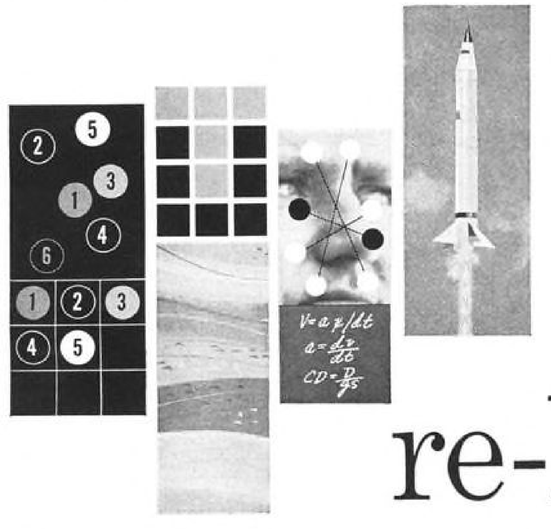
American Bosch Arma Corp.—C. W. Perelle, president and director, $140,000 salary, 10,100 shares of common stock; **C. A. Sharpe,** senior vice president, $61,666 salary; **V. C. Schorlemmer,** vice president, $46,000 salary; **C. Allen, Jr.,** director, 40,457 shares of common stock owned by Allen & Co., investment bankers of which Mr. Allen is a general partner; **F. W. Harder,** director, 8,600 shares of common stock; **J. L. Holtzmann,** director, 1,172 shares of common stock; **J. E. Parker,** director, 1,000 shares of common stock (owned as of Mar. 21, 1962); **R. F. Peo,** director, 671 shares of common stock; **M. L. Sindeband,** director, 132 shares of common stock; **G. C. Textor,** director, 135 shares of common stock; **W. S. Wasserman,** director, 202 shares of common stock. (All stocks shown, unless otherwise noted, are owned as of Mar. 1, 1962.)

Avco Corp.—K. R. Wilson, Jr., chairman of the board, $164,583 salary, 17,300 shares of common stock; **J. R. Kerr,** president, director, and member of the executive committee, $155,417 salary, 12,567 shares of common stock, $2,000 debentures; **E. H. Blaik,** chairman of the executive committee and director, $134,583 salary, 11,000 shares of common stock; **M. A. McLaughlin,** vice president, general counsel and director, $110,000 salary, 8,500 shares of common stock; **A. R. Kantrowitz,** vice president and director, $110,000 salary, 16,833 shares of common stock; **J. D. Shouse,** director, $91,250 salary, 11,980 shares of common stock; **G. E. Allen,** director, 2,500 shares of common stock; **I. B. Babcock,** director, 2,247 shares of common stock; **J. Bruce,** director, 3,000 shares of common stock; **M. W. Clement,** director, 1,250 shares of common stock; **C. C. Darling,** director, 8,000 shares of common stock; **R. H. Deetjen,** director, 2,500 shares of common stock, $5,000 debentures; **R. L. Johnson,** director, 900 shares of common stock; $1,000 debentures; **H. H. Kahn,** director, 5,000 shares of common stock, $4,000 debentures; **E. H. Litchfield,** director, 2,000 shares of common stock; **D. K. Ludwig,** director (since 1961), 1,000 shares of common stock; **M. A. MacIntyre,** director, 100 shares of common stock; **J. A. McDougald,** director, 10,000 shares of common stock; **W. A. Mogensen,** director, 5,000 shares of common stock; **W. I. Myers,** director, 1,000 shares of common stock; **B. H. Namm,** director, 4,306 shares of common stock. (All stocks beneficially owned as of Jan. 29, 1962.)

Aeronca Manufacturing Co.—J. A. Lawler, president and director, $60,000 salary, 40,275 shares of common stock (includes 400 shares held by associates of Mr. Lawler); **S. J. Kuderer,** vice president-finance, secretary treasurer and director, $37,500 salary, 1,175 shares of common stock, 395 shares of 5¼% prior preferred stock; **S. H. Badgett,** group vice president-commercial products, $32,947 salary; **R. A. Dadisman,** director, 470 shares of common stock, 900 shares of 5¼% prior preferred stock, 300 shares of $.55 preferred stock; **G. C. Hill,** director, 525 shares of common stock; **C. Verity,** director (since 1961), 200 shares of common stock; **F. D. Danford,** director, 8,022 shares of common stock; **R. E. Harrison,** director, 1,800 shares of common stock, 625 shares of 5¼% prior preferred stock; **J. M. Lockhart,** director, 1,560 shares of common stock (includes 360 shares held by associates of Mr. Lockhart); **F. L. Roberts,** 115 shares of common stock; **J. Slezak,** director, 105 shares of common stock; **M. S. Smith,** 880 shares of common stock, 943 shares of 5¼% prior preferred stock; **G. J. Wolf,** director, 6,612 shares of common stock, 975 shares of 5¼% prior preferred stock; (includes 100 shares held by an associate of Mr. Wolf). (All stocks beneficially owned as of Feb. 17, 1961.)

Curtiss-Wright Corp.—T. R. Berner, chairman of the board and president, $100,-600 salary, 2,400 shares of common stock; G. R. Hill, executive vice president, vice president-finance and director (until May 10, 1961), $96,200 salary; **J. G. Byron,** vice president and director, $91,200 salary, 900 shares of common stock; **J. V. Miccio,** vice president and general manager of Wright Aeronautical Div., $112,000 salary; **J. B. Morris,** vice president (since Apr. 19, 1961) and director (since Feb. 28, 1961), $32,083 salary, 100 shares of common stock; **J. S. Bull,** director (since 1961), 100 shares of common stock; **F. T. Lane,** director, 2,000 shares of common stock; **E. McSweeney,** director, 100 shares of common stock; **C. D. Perkins,** director (since 1961); **D. C. Power,** director, 100 shares of common stock; **L. H. Smith,** director, 100 shares of common stock; **E. H. White,** director, 100 shares of common stock. (All stockholdings were as of Jan. 30, 1962).

Douglas Aircraft Co.—C. R. Able, vice president and director (since 1961), $46,016 salary, 100 shares of capital stock; **G. E. Donovan,** vice president and director (resigned Jan. 24, 1962), $50,300 salary, **D. W. Douglas,** chairman of the board and chief executive officer, $113,300 salary, 10,150 shares of capital stock; **D. W. Douglas, Jr.,** president and director, $91,425 salary, 1,082 shares of capital stock; **J. A. Dundas,** executive vice president and director, $58,925 salary, 824 shares of capital stock; **I. C. Euker,** vice president and director (retired) Oct. 18, 1961), $35,800 salary; **K. G.**



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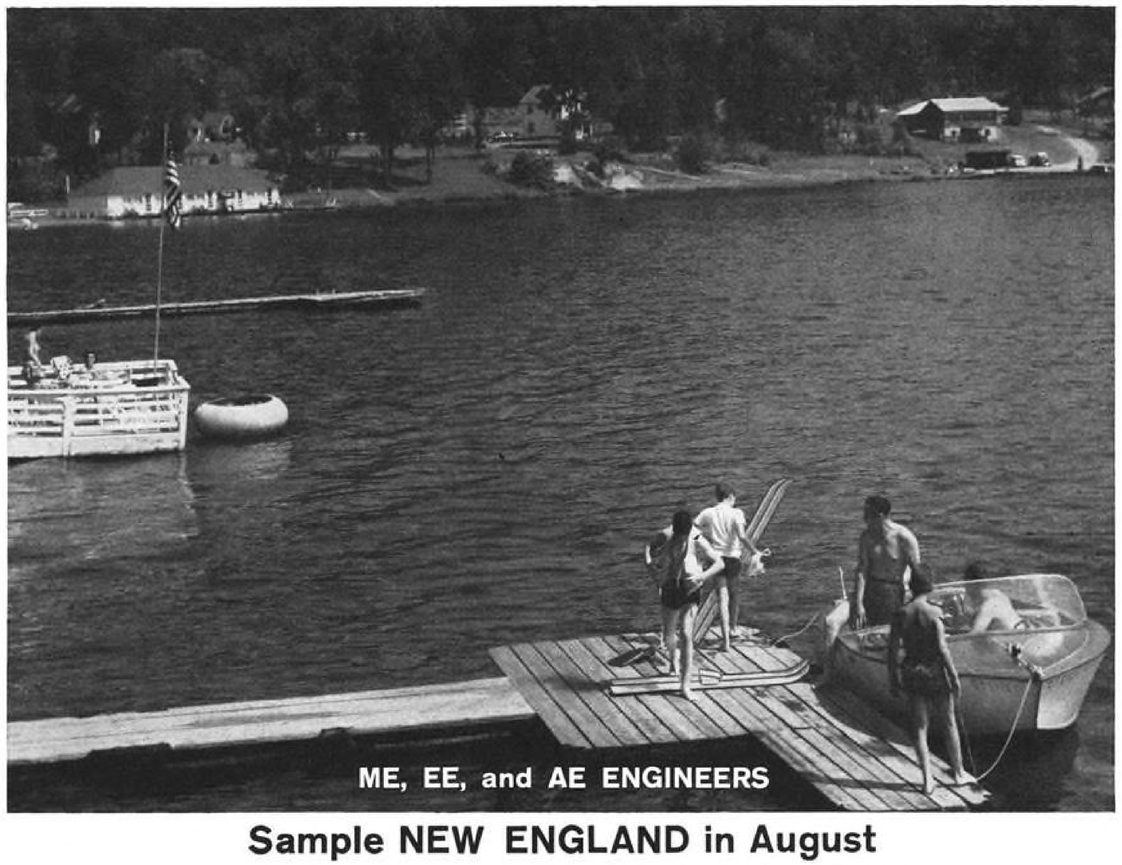
Farrar, vice president and director, $48,300 salary, 109 shares of capital stock; **J. R. McGowen,** vice president and director, $46,016 salary, 108 shares of capital stock; **M. W. Bekins,** director, 518 shares of capital stock; **F. W. Conant,** director, 1,122 shares of capital stock; **L. de Florez,** director, 412 shares of capital stock; **T. W. Johnson,** director; **C. S. Jones,** director; **E.H. McLaughlin,** director, 400 shares of capital stock; **N. Petree,** director, 154 shares of capital stock; **G. Romney,** director, 200 shares of capital stock; **D. Whiting,** director, 1,000 shares of capital stock, $10,000 debentures. (Salaries are for the fiscal year ended Nov. 30, 1961; all stocks beneficially owned as of Mar. 2, 1962).

Fairchild Stratos Corp.—E. G. Uhl, director (since 1961) and president, $60,000 salary, 2,401 shares of common stock; **J. B. Wharton, Jr.,** director and chairman of the executive committee, $50,100 salary, 100 shares of common stock ("associates" of Mr. Wharton's own 24,300 shares of common stock); **F. E. Newbold, Jr.,** director and vice president, $42,333 salary, 100 shares of common stock; **J. T. Dresher,** vice president-finance and treasurer, $34,000 salary; **W. F. Burke,** director, $4,800 salary, 1,000 shares of common stock ("associates" of Mr. Burke's own 1,200 shares of common stock); **C. H. Colvin,** director, 263 shares of common stock; **C. L. DeOrsey,** director, 1,000 shares of common stock; **S. M. Fairchild,** director, 94,259 shares of common stock (in addition, Mr. Fairchild is 100% stockholder of a corporation which owns 10,500 shares of common stock in Fairchild Stratos); **J. C. Hoffberger,** director (since 1961), 2,500 shares of common stock ("associates" of Mr. Hoffberger's own 1,595 shares of common stock); **W. P. Lane, Jr.,** director, 4,000 shares of common stock ("associates" of Mr. Lane's own 1,000 shares of common stock); **F. R. Nichols,** director, 3,000 shares of common; **R. S. Stillman,** director, 100 shares of common; (all stocks beneficially owned as of Feb. 15, 1962).

The Garrett Corp.—J. C. Garrett, president and chairman of the board, $81,190 salary, 28,420 shares of common stock; **K. B. Wolfe,** executive vice president and director, $75,435 salary, 349 shares of common stock; **W. R. Ramsaur,** vice president and director, $71,191 salary 6,933 shares of common stock; **E. A. Bellande,** vice president and vice chairman of the board, $61,017 salary, 324 shares of common stock; **H. H. Wetzel,** vice president and director, $50,692 salary 15,792 shares of common stock; **J. J. O'Brien,** vice president and director (since 1961), $46,283 salary, 205 shares of common stock; **E. Barlow,** vice president and director, 16,520 shares of common stock; **L. T. Cohu,** director, 106 shares of common stock; **H. W. Elliott,** director; **C. T. Leigh,** director, 166 shares of common stock; **W. R. Lovelace, 2nd,** director. (Salaries were paid for fiscal year ended June 30, 1961; all stockholdings are beneficially owned as of Sept. 5, 1961).

The Boeing Co.—W. M. Allen, president, $99,989 salary, 12,061 shares of common stock; **W. E. Beall,** senior vice president, and director, $86,878 salary, 5,641 shares of common stock; **J. E. Prince,** vice president-administration and secretary, $49,575 salary; **E. C. Wells,** vice president-engineering (until Sept. 30, 1961) and vice president-general manager military aircraft systems division (since Sept. 30, 1961), $76,218 salary, 4,805 shares of common stock; **J. O. Yeasting,** vice president-general manager transport division and director, $62,027 salary, 4,072 shares of common stock; **W. L. Campbell,** director (since Jan. 29, 1962), 100 shares of common stock; **C. L. Egtvedt,** company chairman, 18,421 shares of common stock; **D. A. Forward,** director, 530 shares of common stock, $2,200 debentures; **A. L. Gates,** director, 648 shares of common stock; **W. G. Reed,** director, 1,446 shares of common stock; **D. Schmitz,** director, 5,406 shares of common stock; **D. E. Skinner,** director (since Feb. 23, 1962), 100 shares of common stock; **G. H. Weyerhaeuser,** director (since Jan. 29, 1962), 500 shares of common stock. (All stocks beneficially owned as of Feb. 23, 1962.)

Lockheed Aircraft Corp.—C. A. Barker, Jr., consultant and director, $32,077 salary, $23,800 incentive compensation awarded for prior years, $21,384 retirement benefits, 2,101 shares of common stock; **D. E. Browne,** group vice president-finance and administration, and director, $70,192 salary, $7,600 incentive compensation awarded for prior years, 6,845 shares of common stock; **C. Chappellet,** senior vice president and director, $81,380 salary, $25,400 payments of incentive compensation awarded for prior years, 30,914 shares of common stock; **C. S. Gross,** chairman of the board (resigned as president and elected chairman of the board Sept. 13, 1961), $106,346 salary, $14,600 incentive compensation awarded for prior years, 35,847 shares of common stock; **R. E. Gross,** chairman of the board (died Sept. 13, 1961, salary paid reflects that date), $86,355 salary, $27,150 incentive compensation awarded for prior years; **D. J. Haughton,** president (resigned as executive vice president and elected president Sept. 13, 1961) and director, $92,693 salary, $10,000 incentive compensation for prior years, 12,180 shares of common stock; **H. L. Hibbard,** senior vice president and director, $81,380 salary, $11,800 incentive compensation awarded for prior years, 13,049 shares of common stock; **G. Brashears,** director, 200 shares of common stock; **W. A. M. Burden,** director (since 1961), 500 shares of common stock; **J. V. Carmichael,** director; **C. E. Ducommun,** director (since Sept. 13, 1961), 100 shares of common stock; **E. S. Dulin,** director, 510 shares of common stock; **H. L. Dunn,** director, 710 shares of common stock; **W. W. Keith,** director, 1,224 shares of common stock; **H. W. McCurdy,** director, 9,893 shares of common stock; **C. B. Squier,** director, $18,630 retirement benefits, 5,100 shares of common stock, (all shareholdings were beneficially owned as of Mar. 1, 1962).



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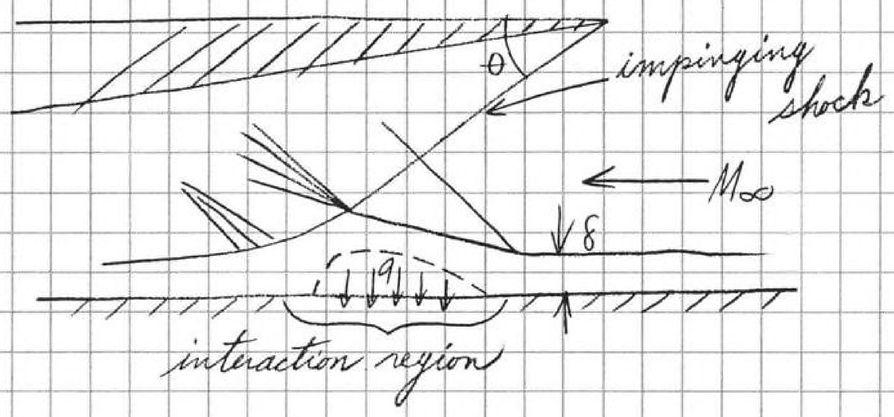
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WHO'S WHERE

(Continued from page 23)

Changes

Wilbur L. Pritchard, director of the newly formed Communication Satellite Systems Program Offices, Aerospace Corp., Los Angeles, Calif. Also: **Dr. Charles M. Price,** associate head, Astrodynamics Department, Aerospace Corp.'s Systems Research and Planning Division.

Douglas Aircraft Co., Inc., Santa Monica, Calif., has announced the following appointments in the International Military Sales Department: **Russell A. Denzer,** assistant director; **J. P. Robinson,** Washington (D. C.) representative; **C. A. Fardelius,** international military sales representative.

Frank D. Allman, senior application engineer, The Fafnir Bearing Co., New Britain, Conn.

Robert A. Hawkins, manager, Lowell Plant, Avco Corp.'s Research and Advanced Development Division, Wilmington, Mass.

C. Harry Knowles, general manager of the newly formed Molecular Electronics Division, Westinghouse Electric Corp., Pittsburgh, Pa.

Douglas W. MacKellar, technical sales manager, Special Products Division, de Havilland Aircraft of Canada, Ltd., Downsview, Canada, and **Alec N. Garnham,** chief of reliability and test.

Z. K. Geanes, marketing director-Western region, General Precision's Librascope Division, Glendale, Calif.

Frederick E. Croxton, Jr., director of the new Redstone Scientific Information Center, U. S. Army Ordnance Missile Command, Huntsville, Ala.

Arthur F. Dickerson, manager-advanced engineering, Advanced Product Planning Operation, General Electric Co.'s Electronic Components Division, Schenectady, N. Y.

Don Webb, manager-marketing and contracts, Molecular Science Corp., Menlo Park, Calif.

Allan H. Outzs, mechanical engineer, Alfred Electronics, Palo Alto, Calif.

Lt. Cmdr. Willard C. Collins (USN, ret.), projects manager-research and development work for the Federal Aviation Agency, All American Engineering Co., Wilmington, Del.

Edward E. Clark, manager of advanced lunar programs-scientific manned space projects, North American Aviation's Space and Information Systems Division, Downey.

Yale Barkan, manager-systems engineering, Electronic Systems Division, Telecomputing Corp., Los Angeles, Calif.

Ronald L. Bentley, administrative manager, Instrumentation Division, Microdot, Inc., South Pasadena, Calif.

Edward F. O'Brien, chief engineer, Motorola Aviation Electronics, Inc., Culver City, Calif., a subsidiary of Motorola, Inc.

Ordway B. Gates, Jr., deputy technical director-systems engineering, Martin Co.'s Space Systems Division, Baltimore, Md.

Harold Goldstein, senior member-technical staff, Paradynamics, Inc., Huntington Station, N. Y.

Neil L. Brown, manager-research, Hytech Division of The Bissett-Berman Corp., Santa Monica, Calif.

Jack E. Branigan, manager-market development, HRB-Singer, Inc., State College, Pa.

Herbert G. Ayers, general manager, California Technical Industries, a Textron Co., Belmont, Calif.

Frederick A. Kanzler, corporate finance manager, Lockheed Aircraft Corp., Burbank, Calif.

Bernard A. Rawson, manager-airline sales, Aircraft-Missiles Division, Fairchild Stratos Corp., Hagerstown, Md.

David J. Hodges, manager of voltage-tunable magnetron engineering, General Electric Co.'s Power Tube Department, Schenectady, N. Y.

Mois Gerson, manager, Manufacturing Department, United AeroSpace Division, United ElectroDynamics, Inc., Pasadena, Calif., succeeding **E. C. Rothenberger,** now chief of administration for the division.

Dr. A. Matther Lord, director-program planning, ITT Federal Laboratories, Nutley, N. J., a division of International Telephone and Telegraph Corp.

Tom Towers, an administrative assistant to the general manager of the Los Angeles Department of Airports, Los Angeles, Calif.

Jackson T. Wills, regional manager of customer relations, Aerojet-General Corp., with offices in San Bernardino, Calif.

John K. Wetherbee, corporate director of research development and engineering, Aeronca Manufacturing Corp., Middletown, Ohio.

Dr. Eldred C. Nelson, director, Programming and Applied Mathematics Laboratory, Computation and Data Reduction Center, Space Technology Laboratories, Inc., Redondo Beach, Calif., a subsidiary of Thompson Ramo Wooldridge, Inc.

Dr. Dietrich Jenny, manager, Semiconductor Division, Hughes Aircraft Co., Newport Beach, Calif., and **Charles W. Curtis,** manager of the newly established Field Service and Support Division for Hughes' Ground Systems Group, Fullerton, Calif.

Dr. Robert J. Gnaedinger, Jr., director of advanced development, American Micro Devices, Inc., Phoenix, Ariz.

Stanley H. Bulmer, manager, Wyle Laboratories' Test Facilities Department, El Segundo, Calif.

Space Technology Laboratories, Inc., a subsidiary of Thompson Ramo Wooldridge, Inc., has appointed **Michael Komich,** customer requirements representative in the Washington, D. C., District Office.

W. J. Chadburn, sales manager-aeronautical products, Robertshaw-Fulton's Aeronautical and Instrument Division, Anaheim, Calif.

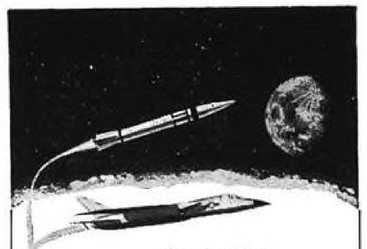
John F. Burlingame, manager-engineering, General Electric Co.'s Light Military Electronics Department, Utica, N. Y., succeeding **William J. Kuehl** (AW July 23, p. 83).

Malcolm T. Stamper, assistant to the operations manager, Aero-Space Division, The Boeing Co., Seattle, Wash.

H. Thomas McHenry, alloy development and evaluation specialist, General Electric Co.'s Large Jet Engine Department, Evendale, Ohio.

Robert F. Schulz, manager of manufacturing, Applied Technology, Inc., Palo Alto, Calif.

Jay D. Wethe, assistant marketing director for Autonetics, a division of North American Aviation, Inc., Downey, Calif.



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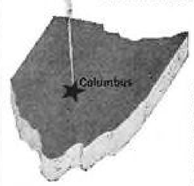
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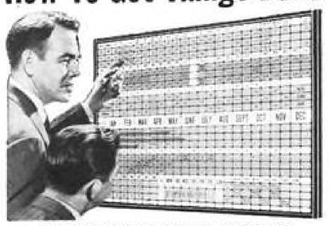
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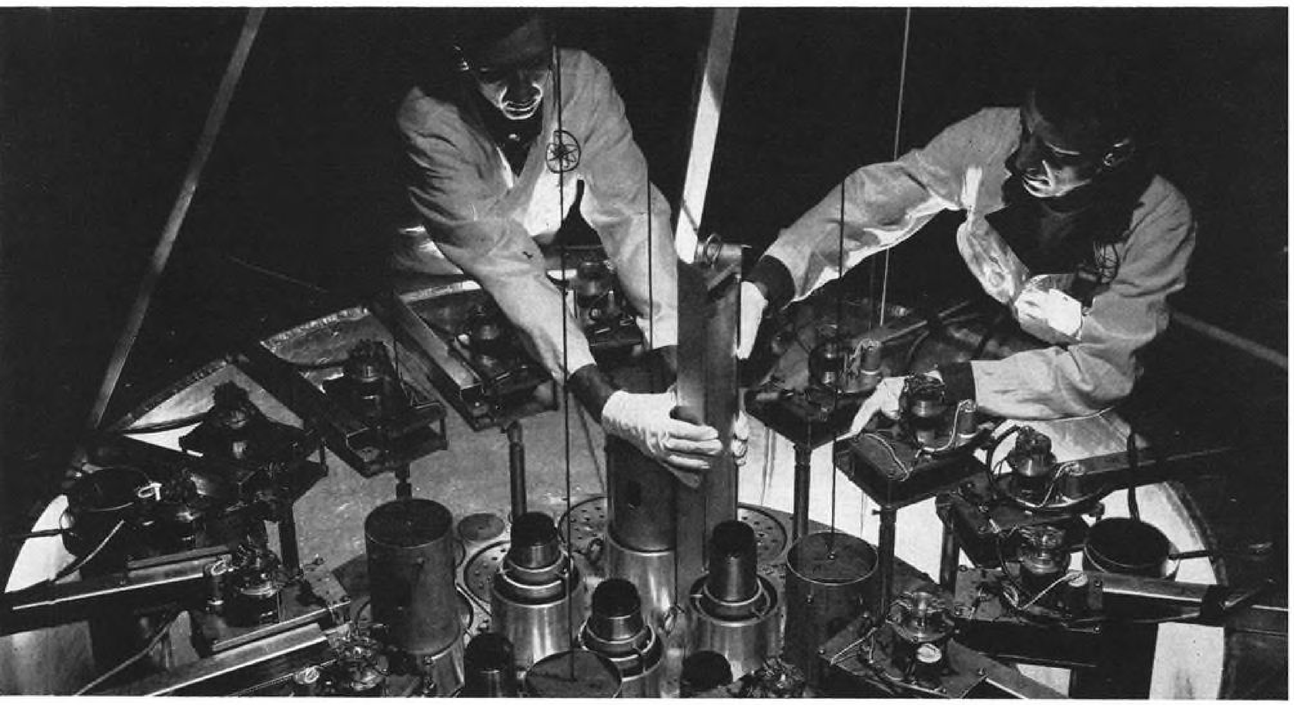
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LETTERS

Team Effort

The July 30 issue of AVIATION WEEK carries a story entitled "NASA May Dictate Economy Measures" (p. 26) which paraphrases a part of my testimony before the House Committee on Science and Astronautics.

This word, "dictates," while brief, does not describe the Marshall Space Flight Center-industry working relationship which is fundamental to our operation. In fact, I seriously question whether any relationship based on one party "dictating" to another could produce the economy and excellent results which both industry and NASA are seeking.

Our policy is to work with industry on a team basis to determine the best and most economical techniques for accomplishing our assigned missions and to make these techniques known to all persons and companies which can benefit from them. It is expected that the kinds of companies selected by MFSC to execute contracts would greatly use techniques well known to be best. Fortunately, this is usually the case. When it is not the case, a remedy for the situation is found.

J. C. McCALL
Assistant to the Director
Marshall Space Flight Center
National Aeronautics and Space Administration
Huntsville, Ala.

Battle of Midway

In the Airline Observer column of your July 16 issue (p. 47) of AVIATION WEEK & SPACE TECHNOLOGY, I noted certain errors in the column which discussed the fact that United Air Lines transferred its last flights from Midway Airport. You indicated in the column that there were no more scheduled airline flights at Midway, and that the only operations were that of private aircraft.

As you can see . . . Chicago Helicopter Airways continues to operate 58 scheduled flights daily between Midway and O'Hare, as well as service to Gary, Indiana, and Winnetka, Illinois.

It is true that we are the only scheduled carrier operating out of the Midway terminal building; however, we are finding that there are about 7,000 passengers per month who reside, work or visit in the southerly part of Chicago who use our services to go to and from O'Hare to make their fixed-wing connections.

This situation is just the reverse of what we had five years ago when there was no business at O'Hare and the people residing in that area used our helicopter service to come to Midway.

We are, of course, looking forward to the fixed wing airlines returning to Midway as we feel the abandonment of this facility is just a temporary one. As you know, the City of Chicago—through the Mayor's office—has petitioned the Civil Aeronautics Board to help solve this problem and, in addition, has held meetings with the presidents of the airlines involved to work out a program for the return of some of their flights to Midway. For your information, I am enclosing copies of the material which the City gave the airline presidents.

It is certainly quite fascinating when one realizes that Midway Airport has in one year's time gone from the world's busiest airport to the world's busiest heliport. Therefore, as we await the return of some of the fixed wing flights to Midway, we need all the positive statements you can put out on our company to help show the traveling public that Chicago Helicopter Airways is still at Midway and ready to offer service to the 3,500,000 people who live on the south side.

C. W. MOORE
Executive Vice President
Chicago Helicopter Airways, Inc.
Chicago, Ill.

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.

Russian Discovery

The article in the July 23 issue (p. 74) on "Antonov Criticizes Soviet 'Quota' System" should be entitled "Comrade Antonov Discovers Free Enterprise."

It was a most enjoyable article.

D. M. PERKINS
Acton, Mass.

'Chasing Rainbows'

I have been closely following the ATC and anti-collision problem for a number of years.

Reading the article "FAA Stresses Proximity Warning Systems" in the July 30 issue (p. 51), I am more than ever convinced that the FAA is in the "muddle" of nowhere. It seems to me that at this stage of the game it should be apparent to everyone that a non-cooperative PWI or anti-collision system is not practical. Even if one could be developed that would really work it's availability would be a nice few years hence, and its cost would preclude its use on certain few aircraft.

Since all aircraft would not be protected, or even a minor percentage, you have gained nothing.

The FAA has been chasing rainbows and, while they have been chasing rainbows, aircraft accidents continue. Now they talk of cooperative systems. This is practical, but their approach is as impractical as you can get.

Why infrared? Its sensitivity to atmospheric conditions is well known, and the optical coding of the lamps used in rotating beacons will defeat the purpose of the beacon.

Has not the FAA heard of Marconi? An airborne cooperative system could have been operational for many years employing radio transmission.

Many systems have been proposed and most are workable from a practical standpoint.

R. F. modulators employing transistors, whereby the pulse repetition rate, pulse symmetry and modulating frequency are each variable via their own variable resistors, can be marketed for a few dollars. We know, since we have worked on these devices.

The three variable resistors can be micro-torque potentiometers that can be directly coupled to the altimeter, compass and airspeed indicator, or if airspeed information is not necessary, a fixed resistor can identify the type of aircraft. Transmission can be via the aircraft's VHF transmitter on a time sharing principle, since transmission of complete data can take place within .01 sec. with ease.

Receiver decoding is straight forward, with range information that would be good enough for a PWI easily attainable. In short, production units of a system that will work can probably be ready within a few months, with price easily less than about $150.

I am speaking from hardware that we have worked on that is directly adaptable, and then leaving plenty of room.

I think it is time the FAA came down from Cloud 9. The FAA idea on navigation lights shows out the deficiencies of their other programs and the desperation now at hand.

M. SHORR
Chief Engineer
Solid State Controls, Inc.
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Evening Score

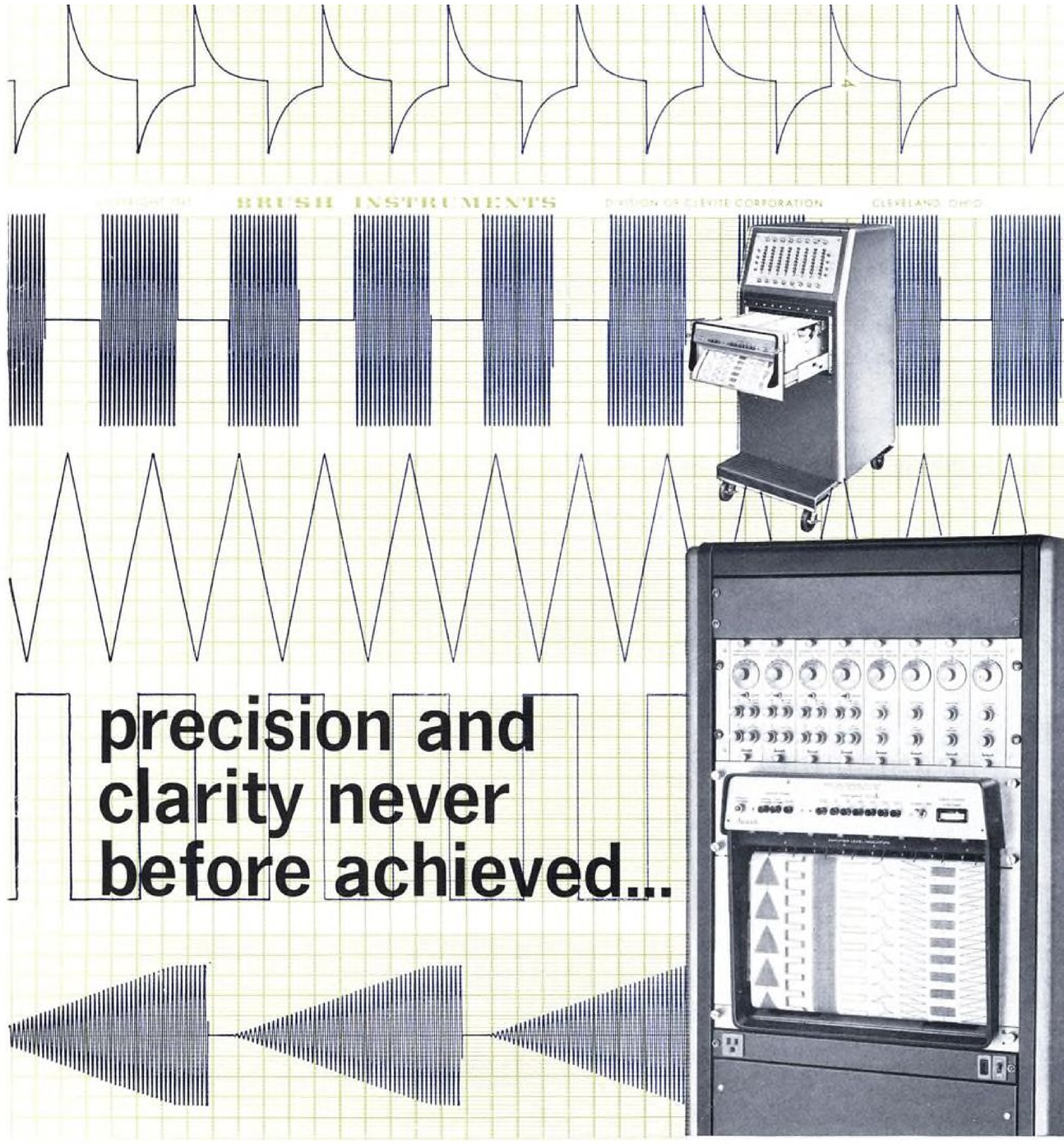
I enjoyed reading your interesting and enlightening accounts of the launching and subsequent communications demonstrations of the AT&T Telstar satellite (AW July 16, p. 26 and July 23, pp. 13, 27).

There is one point of accuracy I would like to clarify. On p. 27 of your July 23 edition, under the heading "Telstar Fails to Sway Comsat Bill Opponents," your second paragraph began: "The excellent performance of the world's first active communication satellite . . ."

Telstar is not the world's first active communications satellite. Project Score and project Courier, Army projects, both produced active communications satellites. Score was launched in 1958 and Courier in 1960. Both received and instantly rebroadcast messages from earth.

They also had the capability to receive, store and later retransmit messages.

C. W. HUFF
Lt. Col., Signal Corps
Advent Technical Liaison Officer
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Fort Monmouth, N. J.



The new Brush Recorder Mark 200 made these incredibly crisp tracings. No other recorder in existence can match them. Note the line width. It never varies . . . regardless of writing velocity, regardless of chart speed. The writing mechanism is electrically signaled by the position-seeking "Metrisite" transducer . . . no parts to wear, infinite resolution, verifiable dynamic ½% accuracy. Traces are permanent, high-contrast, reproducible . . . on low cost chart paper. The Mark 200 has but three standard controls . . . attenuator, pen position, chart speed. Such fidelity, simplicity and economy are possible with no other direct writing recorder. *Available in both vertical and horizontal models* with interchangeable plug-in preamplifiers or signal conditioning push-button controls. Write for details . . . they'll speak for themselves.

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AUG. 12 1962



VA-240 12.4-18.0 Gc. 250 mW minimum.

from Varian: STABLE PUMP TUBES FOR PARAMETRIC AMPLIFIERS

Highly-stable reflex klystrons by Varian can significantly improve your parametric amplifier system design. Tube types, from 8.2 to 26.5 Gc are available for immediate delivery. From low-cost laboratory models to rugged 70 Gc tubes, all have Varian's inherent high quality of manufacture and performance.

Varian parametric amplifier pump tubes benefit from exhaustive research and testing for metals capable of contributing to precise control of temperature coefficients. For Varian pump tubes, this figure is less than 100 Kc per degree Centigrade. More than a dozen types of Varian reflex klystrons suitable for parametric pump use are operable in severe environments—20G shock, —55 to +85° C—and demonstrate excellent unattended long life characteristics. Improved optics in tube design provide maximum bandwidth. Power and frequency remain stable over a wide variety of environmental conditions.

Tubes in the VA-240 series (see chart) are rugged, field trimmable, conduction-cooled. Other Varian tubes suitable for parametric amplifier application have similar features. Write Tube Division.

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VA-253	15.0-22.0	200	1000	40	750
VA-241	18.0-26.5	200	100	40	800
VA-254	18.0-26.5	150	1000	40	850

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